North Reading
MASSACHUSETTS

TOWN OF NORTH READING, MASSACHUSETTS

FEBRUARY 2020

FINAL ENVIRONMENTAL IMPACT REPORT

New Water and Wastewater Solutions

WRIGHT-PIERCE
Engineering a Better Environment

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Water
Wastewater
Infrastructure

February 14, 2020

W-P Project No. 13732A

RE: North Reading, New Water and Wastewater Solutions – FEIR
EEA Number: 14975

Enclosed please find a copy of the Final Environmental Impact Report (FEIR) for the North Reading Water and Wastewater Solution project. You are receiving this document in conformance with the MEPA process.

The FEIR provides a response to comments received during Draft Environmental Impact Report (DEIR) and Notice of Project Change (NPC) comment review periods and describes the long-term water supply plan for the community. The FEIR will be submitted to MEPA and will be published in *The Environmental Monitor* dated February 26, 2020. FEIR comments are due to MEPA by March 27, 2020.

We look forward to your comments on the project as the Town continues the process of developing a long-term solution to its water supply needs.

If you need further assistance, please contact Collin Stuart at 603-570-7123 or by e-mail at collin.stuart@wright-pierce.com.

Respectfully,
WRIGHT-PIERCE

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NEW WATER AND WASTEWATER SOLUTIONS

TOWN OF NORTH READING, MASSACHUSSETTS

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SECTION 1

PROJECT DESCRIPTION AND PERMITTING

1.1 CONTACT INFORMATION

Project Name:	New Water and Wastewater Solutions
Project Location:	North Reading, Massachusetts
EEA No.:	14975
Proponent:	Mark Clark, Water Superintendent North Reading Department of Public Works 235 North Street, North Reading, MA 01864 (781) 270-1672 (978) 664-6046 mclark@northreadingma.gov
Primary Contact:	Amy Coppers Costantino, Wright-Pierce 600 Federal Street, Suite 2151, Andover, MA 01810 (978) 416-8019 amy.coppers@wright-pierce.com

1.2 INTRODUCTION

The Town of North Reading Final Environmental Impact Report (FEIR) provides supplemental data and analysis to augment the Draft Environmental Impact Report (DEIR) and the Notice of Project Change (NPC) and presents the conclusions and recommendations of this process.

The Town of North Reading is looking to replace its existing ground water supplies which have lost their capacity and are unable to meet the Town's needs, with supplemental water purchased from the neighboring community of Andover. North Reading currently purchases up to 1.5 MGD from Andover through existing interconnections by an existing Interbasin Transfer Act permit and is looking to increase their transfer and purchases by another 1.5 MGD or a total of 3.0 MGD.

The project will require the construction of two chemical feed stations at each interconnection to replace chlorine disinfection capabilities that will be lost upon the decommissioning of their existing water treatment plants.

1.3 BACKGROUND

A DEIR was submitted and advertised on March 23, 2016 that initially detailed plans to obtain water through an interconnection to the Massachusetts Water Resources Authority (MWRA) water system by wheeling water through the neighboring water system of Reading. The DEIR contained an inventory of North Readings existing water supplies, and their inability to meet the Town's current and future needs. The DEIR also contained an evaluation of possible alternatives to augment and/or replace the existing supplies. The DEIR presented a cost-effective plan that met the goals established by North Reading, produced environmental benefits, and minimized environmental impact. During the DEIR review period, the Secretary received over 33 pages of comments, and issued a Certificate on that report on May 13, 2016.

Since the receipt of the DEIR Certificate, North Reading has explored and altered its plans to obtain its drinking water from the MWRA. The change in the water supply alternative was driven by comments to the DEIR from the Town of Andover who previously indicated that they had inadequate excess supply capacity. After commenting to the DEIR, Andover conducted further analysis of their water supply system and current water needs and determined that they in fact have ample long-term supply and treatment capacity to meet their in-town needs as well as the long-term needs of North Reading.

A Notice of Project Change (NPC) was submitted to MEPA on October 18, 2018 and included the following changes:

- North Reading will obtain all its future water needs from the Town of Andover through two existing interconnections instead of wheeling water through the Town of Reading to connect to the MWRA. North Reading is currently permitted to purchase water 1.5 MGD from Andover through an IBTA permit.

- North Reading will be seeking an increase in their purchases of an additional 1.5 MGD for a total of 3.0 MGD from Andover for long-term needs.
- North Reading will construct chlorine booster chemical feed stations at each of the two interconnection locations, (Main Street and Central Street) in North Reading to replace existing chlorine systems that will be decommissioned with their water treatment plants. The new chlorine stations are required to ensure that adequate chlorine residual can be maintained in all areas of North Reading's water distribution system.
- The Town of North Reading's local sources will be maintained as emergency backup sources and will be operated and maintained in accordance with MassDEP guidelines for a period of at least two years after full conversion to Andover's supply. Once North Reading is confident that water quality and operation of the increased water transfer from Andover has stabilized, North Reading will begin the process of de-commissioning the existing water treatment plants and conversion of the well sources to emergency use only.
- North Reading will defer the wastewater project included in the DEIR with the understanding they will submit a supplemental FEIR when the wastewater project has been further defined and advanced. The Town has determined that their water needs are much more pressing and since the filing of the DEIR, all efforts have been focused on this task. Advancement of wastewater is well behind the water project

Shortly after the receipt of the DEIR Certificate, North Reading and Andover entered into negotiations to establish a long-term 99-year inter-municipal agreement (IMA) for Andover to supply North Reading with its water supply needs exclusively. The negotiations took place between May 2017 and May 2018 through dozens of meetings between representatives of each communities select boards, Town Managers, Department of Public Works staff, legal counsel, and consultants. The negotiated IMA does not include an expansion of the water commission to include members from North Reading. A copy of the executed IMA is included in Appendix A.

The IMA Agreement between North Reading and Andover was executed on the following dates. Copies of each of the following documents are included in Appendix A:

- The Town of North Reading at its June 4, 2018 Board of Selectmen (now Select Board) meeting voted to approve and sign the IMA to obtain potable water from Andover.
- The Town of Andover at its June 4, 2018 Board of Selectmen meeting voted to approve and sign the IMA to provide potable water to North Reading.
- The Massachusetts House of Representatives on June 6, 2018.
- The Massachusetts Senate on June 7, 2018.
- The Governor of Massachusetts on June 13, 2018.

The basic premise of the IMA between the communities consists of the following:

- Andover will supply North Reading with treated drinking water for a period of 99-years.
- The capacity of water to be supplied and purchased will be in accordance with the following:
  - Andover shall furnish water until June 30, 2019, subject to permitting, up to a maximum withdrawal of 2.4 million gallons per day (MGD); and
  - thereafter, until June 30, 2025, subject to permitting and any necessary infrastructure upgrades, up to a maximum withdrawal of 2.6 MGD; and
  - thereafter, subject to permitting and any necessary infrastructure upgrades, up to a maximum withdrawal of 3.0 MGD to North Reading through existing interconnections at the Andover/North Reading town line at Gould Road and Central Street and the Andover/North Reading town line at Route 28.

It should be noted that North Reading has not exceeded their IBTA regardless of the IMA in place with Andover.

North Reading will obtain water from Andover through two (2) existing interconnections. Since 1991, North Reading has purchased up to 1.5 MGD of water from Andover to supplement their existing sources through an Inter-Basin Transfer Act (IBTA) permit. Hydraulic modeling of the two systems and field testing at the interconnections indicates that Andover’s water system has the capacity to supply the additional volume North Reading is requesting and North Readings system has the capacity to accept the increased flow. By purchasing all their water from Andover and eventually eliminating their treatment capabilities, North Reading will be required to construct two (2) chemical feed stations to replace the existing chlorine feed systems to be decommissioned with their water treatment plants. The chemical feed stations are required to boost chlorine levels for disinfection of water from Andover to the farthest extents of North Reading's distribution system.

With the full conversion of water from existing sources to Andover sources, North Reading's long-term plan is to eventually discontinue use of their well sites and treatment facilities. Initially and for a minimum of at least two years following the conversion, North Reading intends to maintain their existing sources and WTPs. This is intended to ensure that the conversion functions reliably and without issue under actual flow conditions. After the two-year period, and if the conversion is fully capable of meeting North Readings needs, they will consider the necessity of maintaining the existing sources and WTPs.

The proposed chemical feed stations will be located at or near the existing interconnections between North Reading and Andover at North Reading's Central Street Pump Station (CSPS) site and at 303 Main Street where a portion of the property was recently acquired by North Reading through an easement agreement with the property owner. Both sites are located adjacent to but outside of wetland resource areas. The CSPS site is currently used by the Town for the Central Street Pumping Station which will be demolished within 2 years upon completion of the project. The site will be used for one of the proposed chemical feed stations. The Main Street station will require the construction of approximately 650 feet of new 12-inch water main from the existing distribution system on Main Street to the proposed chemical feed station and back into North Reading's distribution system. North Reading has targeted a permanent new water connection with Andover in 2021 pending necessary permitting and approvals.

As noted in the NPC, the wastewater portion of the project has been deferred to a future date. Securing a water source for North Reading is significantly more pressing and urgent and all efforts have been focused on this task. Advancement of wastewater is well behind the water project.

However, North Reading continues to make progress towards assessing the feasibility for sewering portions of the community. North Reading has entered into an agreement with Wright-Pierce to conduct two separate studies whose outcome will help frame some of the technical challenges of sewering North Reading and will further refine conceptual costs estimates and affordability.

The first sewer study will detail the configuration, phasing alternatives and project costs for a sewer collection system from the North Reading/Andover town line south through North Reading along Route 28 to Park Street and from Park Street west to Concord Street and Concord Street to the I-93 interchange.

The second study will detail needed improvements, and their associated costs required to convey increased sewage flows from North Reading through Andover to the Greater Lawrence Sanitary District (GLSD).

The expected timing for these studies to be complete is approximately July 2020.

The Town has formed a sewer steering committee that will review the studies and evaluate the best approach at bringing this project forward to the community. Public engagement is anticipated the earliest in Spring of 2021 Town Meeting, if not later.

At an April 25, 2019 meeting with the WRC, MassDEP, North Reading, and Andover, both the WRC and MassDEP indicated that North Reading's efforts to bring increased water into the Ipswich River Basin through the Andover purchase agreement would be viewed in a positive light when the wastewater project is re-introduced and approval for a wastewater discharge out-of-basin is sought.

The NPC containing the post-DEIR revisions above was advertised in the Environmental Monitor on November 21, 2018. During the NPC review period, the Secretary received over 39 pages of comments, and issued a Certificate on that report on December 21, 2018. This FEIR is intended to augment, rather than replace the previous report. It responds to comments received during the DEIR and NPC review, provides additional information, refines the analysis of needs and alternatives, and presents a modified recommended plan. The full, unaltered text of the comment letters are provided in Appendix B. The FEIR follows and has been prepared in accordance with

301 CMR 11: MEPA Regulations and Section 11.07 for outline and content as modified by the scope in the DEIR Certificate.

1.3.1 Recent Discovery of Per- And Polyfluoroalkyl Substances and MassDEP Action

In 2016, the United States Environmental Protection Agency (EPA) issued a lifetime Health Advisory (HA) of 70 parts per trillion (ppt) for the combination of two PFAS chemicals, PFOS and PFOA, in drinking water. These chemicals have been used in the manufacture of a variety of consumer and governmental products since the 1950's. Testing has shown that ingestion of these chemicals is linked to a variety of health issues.

In 2018, MassDEP established an Office of Research and Standards Guideline (ORSG) level for drinking water that extended the EPA advisory to include the three additional PFAS chemicals. The ORSG level of 70 ppt applied to the total summed level of all five compounds.

On January 27, 2020, MassDEP updated the ORSG for drinking water to add an additional compound, PFDA, for a total of 6 PFAS and lowered the guideline to 20 ppt for the total sum of the concentrations of the 6 PFAS.

In response to recent media reports and public concern over Per- and polyfluoroalkyl substances (PFAS) is drinking water, the Town of North Reading voluntarily sampled its own sources for PFAS in early January 2020, with the expectation that the results would demonstrate to the public that their sources were not impacted by PFAS. Unfortunately, and previously unknown to the Town, one of the samples showed concentrations of PFAS slightly above the proposed and soon to be promulgated MassDEP maximum contaminant level of 20 ppt.

As required, the Town reported the exceedance to the MassDEP. MassDEP, indicated that North Reading could immediately begin obtaining all its drinking water from Andover. And as an interim measure while the Town continues to apply for MEPA approval and an increase in its IBTA, MassDEP will issue an Emergency Declaration to allow the Town to withdraw water from Andover in any amount above its current IBTA limitation of 1.5 MGD. The Emergency

Declaration is expected to be issued between mid-April and no later than May 1, 2020 when water demands of North Reading exceed 1.5 MGD and will extend for a period of 6 months when demands are expected to subside below 1.5 MGD.

Coincidently, the Town of North Readings water treatment plants had been taken out-of-service in early January 2020 as has been traditionally practiced by the Town, to service and perform needed maintenance on these facilities. During this period, North Reading obtains all its drinking water from Andover and per its existing IBTA, can do so until demands reach 1.5 MGD. At this time, the Town does not expect their water treatment plants to be placed back into-service.

It should be noted that based on the Town's historical demands averaged over the past 5 years, the Town's demands exceed 1.5 MGD between the months of May through October as shown below.

TABLE 1-1
NORTH READING HISTORICAL DEMAND (2015-2019)

Month	Average Daily Demand (MGD)
January	1.303
February	1.264
March	1.290
April	1.358
May	1.647
June	1.917
July	1.957
August	1.952
September	1.911
October	1.702
November	1.393
December	1.432

In order to receive water from Andover, North Reading must construct and install chemical feed stations at each of the interconnections with Andover at Main Street and Central Street to provide the Town the ability to booster chlorine concentrations of the water received from Andover. During the warmer summer months, North Reading typically observes chlorine residual concentrations in the far ends of its system drop below detectable limits. The chemical feed stations and boosting of chlorine concentrations will prevent this from occurring in the future.

As part of its plan as outlined within, the Town is currently under design for permanent chemical feed stations to be constructed at each interconnection location. However, based on the anticipated timing for the submission and approval of the FEIR and IBTA, the new chemical feed stations will not be constructed and commissioned until late 2020, well after when they are needed.

As a result, MassDEP has directed the Town to proceed with the design and installation of temporary chemical feed stations at each interconnection location in advance of the insurance of the Emergency Declaration.

The system proposed for the Main Street location will consist of a liquid sodium hypochlorite feed system constructed within a portable trailer owned by the Town and located on the site of its existing flow meter vault between North Reading and Andover. The trailer will be powered by a temporary electrical service from an existing panel located at the selected site. Appropriate controls and instrumentation will be provided to allow the Town the ability to monitor the system remotely, receive alarms and notifications, record usage and generate reports required per MassDEP.

The Central Street location is the site of an existing pump station which currently feeds chlorine for the existing wells and water received from Andover. While the wells will be shut down, this facility will remain in-place and the Town will continue use of the chlorine system. A chlorine residual analyzer will be all that is needed to be added at this location to allow the Town to monitor and control chlorine dosage to the system.

Both temporary systems/sites are expected to remain in-service until the permanent facilities are constructed and commissioned.

1.4 OVERALL PROJECT SCOPE

"The FEIR should discuss steps the Town has taken to further reduce the impacts of the project since the filing of the DEIR, or, if certain measures are infeasible, the FEIR should discuss why these measures will not be adopted."

- The original project (connection to MWRA through Reading) would have required the construction of approximately 14,000 feet of water main improvements within the Town of Reading's water system in order to convey flows from MWRA to North Reading. These improvements would have been disruptive to the community and would have required environmental controls in certain areas to protect adjacent resource areas.
- The original project (connection to MWRA through Reading) would have required an extension of Reading's water system across the Ipswich River on Mill Street to connect to North Reading's water system. This connection would have had to be constructed through a historical area in Reading, through a sensitive wetland resource area and across the Ipswich River.
- The original project (connection to MWRA through Reading) would have required the construction of a large pump station and interconnecting water mains along Mill Street in North Reading to boost water from a lower gradeline of the MWRA/Reading system to a higher gradeline in North Reading. The station was proposed to be constructed adjacent to wetland resource areas.
- The new project (Andover interconnection) will not require any water distribution improvements.
- The new project (Andover interconnection) will require the construction of two small chemical feed stations to re-chlorinate water from Andover. Both stations will be constructed outside of resource areas. Both sites will require environmental controls to protect resource areas adjacent to the proposed sites.

1.5 REGULATORY OVERVIEW

The project will require permits, approval from several state and local agencies and an easement from a local property owner as presented in Table 1-2.

TABLE 1-2
ANTICIPATED PERMITS AND APPROVAL STATUS

Description	Organization	Status
BRP WS-29: Chemical Addition Retrofit for System Serving More Than 3,300 People	MassDEP	Submitted upon completion of design of chemical feed stations
BRP WS-32: Distribution System Modifications for System that Serves More Than 3,300 People	MassDEP	TBD when/if Town abandons WTP's
950 CMR Project Notification Form	MHC	Complete
National Pollutant Discharge Elimination System (NPDES) Construction General Permit	EPA	Included as a requirement in construction contract for chemical feed stations
Application for Permit to Access State Highway	MassDOT	Complete
Natural Heritage and Endangered Species Program	NHESP	Complete
Order of Conditions	North Reading Conservation Commission	NOI Submitted, Awaiting Approval
Inter-Basin Transfer Act	WRC	Review begins upon approval of FEIR by MEPA
Easement from Property Owner	Private property owner	In Progress

<u>Massachusetts Department of Environmental Protection (MassDEP)</u>

Permits will be required for modifications to the water distribution system. The following details anticipated permits required from MassDEP:

- BRP WS-29 – Chemical Addition Retrofit for System Serving More Than 3,300 people: Required for the proposed two chemical feed stations in North Reading.
- BRP WS-32 – Distribution Modifications for Systems that serve more than 3,300 people: Required when North Reading eliminates one or both of its water treatment facilities.

<u>Massachusetts Historical Commission (MHC)</u>

A project notification form (PNF) was submitted to MHC on December 9, 2019 for the Central Street and 303 Main Street chemical feed station sites to determine if any historical sites will be affected as a result of the construction of this project. Upon review of the PNF, MHC determined that the work propose on each chemical feed station, "is unlikely to affect significant historic or archaeological resources." Figure 4-6 depicts the location of historical sites in relation to each project site.

<u>National Pollutant Discharge Elimination System (NPDES) Construction General Permit</u>

A NPDES general permit will be required as the discharges from construction activities associated with portions of the project are anticipated to disturb one or more acres.

<u>Natural Heritage & Endangered Species Program (NHESP)</u>

The proposed locations for the chemical feed stations are not within an estimated/priority habitat area for state-listed species.

The water source for Andover is Haggetts Pond which receives most of its water from a pumped transfer from the Merrimack River through an impoundment of Fish Brook. The Merrimack River is mapped with state-listed rare species protected under the Massachusetts Endangered Species Act (MESA) and the Wetland Protection Act (WPA) as well as federally listed protected species under the U.S. Endangered Species Act implemented by National Marine Fisheries Service. A comment letter received from Massachusetts Division of Fisheries and Wildlife and included in the NPC Certificate indicated that based on their understanding of the Project and the species identified within the project scope, the interbasin transfer should not result in impacts to state-listed species for the water supply project.

<u>North Reading Conservation Commission</u>

The proposed Central Street chemical feed station, demolition of the existing Central Street pump station and abandonment of the Central Street wellfield are proposed in bordering land subject to flooding, bordering vegetative wetlands and the associated protective buffer zones, and an Order of Conditions from the North Reading Conservation Commission is required.

The proposed Main Street chemical feed station is proposed to be constructed in bordering land subject to flooding, bordering vegetative wetlands and the associated protective buffer zones, and an Order of Conditions from the North Reading Conservation Commission is required. Consultation with the North Reading Conservation Commission is underway.

Water Resources Commission

North Reading is in the Ipswich River basin and Andover's water supply source is in the Merrimack River basin making the project subject to the Interbasin Transfer Act (ITA). The WRC will use the FEIR as the ITA application once MEPA has accepted and approved the FEIR. The ITA requirements of the FEIR include:

1. That an environmental review pursuant to M.G.L. c. 30, §§61 and 62H, inclusive, has been complied with for the proposed increase.
2. That all reasonable efforts have been made to identify and develop all viable sources in the receiving area of the proposed interbasin transfer.
3. That all practical measures to conserve water have been taken in the receiving area.
4. That a comprehensive forestry management program which balances water yields, wildlife habitat and natural beauty on watershed lands of surface water supply sources, presently serving the receiving area and under control of the proponent has been implemented.
5. That reasonable instream flow in the river from which the water is transferred is maintained.
6. In the case of groundwater withdrawals, the results of pumping tests will be used to indicate the impact of the proposed withdrawal on static water levels, the cone of depression, the potential impacts on adjacent wells and lake and pond levels, and the potential to affect instream values as listed in 313 CMR 4.09(2)(g). Groundwater is not a source of Andover's supply and therefore is not of issue.
7. The Commission shall consider the cumulative impacts of all past, authorized, or proposed transfers on streamflows, groundwater, lakes, ponds, reservoirs, or other impoundments in the Donor Basin and relevant subbasins.

1.6 PRE-PERMITTING/PERMITTING EFFORTS TO DATE

Several meetings have been held with agencies during the development of this report. The following details the purpose and content of these meetings. Table 1-3 summarizes the details in tabular form.

- A meeting was held at the MEPA office on September 28, 2017 to discuss North Reading's plan to obtain a new water supply, and potential changes from the original scope. North Reading gave a brief overview of the history of the project and what originally led them to the MWRA solution. North Reading detailed recent activities with Andover who indicated a willingness to supply all North Reading's water needs. North Reading also discussed the original plans for a future sewer collection system to discharge to Andover with the ultimate destination of GLSD, and recent developments regarding a potential sewer on Concord Street with discharge to the MWRA, requiring a change in scope for sewer.
- A meeting was held at the Town of Andover's WTP on April 25, 2019 with representatives from MEPA, WRC, MassDEP, and Towns of North Reading and Andover to discuss aspects of comments received as part of the NPC certificate, details of Andover's water supply, treatment, and distribution system and the interbasin transfer permit application process. North Reading gave a brief overview of the history of the project and proposed changes to the NPC. Andover provided details as to the supply and water system operations. A subsequent meeting was held on-site of Andover's Fish Brook water transfer pump station to provide an overview of the station and its operation to MEPA, WRC and MassDEP representatives.

TABLE 1-3
SUMMARY OF MEETINGS AND COORDINATION

Meeting Date	Participants	Meeting Overview
9/28/2017	North Reading, MEPA, MassDEP	Discussed proposed changes to original DEIR scope. Specifically, Andover's willingness to supply water to North Reading.
4/25/2019	North Reading, Andover, MassDEP, MEPA & WRC	Review NPC comments and requirements for final submission of the FEIR.
2018 - 2019	North Reading & Andover	10-12 meetings between North Reading and Andover representatives to negotiate Intermunicipal Agreement
2018 - 2019	North Reading & Andover	Numerous Requests for Information needed to populate FEIR

1.7 PROJECT FUNDING

North Reading intends to fund the design and construction of water improvements with a $3M MassWorks Grant and the balance from local sources.

On March 15, 2018, North Reading was awarded a $3M grant from MassWorks to be used towards public infrastructure improvement projects that support and advance housing production with an emphasis on multi-family housing in qualifying areas. This includes the increase in water demands for redevelopment of the former J.T. Berry State Hospital site. This property was sold by North Reading through the "Open for Business" initiative through a partnership with the Commonwealth of Massachusetts which is an effort to help municipalities create value through its real estate portfolios. The site will be rezoned as a 40R Smart Growth District which will result in construction of a new 450-unit housing development, Martins Landing. This project is consistent with smart growth for the Town of North Reading and the Metropolitan Area Planning Council's MetroFutures Plan.

The original grant application submitted in August 2017 was made based on North Reading connecting to the MWRA system for their water supply. On October 24, 2018, North Reading notified the State and MassWorks program of the project change to obtain water from Andover which was approved. The grant does not require any matching funds from North Reading and can be used for preconstruction costs including design and engineering up to 10% of the total grant requested, and construction costs for the improvement projects. A copy of the grant details and correspondence is included in Appendix C.

The remaining project funding will be made from local sources. At North Reading's June 4, 2018 Annual Town Meeting, voters approved to appropriate (under Article 18) $3M to be used for the design and construction of water system improvements needed for a long-term potable water solution for the Town which includes the two chemical feed stations needed for the project. A copy of the Town Meeting Warrant and a copy of the unanimous vote of North Reading Town Meeting, certified by the Town Clerk, is included in Appendix C.

Wright-Pierce
Engineering a Better Environment

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SECTION 2

LAND ALTERATION

2.1 PRE & POST-DEVELOPMENT SITE CONDITIONS

Detailed pre/post-development site plans for each of the chemical feed stations are included in Appendix D. The plans illustrate the conditions of each of the proposed sites prior to and after development.

The 303 Main Street property is the site of an active restaurant and gym and has been fully developed. The parking area where the chemical feed station is proposed includes a stormwater collection system, infiltration gallery for roof runoff and a septic system. The location of the proposed chemical feed station will require a minor reconfiguration of a part of the stormwater collection system. The infiltration gallery and septic system will not be impacted. Approximately 60% of the proposed chemical feed station footprint will be constructed within the parking lot; the remaining 40% of the station will be constructed on a grass slope just outside of the parking lot. Site grading and stormwater controls are included in the design. The Town has obtained an easement from the property owner to construct and maintain the station.

The Central Street property is the location of the town's Central Street pumping station and one of the two metered interconnection locations between North Reading and Andover. The area of the proposed chemical feed station will require nominal tree clearing and removal of existing soil stockpiles left from prior sand and gravel mining operations to construct the building. The work at Central Street is in proximity to wetland resource areas; no work is anticipated to be within these areas. However, the proposed building will be partially located within the 100-year flood zone of the Skug River. As a result, compensation storage will be included in the project on the property. Appropriate environmental controls and Best Management Practices will be employed during construction in addition to any additional requirements of the North Reading Conservation Commission through an Order of Conditions.

Each station will include new magnetic flow meters to measure and record flows purchased/transferred from Andover into North Reading and used to pace the chemical feed pumps. The new meters will replace the existing meters and will be installed above grade in the interior of each station. In addition, a pressure reducing control valve will be installed within each station to modulate flow from Andover into North Reading.

Each chemical feed station will include a diesel fired back-up emergency generator to power the facility upon loss of primary power. The generators will be installed on the interior of each station and will include dual containment fuel storage tanks integral to the generator.

Upon completion and commissioning of the new Central Street chemical feed station, the existing station will be demolished in its entirety and the site will be restored and stabilized. In addition, the existing wellfield will be decommissioned and abandoned in accordance with the MassDEP protocol for the abandonment of groundwater supplies.

In conjunction with the new chemical feed stations, a new Supervisory Control and Data Acquisition System (SCADA) will be designed and installed for the entire water system. The system will provide full remote monitoring and limited control features and will replace an aged system that has outlived its normal service life. The system will monitor flows from Andover, will monitor the status of equipment and offer limited control (start/stop) at the new chemical feed stations, will provide status of water levels in each of the water storage tanks, and will monitor and allow limited control (start/stop) of equipment at the existing water treatment plants until such time as they are decommissioned.

Other than the abandonment of the wellfield at the Central Street site, all the towns remaining well sites will remain intact and active until such time that the Town is comfortable with the conversion to Andover water. From there after, the wells and equipment will be placed in an emergency status by disconnecting the well discharge from the distribution system and continuing to maintain the equipment in an active and ready state until such time as they may be needed in an emergency. The Town plans to run the wells to waste twice per year (Spring and Fall) to verify capacity and function of the wells.

2.2 ARTICLE 97 LANDS

As noted in the NPC, there will no longer be any work occurring in the Town of Reading; nor is any work required in the Town of Andover. Proposed improvements within North Reading consist of the two chemical feed stations as noted above on North Reading's Central Street site and at the 303 Main Street property where the Town has acquired an easement to construct and maintain the chemical feed station. Figure 4-8 shows the location of Article 97 lands within North Reading.

The location of the proposed Central Street chemical feed station, Parcel ID 213/029.0-0000-0002.0, with an address of 246 Central Street in North Reading consists of 570,636 square feet (13.1 acres) of land that has been the location of North Reading's existing Central Street Wellfield and pump station since 1954. The site is also where one of the two existing water interconnections with Andover is located. The water main from Andover is routed into the existing pump station where water is metered and treated with chlorine. North Reading records this property's primary use as a pumping station under the control and supervision of the Water Department.

The language in the above referenced Article 97 reads, in part, *"Lands and easements taken or acquired for such purposes shall not be used for other purposes or otherwise disposed of except by laws enacted by a two-thirds vote, taken by yeas and nays, of each branch of the general court."*

North Reading does not intend to change the use of this property as a result of the project. Based on the above, North Reading believes there are no restrictions to prevent them for making the proposed improvements on this property.

2.3 LAND PROTECTION STATUS

It is North Reading's intent to maintain their current Water Management Act (WMA) registrations other than the abandonment of the Central Street wellfield, maintain the Zone I and Zone II's associated with the existing sources, and keep the sources and WTPs operational for emergency purposes for a minimum of two years after the permanent transfer of water from Andover. Further details are described later in this Report.

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SECTION 3

WATER SUPPLY

3.1 GENERAL

North Reading has entered into an agreement with Andover to supply all its drinking water needs for the next 99-years. North Reading will discontinue drinking water withdrawals from within the Ipswich River Basin and convert their existing water supply sources to emergency supplies/status.

As noted in the original Certificate, page 2, paragraph 2 under “Project Description”, North Reading had indicated that upon admittance and connection to the MWRA water system that they would voluntarily forfeit their current water supply withdrawal registration. Based on the project change to obtain their water supply solely from the Town of Andover, North Reading has now decided to maintain their local existing water supply wells for emergency supply purposes. As previously discussed, this site will be used for one of the two chemical feed stations required for proposed project.

North Reading’s existing wells are registered under the Town’s WMA permit. If the Town occasionally withdraws water from the remaining wells, even if that water is not supplied to the distribution system for consumption, those wells will continue to be considered active and not abandoned. Therefore, the Town will keep the wells active and maintain their permitted status by routinely exercising both the well pump and associated equipment, as well as any emergency generator. The Town plans to run the wells to waste twice per year (Spring and Fall) to verify capacity and function of the wells. The emergency supply wells will be physically disconnected from the distribution system by the Water Department by disconnecting the discharge pipe and capping the open ends of the pipe. Provisions will be included in each well discharge for the introduction of chlorine solution should the wells need to be placed into service under an emergency condition. If the wells are ever activated for service, the Town will issue a boil order to all its customers.

It is the intent of the Town that after a period of at least two years following the full conversion to Andover water, the existing treatment facilities may be decommissioned but the wells would remain. In addition to its own sources, North Reading currently purchases up to 1.5 MGD from the Town of Andover through two interconnections. However, as noted, with the recent discovery of PFAS in the Towns drinking water supply, the existing water treatment plants are currently off-line and are not expected to be placed back-in service. The final disposition of these facilities has yet to be determined.

3.2 WATER SUPPLY

3.2.1 North Reading Supply

North Reading obtains its potable water from four groundwater supplies that include three wells at the Lakeside site, a single well from the Route 125 site, a tubular wellfield at Central Street, and two wells at their Railroad bed site. In addition to the groundwater supplies, North Reading supplements demands above the current supply capacity with water purchased from the Town of Andover through two existing interconnections.

North Reading also has six (6) inactive/emergency interconnections with neighboring communities including; Middleton (1), Reading (1), Wilmington (2), and Lynnfield (2). These connections are rarely used. The water systems of the connecting communities are operated at a lower hydraulic gradeline than that of North Reading and therefore to convey water from those systems to North Reading requires the use of temporary booster pumps.

North Readings existing sources have degraded significantly over time and now are only capable of producing approximately 60% of the permitted volume. In fact, today, the Central Street tubular wells produce less than 25% of their original capacity. Each of the Towns wells has been rehabilitated numerous times over their lifetime. Recent attempts to restore the capacity of the wells have been unsuccessful.

Once North Reading transitions to 100% Andover water, North Readings supplies will no longer be used. However, the Town' water storage tanks will remain in-service. In addition, two chlorine feed stations are currently being designed and are expected to be constructed by spring of 2021 that will be located at each of the existing Andover interconnections to boost chlorine residuals as needed during summer months.

3.2.2 Andover Supply

Andover obtains its potable water from Haggetts Pond, which is supplemented by flows from the Fish Brook and Merrimack River. Haggetts Pond is a 220-acre glaciated natural pond with a draw down capacity of 6 feet. Haggetts Pond is full at an elevation of 117.6 feet and is not allowed to drop below 113.5 feet to maintain required submergence of the raw water pumps. When the water level in Haggetts Pond reaches 116.5 feet, Andover activates the Fish Brook Pump Station to pump water from the Fish Brook impoundment to replenish Haggetts Pond.

The Fish Brook Pump Station and impoundment were constructed in 1965. The station includes four (4) pumps which convey raw water from the impoundment cross country through a 36-inch transmission main where it discharges into the north side of Haggetts Pond. Once the water level in Haggetts Pond reaches 117.6 feet, the pumps at the Fish Brook Pump Station are shut off. At 117.6 feet Haggetts Pond spills into the Fish Brook Watershed.

As required for the Fish Brook Pump Station pumps, and to maintain flow over the fish ladder, the water level in Fish Brook must be maintained at the top of the impoundment (12-13 feet). Water in Fish Brook enters the pumping station via a 30-inch sluice gate and through a bar rack and screen before entering the wet well, where each of the four pumps have an individual screen. Figure 3-1 depicts the bar rack, screen, and an individual pump screen at the Fish Brook Pump Station.

When flows from Fish Brook are insufficient to keep the impoundment full, supplemental water from the Merrimack River is pumped into the Fish Brook impoundment via a submersible pump. The submersible pump is used only to maintain the 12-13-foot water level in the impoundment. Figures 3-2 and 3-3 depict the submersible pump in the Merrimack River and the pipe carrying water from the Merrimack River into the Fish Brook Impoundment.

FIGURE 3-1
FISH BROOK PUMP STATION SCREEN COMPONENTS

A)

B)

C)

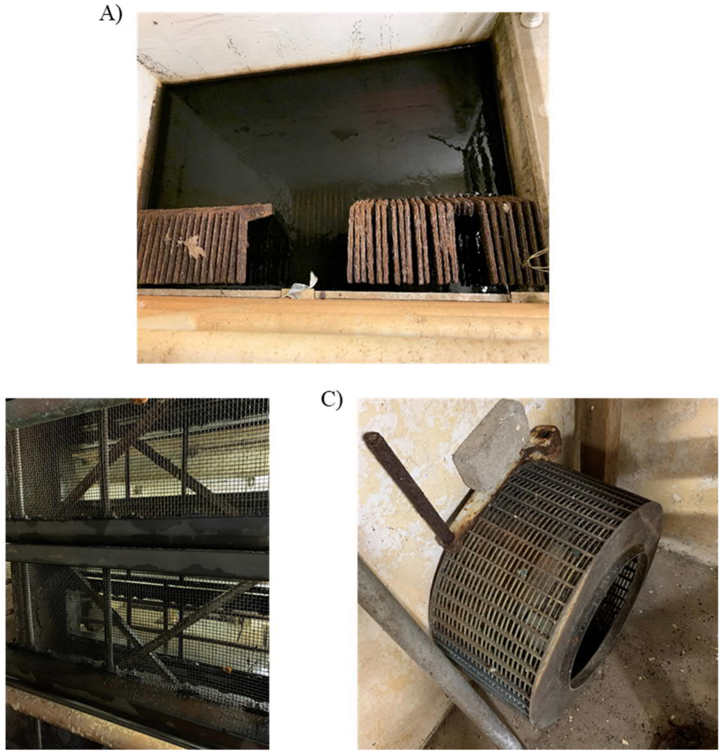


FIGURE 3-2
MERRIMACK RIVER SUBMERSIBLE PUMP

FIGURE 3-3
CONNECTION BETWEEN MERRIMACK RIVER AND FISH BROOK IMPOUNDMENT

A Final WMA Modified Permit #9P-3-13-009.01 for withdrawal from the Merrimack River and Haggetts Pond (located in Merrimack River Basin) was issued to Andover. The modified permit and registration together authorize Andover to withdraw from its water sources an annual average daily volume of 8.51 MGD or 3,106.15 MGY. The safe yield of Haggetts Pond is 1.1 MGD (safe yield is defined as the maximum amount of water that can be drawn during the severest drought on record) which is well below the daily demand needed by Andover. However, the Fish Brook and Merrimack River are the main sources of water to the system. Andover's permitted withdrawal volume is greater than the current and projected average daily demand of Andover plus the additional transfer volume to North Reading. Between the years of 2012 and 2017, the Town of Andover has had an average withdrawal of 7.33 MGD from Fish Brook Station with a highest ADD of 7.75 in 2015. Water from the Merrimack River passes through the Fish Brook Station which in turn is pumped to Haggetts Pond. The additional ADD transfer to North Reading is calculated by taking the future estimated ADD of 1.6 MGD for North Reading and subtract the historical ADD purchased by North Reading from Andover of 0.89 MGD. The additional transfer proposed by North Reading is 0.71 MGD. Assuming Andover's historical average demand of 7.33 MGD, the additional transfer to North Reading will result in a total withdrawal of 8.04 MGD. Being conservative, if you used the historical high ADD of 7.75 MGD as experienced in 2015, the proposed increase in withdrawal would equate to approximately 8.46 (7.75 + 0.71) which is still within Andover's WMA permit.

Figure 3-4 presents a schematic of Andover's water supply sources and major distribution piping network.

FIGURE 3-4
ANDOVER SUPPLY AND DISTRIBUTION SYSTEM

There is no limit on the amount of water that can be withdrawn from Fish Brook. Nor are there any restrictions on when water is withdrawn from the Merrimack River and Fish Brook. Andover's common operating practice for the Fish Brook pumping station is to pump and fill Haggetts Pond continuously between March through December of each year. However, the pumping duration can vary depending on weather and demands.

Andover's 2024 Capital Improvement Program will include $15M for the replacement of the Fish Brook Pump Station within the next 5-10 years. The station and equipment will have served its useful life and will require replacement to maintain its reliability.

Donor Basin Analysis

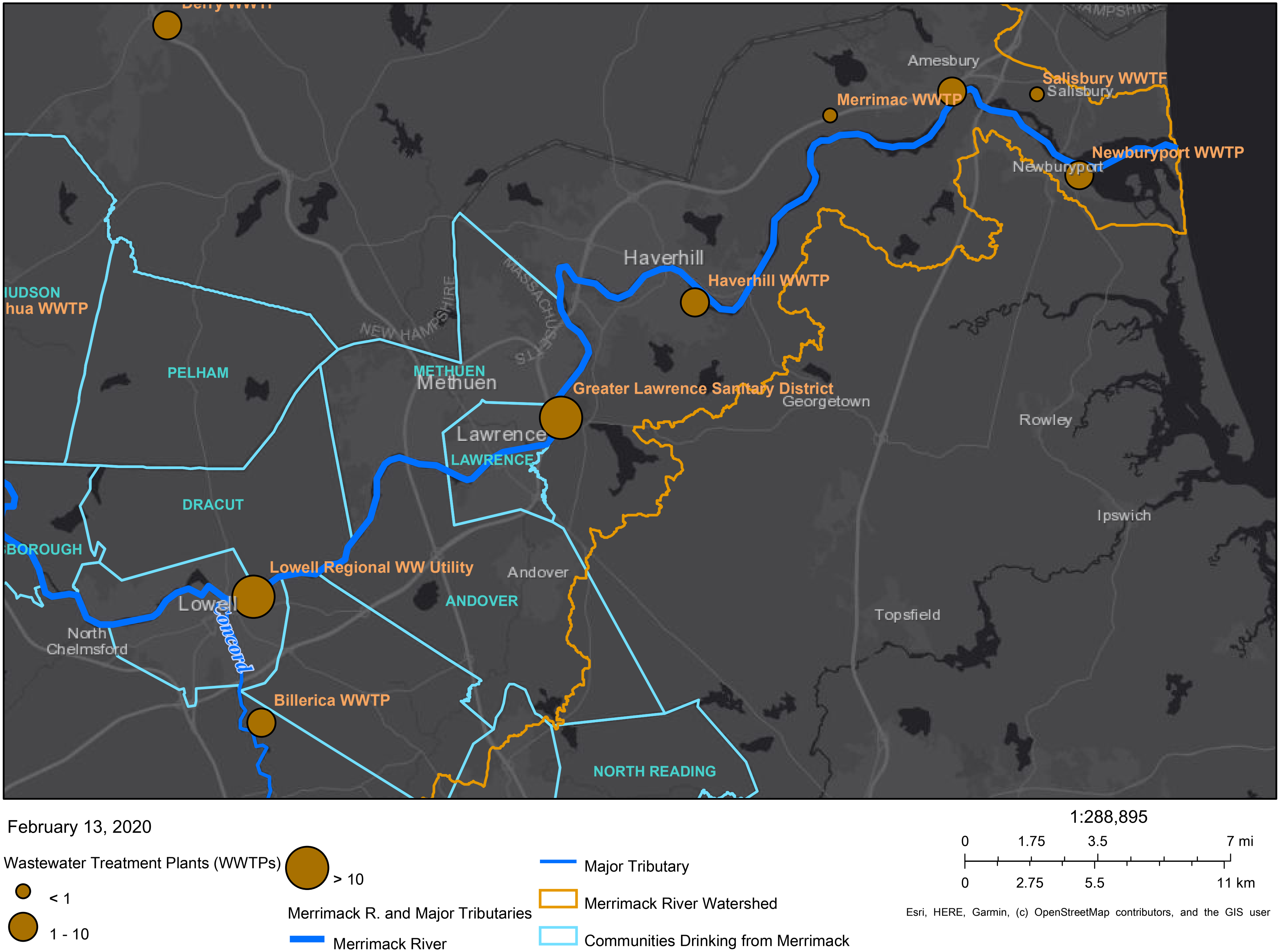
The DEIR and NPC documented the historical and projected demands for North Reading and thoroughly reviewed available of long-term water supply alternatives. Based on that analysis, North Reading is seeking an increase in their IBTA of 1.5 MGD for a total of 3.0 MGD to be provided from the Merrimack River through the Town of Andover water system. When assessing the impacts to the Merrimack River from the increase in transfer to North Reading, maintaining reasonable instream flow is a priority to ensure the hydrologic characteristics of the Merrimack.

The Merrimack River and its watershed is the largest watershed in New England. The Merrimack River originates in Franklin, New Hampshire and discharges to the Atlantic in Newburyport, Massachusetts. The Merrimack River watershed encompasses approximately 2.1 million acres and over 200 communities. The Merrimack River provides drinking water to approximately 500,000 people in Massachusetts including Lowell, Methuen, Andover, Tewksbury and Lawrence. Future withdrawals are proposed in Haverhill through radial collector wells installed under the river to serve an additional 56,800 people.

Downstream of Andover's withdrawal location is the City of Lawrence intake and the future river infiltration well for the City of Haverhill.

NPDES discharges along the Merrimack River and tributaries downstream of Andover's withdrawal location includes: Greater Lawrence Sanitary District (GLSD), Haverhill wastewater treatment plant (WWTP), Merrimac WWTP, Salisbury WWTP, and Newburyport WWTP. See Figure 3-5 for a map of the Merrimack River and downstream WWTP's and communities.

Merrimack River Map



Based on historical flows from drought years spanning 1962 to 1966, 1979 and 1984, and 2016 to 2017 as presented in Table 3-1, the percentage of additional flows proposed for North Reading are as follows:

North Reading Flow = 1.5 MGD (increase only) = 1,042 gpm = 2.32 cfs

TABLE 3-1
HISTORICAL FLOWS OF MERRIMACK RIVER IN CUBIC FEET PER SECOND (CFS)

Data	1962-1966	1979-1984	2016-2017
Minimum (cfs)	214	323	695
% of Minimum	1%	0.7%	0.3%
Mean (cfs)	9,754	8,926	7,061
% of Mean	0.02%	0.03%	0.03%

At the historical minimum flow of 214 cfs, the increase of flow to North Reading is only 1% of the minimum flow of the Merrimack River. Based on this information, there will be no impacts to the Merrimack River for the additional withdrawal. Between the years of 2012 and 2017, Andover has transferred approximately 57% to 77% of its total raw water usage from the Merrimack River. The proposed increase in withdrawal for North Reading would results in additional withdrawal from the Merrimack River and not Haggetts Pond since the safe yield of Haggetts Pond is only 1.1 MGD. The proposed transfer would also not result in additional spillage to Fish Brook from Haggetts Pond since Andover's operations would limit flows to maintain existing operating levels.

TABLE 3-2
HISTORICAL PUMPING RECORDS FROM FISH BROOK AND HAGGETTS POND IN MILLION GALLONS (MG)

ASR Year	2012	2013	2014	2015	2016	2017
Fish Brook Station (Merrimack River)	1,965	1,801	1,604	1,969	1,935	1,536
Haggetts Pond	2,563	2,696	2,807	2,836	2,659	2,481
% of Haggetts Pond	77%	67%	57%	69%	73%	62%

95% Exceedance Flow

The calculated 95% Exceedance Flow for the Merrimack River was based on Station 01100000 for daily flows observed over the past 10-years from January 28, 2010 through January 28, 2020. The 95% exceedance flow was determined using the following equation:

$$P = 100 \times (m/(n+1))$$

Where:

- P is the exceedance probability.
- *m* is the ranking, from highest to lowest, of all daily mean flows from the specified period of record.
- *n* is the total number of daily mean flows.

The 95% exceedance flow was determined to be 1,370 cfs. The proposed flows to be transferred to North Reading, if all flows were pumped from the Merrimack River, equates to 0.17% of the 95% Exceedance Flow. Based on this, there are no impacts to the Merrimack River for the proposed transfer to North Reading.

7Q10 Flows

7Q10 flows were evaluated for the wastewater treatment plants (WWTP) located downstream of Andover's intake location which includes GLSD, Haverhill WWTP, Merrimac WWTP, and Amesbury WWTP. Table 3-3 includes the 7Q10 flows for the facilities and the percentage of the flow that is proposed to be transferred to North Reading. Based on this analysis, there will be no impacts to wastewater facilities downstream and their dilution factors and permits.

TABLE 3-3
PERCENT OF NORTH READING WITHDRAWAL TO 7Q10 FLOWS OF MERRIMACK RIVER IN CUBIC FEET PER SECOND (CFS)

Data	GLSD	Haverhill	Merrimac	Amesbury
7Q10 Flows	832	878	611	900
% of 7Q10 Flows	0.28%	0.26%	0.38%	0.26%

Assuming all flows were pumped from the Merrimack River to supplement the additional demand of North Reading, the maximum impact is less than 0.38%.

Flood Flows

The transfer of water from the Merrimack River for North Reading will not impact the duration, frequency, and magnitude of flood flows since the overall transfer is negligible even during periods where the Merrimack is experience low flows and drought conditions.

Agricultural Impacts

The transfer of water from the Merrimack River for North Reading will not impact any agricultural operations reliant on the Merrimack River since the overall transfer is 1% during periods of extreme low flows and drought conditions.

Effect on Anadromous Fisheries

The proposed transfer to North Reading will have no effect on anadromous fisheries. Based on the small percentage of flows requested to be transferred for North Reading's use, even during historical drought conditions, there will be no effects on indigenous and anadromous fisheries, wetlands and dependent flora and fauna, recreational uses, aesthetic values, or water quality of the Merrimack River.

It is important to note, that while maintaining the fish ladder is not part of Andover's normal operating procedures, by maintaining 12 to 13-feet in the impoundment area of Fish Brook in order to maintain operation of the Fish Brook Pump Station, flows are maintained in the fish ladder. When water levels in the Fish Brook impoundment drop below the 12 to 13-foot water level flows are transferred from the Merrimack River.

The Essex Dam in Lawrence, Massachusetts, located downstream of the Fish Brook impoundment and fish ladder, has a fish lift where anadromous fish counts are taken. Central New England Fish and Wildlife Conservation Office publishes fish return counts. Tables 3-4 and 3-5 present Historical Anadromous Fish Returns on the Merrimack River.

TABLE 3-4
HISTORICAL ANADROMOUS FISH RETURNS IN THE MERRIMACK RIVER

Year	River Herring *	American Shad	Atlantic Salmon
1991	379,588	16,098	332
1992	102,166	20,796	199
1993	14,027	8,599	61
1994	88,913	4,349	21
1995	33,425	13,861	34
1996	51	11,322	76
1997	403	22,661	71
1998	1,362	27,891	123
1999	7,898	56,461	185
2000	19,405	72,800	82
2001	1,550	76,717	83
2002	526	54,586	56
2003	10,866	55,620	147
2004	15,051	36,593	129
2005	99	6,382	34
2006	1,257	1,205	91
2007	1,169	15,876	74
2008	108	25,116	119

Year	River Herring *	American Shad	Atlantic Salmon
2009	1,456	23,199	81
2010	518	10,442	85
2011	740	13,835	402
2012	8,992	21,396	137
2013	17,359	37,149	22
2014	57,213	38,107	75
2015	128,692	89,467	13
2016	417,240	67,528	6
2017	91,616	62,846	5
2018	449,356	29,060	10
Total	**1,851,046**	**919,962**	**2,753**

TABLE 3-5
ANADROMOUS FISH RETURNS IN THE MERRIMACK RIVER
AS OF JULY 2, 2019

Species (Average Length)	Total Returns
Atlantic Salmon (30 inches)	14
American Shad (20 inches)	18,653
River Herring * (11 inches)	143,541
Striped Bass (25 inches)	272
Sea Lamprey (25 inches)	8,897
American Eel (20 inches)	44
Gizzard Shad (11 inches)	0

**River Herring refers collectively to two fish species: Blueback Herring and Alewife.*

It should be noted that there are coldwater fisheries located downstream of Andover's withdrawal location in the Merrimack River such as; Cottles Creek in Haverhill, Cobbler Brook in Merrimac, and Presbus Creek in Amesbury. However, based on the percent transferred to North Reading during the historical drought and low flow occurrence, there will be no impact to the coldwater fisheries.

Effect on Resident Fisheries

As noted above, providing water to North Reading would not affect the flows of the Merrimack River. Existing instream flows will be maintained, with only a 1% impact to the minimum flows experienced on the Merrimack River since 1962.

Effect on Wetlands and Dependent Flora and Fauna

The current variation of flows would not be altered as a result of supplying North Reading 1.5 MGD (2.32 cfs). No perceptible effect on the reservoirs, river hydrology, and any adjacent wetlands and dependent flora and fauna is anticipated.

Effects on Rare and Endangered Species

The water source for Andover is Haggetts Pond which receives most of its water from a pumped transfer from the Merrimack River through an impoundment of Fish Brook. The Merrimack River is mapped with state-listed rare species protected under the Massachusetts Endangered Species Act (MESA) and the Wetland Protection Act (WPA) as well as federally listed protected species under the U.S. Endangered Species Act implemented by National Marine Fisheries Service. A comment letter received from Massachusetts Division of Fisheries and Wildlife and included in the NPC Certificate indicated that based on their understanding of the Project and the species identified within the project scope, the interbasin transfer should not result in impacts to state-listed species for the water supply project. Based on the small percentage of flows requested to be transferred for North Reading's use, even during historical drought conditions, there will be no effects on these species.

Effects on Water Quality, Recreational Uses and Aesthetic Values, Values of Critical Environmental Concern, Areas Protected Under Article 97, and Designated Scenic Rivers

The Merrimack River offers natural, cultural, and aesthetic values such as boating, fishing, swimming, and bird watching. Public education programs for communities along the Merrimack River provide a variety of information about the watershed and river, with a focus on water quality and conservation.

There will be no effects on water quality, recreational uses, or aesthetic values.

Effect on Existing and Planned Future Uses

Increase in transfer for North Reading will have no effect on existing and planned uses of the Merrimack River.

Net Increase of Water into the Ipswich River Basin

The additional flows transferred to the Ipswich River basin will be disposed of through local subsurface wastewater disposal systems.

As documented in the DEIR, the Town of North Reading does not own or operate a public sewer system or wastewater treatment facility. Virtually all the properties in North Reading use on-site treatment and sub-surface disposal systems. The one exception is a private facility located on Riverpark Drive off Concord Street, which has a privately-owned connection. The facility discharges wastewater to the Reading wastewater collection system for ultimate transport, treatment, and disposal by the MWRA.

The Town's original ENF and DEIR included a proposed wastewater collection system that would be constructed in the Town of North Reading to serve targeted needs areas. Up to 0.503 MGD of wastewater is proposed to be collected and discharged to Andover's wastewater collection system with its ultimate disposal at the GLSD WWTF. As documented in a subsequent NPC, North Reading will defer the wastewater project included in the DEIR with the understanding they will submit a supplemental FEIR when the wastewater project has been further defined and advanced. The Town has determined that their water needs are much more pressing and since the filing of the DEIR, all efforts have been focused on this task. Wright-Pierce, North Reading, and MEPA met on September 28, 2017 to discuss the project changes and Notice of Project Change filing. At this meeting the Town made a request to MEPA staff that if the Town split the water/wastewater projects at the FEIR, they would expect to receive credit for the water increase into the Ipswich River basin in the future and that deferring the wastewater portion would not negatively impact the wastewater project from discharging flows out of basin in the future. It is the request of the Town that baseline (existing) conditions be established from when the ENF and DEIR were filed for joint water/wastewater projects, when submitting future permitting for the proposed wastewater project. From 2008 through 2017, the average amount North Reading has pumped from its local sources is 0.52 MGD. Under this scenario, the Town is bringing in a net increase of 1.1 MGD into the stressed Ipswich River basin. When the Town no longer uses its own sources, the Town will be bringing in a net increase of 1.6 MGD into the Ipswich River Basin.

<u>Effects on Hydropower Production</u>

The 1991 Water Resources Decision on North Reading's IBTA request stated that Lawrence Hydroelectric Associates (now known as Enel Green Power) is required under its FERC License to release 951 cfs (615 GPD) from the dam directly downstream of Andover's intake on the Merrimack River when flows approach this limit. Enel Green Power's FERC License was issued on December 4, 1978. The required release of 951 cfs was determined by the Massachusetts Division of Pollution Control. The license is subject to a minimum release of 951 cfs unless and until the water level is drawn below the crest of the dam; thereupon the required minimum release would be equal to inflow. Andover does not continuously monitor the stream gauge and has never been notified by Enel or any other licensee of the FERC License to restrict withdrawal from the Merrimack River due to their release restriction at the Lawrence Dam. With the proposed transfer of 2.32 cfs to North Reading and net impact to the Merrimack River flows being less than 1% under the worst historical drought period, there will be no impact to Enel's operations from the proposed transfer.

3.2.2.1 Andover Treatment

Water from Haggetts Pond is treated at Andover's WTP which is located on the southeastern shore of Haggetts Pond. The WTP has a design capacity of 24 MGD which exceeds the future projected demand of Andover and North Reading combined. Andover's WTP includes the following processes; ozone system for oxidation followed by chemical addition for coagulation, pH adjustment, and oxidation. The chemically treated water then enters a rapid mixing system followed by flocculation and sedimentation. After sedimentation, the water is filtered and then disinfected with sodium hypochlorite before being pumped into the distribution system.

Backwash water generated during the treatment process is discharged back to Haggetts Pond and was authorized under the NPDES permit to discharge up to 1.5 MGD of backwash water.

EPA did not renew the General Discharge Permit for the Water Treatment Plant and is expected to deny the permit renewal application submitted by the Town. This will require Andover to provide an alternative method for the backwash water treatment and disposal because aluminum levels in the discharge might exceed the National Recommended Water Quality Criteria in Haggetts Pond.

The Town of Andover explored several options with their engineering consultant to manage the backwash discharges from their water treatment plant process. (1) Utilize a storage/equalization tank that can be located on-site at the WTF to hold filter backwash water until it can be pumped back into the treatment train at a controlled rate (10% of total flow) to the raw water intake. (2) Switching to a more complex form of aluminum-based coagulants. These chemicals are more effective; however, they are typically more expensive than alum. (3) Construct backwash lagoons in order to allow for the aluminum laden-solids to settle and collect in the lagoon while the supernatant overflows to Haggetts Pond. The lagoons would have to be cleaned periodically to remove the solids that would have to be trucked off-site to a disposal facility.

Andover is proceeding with design and construction of a new filter backwash discharge storage and equalization tank to store backwash water until it can be pumped back into the treatment train at the raw water intake for further treatment. Andover appropriated money at Andover's Town Meeting in FY 2012 for the design of this system and is planning for the construction of this system in FY 2021 under the Town's Capital Improvements Program. The system will be sized to accommodate the additional discharges created through the treatment process by the increase in water sold to North Reading.

3.2.2.2 Andover's Distribution System

A hydraulic evaluation of the Town of Andover's water system was completed to assess the capacity of their system to deliver the needed flows to North Reading through the proposed interconnection options.

Andover's distribution system consists of three distinct pressure zones; (1) the West High zone, (2) the Central Low zone, and (3) the East High zone. The West High zone generally serves the western portions of the community. The Central Low service zone serves the majority of the community in the central areas of town. The East High zone serves eastern areas of the town including North Reading.

Interconnection scenarios were simulated in the model under Maximum Day Demand (MDD) and Average Day Demand (ADD) conditions. Demand conditions within Andover's system including current and project demands to North Reading were evaluated. According to the hydraulic evaluation completed by Andover's consultant, there are no deficiencies within the Andover distribution system to meet the increased North Reading demand. Additionally, only two of the twenty-two ISO locations have fire flow deficiencies and much of the system consists of old and unlined pipe. Replacement of old and unlined water mains is planned in Andover and is discussed further within this Section.

3.2.2.3 Interconnections with Andover

Andover has 10 interconnections with neighboring communities. Two (2) of the interconnections are actively used to transfer water from Andover to North Reading; eight (8) connections are inactive and closed and are only used in an emergency. Table 3-6 presents details of each interconnection.

TABLE 3-6
INTERCONNECTIONS WITH ANDOVER

ID	PWS	Location	Status	Size/Material	Connection Type
LA-1	Lawrence	River Road	Inactive	12 CLDI	Gate Valve
LA-2	Lawrence	North Street	Inactive	8 CI	Gate Valve
LA-3	Lawrence	Union Street	Inactive	6 CI	Gate Valve
NA-1	North Andover	Route 114	Inactive	12 CLDI	Metered Vault
NA-2	North Andover	Haverhill Street	Inactive	16 CLDI	Metered Pump Station
NR-1	North Reading	South Main Street	Active	12 CLDI	Metered Vault
NR-2	North Reading	Gould Road	Active	8 CI	Metered in Building
TE-1	Tewksbury	Dascomb Road	Inactive	12 CI	Gate Valve
TE-2	Tewksbury	Bellevue Road	Inactive	8	Gate Valve
TE-3	Tewksbury	Lowell Street	Inactive	12 CLDI	Gate Valve

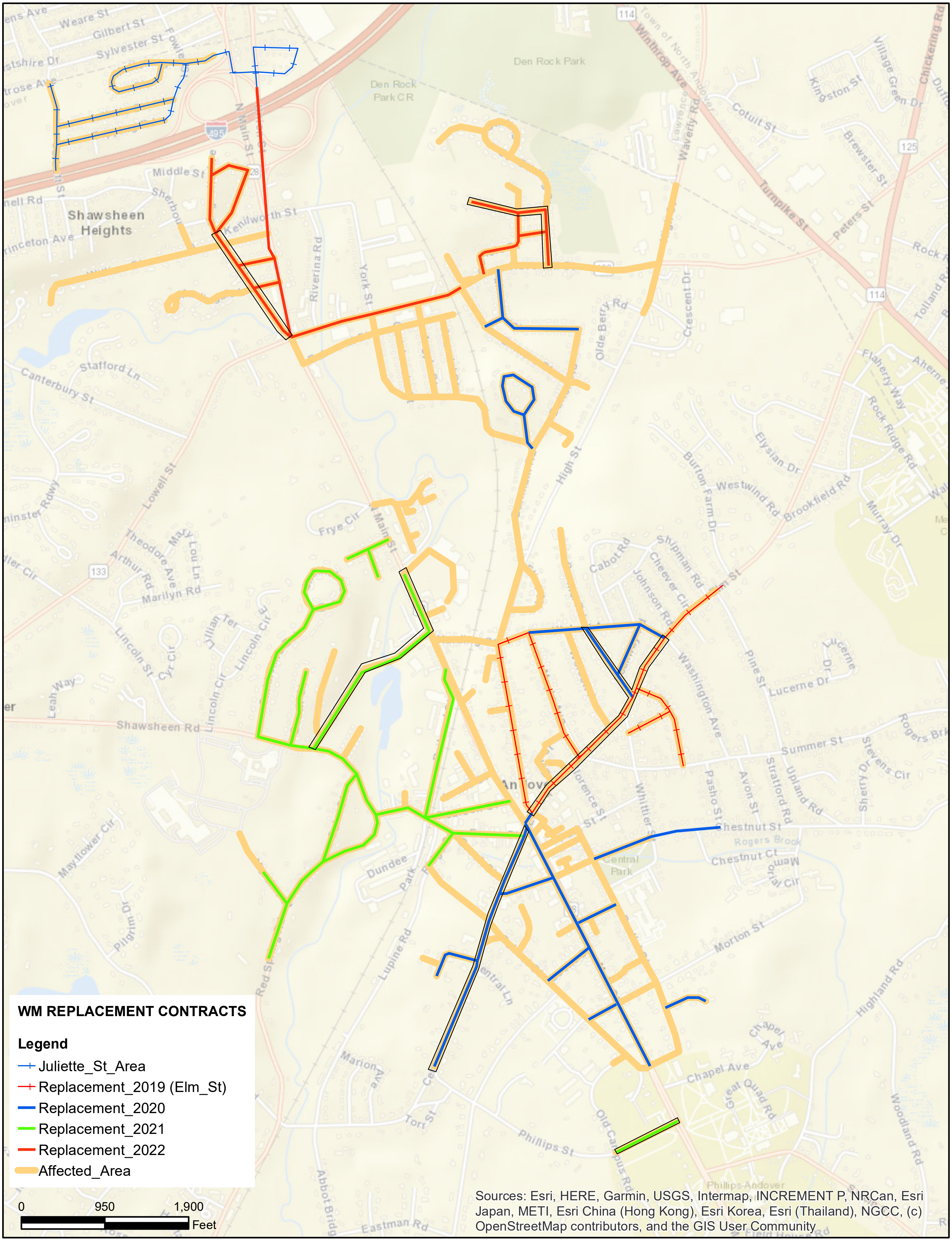
3.2.2.4 Distribution System Water Quality

Between 2015-2018, Andover received numerous complaints from residents and advocacy groups regarding dirty water and other aesthetic water quality issues. The complainants contend that aesthetic water quality issues are from the significant amount of unlined cast iron water mains in Andover's water distribution system. Andover attributes most of aesthetic complaints to water main breaks and routine system flushing. Andover reports that there was a large increase in aesthetic incidents in 2018 immediately following the Columbia Gas explosions. These cases were traced to unauthorized use of system hydrants by the gas company's construction crews.

Shortly after the complaints began, Andover began working to reduce dirty water incidents.

1. The Town has implemented a uni-directional flushing program to remove natural sediment built-up in pipes which can become suspended when velocity in the mains exceeds normal conditions. The Town of Andover is divided into 4 zones. Two zones are flushed every year; therefore, each zone is flushed every two years.
2. The Town has increased the frequency of leak detection activity to identify and repair leaks prior to a main break. Currently the Town is performing leak detection every year.
3. The Town recently approved $54M authorizing the Water Department to replace tuberculated water mains over the next 10 years.
4. The Town of Andover's Capital Improvement Plan (CIP) includes a plan to allocate $3M to line or replace the unlined cast iron mains over the next five years. However, as a result of the gas work, Andover now has additional funding that can be devoted to water main replacement. Figure 3-6 highlights water mains scheduled to be replaced by Andover between 2019-2022.

Andover contends that as a result of their current activities, there have been no recent water quality/aesthetic issues. Also, they do not anticipate any water quality impacts from the increased withdrawals for the Town of North Reading. The records of water quality complaints are included in Appendix B.


WM REPLACEMENT CONTRACTS
Legend
Juliette_St_Area
Replacement_2019 (Elm_St)
Replacement_2020
Replacement_2021
Replacement_2022
Affected_Area
0
950
1,900
Feet
Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community
Weare St
Gilbert St
Sylvester St
Den Rock Park
Den Rock Park C R
Winthrop Ave
Town of North Andover
Kingston St
Village Green Dr
Cotuit St
Brewster St
Turnpike St
Peters St
Rock Rd
Middle St
Shawsheen Heights
Kenilworth St
Riverina Rd
York St
Olde Berry Rd
Crescent Dr
Stafford Ln
Canterbury St
Flaherty Way
Rock Ridge Rd
Elysian Dr
Lowell St
High St
Burton Farm Dr
Westwind Rd
Brookfield Rd
Murray Dr
Frye Cir
Main St
Theodore Ave
Mary Lou Ln
Arthur Rd
Marilyn Rd
Cabot Rd
Shipman Rd
Cheever Cir
Johnson Rd
Lincoln St
Lincoln Cir
Jillian Ter
Cyr Cir
Leah Way
Washington Ave
Pine St
Lucerne Dr
Shawsheen Rd
Summer St
Stevens Cir
Rogers Brk
Andover
Florence St
Whittier St
Pasho St
Avon St
Stratford Rd
Upland Rd
Chestnut St
Rogers Brook
Chestnut Ct
Memorial Cir
Central Park
Mayflower Cir
Dundee
Park
Pilgrim Dr
Morton St
Lupine Rd
Central Ln
Highland Rd
Red St
Chapel Ave
Marion Ave
Great Quad Rd
Torr St
Phillips St
Old Campus Rd
Woodland Rd
Phillips Andover
Abbot Bridge
Eastman Rd

Hydraulic modeling was performed for the proposed project and helped determine the impacts to pipe velocities in Andover's system for the proposed increase in flows to North Reading. This report was included in the NPC submission. Under future MDD conditions with two active interconnections with North Reading at Main Street and Central Street, pipe velocities are generally comparable to existing conditions. Pipe velocities throughout the majority of the system remained less than 2 fps, with several locations surrounding the Bancroft Pump Station and treatment plant at Haggetts Pond experiencing pipe velocities between 2-5 fps. Pipe velocities increase as compared to existing conditions along the southern half of Main Street towards the connection point with North Reading but remain within 2-5 fps. Based on the findings, there are no impacts to velocities that will exacerbate the water quality issues/complaints in Andover's system from the proposed project.

3.2.2.5 System Storage

Andover recently completed a storage analysis (through their consultant) and concluded that the Town's current storage volume is adequate and capable of supporting both Andover and North Reading through 2025. North Reading is served from the East High-pressure zone and Bancroft water storage tank and the two Prospect Hill Tanks. The Bancroft storage tank is supplied by three (3) high lift pumps located at the WTP. These pumps were recently replaced to insure reliable service. Each pump is rated for 3,600 gpm, run on a lead/lag/standby setup, and meet design capacity with two pumps working and the third as a backup. The transmission main from the high service pumps to the Bancroft tank is scheduled to be upgraded in 2019 to increase redundancy to the East High-pressure zone.

A 2010 Master Plan prepared by CDM/Smith for the town concluded that Andover's existing storage capacity was adequate through 2025. They recommended that the tanks be inspected routinely in accordance with MassDEP policy, and the interior of the steel tanks be recoated. Since the 2010 Master Plan was published, the tanks have been inspected and cleaned and are now being inspected regularly per MassDEP recommendations.

The Bancroft Pump Station pumps water to the East High zone and Prospect Hill Tanks from the Bancroft Reservoir. The East High zone provides water to North Reading. The Bancroft Reservoir is a reinforced concrete underground tank with a total capacity of 6.0 MG segmented into two-compartments with a capacity of 3.0 MG each. The East High zone includes two water storage tanks, Prospect Hill Tanks #1 and #2. Prospect Hill #1 tank is a steel tank having a total volume of 0.8 million gallons (MG). The tank has a diameter of 66 feet and is 31.5 feet tall. The tank was constructed in 1957. Prospect Hill #2 tank is a concrete tank having a total volume of 3.0 MG. The tank has a diameter of 145 feet and is 25 feet tall. The tank was constructed in 1976.

A question/comment was raised during the NPC Submission regarding the Standard Operating Procedures (SOPs) of Andover's water storage tank inspections and cleaning. The Bancroft and Prospect Hill tanks are not drained when they are inspected and cleaned. The steel tanks at Prospect Hill were drained when they were cleaned and recoated in 2016. The steel tank levels were initially lowered via system demand, then the tank was isolated and drained via the tank drain. The discharged water flowed through a series of hay bales and silt fences to dissipate any remaining chlorine residual and to reduce water velocity. The remaining material was removed via vac-truck or tight tank and disposed of off-site depending on the metals content.

3.2.3 Corrosion Control Analysis

North Reading will discontinue use of its groundwater supplies and will transition exclusively to a water supply purchased from Andover. North Reading's current potable water consists of a blend of approximately 1/3 groundwater from North Reading wells and 2/3 surface water from Andover. In the future, all water will be supplied by Andover from their surface water sources. Changes in water quality, generated either by changing sources or treatment, should always be evaluated for the resulting effect on lead and copper corrosion.

Prior to the conversion to 100% Andover sources, the MassDEP is requiring that North Reading evaluate the need for treatment of Andover's purchased water for North Reading to remain in compliance with the Lead and Copper Rule. North Reading seeks to be simultaneously compliant with all its water quality goals.

The USEPA Action Level (AL) for the 90th percentile for lead (Pb) is 15 ppb (μg/L) and the 90th percentile for copper (Cu) is 1.3 ppm (mg/L). North Reading has been below the action levels and in compliance for its last five testing rounds (2006, 2009, 2012, 2015, and 2018). Similarly, the Andover system has been below the action levels and in compliance during its last five testing rounds (2004, 2007, 2010, 2013, and 2016).

To identify mechanisms that could possibly increase corrosion within the system, the Rothberg, Tamberini and Windsor (RTW) water quality model was used to examine factors that can indicate possible metals leaching, and to calculate levels of dissolved inorganic carbon (DIC), a relevant water quality parameter. The results from the model assist in evaluating potential approaches which can reduce corrosion, considering levels of, and establishing targets for dissolved inorganic carbonate (DIC), pH, alkalinity, and chloride-to-sulfate mass ratio (CSMR). Water quality factors and treatment options were evaluated with respect to the USEPA's March 2016 Optimal Corrosion Control Treatment Evaluation Technical Recommendations for Primacy Agencies and Public Water Systems." (OCCT).

3.2.3.1 North Reading and Andover Water Supplies

North Reading treats groundwater supplies at two greensand water treatment plants (WTP). The Lakeside Boulevard WTP treats groundwater from the Lakeside and Route 125 wells. The West Village WTP treats groundwater from the Railroad Bed wells. In addition to the North Reading groundwater supplies, North Reading supplements demands above the current supply capacity with water from the Town of Andover through two existing interconnections at Main Street and Central Street. The West Village and Lakeside supplies are blended at a volume ratio roughly 2.5 to 1 West Village to Lakeside.

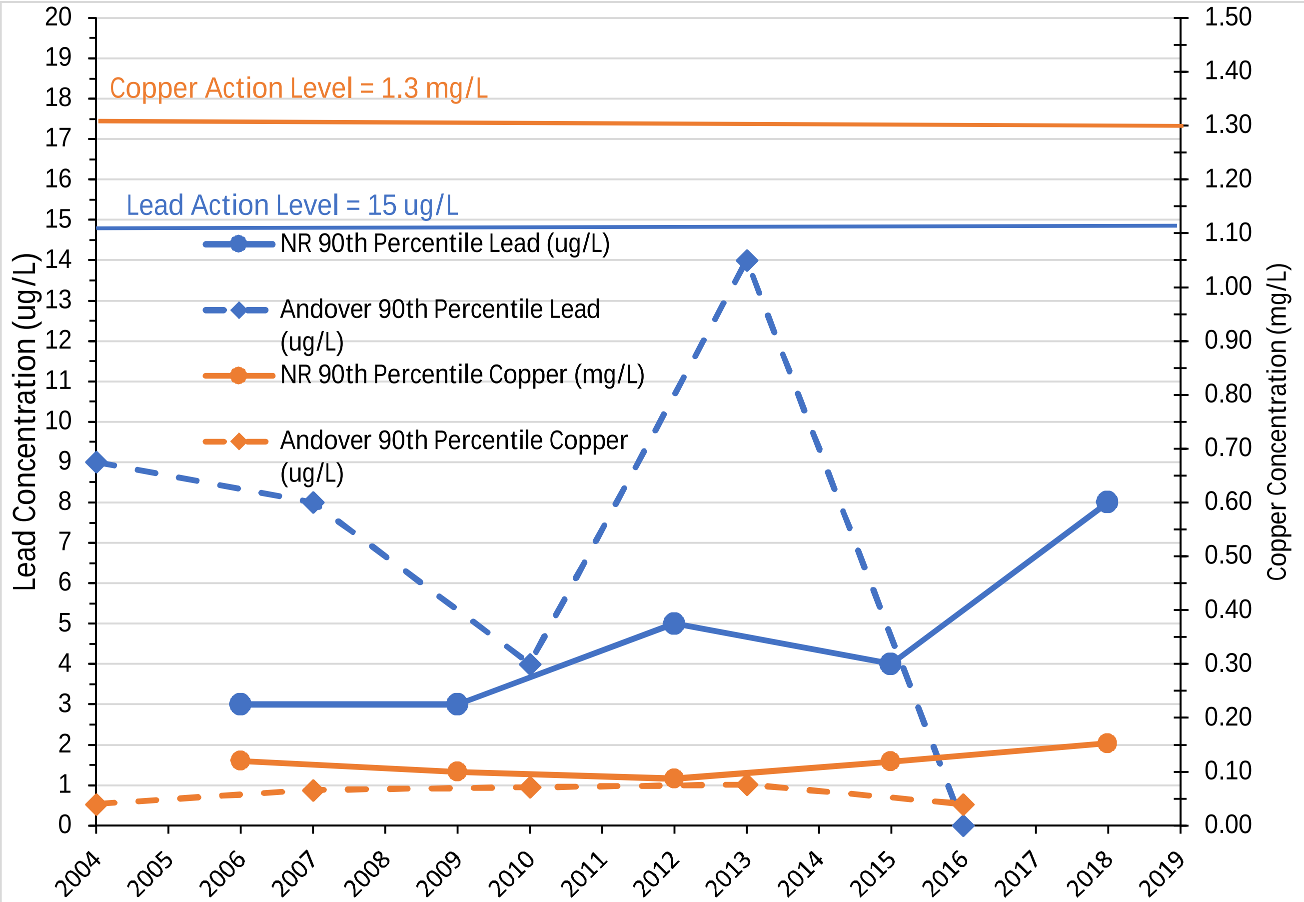
Corrosion control in North Reading is by adjusting pH to target levels of 8.9 to 9.1 using potassium hydroxide (KOH). The system generates chloramine for its distribution system (secondary) disinfectant, which also benefits from these higher pH levels.

Andover treats surface water from Haggetts Pond which is supplemented by flows from Fish Brook, and the Merrimack River. The Andover WTP has a capacity of 24 MGD. Andover's WTP uses conventional treatment that includes coagulation (alum and NaOH), flocculation, sedimentation, and multimedia filtration, followed by disinfection contact (using sodium hypochlorite). Incoming raw water is first screened and ozonated. Filter media consists of 6 inches of silica sand topped by 48 inches of granular activated carbon. Corrosion control is by means of pH adjustment using sodium hydroxide (NaOH) after disinfection contact. Chloramine is used as the secondary disinfectant for the distribution system. Andover maintains its pH in a range that is like that used in North Reading, targeting pH 9.0.

3.2.3.2 History of Lead and Copper in No. Reading and Andover

Figure 3-7 shows the 90^{th} percentile history for lead and copper in North Reading (2006 to 2018) and for Andover (2004 to 2016). The data for North Reading shows that the 90^{th} percentile concentrations of both lead and copper have been well below the Action Levels. Andover saw an increase in the lead 90^{th} percentile in their 2013 round of sampling; however, this was below the Action Level but higher than their historical 90^{th} percentile values. For Andover's most recent (2016) sampling event, the 90^{th} percentile dropped to non-detect. Both systems have very low levels of copper which is common for systems with a pH of 9.

FIGURE 3-7
HISTORICAL 90TH PERCENTILES LEAD & COPPER
NORTH READING AND ANDOVER



3.2.3.4 Finished Water Quality, Current Water Blend, and Corrosion Parameters

Representative corrosion control water quality parameters for both North Reading and Andover are shown in Table 3-7. The North Reading columns 3 and 4 (Lakeside and West Village WTP) represent the finished water at each source. Lakeside WTP contributes roughly 29% and West Village WTP produces 79% of North Reading's finished water. Column 5 in Table 3-7 shows the parameter concentrations for 29% Lakeside and 71% West Village blended North Reading water. The calculated corrosion parameter dissolved inorganic carbonate (DIC) and the calculated corrosion index chloride-to-sulfate ratio (CSMR) are also shown in Table 3-7.

Column 6 shows estimated parameters for the existing North Reading-Andover blend that is approximately 1/3 North Reading and 2/3 Andover water. This blend was modeled in the RTW model and compared to the modeled 100% Andover water.

To avoid metals release, 5-10 mg/L as C is the recommended range for dissolved inorganic carbonate (DIC). Species containing carbon "C" comprise dissolved inorganic carbonate (DIC). DIC is an aggregate measure of carbon-containing molecules including carbonate (CO_3^{2-}), bicarbonate (HCO_3^-), carbon dioxide (CO_2 gas), and carbonic acid (HCO_3^-). expressing the concentration as "C" or "$CaCO_3$". DIC is a value that cannot be measured and must be calculated. At optimal concentration, DIC reacts with lead and copper to form passivating mineral scales that prevent release of these metals into the bulk water. However, in excess, DIC can also promote corrosion. Andover water contains 9 mg/L DIC which is within the recommended range.

For both the blend and the Andover-only water, the ratios of the mass of chloride-to-sulfate (CSMR, chloride to sulfate mass ratio) are above the recommended ratio of 0.5 for avoiding corrosion. It is thought that chloride aggravates lead release from galvanic connections such as lead solder on copper pipes or partial lead line replacements, whereas sulfur forms passivating compounds. However, it is not a strong indicator as research has found that further increasing the chloride-to-sulfate mass ratio above 0.7 may not necessarily be an indicator of increased lead release. Lower CSMRs may be indicative of lower lead release caused by the formation of an insoluble sulfate precipitate with lead.

TABLE 3-7
CORROSION CONTROL WATER QUALITY PARAMETERS

Parameter	Unit	North Reading Sources			Est. Existing 1/3 NR:2/3 Andover Blend	100% Andover
		Lakeside WTP	W. Village WTP	Est. Lakeside-W. Village Est. Blend		
1	2	3	4	5	6	7
Production [1]	MGD	0.138	0.341	0.479	0.479 + 1.04 = 1.52	1.52
pH	S.U.	8.9	9.1	9.0	9.0	9.0
Alkalinity	mg/L as $CaCO_3$	35.7	130.0	102.8	59.1	37.3
Chloride	mg/L	105	152	138.5	119.5	110
Calcium	mg/L	11.7	19.4	17.2	13.6	11.8
Sulfate	mg/L	26.1	8.37	13.5	19.2	22.0
TDS [2]	mg/L	230	410	358.1	272.7	230
Calculated Values						
DIC [3]	mg/L as C	8	30	24	14	9
LI [4]	--	0.01	0.95	0.71	0.38	0.13
CSMR[5]		4.0	18.2	10.3	6.2	5.0

1. No. Reading volume treated on 9/24/18. 2. TDS = Total Dissolved Solids, 3. DIC = Dissolved Inorganic Carbonate, 4. LI = Langlier Index (indicates scaling potential), 5. CSMR = chloride-to-sulfate mass ratio

The calculated corrosion values for 100% Andover water, DIC and CSMR were better than for the existing blended water, with these indicators discussed in the next section.

3.2.3.5 Findings

Characteristics of water quality presented in Table 3-7 suggest that both North Reading's Lakeside and Andover waters are generally non-corrosive toward lead and copper. North Reading's West Village water is somewhat more aggressive.

Specifically:

1. Concentrations of dissolved inorganic carbonate (DIC) in West Village is 30 mg C/L, which is above the recommended range of 5 to 10 mg/L as C (20-40 mg/L as $CaCO_3$ equivalents) for corrosion control. Lakeside and Andover sources were 8 and 9, respectively, within the recommended range. The DIC level of 9 mg/L as C for 100% Andover water is within the optimal range of DIC levels for corrosion control.
2. A Langlier Index (LI) (calculated in RTW) above zero is a non-quantitative indicator of a water's tendency to precipitate calcium carbonate, used for evaluating a water's corrosivity. For each source and blend examined, LI was positive, above zero, indicating non-aggressive water. LI was not above 1 in each case, indicating water that would not tend towards nuisance scaling.
3. All sources were above the recommended chloride-to-sulfate mass ratio (CSMR) ratio of 0.5 – 0.7 for avoiding lead release from galvanic solder corrosion. The OCCT reported (Section 2.3.7) that in a Water research Foundation study, 40% of systems with CSMRs greater than 0.58 met the action level. It has been reported that further increase of the mass ratio much beyond 0.7 does not proportionately increase possible lead release. Moreover, the correlation of CSMRs to corrosion varies in the country and is not always a strong correlation to LCR violations as other factors are more important (J. Malley, UNH, personal communication).
4. Although Figure 3-7 shows an upward trend for lead in North Reading, the conversion to all Andover water could result in the same trends in North Reading as for Andover if these are based on water quality.

3.2.3.6 Recommendations

The water quality treatment recommendations for North Reading using 100% Andover water would fall under Flowchart 1c. of the USEPA's OCCT. For a water with DIC greater than 5 mg/L as C, the EPA recommendations are for using pH 9 to 9.5 which is the current approach used by Andover.

It is likely that the North Reading system will continue to be in compliance with the Lead and Copper Rule as it transitions from 2/3 Andover water to 100% Andover water. Because both systems are currently in compliance, we cannot at this time recommend the addition of corrosion inhibitor. If a corrosion inhibitor were to be recommended, orthophosphate can be used as a prophylactic to bridge the changeover if additional protection is desired, but it is likely that it would not be required long-term. If lead levels (averaged levels rather than 90th percentiles) were to increase after the changeover to Andover water, then we could recommend an increase.

3.2.4 WMA Compliance

It is North Reading's intent to maintain its current WMA registration. North Reading currently holds a WMA registered rate of 0.96 MGD for its sources within the Ipswich River basin.

The modified permit and registration together authorize Andover to withdraw from its water sources an annual average daily volume of 8.51 MGD or 3,106.15 MGY. Andover receives its source water from surface water sources, and they are subject to the WMA perform performance standards of 65 RGPCD and 10% Unaccounted for water (UAW). Andover has filed to renew their WMA permit and is waiting for Mass Department of Conservation and Recreation (DCR) approval. However, DCR has been unable perform a water needs forecast because of the high UAW levels in the system. Andover is in the process of implementing strategies to reduce UAW in the distribution system. The WMA Permit will be amended by Andover as required to meet the future needs to North Reading as noted in the IMA Agreement.

Both North Reading’s and Andover’s current performance standards are set at 65 RGPCD and 10% UAW. As defined by MassDEP:

“RGPCD and UAW are performance standards used to measure how efficiently municipal public water systems (PWS) are operating their systems. Under the authority of the Water Management Act, municipal PWSs using on average 100,000 gallons/day or more over a year are required to calculate the RGPCD and UAW values for their systems in the Annual Statistical Report (ASR) submitted to MassDEP… RGPCD is a performance standard for public water suppliers serving municipalities and is a measure of the average amount of water a resident uses each day during

the reporting period. High RGPCD values are associated with unrestricted outdoor water use (lawn watering). Lower RGPCD values may indicate that a community controls outdoor water use or that the community is densely settled with small lawn areas."

Figures 3-8 and 3-9 present North Reading and Andover's RGPCD and UAW numbers from 2011-2017 as compared to current and future WMA permit requirements.

FIGURE 3-8
HISTORICAL WATER-USE TRENDS RGPCD

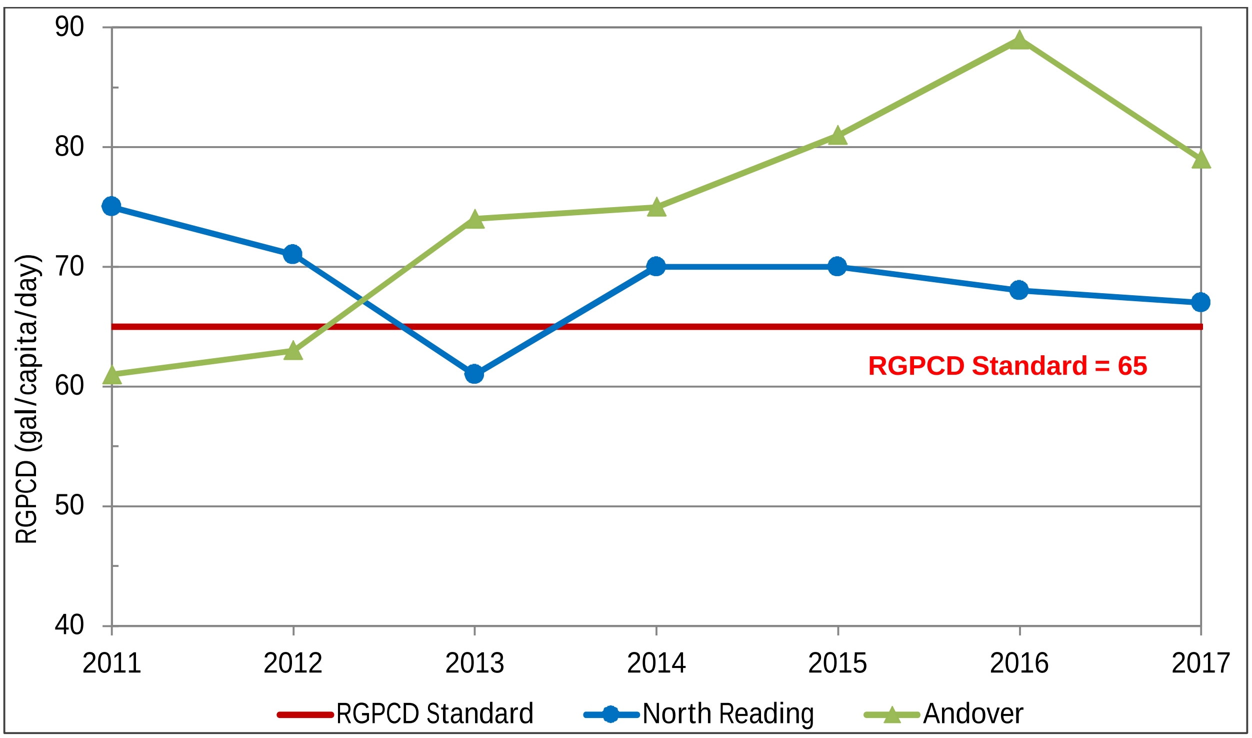
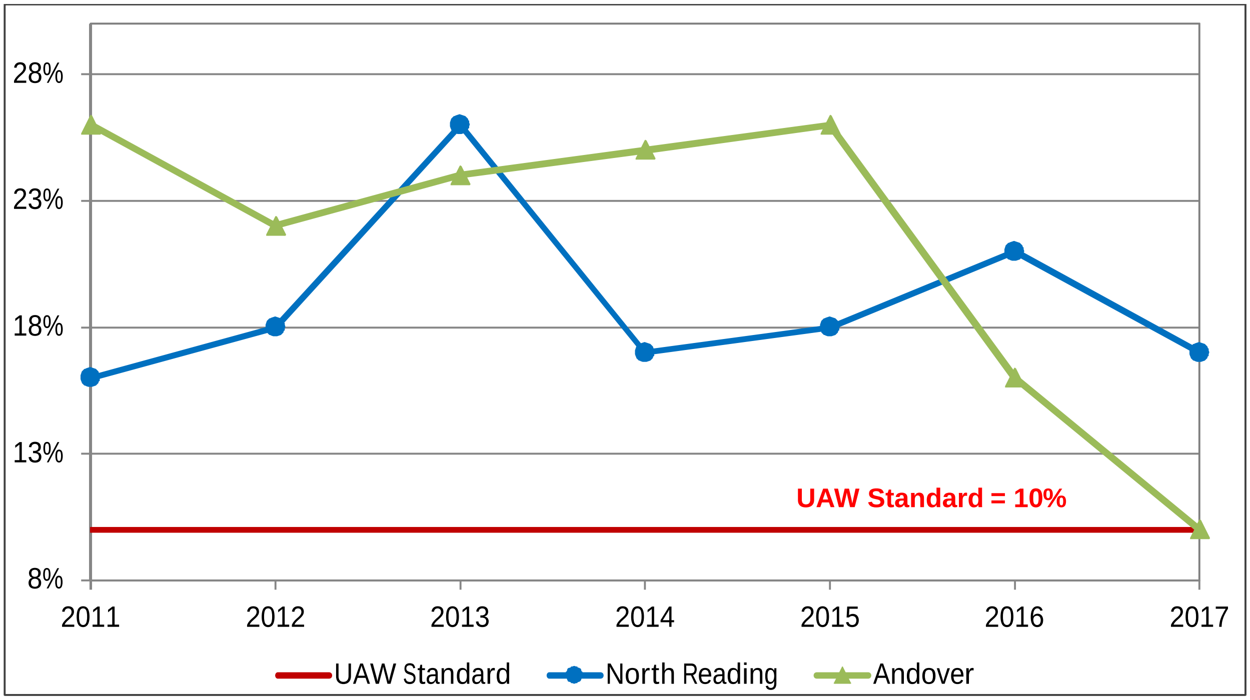


FIGURE 3-9
UNACCOUNTED FOR WATER USE



As shown in both figures above, both towns have exceeded the industry standards of 65 RGPCD and 10% UAW on many occasions in recent history. The following provides an explanation for the exceedances and steps being taken to reduce UAW.

3.2.4.1 North Reading

Exceedances of the RGPCD standard can be attributed to several issues: water lost to "unavoidable/unrecoverable" leaks; recoverable leaks; theft/meter tampering; meter under-registration; and master meter calibration.

1. *Unavoidable/Unrecoverable Leakage*
   Ductile and cast-iron pipe will leak no matter how well they are constructed. There are formulas for determining the acceptable (allowable) leakage in newly installed pipe. Water leaks in general, do not decrease over time, so a length of newly installed water main that meets the allowable leakage requirements can be expected to exceed those levels over time, due to settling and other factors.

Water services are another source of leakage. Over the years, North Reading has had to replace copper water services that had developed several "pinhole" leaks. Because of their small size, service leaks are difficult to identify until they become large enough resulting in puddling on the ground surface above the leak, customers notice a reduction in water pressure, or are large enough to be detected during leak surveys.

North Reading estimates that approximately 5 MG of water is lost annually to unavoidable leakage. This represents a flow equal to 9.5 gpm, or approximately 0.9% of North Reading's total water distributed in 2017.

2. *Recoverable Leakage*

Recoverable leaks are those leaks identified during leak detection surveys which are repaired thereafter. These leaks are generally larger than service leaks but smaller than main breaks and typically have a leakage rate of 1 - 5 gpm. Like service leaks, they can be difficult to identify without leak detection equipment. As a result, the volume of water lost from these types of leaks is difficult to quantify. North Reading did not include an estimate of recoverable leakage in the 2017 UAW calculations.

3. *Water Theft*

Water theft or metering tampering is another category of unaccounted-for water in North Reading. Water theft occurs from the installation of unapproved taps, unapproved use of fire hydrants, from developers using water before approved meters are installed, or from customers tampering with their water meter to under-register water passing through the meter. While this is not believed to be a wide-spread problem, incidents of theft and meter tampering are encountered annually. North Reading has historically included a volume of water lost to water theft in their calculations of UAW of 3% of the total water distributed annually.

4. *Customer Meter Under-Registration/Inaccuracy*

Lost water from customer meter under-registration and inaccuracies is another source of UAW in North Reading. Under-registration and inaccuracies develop over time as the meters age and components wear. In addition, sediment build-up within the meter can result in the meter registering less water than is passing through it. This is especially true at lower flow rates associated with residential accounts. In many cases we have found that the meters cease to register flows in the lower ranges.

The Town approved $1.7 M to replace all the system meters and upgrade the meter reading equipment with an Automatic Meter Infrastructure system. The new system will allow more timely billing, will improve customer service through an enhanced ability to detect and stop leaks, and will provide customers the ability to track their own water usage and receive alters for high water use. The new system, in combination with the improvements to master meters, is expected to greatly improve water use accounting and reduce UAW. The project is nearly complete with over 95% of the meters having been changed. It will take 1-2 years to collect new water information before the Town can reassess the impacts and benefits to UAW use.

Most of the residential and commercial meters in use prior being replaced under this program were in service for 20 years or more. The new meters are certified by the supplier to meet AWWA standards for meter accuracy at low, medium, and high flow rates which will reduce under-registration. The new meters will also reduce if not eliminate meter tampering as they include a variety of features that provide hourly water use data and have the capacity to notify the North Reading Water Department of meter tampering and reverse flow incidents. North Reading has historically included a volume of water lost to under-registration and inaccuracies in their calculations of UAW of 3% of the total water distributed annually.

5. *Master Meter Inaccuracies*

Until recently, the master meters throughout the system had not been routinely calibrated. In 2015-2016, Wright-Pierce conducted a master meter study that evaluated the installation, sizing, accuracy, and applicability of each of the Towns 11 master meters. The study found that several of the meters should be replaced with more modern type meters, the up-stream and downstream piping of certain meters should be reconfigured to improve accuracy, venturi meters should be routinely cleaned, some meters should be re-sized, and all of the meters should be calibrated yearly.

In addition to these improvements, the Town has increased its commitment to water conservation. Refer to the sections below for details regarding the water conservation measures that have been implemented by North Reading.

3.2.4.2 Andover

The Town of Andover has been saddled with high UAW percentages for several years. To address the high percentages of lost revenue water, Andover undertook a series of measures to find the root of the cause(s) and implement effective measures to reduce UAW. These measures included conducting AWWA Water Audits, hiring a consultant to provide a detailed review of previous five years of statistical reporting data, discussions with meter manufacturer and service team regarding meter dials and how meter information had been input into their billing system; focusing on timely repair of leaks found during annual leak detection efforts, investigating meter measurements of a neighboring community that purchases water from Andover; and a full evaluation of venturi-type master meters.

Several measures have been implemented to improve the amount of UAW in Andover and reported annually to MassDEP. These include:

1. *Water Audits*

   Level 1 Water Audits were conducted in 2014 and 2016 utilizing American Water Works Association (AWWA) software. In June 2015, Andover hired a consultant to investigate and analyze five (5) years of water production, consumption, and statistical reporting records. Their prioritized recommendations to reduce UAW included:

   - Continue independent quarterly calibration of master meters. Adjust the raw and finished water values in the ASR based on the results.
   - Document leaks found and date that they were repaired.
   - Reduce seven-meter routes to three to match the three pressure zones.
   - Consider creating district metering areas (DMAs) for enhanced leak detection.

- Consider special high sensitivity leak detection on transmission mains and at stream, railroad, and highway crossings.
- Conduct a test scenario for using pressure zones as DMAs.
- Conduct quality reviews of all accounts to make sure that at a minimum 100 HCF is entered as the estimated water use for each billing period.
- Increase flat billing quantity from 200 HCF to a higher value in order to incentivize getting a water meter installed.
- Consider increasing billing frequency to monthly, to increase the opportunities to recognize and address poor data.
- Verify in CUSI that the number of dials on the customer meter, the multiplier, and meter size are correct for all accounts.
- "Right size" large size meters.
- Include water used while on bypass for construction in CEMU estimate. Include backup to support the estimate in the ASR.
- Verify flushing flow rates used to address complaints.
- Confirm that all the interconnections with adjacent towns are closed and not leaking.
- Independently calibrate meters at interconnections yearly, particularly the meters at the North Reading interconnections.

This report was peer reviewed in 2016 by a third-party consulting firm, who concurred with recommendations but added the following recommendations:

- Should expedite drafting and implementing a policy that will require service leaks on private property to be repaired within 30-days of discovery.
- Continue increasing the level of detail for confidently estimated municipal use.
- Consider replacing and taking ownership of all large meters, including interconnections, and perform testing and maintenance to ensure accuracy. Other communities who recently did this reduced UAW and substantially increased water and sewer revenue.

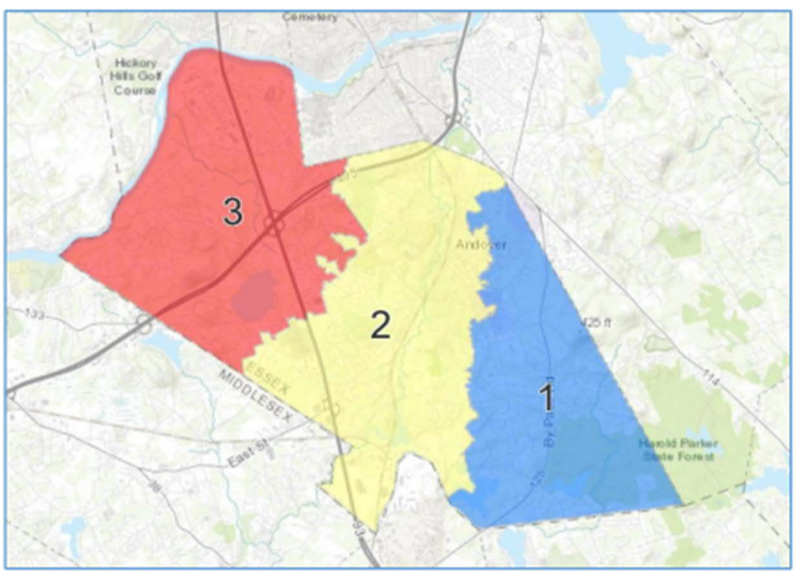
- Meters should be installed for all interconnections that are unmetered, regardless of how often the connection is used.
- The Town should add anti-tampering measures such as isolation valves on the Andover side of each interconnection or locked valve boxes.
- Flat fee accounts should be revisited. It is in the Town's best interest to eliminate all flat fee accounts. The Town should consider additional fees for the flat fee accounts.
- Verify that all closed accounts have been properly closed.

The recommendations above have been implemented by the Town and the implementation efforts are described below. A copy of the water audit and peer review are included in Appendix E.

2. *District Metering Areas*

In January 2017, the Water Department created three DMA's as shown in Figure 3-10, to track and reduce UAW. The DMAs are based on the three existing pressure zones in the system with the goal of performing a mass-balance of finished water delivered and finish water metered in those zones.

FIGURE 3-10
ANDOVER'S DISTRICT METERING AREAS



The Town's plan was to read the meters in one of the DMA's each month and compare the readings of the water usage to the actual flow through the Town's SCADA. The zones would be read every 3 months and 4 times per year. The Town also adjusted to quarterly billing during the implementation of the DMA's, which is discussed further below. While the Town was implementing the DMA's, the Water Department coordinated with the water meter software vendor and the Town's GIS department in order to provide real-time update on which meters correctly transmitted data versus others that did not and required another drive by or stop at the property, so the readings were transmitted and obtained. This decreased the occurrence of unread meters and additional efforts to return to the field to obtain missing data.

3. *Metering/Billing*

Andover recently implemented many procedures to assure the accuracy of data collected and reported. These efforts include:

- *Billing Cycle* – In 2017, Andover replaced bi-annual billing cycles with quarterly billing cycles. This resulted in a decrease in the number of billing refunds, rebates, and credits being issued.
- *Small Meters (5/8" to 1.5")* – All small meter accounts have been reviewed by staff to validate that they are being read and billed.
- *Large Meters (1.5" and above)* – Staff have been reviewing the Town's large meter database and checking that all large meters are tested annually for accuracy, in accordance with the Town's Large Meter Policy. Replacement of large meters not conforming to AWWA standards is an ongoing cooperative effort with customers and there is no specified timeline to complete this work. When a large meter is suspected to be inaccurate the owner is contacted, but the calibration repair and replacement is the owner's responsibility. The Town requires the owner to provide proof of calibration.
- *"Right-Sizing Meters"* – Water Division staff continue to coordinate with large meter owners by reviewing their range of flows and replacing meters with the

appropriate size and meter type to capture all usage, especially under low flow conditions.

- *Fixed Zeroes* – Fixed zeros are multipliers of actual readings, (1 fixed X10, 2 fixed X100, etc.). All large meter accounts have been reviewed/investigated/compared with the Towns billing software database for accuracy regarding the number of active digits and fixed zeros. All incorrectly entered fixed zero multipliers have been rectified to account for uncaptured use.
- *Master Meters* – The Town of Andover hires an independent company to calibrate the master meters in the WTP quarterly. Each interconnection with North Reading is metered. Pitometers were installed at each interconnection and calibrated to match the venturi master meters at the WTP. These meters were last calibrated in April 2018 and the accuracy levels of the meter readings fell within the American Water Works Association (AWWA) acceptance limit range of 96% to 102% after testing or recalibration.
- *Non-meter accounts* – The system include numerous customers whose meters are not equipped with radios for automatic remote reading. These customers refused to allow radio meter installation when the program was implemented between 2009 and 2010. These customers are billed at a flat rate of 100 HCF per quarter to incentivize those customers to request a new water meter installation. Notifications to these account holders are sent annually. Since the meter replacement program began 99% of customers have had their meters replaced with radio meters.

4. *Leak Detection*

Since 2012, the Town has conducted annual leak detection surveys for each of the three district metering areas (East High, Central Low, West High). When leaks are identified, the leakage volume is quantified, and the leaks are repaired immediately after the leak detection report is issued. The leakage volumes calculated are included in the annual statistical report submitted to MassDEP. Where leaks are identified on private property, the customers are notified and asked to make the appropriate repairs. Private leaks are not repaired as quickly, as it is the responsibility of the property owner to repair the leak and they are not always responsive. Leak detection of private water mains and cross-country easements are also included in surveys.

In 2017, two major leaks; one in DMA 3 and one in DMA 2 were located during enhanced leak detection efforts. The major DMA-2 leak was found on May 1, 2017, was a service leak, was estimated to be 10-15 gpm, and was repaired on June 15th, 2017. The major DMA-3 leak was found on December 28, 2016, was a water main leak, was estimated to be 4-8 gpm, and was repaired on July 22, 2017. In 2018, one major leak was found in DMA-2 on May 19, 2018, was a water main leak, was estimated to be 8-10 gpm, and was repaired on June 14, 2018. Leak detection reports for 2017 and 2018 are included in Appendix F.

As a part of stepped up efforts to identify and eliminate leakage, the Town developed an internal policy outlining specific timelines for the repair of water main leaks, service leaks, and hydrant leaks. The policy was distributed to all pertinent water personnel.

5. *Interconnections*

Interconnections with neighboring communities such as Lawrence and Tewksbury have been inspected to verify they are closed and not leaking. A plan to install redundant valves and secure gate valve boxes at these locations was implemented during the 2018 construction season.

6. *Flushing Program*

Andover is divided into four flushing sectors and two sectors are completed each year, Therefore the entire system is completely flushed every two years. The Town does not regularly conduct water quality testing after flushing. All water used for flushing is tracked and reported in the ASR.

7. *Miscellaneous*

The Town identified a large unmetered Irrigation Service Meter line in DMA-1. Subsequently, a new meter was installed for water use accounting.

The Town also requires use of portable meters for use by Water and Engineering Department staff during water main flushing, temporary bypass uses, and any other non-metered needs so that the water consumption can be accounted for. In addition, Andover also preforms valve exercising and hydrant inspections which often result in the identification of leaks.

3.3 ADHERENCE TO SWMI

In accordance with the Massachusetts Sustainable Water Management Initiative (SWMI) regulations, MassDEP has established a water allocation program to balance water needs while assessing safe yield, streamflow and baseline conditions. Mitigation measures are implemented to help define actual water needs while reducing demands of the water sources for nonessential or inefficient water use, recharging the aquifer through stormwater and wastewater recharge, and improving habitats such as land acquisition and protection measures.

North Reading is proposing to obtain all its water through the Town of Andover, Merrimack River Basin. This proposed project is consistent with the goals of the State's SWMI program in that it will:

- no longer use its local groundwater sources located in the stressed Ipswich River Basin. The groundwater supply wells will be maintained for emergency use only and the important ecological water supply lands will be maintained and protected under Article 97,
- be bringing water from the plentiful Merrimack River Basin and discharging through septic systems in the stressed Ipswich River Basin. Even with the future wastewater collection project the Town of North Reading is considering with a discharge to GLSD of approximately 0.5 MGD, the Town will be bringing in a net of 1.1 MGD and average into the Ipswich River Basin,
- continue with their demand management practices by maintaining its water use restrictions and nonessential, outdoor water use restrictions,
- and maintain its current rate structures, increasing block rate.

The following section documents other conservation measures implemented by North Reading which is consistent with SWMI goals.

3.4 WATER CONSERVATION PROGRAM

The North Reading Department of Public Works has implemented several initiatives promoting residential water conservation measures to reduce residential water use. To date, much of this effort has been directed at educating residents and customers on becoming more efficient in outdoor water use practices. Information on the Town's water conservation efforts can be found on the Town's web site through the following URLs:

https://www.northreadingma.gov/water-division/pages/water-conservation

https://www.northreadingma.gov/water-division/pages/how-much-water-your-lawn

https://www.northreadingma.gov/water-division/pages/when-water-your-lawn

https://www.northreadingma.gov/water-division/pages/how-water-your-lawn

https://www.northreadingma.gov/water-division/pages/watering-techniques

https://www.northreadingma.gov/water-division/pages/mowing-your-lawn

https://www.northreadingma.gov/water-division/pages/water-conserving-soils

https://www.northreadingma.gov/water-division/pages/planting-conserve-water

https://www.northreadingma.gov/sites/northreadingma/files/uploads/waterright.pdf

https://www.northreadingma.gov/water-division/pages/saving-water-indoors

North Reading, through its Building Department, already enforces the Massachusetts Building Code, which requires the use of water saving plumbing fixtures in new construction and rehabilitation of existing plumbing fixtures. Note that North Reading has implemented and completed an Automatic Meter Infrastructure system (AMI). The new AMI system will allow the Town to more closely monitor illicit irrigation use. Further, North Reading's bylaw governing restrictions on water use contains the following language relative to sensors for outdoor irrigation systems:

"(2) in order to prevent excessive outside water use, all outdoor irrigation systems connected to the Town of North Reading public water supply shall be equipped with a rain sensing device, approved by the NRDPW, so that watering will be automatically prevented during rainstorms.

(4) All outdoor irrigation systems not connected to the Town of North Reading public water supply should also be equipped with a rain sensing device so that watering will be automatically prevented during rainstorms. This benefits the customer as it reduces pump energy use and cost; and reduces withdrawals from the Ipswich River basin."

The Department of Public Works also manages a Rain Barrel Program, through which residents can purchase rain barrels at below cost.

With respect to rebates, the North Reading water rate structure, with its 3-tier, increasing block rates, is a strong economic incentive toward water conservation. While not a true "rebate" program, it encourages customers to reward themselves with lower rates and lower water bills by taking advantage of all means of water conservation.

There have not been any recent updates to the Town's water conservation plans beyond what was provided in the DEIR, and what is described under the meter replacement program section detailed further in this document. There are two golf courses in North Reading - the Hillview Country Club, which is owned by the Town, and the Thompson Country Club, which is a privately-owned club. Both golf courses have their own WMA permits - separate and distinct from the Town's requirements. These permits, issued by MassDEP, likely contain specific conditions and limitations relative to water use and water conservation. As such, Town-wide water conservation restrictions may not be applicable to these two facilities.

North Reading has an existing Water Conservation Bylaw (Chapter 191, Article II of the Code of North Reading) that provides two mechanisms for the implementation of water use restrictions.

Under this bylaw, a State of Water Supply Conservation may be enacted through the North Reading Select Board, placing restrictions that apply to all consumers, with the term consumers defined as "all public and private users of the Town's public water system". In the past, the Select Board has declared a State of Water Supply Conservation, and the Town has enacted water use restrictions, in periods when excessive water demands threaten the ability of the water system to provide an adequate supply to all water consumers.

A second mechanism provided under this bylaw, a State of Water Supply Emergency, is defined as a declaration issued by the MassDEP, and this mechanism provides that "no person" shall violate the water use conditions enacted by the MassDEP. If there is a larger water issue extending beyond the boundaries of the Town and not relating to the internal ability of the Town to deliver water to its customers, the bylaw provides for restrictions to be extended to private wells under this State of Water Supply Emergency declaration. A copy of the Town's water conservation bylaw is attached in Appendix E.

3.4.1 Private Wells Bylaw

North Reading does not have a private well bylaw. A link to the North Reading Board of Health private well regulations is as follows:

https://www.northreadingma.gov/sites/northreadingma/files/uploads/well.pdf

Board of Health records show 16 private wells were installed in calendar year 2016, 7 private wells were installed in calendar year 2017, and 10 private wells were installed in calendar year 2018.

3.4.2 Drought Management Plans

3.4.2.1 North Reading

North Reading is continuously evaluating water management and addressing needs through local regulations. North Reading has updated its Water Use Restrictions Rules & Regulations (R&R) in October 2010, April 2012, and March 2014. North Reading also updated its Demand/Drought

Management Plan (DMP) in November 2013. Additionally, the Town has an Emergency Response Plan that was last updated in 2009 which serves as the contingency planning document. North Reading also maintains emergency connections to neighboring communities. The most recent version of the Town's Drought Management Plan is attached in Appendix G.

The primary drought indicators for North Reading are water demand, Andover water use, storage capacity, and Andover Drought Phase. North Reading purchases most of its water from the neighboring Town of Andover; therefore, North Reading is directly impacted by any drought related issues Andover experiences. Table 3-8 presents North Reading's drought stage triggers and Table 3-9 lists the water use restrictions for each drought stage. These measures are in place to sustain the long-term use of North Readings supplies and limit the chance of exceedances of the authorized water use allowed by the Town's Water Registration. The Drought Management Plan and Primary Drought Indicators will need to be updated in regard to Andover Water Use since the Town will be solely dependent on Andover for all its water demands under this proposed project.

TABLE 3-8
PRIMARY DROUGHT INDICATORS FOR EACH DESIGNATED STAGE

Drought Stage	Condition	Total Water Demand (7-Day Average) (MGD)	Tower Hill Storage Tank Capacity at 4 AM	Andover Drought Phase	Andover Water Use*
0	Normal	< 1.5	> 95%	Normal	< 0.90
I	Advisory	1.5 - 1.75	90 - 95%	Watch	0.90 – 0.95
II	Watch	1.75 - 2.0	85 - 90%	Warning	0.95 – 1.0
III	Warning	2.0 - 2.25	80 - 85%	Emergency	1.0 – 1.25
IV	Emergency	> 2.25	< 80%	Critical	> 1.25

TABLE 3-9
NORTH READING EXISTING WATER USE RESTRICTIONS

Stage	Condition	Restrictions
0	Normal	• Winter (October 1 - April 30) = No Restrictions. • Summer (May 1 - September 30) = Voluntary Water Conservation. * • Outdoor water use on ODD and EVEN days between 7 PM and 7 AM. • Residents with ODD numbered addresses may water lawns on ODD numbered days. • Residents with EVEN numbered addresses may water lawns on EVEN numbered days.
I	Advisory	• Mandatory Water Conservation. • Lawn watering restricted to two (2) times per week per Precinct between 7 PM and7 AM as follows: o Precinct 1: Monday & Thursday o Precinct 2 & 3: Tuesday & Friday o Precinct 4: Wednesday & Saturday
II	Watch	• Mandatory Water Conservation. • Lawn watering restricted to one (1) time per week per Precinct between 7 PM and 10 PM as follows: o Precinct 1: Monday o Precinct 2 & 3: Wednesday o Precinct 4: Friday
III	Warning	• Mandatory Water Conservation. • Outdoor water use restricted to handheld hose or water can with person in attendance between 7 PM and 10 PM for irrigation of shrubs, flowers, and gardens only. • The following are prohibited: o Lawn watering; swimming pool filling; washing of cars, trucks, boats, buildings; and cleaning of driveways.
IV	Emergency	• No outdoor water uses. • Water use restricted to normal bathing, cooking, laundry and sanitary use, or to meet the core function of a business or maintenance of livestock.

At North Reading's Fall 2014 Town meeting, the voters approved DPW Enforcement Authority which will aid in the enforcement of local regulations, especially regarding the implementation of the DMP.

3.4.2.2 Andover

The Town of Andover last updated their DMP in May 2015. The DMP consists of a series of four stages of drought management. A drought stage level can change in one of three ways after it has been reached. If conditions reach the criteria for the next drought level, the severity will be increased. If conditions persist, but do not reach the next level, the drought response action will remain constant. If conditions improve, the severity can be reduced based on either site-specific information or on progress toward returning to normal. Table 3-10 contains the response actions to be implemented at each drought stage.

TABLE 3-10
DROUGHT INDICATOR: ANDOVER DROUGHT TRIGGER LEVELS

Drought Phase	Label	Response Action
Phase I	Watch	Voluntary Conservation *Target Largest Users*
Phase II	Warning	Voluntary Conservation of all users. Mandatory conservation for targeted largest users.
Phase III	Emergency	Mandatory restrictions with by-law in effect.
Phase IV	Critical	Maximum mandatory restriction.

Phase I (Watch) seeks the voluntary conservation of the 25 largest water users who are contacted and asked to implement their conservation practices. The list of major water users is updated annually. Also, outdoor water use is restricted at municipal facilities. The water use reduction goal in this Phase is 10%-15%. It should be noted that the new IMA between Andover and North Reading will implement restrictions to North Reading's largest users as well as Andover's, during Drought conditions. North Reading as a Town will not be viewed as Andover's largest user.

Phase II (Warning) implements a mandatory restriction of the 25 largest users in conjunction with an appeal for voluntary conservation of all public users. Outreach includes notifications using radio, cable television, newspapers, printed flyers, and bill stuffers. The water use reduction goal in this Phase is 15%-25%.

Phase III (Emergency) implements the Water Use Restriction By-Law adopted by the Town of Andover at an April 29, 2002 Annual Town Meeting. The by-law establishes enforceable limitations on the use of municipal water during periods of water shortages or drought conditions. The purpose of the by-law is to protect, preserve and maintain public health, safety, and welfare when water supply conservation is mandated, or a water supply emergency has been declared. The by-law is included in Appendix A. The water use reduction goal in this Phase is 25%-40%.

Phase IV (Critical) implements maximum response to a water supply emergency. All Phases of the Drought Management Plan for conservation measures and restrictions are intensified. The by-law will enforce maximum limitations on municipal water use and emergency public agency actions will commence. The water use reduction goal in this Phase is greater than 40%.

Violations of Phase III and Phase IV is subject to a warning for the first offense and thereafter a fine of $50 for a second violation and $100 for each subsequent violation.

Andover does not have a Comprehensive Forestry Plan, Reservoir Management Plan, or Watershed Management Plan. However, Andover has a Drought Management Plan and Surface Water Supply Protection Plan which is included in Appendix G.

3.4.3 Master Meter Calibration

Master meter calibration is an important maintenance activity for any water system. Properly calibrated master meters provide reliable and accurate data that is used to compare to consumption data and to understand the degree of unaccounted-for water in a system. North Reading's two WTP master meters were calibrated on four different occasions in 2018 with results shown in Table 3-11 and the two Andover interconnection meters were last calibrated by Andover in April 2018 and results are shown in Table 3-12. Currently, North Reading calibrates their master meters quarterly and is committed to continuing annual master meter calibration in accordance with the ITA performance standards.

TABLE 3-11
MASTER METER CALIBRATION HISTORY

Meter Location	Date	Source Meter (gpm)	Test Meter (gpm)	% Difference	Volume (MG)	Corrected Volume (MG)	Volume Difference (MG)
Lakeside Blvd WTP	3/23/17	249	231	-7.2	15.37	14.33	1.03
West Village WTP	3/23/17	197	184	-6.6	24.30	22.79	1.50
Lakeside Blvd WTP	6/14/17	256	237	-7.4	32.11	29.89	2.21
West Village WTP	6/14/17	205	187	-8.8	25.73	23.65	2.08
Lakeside Blvd WTP	8/30/17	245	228	-6.9	31.79	29.74	2.05
West Village WTP	8/30/17	206	192	-6.8	28.28	26.48	1.80
Main Street Andover	8/30/17	709	704	-0.7	238.04	236.35	1.69
Central Street Andover	8/30/17	338	337	-0.3	190.82	190.25	0.57
Lakeside Blvd WTP	11/3/17	271	251	-7.4	31.66	29.48	2.18
West Village WTP	11/3/17	189	175	-7.4	15.33	14.28	1.06
Lakeside Blvd WTP	3/28/18	252	231	-8.3	17.27	15.83	1.44
West Village WTP	3/28/18	197	181	-8.1	2.87	2.64	0.23
Lakeside Blvd WTP	6/11/18	126	116	-7.9	15.99	14.72	1.27
West Village WTP	6/11/18	205	185	-9.8	29.74	26.84	2.90
Lakeside Blvd WTP	8/21/18	132	119	-9.8	13.94	12.57	1.37
West Village WTP	8/21/18	206	186	-9.7	28.42	25.66	2.76
Main Street Andover	8/30/18	712	702	-1.4	277.06	273.17	3.89
Central Street Andover	8/30/18	339	335	-1.2	198.58	196.23	2.34
Lakeside Blvd WTP	10/22/18	127	117	-7.9	8.71	8.03	0.69
West Village WTP	10/22/18	189	172	-9.0	14.92	13.58	1.34

TABLE 3-12
ANDOVER 2018 METER CALIBRATION TESTING RESULTS

Data	Central Street		Main Street	
Test Info	Sensing Element	SCADA	Sensing Element	SCADA
Meter Flow (gpm)	5,370	5,370	9,500	9,500
Test Meter Flow (gpm)	5,457.6	5,457.6	9,458.0	9,458.0
Difference	87.6	87.6	-42.0	-42.0
Meter Accuracy	98.4	98.4	100.4	100.4

3.4.4 Advanced Meter Infrastructure and Meter Replacement Program

In 2018, North Reading initiated a system-wide meter replacement and Advanced Metering Infrastructure (AMI) project to replace all residential and commercial water meters with new "smart meters" as an initiative to improve meter accuracy. The new metering system consists of a fixed network of five fixed collectors spaced across the Town that will gather hourly water meter data from each of the approximately 4,900 water meters in the system. Data from the meters is communicated daily to a central location where it is available for analysis by Water Department staff. The system has the capability to collect daily and hourly water meter readings allowing more timely billing as well as faster access to accounts that are using high volumes of water or exhibit signs of leaks. The system will also notify the Water Department of suspected continuous and intermittent leaks at individual properties (including the estimated volume of the leak in gallons per hour and in gallons per day), reverse flow events, and meter tampering incidents.

Because of the nearly instantaneous access to customer water-use, the Water Department is able to target individual customers during periods when a State of Water Supply Conservation has been declared by identifying customers who are not complying with water use restrictions, providing a more effective means of enforcing water use restrictions.

The more frequent meter readings and discrete level of data that is available through the new AMI system will facilitate the expansion of North Reading's public education and outreach plan with respect to water conservation. The data collected from the AMI system will increase the accuracy of the unbilled and unaccounted-for water volumes in the system. This data can then be used by the Town to better focus its resources in the most efficient manor to reduce these numbers.

The AMI system includes a Customer Portal to allow residential and commercial customers to view their water consumption history to the nearest hour, to set water consumption and billing thresholds so that they will be notified in the event of suspected leaks, unusually high usage or bills that are higher than normal, and to receive information on reducing their water consumption. The number of customers who have registered for access to this portal is currently 300, or approximately 6% of all water accounts in North Reading.

As of January 2020, the AMI system is complete, and the Town has replaced 98% of the meters. The Town is working closely with homeowners to make necessary adjustments in their home plumbing required to replace the remaining meters.

Most of the meters within North Readings system were older than 20 years and their accuracy had likely diminished. The Town previously collected meter readings approximately every 90 days and the resolution of the data was to the nearest 1,000 gallons (10,000 gallons for larger meters). The new AMI system will allow readings to be taken at any time (monthly and hourly) and the new meters will have a reading resolution down to 0.1 gallons.

3.4.5 Public Building Water Audit

North Reading completed an audit of Public Building Water Use in December of 2014. The audit identified short and long term retrofit projects. The improvements will be completed in phases, and North Reading appropriated $26,000 for the first phase of improvements at the June 2016 town meeting.

A link to the Public Building Audit report can be found at the following link:

https://www.northreadingma.gov/sites/northreadingma/files/uploads/tbwca.pdf

Water system audits can help water conservation through the identification of the causes for UAW. The Town of North Reading has deferred the completion of a town-wide water audit until the completion of the on-going AMI and meter replacement program.

Andover meters all public buildings and athletic fields as an effort to reduce UAW. A water audit has not been conducted as it is not required in the permit.

3.4.6 Leak Detection

North Reading completes a leak detection survey of the entire water distribution system every two years in which is in accordance with ITA performance standards. Any leaks identified are immediately repaired.

North Reading last completed a leak detection survey on the entire water distribution system in December 2017 and again in 2019. The 2014 survey identified 25 leaking services & 11 leaking hydrants. The repairs were completed in 2015.

The 2019 survey was conducted over 80 miles of mains by Arthur Pyburn & Sons, Inc. between November 2019 and January 2020. The survey identified 23 individual service leaks that were estimated to be 101 gallons per minute (gpm). In addition, two main line leaks and one hydrant leak were identified having an estimated leakage rate of 115 gpm and 1 gpm, respectively. The total estimated leakage from all sources identified was estimated to be 217 gpm. A copy of the 2019 leak detection survey report is included in Appendix F.

The 2017 survey was conducted over 86 miles of mains by Arthur Pyburn & Sons, Inc. in March of 2017. The survey identified 34 individual service leaks that were estimated to be 69 – 138 gallons per minute (gpm). In addition, two main line leaks were identified having an estimated leakage rate of 550 – 575 gpm. The total estimated leakage from all sources identified was estimated to be 619-713 gpm. All leaks identified during the study were subsequently repaired. A copy of the 2017 leak detection survey report is included in Appendix F.

North Reading repairs leaks on Town-owned water services as soon as possible after the leak is detected. The Town is currently in the process of obtaining quotes to provide another comprehensive leak detection survey of the water distribution system. North Reading completed the current leak detection survey in January 2020. The Water Department has repaired all water main and hydrant leaks identified and they are continuing to resolve the smaller leaks on water services, as well as the normal ongoing practice of repairing non-survey related leaks as they are identified. A number of the water service leaks were found on the "house" side of the shutoff and it is the responsibility of the homeowner to repair. The Town will be working closely with the homeowners on these issues.

3.4.7 System-Wide Water Audit

The Town has not appropriated funds for conducting a water audit. Two of the most important components of a water audit are the accuracy of both the source water meters and the accuracy of the point of use (residential and commercial) water meters.

The project to fully connect with Andover will include the replacement of the two interconnection master meters. And as the existing treatment and groundwater sources are taken out-of-service, the master meters associate with those facilities will be retired. Within two years of connecting fully to Andover, the Town will only have two master meters remaining in the system. And as noted above, the Town is nearing the completion of a system-wide meter replacement program which will include newer, more accurate meters and reliable data.

Once these projects and improvements are made, the Town will make an investment in a system - wide water audit.

4

SECTION 4

COLLATERAL IMPACTS

4.1 PROJECT GOALS

The goal of the impacts/integration analysis is to assess the impacts and highlight the benefits of the recommended water solution project to ensure town goals are met, environmental protection is achieved, and solutions are cost effective.

The recommended plan is assessed on its impacts to water quality, public health, the water balance, stormwater, land/open space, resource areas, historic/archeological resources.

The projects included within the recommended plan will be finalized during design. The exact size and location of various infrastructure elements may change. The impact analysis serves to identify impacts that will require specific mitigation. Since the recommended plan includes an existing connection to the Town of Andover, construction and permanent impacts will be limited to the two chemical feed stations.

Figures are used to illustrate the locations improvements overlaid with GIS layers representing various impact factors. It should be noted that at the given scale and for clarity, the symbols used are many times larger than the item they represent. This is relevant because in some cases the chemical feed stations may appear to overlap with a resource boundary; however, as proposed there are proposed activities within a resource area. The chemical feed stations will have a footprint of approximately 25’ x 30’.

The chemical feed stations will be unmanned facilities. Each station will be connected to a new Supervisory Control and Data Acquisition (SCADA) system which will allow the Town the ability to monitor and control (start/stop) the station from a remote location. An operator will visit the facility once a day while in operation. Because the stations will be unmanned and will be operated and monitored remotely through SCADA, greenhouse gas emissions impacts will be reduced as compared to a manned facility. A manned facility would require additional HVAC equipment, bathroom facility, and a larger footprint to accommodate the additional facilities needed.

Pump motors and lighting will be designed to increase efficient by use of variable frequency drives (VFD's), high efficiency motors, and LED lighting. During the construction period, greenhouse gas emissions will be reduced by limiting idling and using absorbent pads during re-fueling construction equipment.

During construction, contractors will be held to a no-idle restriction for equipment, reducing GHG emissions.

4.2 GREENHOUSE GAS EMISSIONS

The EEA Climate Change Adaptation Report included several recommendations to reduce GHG emissions. The recommendations that pertain to the proposed project include:

- Energy efficiency improvements and lowered demand will reduce loads on stressed electrical infrastructure while mitigating climate change through a reduction in greenhouse gas emissions.
- Reducing vehicle miles traveled reduces physical and capacity stresses on roads, bridges, and tunnels, increasing their resiliency to climate and weather-related impacts. When the population diversifies its travel patterns, individuals have greater flexibility in their transportation options. Reducing vehicle miles travelled also has implications for lower greenhouse gas emissions, providing climate change mitigation and reducing the need for adaptation.

The original greenhouse gas (GHG) study presented in the DEIR based on the preferred water and wastewater alternatives focused heavily on wastewater collection system and septic system emissions. Many comments on the DEIR requested greater detail, reevaluation, discussion of assumptions made, etc. regarding the wastewater and septic system emissions analysis. However, the proposed project scope has since changed for both the water and wastewater projects. North

Reading is seeking to obtain all its water from Andover rather than the MWRA, and the Town has removed the wastewater project from the FEIR since the project schedule is further behind the water project. By eliminating the wastewater project from the FEIR, GHG analysis scope and impacts have been greatly reduced as they relate to that project. Also, with the Town proposing to obtain all of its water through the existing connections with the Town of Andover, the required infrastructure in order to obtain water from the MWRA is greatly reduced.

The following GHG analysis has been revised to reflect emissions from the production of Andover water and converting North Reading's sources to emergency use only.

4.2.1 Water Analysis

This section presents an analysis of GHG emissions associated with the updated preferred water alternative, North Reading obtaining all of its water from Andover. The Executive Office of Energy and Environmental Affairs (EEA) developed and issued the GHG Policy and Protocol. Projects involving indirect emissions associated with significant consumption of water undergoing review by MEPA are required to assess the projects' GHG emissions. Measures to avoid, minimize or mitigate such emissions are identified as well. Currently the GHG Policy and Protocol's focus is on carbon dioxide (CO2).

Projects that will consume greater than 300,000 gallons per day (gpd) of water will typically be considered to fall within this category.

There are several steps to calculating GHG emissions:

- Identify appropriate conditions for each aspect of the project
- Calculate GHG emissions associated with baseline and preferred alternative separately
- Estimate GHG reductions associated with alternatives and GHG reductions associated with mitigation efforts not adopted, as a percent of total
- Clearly state which GHG mitigation measures will be adopted, and provide reasoning

Comments on the DEIR for this Project suggest that an alternative analysis must be performed for the two scenarios; the baseline case (no-build) and the new preferred alternative (obtaining all water from Andover). There are many factors and emission sources to consider for both cases. It should be noted that these estimates are not exact as GHG analysis is done before the final design is completed and many assumptions are made. Furthermore, GHG emissions associated with construction are not considered.

4.2.1.1 Methodology

In order to calculate Greenhouse Gas emissions, a number of resources, summarized in Table 4-1, were used to determine CO2 and CO2 equivalent emissions rate from various sources.

TABLE 4-1
SUMMARY OF RESOURCES USED

Emission Type	CO_2 Emission Rate	Data Source
Electricity	996 lb/MWh	Massachusetts Average, ISO New England Electric Generator Air Emissions Report, 2013
Natural Gas	117 lb/mmBTU	EPA, Greenhouse Gas Equivalencies Calculator, 2015
Vehicle Fleet	8.81 kg/gallon gasoline	GHG Protocol, Emission Factors from Cross Sector Tools, 2017

In addition, the MEPA office provides, with the assistance of MassDEP, average energy use data for water treatment facilities. These averages were used to estimate GHGs associated with the baseline and preferred case alternative. MEPA states that for projects located outside MWRA communities, and average of 1.1 kWh of electricity are used for every 1,000 gallons treated.

Data was also collected from both North Reading and Andover to assist in GHG calculations. Records include:

1. Electrical bills for each treatment plant and pump station
2. Vehicle fleet and usage information
3. Natural Gas bills for each treatment plant

The following sections describe the steps taken and assumptions made in calculating CO2 emissions associated with the baseline case and the preferred case alternative. Since each case involves only a portion of the total water treated in Andover, the electricity and natural gas usage have been calculated by the percentage of water sold to North Reading. Vehicle emissions from Andover will not be included as the volume will not change between baseline and preferred alternative. Calculated emissions will be presented as an average of CO2 tons per year, as requested.

4.2.1.2 Baseline (No Build Alternative)

The Baseline Case involves calculating GHG emissions from the current water treatment operations. North Reading currently operates two water treatment plants, two well houses that also perform water treatment, and purchases water from Andover. Electricity used to power and natural gas used to heat these facilities will be used to determine CO2 emissions. Mobile emissions from the vehicle fleet that manages treatment facilities will also be considered.

Electricity

Table 4-2 presents the average amount of water treated and purchased by North Reading as presented in the Water Supply Section. These numbers will be used in estimated CO2 emissions from treatment electricity.

TABLE 4-2
WATER TREATED AND PURCHASED BY NORTH READING

Source	Current Usage (MGD)
Andover	0.89
North Reading	0.68
Total	**1.57**

Two different approaches for calculating baseline GHG emissions associated with electricity usage were used. The first approach used MEPA's average electrical energy usage with treatment facilities, which estimates that 1.1 kWh are needed to treat every 1,000 gallons of water. The current treated flows as presented in the Water Needs Analysis section and summarized in Table 4-3 were used in this estimate. It was assumed that 996 lbs of CO2 were generated per MWh used. Table 4-3 summarizes emissions based on MEPA averages.

TABLE 4-3
APPROACH 1: EMISSIONS BASED ON MEPA AVERAGES

Water Source	Water Treated (MGD)	MWh/day Required	Tons CO_2/year
Andover	0.89	1.056	127.966
North Reading	0.68	0.704	191.949
Total	1.57	1.760	319.915

The second approach, summarized in Table 4-4, used electrical bills for the treatment and pumping facilities. Monthly electrical bills were collected for each treatment facility. Utility bills show the kWh used between periods. Average daily and annual MWh usage and CO2 emissions were calculated for both treatment facilities.

TABLE 4-4
APPROACH 2: EMISSIONS BASED ON ELECTRICAL BILLS

Treatment Facility	Water Treated (MGD)	Average MWh/day	Average tons CO_2 /year
Andover	0.89	2.224	404.211
North Reading	0.68	1.494	271.538
Total	1.57	3.718	675.749

The second method is a more conservative, higher estimate of CO2 emissions from North Reading and Andover treatment processes and will be used moving forward. As shown, the treatment facilities use an average of 3.718 MWh per day and produce approximately 675.749 tons of CO2 per year.

Natural Gas

Natural Gas bills were also obtained for the treatment facilities with reported volume used in Therms. Assuming 117 lbs of CO_2 are produced per mmBTU, an average CO_2 emission was calculated to be approximately 41.640 tons per year.

Vehicle Fleet

Both towns also provided details of the town-owned vehicles used to operate and maintain the facilities. Using vehicle type, make, and model, miles per gallon estimates were found using fueleconomy.gov. From there, average miles driven per week was converted to an annual estimate and multiplied by the estimated fuel economy to determine gallons of gasoline used per year. Using an assumption that 8.81 kg of CO_2 were produced per gallon of gasoline, an average CO_2 emission was calculated to be approximately 51.073 tons per year.

4.2.1.3 Preferred Water Alternative (Andover water)

The preferred water alternative involves calculating GHG emissions associated with North Reading purchasing their total average demand from Andover. A number of assumptions are made with the preferred alternative. First, the Town would no longer use their local water sources and will maintain them in emergency status. Therefore, GHG emissions associated with these sources will be eliminated since the facilities will be visited monthly for routine checks and exercise of well and GHG impacts is negligible. Also, North Reading water vehicle fleet will be reduced to approximately 80% of the current use while Andover remains the same.

Electricity

The same analysis was performed to determine the CO_2 emissions for the preferred case alternative. Using a total of 1.57 MGD from Andover results in an average of 621.863 tons of CO_2 per year produced.

Natural Gas

The natural gas analysis was also conducted the same as the baseline case. Assuming 117 lbs of CO_2 are produced per mmBTU, an average CO_2 emission was calculated to be approximately 35.352 tons per year.

Vehicle Fleet

North Reading has determined that they would maintain their vehicle fleet at a reduced capacity of about 80%. This reduction results in an average of approximately 35.352 tons of CO2 per year.

4.2.1.4 Summary

Table 4-5 presents a summary of GHG emissions associated with both the baseline case and preferred case alternative. Overall the preferred case alternative results in approximately 9.160 percent reduction in CO2 production per year.

TABLE 4-5
SUMMARY

Emission Source	Emission Type (tons CO_2/year)					Total
	Electricity		Natural Gas		Vehicle Fleet Fuel	
	North Reading	Andover	North Reading	Andover		
Baseline	271.538	404.211	18.662	22.979	51.073	768.463
Alternative	-	621.863	-	35.352	40.858	698.073
					Emissions Reduction	9.160%

As shown, GHG emissions are still reduced by the new recommended plan. While not quantified as a part of this analysis, emissions as a result of construction will be minimal compared to the original preferred alternative since the water main improvements through Reading are no longer required for the MWRA Connection. In addition, further measures may be taken to ensure GHG emissions are as low as possible. Equipment selection for the chemical feed stations will be made with premium efficiency in mind.

4.2.2 GHG Mitigation for Recommended Plan

This project benefits from the recommended plan causing an overall benefit by reducing GHG production compared to existing conditions in North Reading.

4.3 EXISTING RESOURCE REVIEW

As introduced in Section 1, North Reading will be required to construct two (2) chemical feed stations for the proposed project. The chemical feed stations are required to boost chlorine levels of water from Andover to the farthest extents of North Reading's distribution system.

The proposed chemical feed stations will be located at or near the existing interconnections between North Reading and Andover at North Reading's Central Street Pump Station site (Central Street) and at 303 Main Street (Main Street) where a portion of the property was recently acquired by North Reading through an easement agreement with the property owner. The Central Street site is currently used by the Town for the Central Street Pumping Station. A new chemical feed station will be constructed adjacent to the existing station. The existing station will be demolished i after the new station has been commissioned. chemical feed stations. The Main Street station will require the construction of approximately 650 feet of new 12-inch water main from the existing distribution system on Main Street to the proposed chemical feed station and back into North Reading's distribution system. North Reading has targeted a permanent new water connection with Andover in 2021 pending necessary permitting and approvals.

All work at each project location is proposed on previously developed properties within existing paved surfaces and pre-disturbed areas so no direct impacts or permanent alterations to resource areas are anticipated. Best management practices and proper erosion control will be implemented to inhibit sediment migration. Figure 4-1 depicts the general project location.

4.3.1 Wetlands

Portions of the construction activities will occur within the 100-foot Wetlands Buffer associated with manmade retention ponds, streams and wetlands in the vicinity of each project site. Resources of note include the Skug River. The North Reading Conservation Commission requires that a permit be filed (NOI or RDA) if work is proposed "within 100 feet of any freshwater wetland; marshes; wet meadows; bogs, swamps, vernal pools, river banks, reservoirs, lakes, ponds, rivers, streams, creeks, beaches, lands under waterbodies, and lands subject to flooding or inundation by groundwater, or surface water." Figure 4-2 depicts the location of wetlands in relation to each project location. Erosion control measures will be implemented in areas abutting wetlands.

4.3.2 Flood Plain

The FEMA floodplains that are anticipated to be encountered during construction include the 100/500-year floodplains. The FEMA 100-year floodplain is defined as, "areas with a 1% annual chance of flooding and a 26% chance of flooding over the life of a 30-year period." The FEMA 500-year floodplain is defined as "areas with a 0.2% annual chance of flooding." Flood Plains are anticipated to be encountered at the Central Street site. Erosion control measures will be implemented in areas located within flood plains. Additionally, the finish floor elevation of the proposed chemical feed station is EL. 83.00, two feet above the 100-year flood elevation (81.00). Figure 4-3 depicts the flood plains in relation to each project location.

4.3.3 Water Resource Protection Areas

The Central Street site in its entirety is located within an approved MassDEP Zone II Wellhead Protection Area. Figure 4-4 depicts water supply protection areas in relation to each project location. Erosion control measures will be implemented in areas located within these water resource protection areas.

All aspects of this project are located outside of the NHESP Estimated Habitat of Rare Species and Areas of Critical Environmental Concern (ACEC). Figure 4-5 depicts the location of NHESP habitats, vernal pools, and ACECs in relation to each project site. No known vernal pools will be disturbed by the construction of the proposed chemical feed stations. This was confirmed by Caron Environmental Consulting during wetlands field delineations on March 6, 2019 and October 23, 2019. A copy of the wetland's delineation reports is included in Appendix H.

4.3.4 Historical Sites

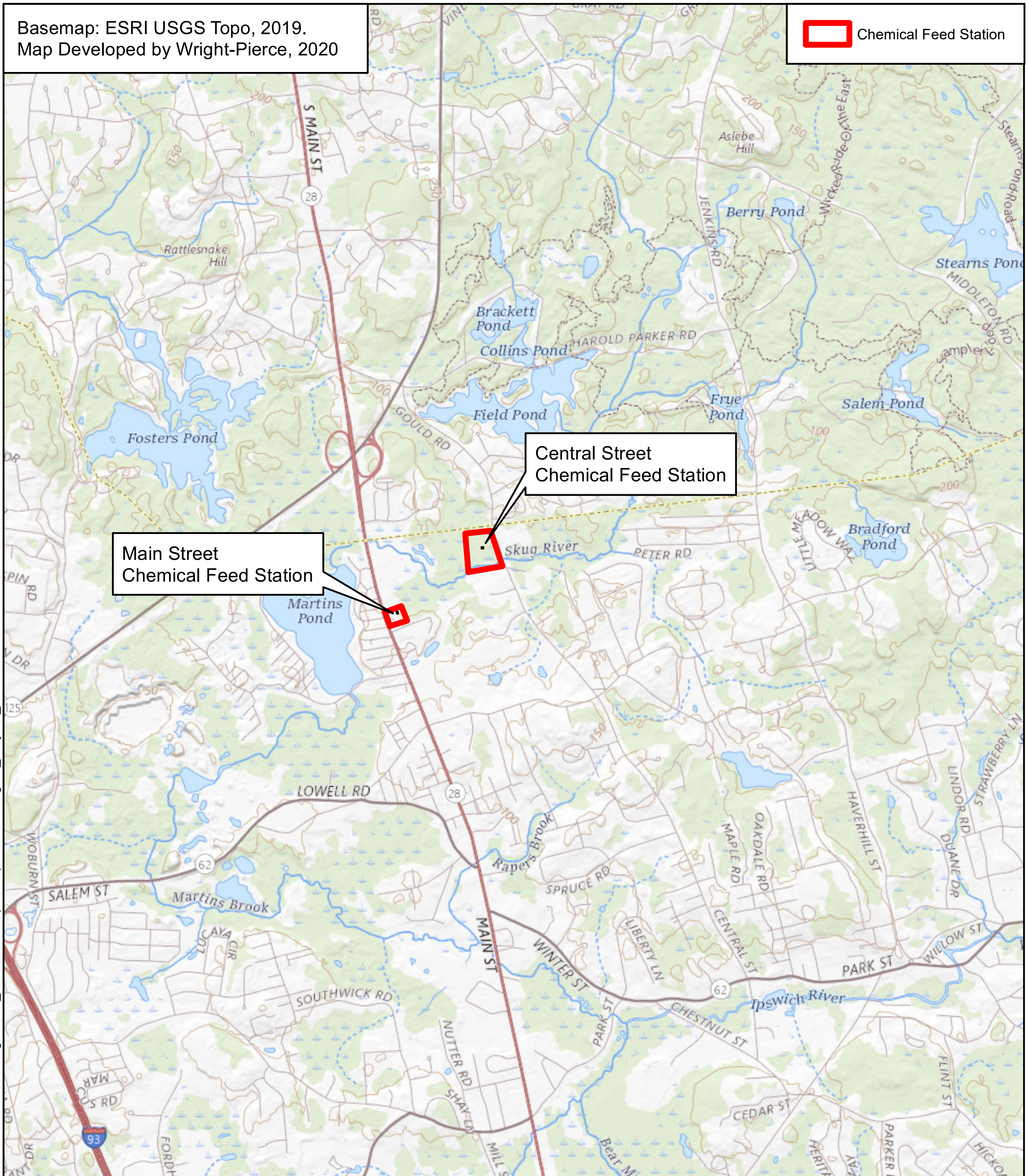
A project notification form (PNF) was submitted to MHC on December 9, 2019 for the Central Street and Main Street chemical feed station sites to determine if any historical sites will be affected as a result of the construction of this project. Upon review of the PNF, MHC determined that the work propose on each chemical feed station, "is unlikely to affect significant historic or archaeological resources." Figure 4-6 depicts the location of historical sites in relation to each project site. A copy of the PNF is included in Appendix I.

4.3.5 Potential Contamination Sources

A search of the Massachusetts Executive Office of Energy & Environmental Affairs Waste Site and Reportable Releases database identified no UST's or AUL's on or adjacent to the project sites and are not anticipated to affect the work of this project. Figure 4-7 depicts potential contamination sources in relation to each project location.

4.3.6 Article 97 Lands

The Central Street site is entirely Article 97 land and the Main Street site is not Article 97 land. The Central Street site is municipally owned and currently contains a wellfield and pump station for the Town of North Reading. It is North Reading's intention to keep their sources for emergency backup supply and the land protected under Article 97. The intended use of the property is consistent as a water supply protection. All proposed work for the Central Street site will be located on previously disturbed land. Figure 4-8 depicts Article 97 lands in relation to each project location.



USGS Project Location Map
North Reading, MA

PROJ NO:	DATE:
13732B	2/12/2020

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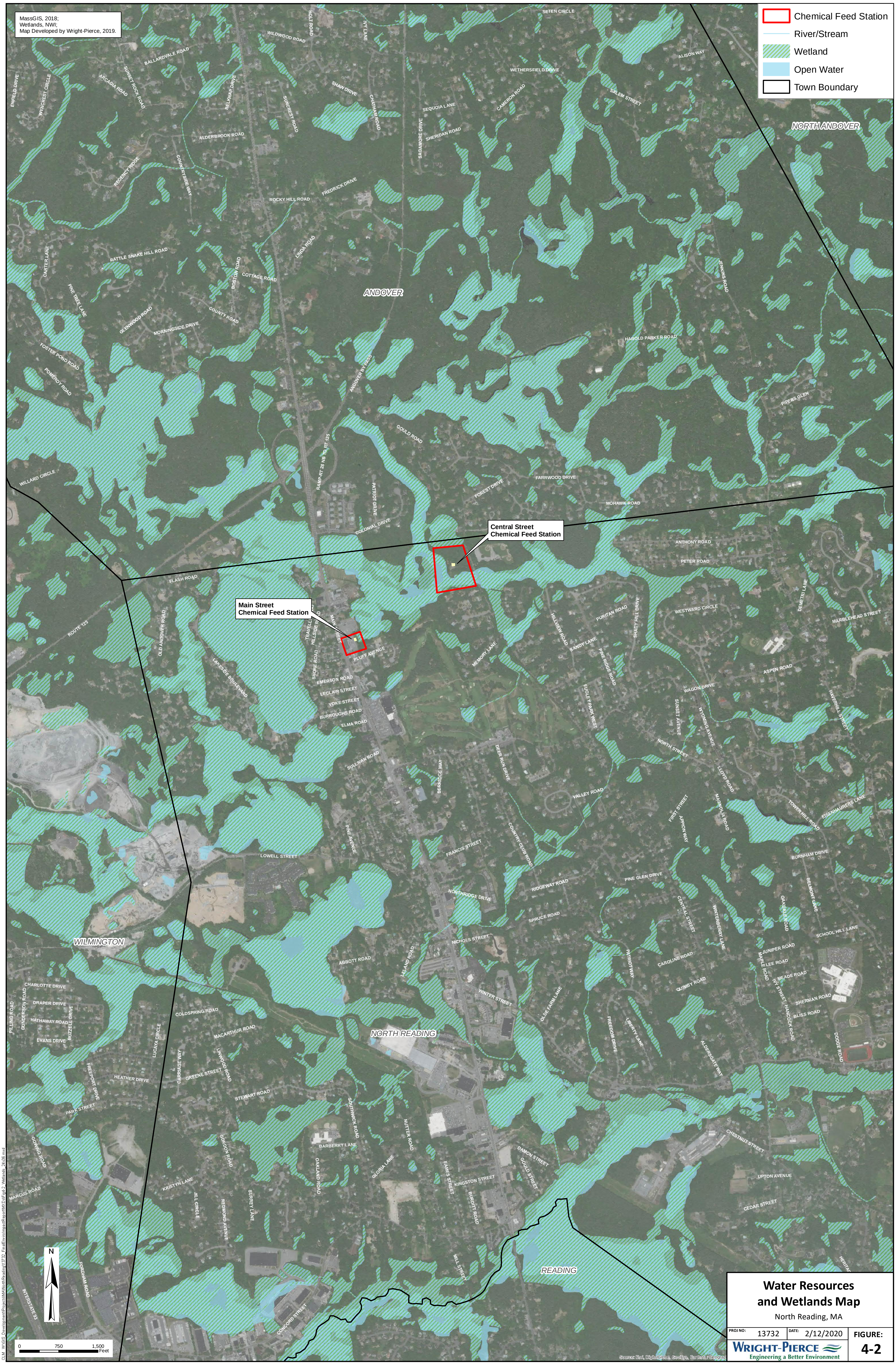
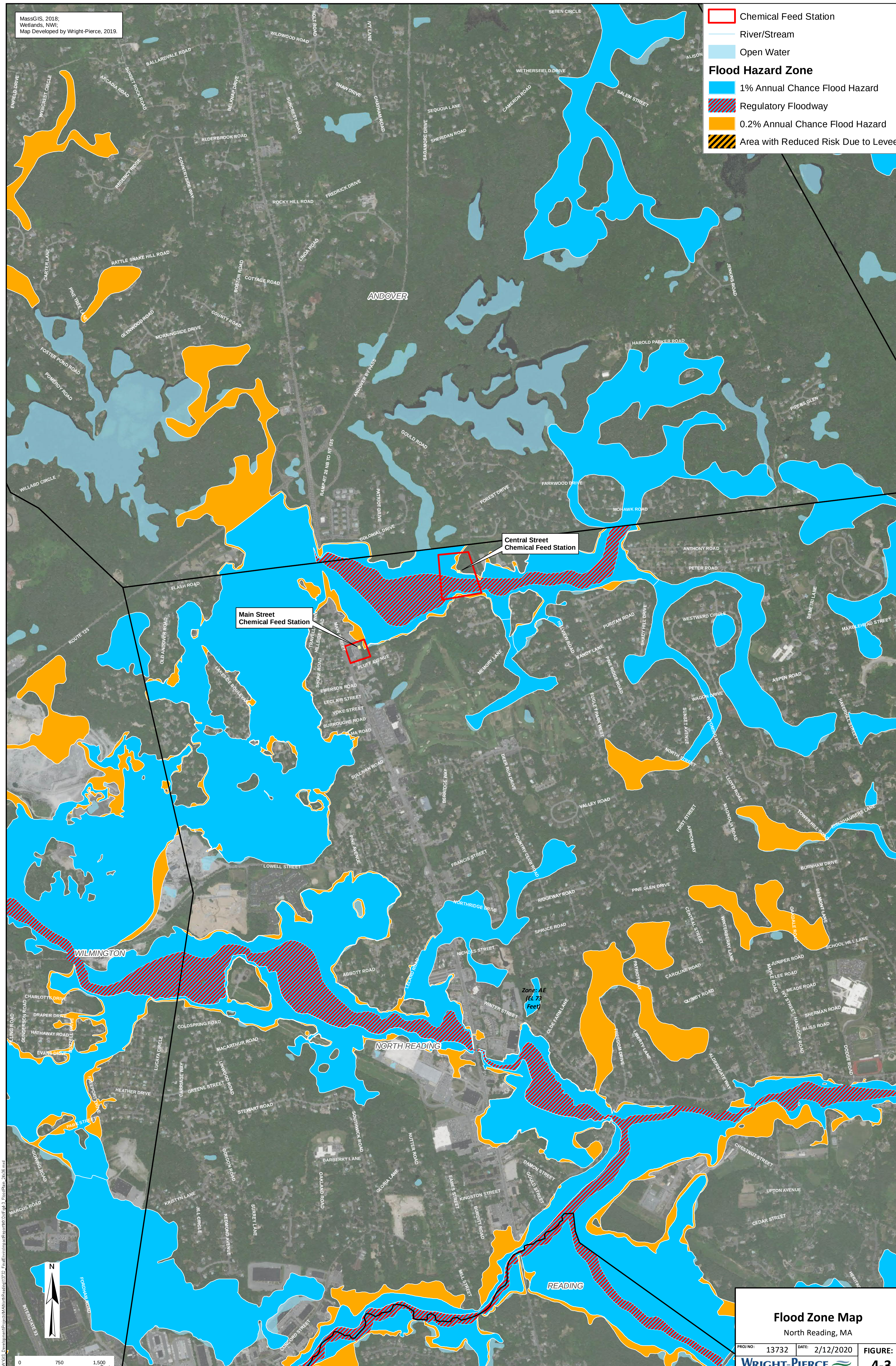
FIGURE: 4-1

CLM W:\GIS_Development\Projects\MA\NorthReading\13732_FinalEnviroImpactReport\MXDs\Fig4-1_ProjLoc_8x11.mxd


MassGIS, 2018;
Wetlands, NWI;
Map Developed by Wright-Pierce, 2019.
Chemical Feed Station
River/Stream
Wetland
Open Water
Town Boundary
Central Street
Chemical Feed Station
Main Street
Chemical Feed Station
ANDOVER
NORTH ANDOVER
WILMINGTON
NORTH READING
READING
N
0 750 1,500
Feet
Water Resources
and Wetlands Map
North Reading, MA
PROJ NO: 13732
DATE: 2/12/2020
FIGURE:
4-2
WRIGHT-PIERCE
Engineering a Better Environment

NOT TO SCALE



MassGIS, 2018;
Wetlands, NWI;
Map Developed by Wright-Pierce, 2019.
Chemical Feed Station
River/Stream
Open Water
Flood Hazard Zone
1% Annual Chance Flood Hazard
Regulatory Floodway
0.2% Annual Chance Flood Hazard
Area with Reduced Risk Due to Levee
ANDOVER
WILMINGTON
NORTH READING
READING
Central Street Chemical Feed Station
Main Street Chemical Feed Station
Zone: AE (EL 73 Feet)
N
0 750 1,500 Feet
Flood Zone Map
North Reading, MA
PROJ NO: 13732
DATE: 2/12/2020
FIGURE: 4-3
WRIGHT-PIERCE
Engineering a Better Environment

NOT TO SCALE


MassGIS, 2018;
Wetlands, NWI;
Map Developed by Wright-Pierce, 2019.
Chemical Feed Station
Wellhead Protection Areas
DEP Approved Zone I
DEP Approved Zone II
Interim Wellhead Protection Areas
Surface Water Protection Areas
ZONE A
ZONE B
ZONE C
Central Street
Chemical Feed Station
Main Street
Chemical Feed Station
ANDOVER
WILMINGTON
NORTH READING
READING
N
0 750 1,500
Feet
Water Supply Sources
North Reading, MA
PROJ NO: 13732
DATE: 2/12/2020
FIGURE:
4-4
WRIGHT-PIERCE
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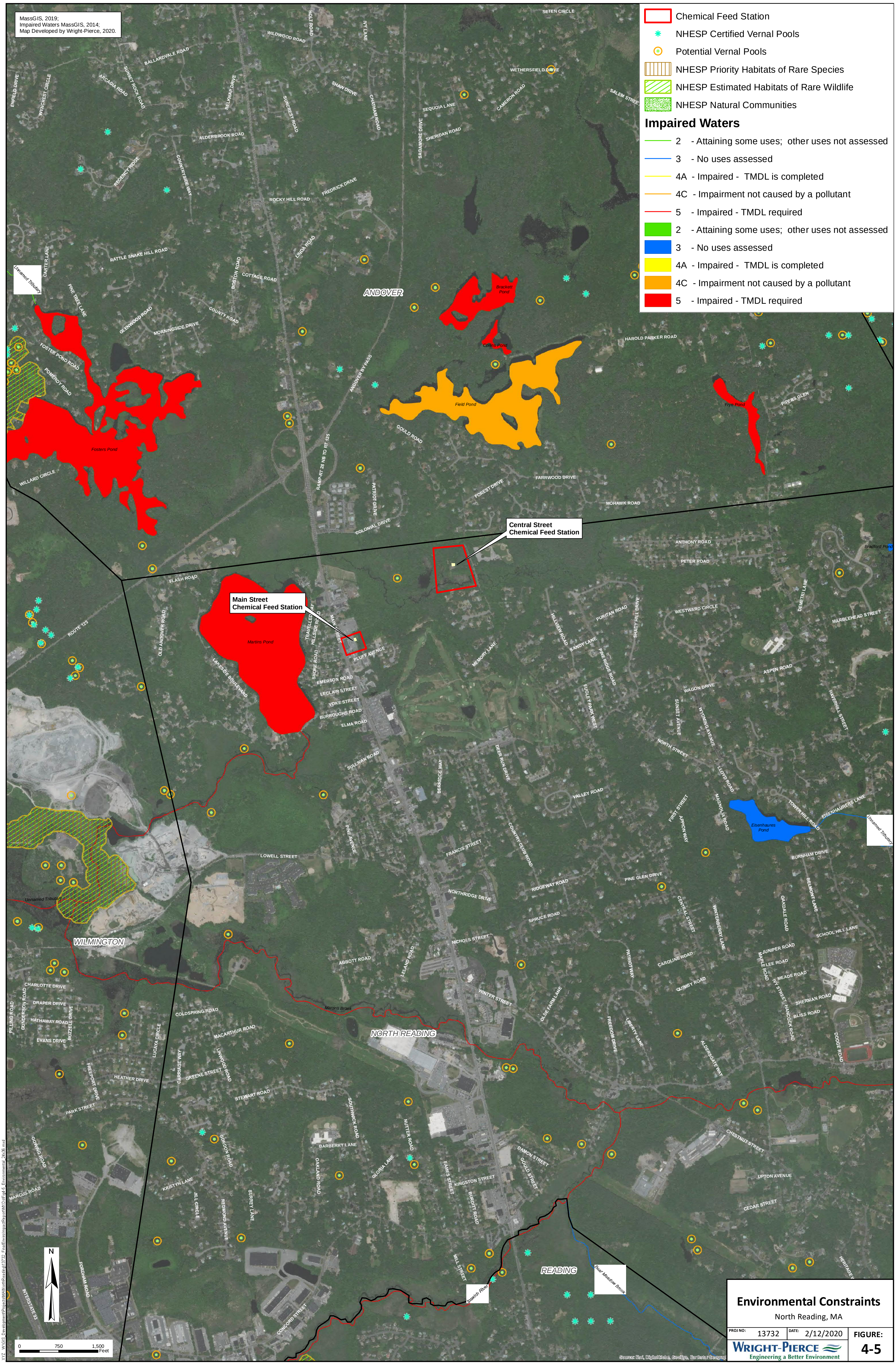
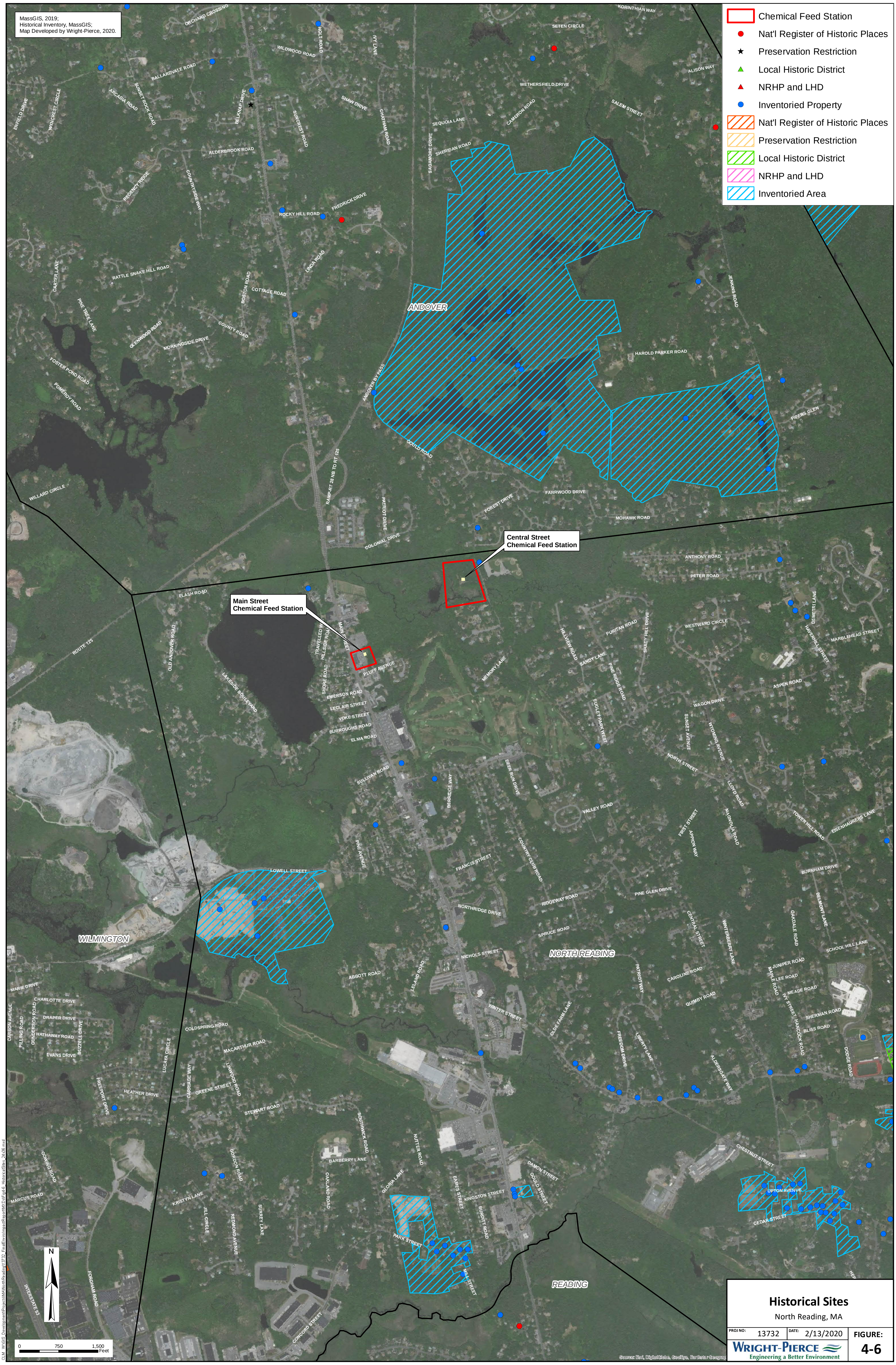
NOT TO SCALE



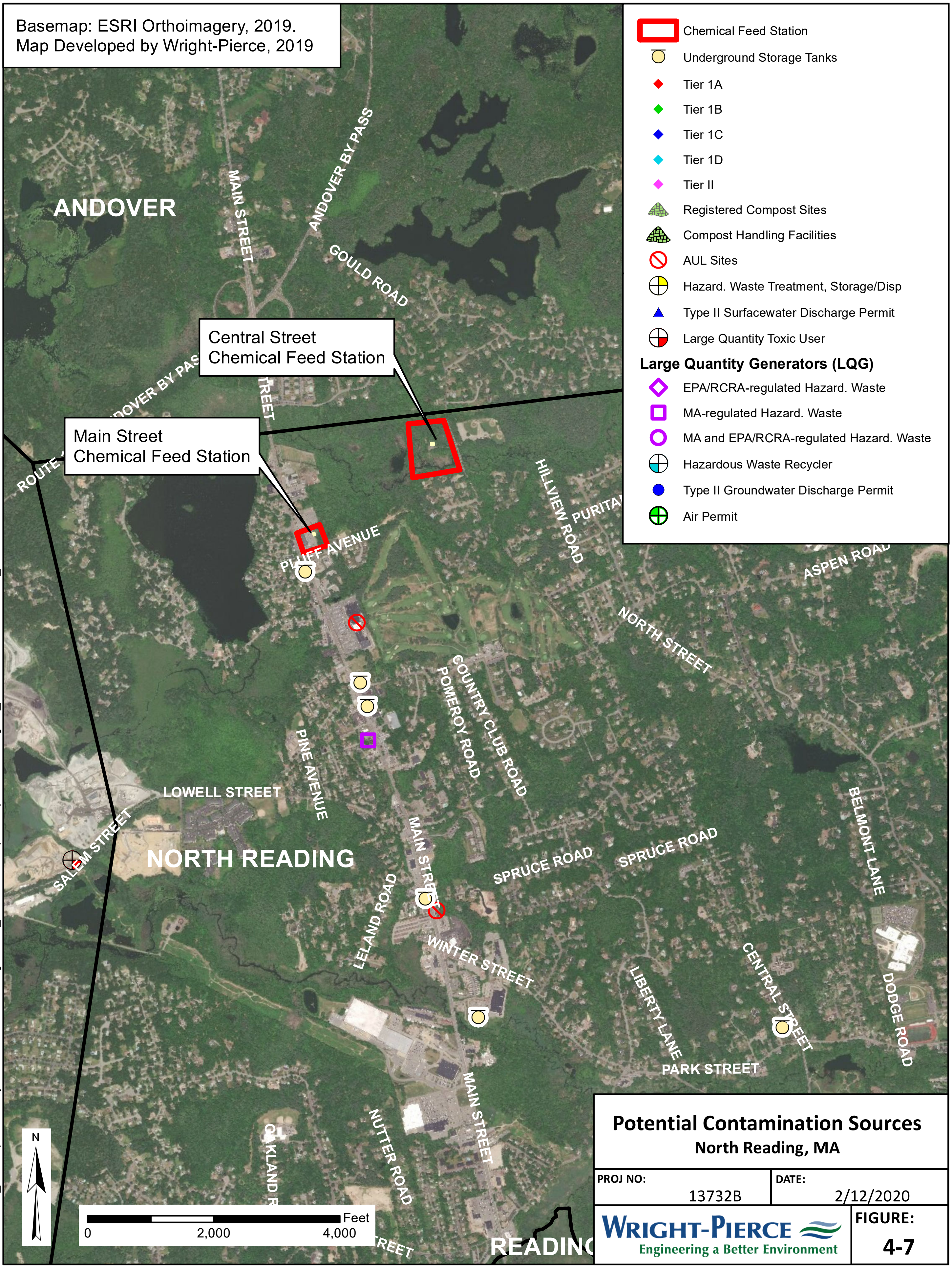
MassGIS, 2019;
Impaired Waters MassGIS, 2014;
Map Developed by Wright-Pierce, 2020.
Chemical Feed Station
NHESP Certified Vernal Pools
Potential Vernal Pools
NHESP Priority Habitats of Rare Species
NHESP Estimated Habitats of Rare Wildlife
NHESP Natural Communities
Impaired Waters
2 - Attaining some uses; other uses not assessed
3 - No uses assessed
4A - Impaired - TMDL is completed
4C - Impairment not caused by a pollutant
5 - Impaired - TMDL required
2 - Attaining some uses; other uses not assessed
3 - No uses assessed
4A - Impaired - TMDL is completed
4C - Impairment not caused by a pollutant
5 - Impaired - TMDL required
Central Street
Chemical Feed Station
Main Street
Chemical Feed Station
ANDOVER
WILMINGTON
NORTH READING
READING
Fosters Pond
Field Pond
Martins Pond
Eisenhaures Pond
Martins Brook
Unnamed Tributary
Ipswich River
Bear Meadow Brook
Environmental Constraints
North Reading, MA
PROJ NO: 13732
DATE: 2/12/2020
FIGURE: 4-5
WRIGHT-PIERCE
Engineering a Better Environment
0 750 1,500 Feet
N

NOT TO SCALE



MassGIS, 2019;
Historical Inventory, MassGIS;
Map Developed by Wright-Pierce, 2020.
Chemical Feed Station
Nat'l Register of Historic Places
Preservation Restriction
Local Historic District
NRHP and LHD
Inventoried Property
Nat'l Register of Historic Places
Preservation Restriction
Local Historic District
NRHP and LHD
Inventoried Area
Central Street
Chemical Feed Station
Main Street
Chemical Feed Station
ANDOVER
WILMINGTON
NORTH READING
READING
Historical Sites
North Reading, MA
PROJ NO: 13732
DATE: 2/13/2020
FIGURE: 4-6
WRIGHT-PIERCE
Engineering a Better Environment
N
0 750 1,500 Feet

NOT TO SCALE



Potential Contamination Sources
North Reading, MA

PROJ NO:	DATE:
13732B	2/12/2020

WRIGHT-PIERCE
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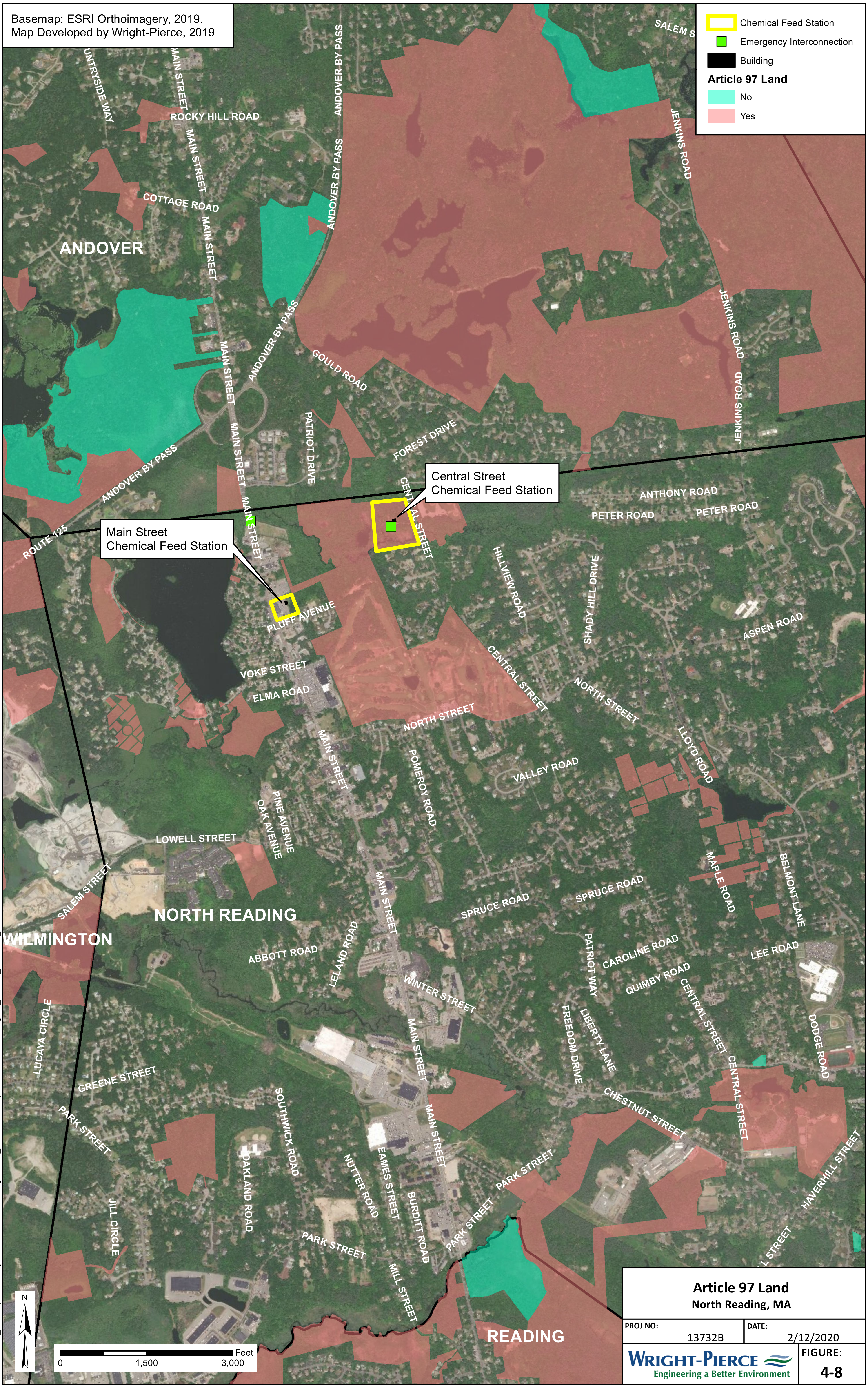
FIGURE: 4-7

CLM W:\GIS_Development\Projects\MA\NorthReading\13732_FinalEnviroImpactReport\MXDs\Fig4-7_PotentialContamination_8x11.mxd



Article 97 Land
North Reading, MA

PROJ NO:	DATE:
13732B	2/12/2020

WRIGHT-PIERCE
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FIGURE: 4-8

CLM W:\GIS_Development\Projects\MA\NorthReading\13732_FinalEnviroImpactReport\MXDs\Fig4-8_MWRA_Article97_11X17.mxd

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5

SECTION 5

CONSTRUCTION AND MITIGATION

5.1 CONSTRUCTION PHASING

We anticipate that the project scope as described in Section 1 of this report will be completed under a single construction contract. The following is an overview of the anticipated sequence of the work:

1. Prior to beginning any work, install erosion control measures detailed in the Order of Conditions and have them inspected and approved by the North Reading Conservation Commission.
2. Remove trees and clear and grub (if necessary).
3. Remove and stockpile existing loam and topsoil and pavement as appropriate from the area.
4. Excavate and construct the building foundation.
5. Construct the building and interior building systems and equipment
6. Construct site work including water and storm water piping, electrical and other site improvements.
7. Finalize building construction, site utilities and piping.
8. Establish finish grades, finalize stormwater management controls, and complete site work.
9. Stabilize all remaining disturbed areas. Continue to touch-up and maintain all areas that have received loam and seed as needed until a 90% catch of vegetative growth has established.
10. Once the site has become permanently stabilized as determined by the Owner and the Engineer, remove all remaining temporary erosion and sedimentation control measures.

5.2 STAGING

Excavated soils from the site will be stockpiled by the Contractor at an approved location outside of resource areas. Stockpiles will be neatly trimmed and graded to allow drainage from surfaces and to prevent impressions where water could be impounded. Temporary erosion control devices for stockpiled material will be constructed around the piles. All loam stripped and stockpiled will be seeded. The stockpile will be removed from the site prior to final completion.

All work at the Main Street site will be maintained within the confines of the temporary easement plan included in Appendix J. The contractor will be restricted to this area for his work, storage of materials and equipment, and all construction activities. Any disturbed surfaces will be repaved and reseeded as necessary.

Work at the Central Street site will be confined to the property upgradient of the existing pump station and immediately adjacent to the site of the proposed chemical feed station. Contractors laydown and storage areas will be confined to the cul-de-sac on site and any other area outside of resource areas and where it does not interfere with on-going water operations. The entire work area will be protected from runoff using erosion control devices such as haybales, silt fencing and/or silt socks in accordance with the Town of North Reading Conservation Commission Order of Conditions.

5.3 MITIGATION MEASURES

Several measures will be taken to prevent disturbance to the community.

Construction work will be limited to the hours of 7 AM to 5 PM, Monday through Friday only. As a direct short-term impact, construction noise is unavoidable, but every effort will be made to minimize it in so much as is possible. However, excavation equipment and machinery, pumps, standby generators, and other equipment will emit noise at construction sites.

Refueling and storage of all construction equipment will be restricted to areas outside of floodplains, wetlands buffer zones, and riverfront buffer areas. The construction contract will include provisions for the Contractor to have absorbent pads, shovels, oil dry, and access to a backhoe during refueling as necessary. They will also be required to have absorbent pads in each piece of equipment and placed under all equipment prior to refueling. If a spill should occur, the

Contractor will be required to immediately initiate clean up procedures and notify the Owner, Engineer, Conservation Commission, and State authorities.

Prior to the start of any construction activity, the Contractor will be required to install temporary erosion control measures in compliance with the Order of Conditions using hay bales, siltation fencing, or geotextile materials as outlined in the MassDEP Erosion & Sedimentation Control Guidelines.

Construction may require the dewatering of trenches and open excavations. Water discharged from dewatering operations will be required to be discharged to a temporary sediment trap or catch basin with sediment sock and silt sack. These controls will trap and prevent the migration of sand, silt, and debris from leaving the work zone. All erosion controls required to be implemented will be detailed on the construction drawings.

The construction contract will also require the Contractor to reduce diesel fuel emissions through the implementation of diesel oxidation catalysts or diesel particulate filters on equipment. Information on each product can be found in Appendix K. In addition, all “off-road” construction vehicles will use ultra-low sulfur diesel fuel to reduce sulfur damage to emission control devices. The use of low sulfur diesel fuels has become an EPA requirement since 2014.

At the completion of work on each site, the Contractor will be required restore the site to the original grade in areas impacted by construction activities. Loaming and seeding will be used to stabilize areas disturbed during construction. Temporary fencing and erosion controls will be removed from the site once stabilization of surface soils has occurred. Temporary pavement may be left to settle for one winter season, followed by permanent pavement the following Spring.

5.3.1 Comprehensive Soils Management Plan

The construction contract will include a section detailing procedures and precautions that the contractor must use during the work. The documents will require the contractor to submit a soil management plan detailing the Contractors procedures for soil stockpiling and offsite disposal prior to the start of work.

5.3.2 Asbestos Management and Abatement Plan

The construction contract will include a specification detailing the procedures and precautions that the contractor must follow if and when asbestos-containing materials are encountered. Asbestos piping is not expected to be encountered during the work. However, asbestos-containing materials were identified within building materials used in the construction of the existing Central Street pump station during a hazardous materials survey completed as part of the preliminary design for the station. A copy of the report is attached for reference. This report will be included with the construction contract documents.

5.3.3 Energy Efficient Design

The stations will be designed in accordance with the latest Massachusetts Building Code requirements. These include energy efficiency thermal standards for building efficiency.

5.4 CONSTRUCTION COORDINATION AND ADHERENCE TO LOCAL AND STATE PERMITS

The chemical feed stations will be constructed in accordance with the Town of North Reading Construction Standards dated January 5, 2012 and Wetland By-Laws approved August 6, 1992. The documents are located on the Town's website at the following addresses:

Construction Standards
https://www.northreadingma.gov/sites/northreadingma/files/uploads/waterconsstd.pdf.

Wetland By-Laws
https://www.northreadingma.gov/sites/northreadingma/files/uploads/wetlands.pdf

6

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SECTION 6

DEIR AND NPC COMMENTS

6.1 GENERAL

A DEIR was submitted to MEPA by Wright-Pierce in March of 2016 on behalf of the Town of North Reading. In addition, an NPC was submitted by Wright-Pierce to MEPA in November of 2018 on behalf of the Town of North Reading. As a part of the DEIR/NPC submittal process, copies of the DEIR/NPC were sent to a list of regulatory stakeholders for review and comment. The subsections below summarize all DEIR and NPC review comments that were received. It should be noted that due to the scope change included in the NPC, many of the DEIR comments received are no longer applicable and were not addressed.

6.2 EXECUTIVE OFFICE OF ENERGY AND ENVIRONMENTAL AFFAIRS (EOEEA)

In a letter dated May 13, 2016, the EOEEA provided comments to the DEIR. The EOEEA also provided comments to the NPC in a letter dated December 21, 2018. Tables 6-1 and 6-2 summarizes EOEEA's questions and provides direction as to where in this document the responses can be found.

TABLE 6-1
EOEEA RESPONSES TO DEIR

Comment	Response Location
The FEIR should follow Section 11.07 of the MEPA regulations for outline and content, as modified by this Scope	Section 1
The FEIR should discuss steps the Town has taken to further reduce the impacts of the project since the filing of the DEIR, or, if certain measures are infeasible, the FEIR should discuss why these measures will not be adopted.	Section 7
The FEIR should include a detailed description of the project and describe any changes to the project since the filing of the DEIR.	Section 1
The FEIR should include a discussion of permitting requirements associated with the project, the results of any pre-permitting coordination held with State Agencies, and how the project will be constructed in accordance with applicable regulatory performance standards.	Section 1
The FEIR should clarify if the Town will be seeking State of Federal funding sources for design and construction of the project."	Section 1
The FEIR should include updated site plans for existing and post-development conditions at a legible scale to clearly illustrate project activity and infrastructure, environmental resource areas and environmental impacts."	Section 2
The FEIR should identify Article 97 lands within the Town, Andover, and Reading to confirm that the project will not directly impact, or require takings for easements, these protected properties.	Section 2 / Reading No Longer Applicable
Comments from MassDEP and the Ipswich River Watershed Association (IRWA) identify concerns about the fate of currently protected water supply lands if the Town's current water withdrawal registration is forfeited and wells are abandoned. MassDEP indicated that it will rescind its approval of the Zone II wellhead protection area for the wells and the Interim Wellhead Protection Area (IWPA) for the Stickney Well. While Zone II's related to wells in neighboring towns will continue to extend into Town, those associated with decommissioned Town wells will no longer be subject to the regulatory protections conferred by that designation. The FEIR should identify those areas that would no longer be encumbered by Town well Zone II's and discuss if the Town will also revise the boundaries of its aquifer protection zoning to reflect the elimination of these Zone II's The FEIR should address how former water supply protection properties will be managed in the Preferred Alternative and discuss whether land currently within Zone I may be sold or transferred.	Section 1
The FEIR should discuss the feasibility and potential benefits of seeking an IBTA from the Merrimack River Basin and "wheeling water" through Andover. While this would require potential changes to Andover's WMA permit it may provide economic benefits compared to the Preferred Alternative. The FEIR should discuss consistency of this alternative with stated project goals and potential impacts to the Ipswich River Basin water balance.	New Preferred Alternative
The FEIR should provide additional discussion of converting the interconnection with Andover to an emergency-only supply in the Preferred Alternative. The FEIR should discuss why this interconnection must be maintained and discuss implications for permitting, the IBTA, and the current or any future IMA. The comment letter from the Town of Andover indicates that it is not supportive of acting as an emergency backup water supply for the Town. Furthermore, Andover noted that such a connection is not hydraulically possible and identified challenges with water quality due to the differences in water chemistry between Andover's and the MWRA's finished water. The FEIR should address alternative emergency water supply needs and provide an update on any meetings with Andover officials to discuss the Preferred Alternative.	No Longer Applicable

Comment	Response Location
The Preferred Alternative includes the forfeiture of the Town's local sources upon confirmation of a stable MWRA connection. The FEIR should discuss how decommissioning of abandoned wells will be conducted in a manner consistent with MassDEP's Guidelines for Public Water Systems.	No Longer Applicable
Finally, the FEIR should specifically discuss how the Preferred Alternative will be consistent with the goals of the State's Sustainable Water Management Initiative (SWMI).	Section 3
MassDEP comments indicated that it generally concurs with the factors used to develop the wastewater needs analysis. However, the FEIR should address the comments from MassDEP and include a revised analysis, as necessary. The FEIR should discuss the Town's ongoing need to manage remaining on-site disposal systems. Specifically, the FEIR should address: identification of Town resources to administer Title 5; track septic system pumping and repairs; and use or participation in MassDEP' s Community Septic Management Program. As requested by MassDEP, the FEIR should provide additional analysis of the groundwater discharge alternative at the DPW site. The Town should review site limitations that informed the assumption of a 0.3 gpd/sf loading rate, as MassDEP noted that this loading rate is substantially less than any facility operating under a typical groundwater discharge permit. The Town should consult with MassDEP regarding the loading rate prior to submitting the FEIR. If consultation results in a change in the loading rate, the Town should re-analyze discharge treatment capabilities. The FEIR should identify site constraints and describe consultation with MassDEP. The FEIR should respond to MassDEP's comments regarding a potential reserve allowance of 100,000 to 150,000 gpd at the Berry Site (Edgewood Luxury Apartments) that was included in the project design. The FEIR should confirm the capacity allotted to the Town and describe and analyze potential use of this site to meet wastewater needs. Finally, the FEIR should discuss the feasibility of using the Hillview Country Club and U.S. Postal Service sites for groundwater discharge, including conceptual treatment capacities, relationship to identified needs areas, and any constraints that may preclude their incorporation into the Town's wastewater management plan. The potential cost and environmental impacts of these aforementioned in-Town treatment options should be provided to allow for comparison to the Preferred Alternative. The DEIR indicated that the privately-owned WWTFs in Town will be abandoned under the Preferred Alternative. The FEIR should discuss how these WWTFs will be decommissioned, included the entity responsible for the cost and implementation of decommissioning. It is clear from comments submitted by Andover that the Town must initiate meaningful discussion between the two parties to ensure the feasibility of the Preferred Alternative. Without a commitment by Andover to allow the Town to convey its wastewater through the Andover collection system, it is unclear how the Preferred Alternative can proceed. The FEIR must either a) include a commitment by Andover to agree in principle to the Preferred Alternative and outline issues that must be addressed by both communities prior to construction of the Preferred Alternative (i.e., impacts to Andover's infrastructure, potential cost and/or fees, etc.) orb) identify another alternative that meets the Town's wastewater needs that does not require approval by Andover. If a revised Preferred Alternative is proposed in the FEIR, the FEIR must include a comprehensive analysis of potential environmental impacts of all its components, a revised donor basin analysis (if necessary) and an updated discussion of project impacts to the Ipswich River Basin. Furthermore, if a revised Preferred Alternative is proposed the Town must meet with the MEPA office, MassDEP and the WRC prior to submitting the FEIR to discuss the appropriate level of detail necessary in the review document to ensure comprehensive review.	No Longer Applicable

Comment	Response Location
The FEIR should identify potential opportunities to ensure that the project maximizes potential benefits to the Ipswich River Basin. In particular, I note the comments from the IRWA regarding limiting future backsliding away from current and proposed net benefits to the watershed due to the expanded use of private irrigation wells in Town. The FEIR should address comments from the IRWA and the Water Supply Citizens Advisory Committee (WSCAC) pertaining to establishment of a private well bylaw, requirements for additional sewer expansion, and water conservation measures. The FEIR should indicate if a bylaw and additional water conservation will be adopted and, if not, describe why they are not feasible. The FEIR should also discuss potential impacts on the established Safe Yield on the Ipswich River associated with how surrendering the Town's water withdrawal registration.	Section 3
If wetland crossings are required within the ROW, the FEIR should identify these locations (with supporting graphics as necessary) and indicate how impacts to wetlands will be avoided, minimized, and mitigated. The FEIR should explain how the project will be designed to comply with applicable performance standards in the wetland's regulations (310 CMR 10.00) and demonstrate that alteration of wetland resource areas can be either avoided or minimized. The FEIR should identify stream crossings along the project route and the nature of the crossing (i.e., bridge span, culvert, etc.). The FEIR should note if culvert upgrades or other modifications to existing stream crossings will be required (or if new crossings are proposed) and confirm that new construction or modifications will meet MassDEP stream crossing requirements. Finally, I strongly encourage the Town to consider placing critical infrastructure outside of flood-prone areas to the maximum extent practicable.	Section 5 / No Longer Applicable
The FEIR should include an updated GHG analysis to reflect changes to the Preferred Alternative and to address comments submitted by MassDEP. All GHG emissions should be presented in tons per year rather than pounds per day, consistent with the GHG Policy. MassDEP's comments focused on the high rate of fugitive methane emissions assigned to septic systems within the analysis. The FEIR should provide greater detail on the source of septic system emissions rates and assumptions made in the calculation of their potential GHG impact. The analysis should also reevaluate whether methane emissions and pelletization of sludge should be included in the GHG emissions calculations for the GLSD WWTF and whether methane emissions should be incorporated into the GHG emissions from the optimized High and Middle School WWTF. The FEIR should either provide revised calculations with a discussion of assumptions or explain the rationale for their omission from the analysis. The FEIR should also revisit the incorporation of GHG emissions from chemical production in the water treatment Baseline Case depending on whether these emissions are already accounted for in the average water treatment energy use for MWRA communities. Finally, the FEIR should consider the potential energy reduction measures attributable to water conservation measures. Reducing overall water demand and wastewater generation will further reduce project related GHG emissions. The FEIR should discuss energy efficiency measures implemented by the GLSD and MWRA to clarify how these systems independently focus on GHG emissions. The FEIR should discuss these energy efficiency measures in terms of systems equipment, operations, and water conservation initiatives. The FEIR should discuss how the proposed infrastructure and operations within the Town will be designed in a manner consistent with MWRA and GLSD sustainability goals. The FEIR should provide additional analysis on potential PV systems to offset pumping station electrical costs, particularly at the Central Pump Station. The FEIR should compare potential PV generation to the overall electrical demand of the Central Pump Station and the five smaller pump stations. Potential PV generation should be estimated based upon not only available roof area of the pump houses, but also available area around these facilities for ground-mounted units. The FEIR should include conceptual site plans, especially for the Central Pump Station site, to allow for an assessment of PV system feasibility and sizing. The DOER and MEPA are available to assist the Town in identifying appropriate resources to calculate potential project cost, payback periods, return on investment, and rebates or utility incentives. The Town should consider both first-party and third-party ownership/lease scenarios. The FEIR should state assumptions with regard to available area for PV equipment, efficiencies, etc. The Town should set up a pre-filing meeting to discuss assumptions and	Section 4

Comment	Response Location
modeling protocols with DOER, MassDEP and the MEPA Office in advance of preparing the FEIR to assist in these modeling efforts.	
The FEIR should identify properties regulated under the MCP, locations of USTs and the presence of AULs to the project routes in Reading and Andover to identify potential for interaction with contaminated soil and groundwater. The FEIR should discuss hazardous waste mitigation measures to be implemented during the construction period within these communities.	Section 4
The FEIR should respond to the concerns raised by the Reading Historical Commission comment letter. It is unclear if construction is proposed in the vicinity of the Lob's Pound Mill archaeological site. The FEIR should describe the proposed work in this location, potential impacts and identify measures to avoid, minimize or mitigate impacts to archaeological resources."	No Longer Applicable
The FEIR should discuss project staging and how staging areas will be identified and operated to avoid or minimize environmental impacts. The FEIR should discuss how water and/or wastewater services will be maintained during the construction period. Given the potential construction-related impacts near sensitive resources such as wetlands, endangered species habitat, or Article 97 lands, the DEIR should discuss post-construction mitigation measures for these areas with regard to re-seeding, revegetation, or other restoration efforts within the project corridor.	Section 5
The FEIR should discuss measures to mitigate the construction period impacts of diesel emissions to the maximum extent feasible. This mitigation may be achieved through the installation of after-engine emission controls such as diesel oxidation catalysts (DOCs) or diesel particulate filters (DPFs). Construction equipment should use ultra-low sulfur diesel (ULSD) fuel in off-road engines.	Section 5
The DEIR proposed the sewering of the Martins Pond Study Area as the fourth phase of construction. Based on water quality concerns of Martins Pond, the FEIR should provide additional discussion on how construction phasing was determined to ensure that maximum benefit is achieved in the initial project phases.	No Longer Applicable
The FEIR should include a separate chapter summarizing proposed mitigation measures. The FEIR should include draft Section 61 Findings for each anticipated State Agency Action. The FEIR should contain clear commitments to implement these mitigation measures, estimate the individual costs of each proposed measure, identify the parties responsible for implementation, and a schedule for implementation.	Section 7
In order to ensure that all GHG emissions reduction measures adopted by the Proponent in the Preferred Alternative are actually constructed or performed, I require proponents to provide a self-certification to the MEPA Office indicating that all of the required mitigation measures, or their equivalent, have been completed. Specifically, I will require, as a condition of a Certificate approving an FEIR, that following completion of construction the Proponent provide a certification to the MEPA Office signed by an appropriate professional (e.g., engineer, architect, transportation planner, general contractor) indicating that the all of the mitigation measures proposed in the FEIR have been incorporated into the project. Alternatively, the Proponent may certify that equivalent emissions reduction measures that collectively are designed to reduce GHG emissions by the same percentage as the measures outlined in the FEIR, based on the same modeling assumptions, have been adopted. The certification should be supported by plans that clearly illustrate where GHG mitigation measures have been incorporated. The commitment to provide this self-certification in the manner outlined above should be incorporated into the draft Section 61 Findings included in the FEIR.	Section 7
The FEIR should contain a copy of this Certificate and a copy of each comment letter received. In order to ensure that the issues raised by commenters are addressed, the FEIR should include direct responses to comments to the extent that they are within MEPA jurisdiction in a separate Response to Comments section of the FEIR. This directive is not intended to, and shall not be construed to, enlarge the scope of the FEIR beyond what has been expressly identified in this Certificate.	Section 6

TABLE 6-2
EOEEA RESPONSES TO NPC

Comment	Response Location
The FEIR should include a detailed description of the proposed project. This description should include: a project history, a description of the overall project scope, a discussion of key planning initiatives and reports completed to date regarding water supply planning and wastewater management, and project objectives and goals. The FEIR should quantify all environmental impacts associated with the water supply project, including impacts associated with water system infrastructure upgrades in the Town of Andover.	Section 1, Section 3
Additional analysis of wastewater is not required in this Scope; however, the Town should describe the status of planning, identify any significant developments and provide a schedule for development of alternatives and filing with MEPA	Section 1
The FEIR should follow Section 11.07 of the MEPA regulations for outline and content, as modified by this Scope. The FEIR should include a description of the existing environment including North Reading and Andover in accordance with 301 CMR 11.07(6)(g). The FEIR should describe proposed conditions for each project alternative to allow for an accurate assessment of potential environmental impacts including, but not limited to, the location of water, the proposed locations of pump stations and other related equipment. These descriptions should encompass all areas of potential project impact, including areas beyond the boundaries of North Reading.	Section 4
The FEIR should clearly demonstrate that the Town has sought to avoid, minimize and mitigate Damage to the Environment to the maximum extent feasible. The FEIR should include a detailed description of the project and describe any changes to the project since the filing of the NPC. The FEIR should include a discussion of permitting requirements, the results of any consultation with State Agencies, and how the project will be constructed in accordance with applicable regulatory performance standards.	Section 1, Section 5
The FEIR should identify Article 97 lands within the Town of Reading and Andover to identify any direct impacts to Article 97 lands or need for easements. If wells are abandoned, the FEIR should address how former water supply protection properties will be managed and whether land currently within the Zone 1 may be sold or transferred. If the wells will be abandoned, I highly encourage the town to preserve the land.	Section 4
The FEIR must include all information necessary to complete the Interbasin Transfer approval process. Comments from WRC include a general scope for the FEIR. I strongly recommend that the Town meet with the WRC prior to the submission of the FEIR to ensure that all Scope items specific to this project are addressed so that the WRC process, including a public hearing, can be initiated. The FEIR should include direct responses, with supporting data or graphics as necessary.	Section 1, Section 3, Section 4
The ITA review process will include reviewing North Reading's compliance with the Massachusetts Water Conservation Standards, including the performance standards for unaccounted-for water (no more than 10% of the water that enters the distribution system should be unaccounted for) and residential per capita day water use of no more than 65 gallons per person. As identified in WRC's comment letter on the DEIR, North Reading does not meet the ITA Performance Standards for UAW or residential water use in gallons per capita per day (rgcd). The FEIR should discuss how the Town will improve its accounting of water use and describe its water loss control program. In addition, the FEIR should identify water conservation measures the Town will implement (e.g., rebates for low flow fixtures, residential water use audits), a timeline for implementation and an estimate of reductions.	Section 3

Comment	Response Location
The FEIR should include additional information on Andover's water system. It should identify the current timing of the diversions from the Merrimack River and Fish Brook and describe the potential impacts to these resources and Haggetts Pond associated with the increased water withdrawal. The FEIR should identify whether the increased supply of water to North Reading will increase the frequency of water diversions from the Merrimack River or Fish Brook. The FEIR should identify the percentage of usable capacity of Haggetts Pond that will be transferred to North Reading. The FEIR should include the applicable reservoir and/or drought management plan for Haggetts Pond.	Section 3
The FEIR should clearly identify any deficiencies in Andover's water system, including any water quality issues. It should identify measures proposed to resolve any deficiencies, identify the party responsible for implementation and provide a schedule for implementation. In addition, the FEIR should identify proposed improvements to Andover and North Reading's distribution systems, including upgrading transmission mains and associated environmental impacts.	Section 3
The FEIR should clarify whether North Reading will abandon its wells and retire its WMA registration. If the Town intends to abandon the wells, the FEIR should address consistency of the decommissioning with MassDEP Guidelines for Public Water Systems.	Section 1, Section 2
The project is subject to the MEPA Greenhouse Gas Emissions Policy and Protocol ("the Policy"). The Policy requires projects to quantify carbon dioxide (CO_2) emissions and identify measures to avoid, minimize or mitigate such emissions. The Town will be required to quantify the direct and/or indirect CO_2 emissions associated with the project's stationary source energy usage (e.g., building energy use, process-related energy use, pump stations, etc.) and transportation-related emissions (mobile sources), if applicable. To facilitate this evaluation, the GHG analysis should include a comparison of CO_2 emissions associated with an established project baseline to estimated CO_2 emissions associated with a final build condition that incorporates feasible mitigation measures to reduce CO_2 emissions.	Section 4
The FEIR should include a GHG analysis that calculates and compares GHG emissions associated with: 1) a Baseline, or Business As Usual case (direct and indirect emissions from energy consumption based upon a typical pumping and treatment design and operations) and 2) the proposed Preferred Alternative (direct and indirect emissions from energy consumption based upon the implementation of equipment and operations that achieve reduced GHG emissions compared to the Baseline). The GHG analysis should specifically evaluate proposed pumping and treatment equipment and/or operations protocols to determine if indirect GHG emissions can be reduced compared to the Baseline case. The Town should identify the model or methodology used to analyze GHG emissions, clearly state modeling assumptions, and explicitly note which GHG reduction measures have been modeled and will be implemented within the system.	Section 4
The FEIR should include a separate chapter summarizing proposed mitigation measures. The FEIR should include draft Section 61 Findings for each anticipated State Agency Action. The FEIR should contain clear commitments to implement these mitigation measures, estimate the individual costs of each proposed measure, identify the parties responsible for implementation, and a schedule for implementation in a tabular format.	Section 7
The FEIR should contain a copy of this Certificate and a copy of each comment letter received. In order to ensure that the issues raised by commenters are addressed, the FEIR should include direct responses to comments to the extent that they are within MEPA jurisdiction. This directive is not intended, and shall not be construed, to enlarge the scope of the FEIR beyond what has been expressly identified in this certificate.	Section 6, Appendices

Comment	Response Location
The Town should circulate the FEIR to those parties who commented on the EENF, DEIR, NPC, and to any State Agencies from which the Town will seek permits or approvals, and to any additional parties specified in section 11.16 of the MEPA regulations. To save paper and other resources, the Town may circulate copies of the FEIR to commenters other than State Agencies in a digital format (e.g., CD-ROM, USB drive) or post to an online website. However, the Town should make available a reasonable number of hard copies to accommodate those without convenient access to a computer to be distributed upon request on a first come, first served basis. The Town should send a letter accompanying the digital copy or identifying the web address of the online version of the FEIR indicating that hard copies are available upon request, noting relevant comment deadlines, and addresses for submission of comments. The FEIR submitted to the MEPA office should include a digital copy of the complete document. A copy of the FEIR should be made available for review at the Eastham public library.	Noted

6.3 MASSACHUSETTS HISTORICAL COMMISSION (MHC)

In a letter dated April 8, 2016, the MHC provided comments to the DEIR. The MHC also provided comments to the NPC in a letter dated November 22, 2018. Because of the changes to the project, the MHC comments to the DEIR no longer apply. Table 6-3 summarize the MHC questions to the NPC and provides direction as to where in this document the responses can be found.

TABLE 6-3
MHC RESPONSES TO NPC

Comment	Response Location
The MHC notes that the project has been modified and multiple project alternatives are under consideration. Project planners should submit the Final Environmental Impact Report (FEIR) and scaled project plans showing existing and proposed conditions for the preferred project alternative to the MHC for review and comment. Project plans should show each phase of improvements or expansion projects, including treatment plant location(s), recharge areas, pump stations, equipment storage and materials staging areas and cross-country water and/or pipeline right-of-ways. The MHC encourages project planners to continue to consult with the North Reading Historical Commission as project planning proceeds.	Section 1, Section 4
Project planners should continue to consult the Inventory of Historic and Archaeological Assets of the Commonwealth for identified historic and archaeological properties. Feasible designs and locations that meet the engineering requirements, while also seeking to avoid or minimize impacts to historic and archaeological properties and areas should be considered. Design elements for new construction in historic areas should consider size, scale, massing, height and materials in developing the specifications, and also consider vegetative screening to minimize visual effects.	Section 1, Section 4
If the project requires federal funding, licensing, permits or approvals, such as use of State Revolving Fund funding administered by the Massachusetts Department of Environmental Protection, then the MHC will continue to review the project pursuant to Section 106 of the National Historic Preservation Act of 1966, as amended (36 CFR 800) in consultation with the involved federal agencies.	Not Applicable

6.4 READING HISTORICAL COMMISSION (RHC)

In a letter dated April 5, 2016, the RHC provided comments to the DEIR. However, because of the changes to the scope detailed in the NPC, the RHC comments are no longer relevant to this project.

6.5 MASSACHUSETTS WATER RESOURCES AUTHORITY (MWRA)

In a letter dated April 19, 2016, the MWRA provided comments to the DEIR. However, because of the changes to the scope detailed in the NPC, the comments are no longer relevant to this project.

6.6 WATER RESOURCES COMMISSION (WRC)

In a letter dated April 21, 2016, the WRC provided comments to the DEIR. The WRC also provided comments to the NPC in a letter dated December 7, 2018. Tables 6-4 and 6-5 summarize the WRC questions and provides direction as to where in this document the responses can be found.

TABLE 6-4
WRC RESPONSES TO DEIR

Comment	Response Location
The ITA Performance Standards require that unaccounted-for water (UAW) should be 10% or less. North Reading does not meet the ITA Performance Standard for UAW. The FEIR should discuss how the Town intends to better account for water use and describe its water loss control program. This program should be described in detail and be as specific as possible, listing the actions that have been implemented or are scheduled to be implemented in the very near future. Section 9.1.3.2 discusses plans to appropriate funds at Town Meeting in FY17 for a water system audit to identify the causes of UAW. Water audits are an important first step of water loss control and help to categorize losses from a system. Will this water audit be conducted according to the American Water Works Association methodology (M-36) or other similar methodology? A description of the method for the water audit and any proposed validation of the audit should be provided in the FEIR. The FEIR should also provide an update on the status of the Town Meeting appropriation.	Section 3
The DEIR states that the last leak detection survey was conducted in 2014. The report from this survey must be provided and should include a description of the methodology used (this can be provided electronically or, if it is available on-line, a link can be provided). Section 9.1.3.3 recommends that leak detection surveys should be conducted every two years. We suggest that the results and recommendations of the water audit be reviewed prior to scheduling the next leak detection survey, to assure that water loss control activities are best focused and prioritized. If an additional leak detection survey is to be scheduled, the schedule for this survey should be provided in the FEIR. If the survey is conducted prior to the submittal of the FEIR, the survey report should also be provided, if completed. If the report has not been completed at the time of the FEIR submittal, the FEIR should list the schedule for completion.	Section 3, Appendices

Comment	Response Location
Provide documentation of the master meter and sub-master meter calibration conducted in February 2016 and described on page 9-5. It is stated that 11 meters across six sites were calibrated. What percentage of the master and sub-master meters did this calibration cover? The DEIR recommends conducting master and sub-master meter calibrations on an annual basis. Annual master meter calibration is also a requirement of the ITA Performance Standards. Does the Town commit to annual master meter calibration?	Section 3
Provide a timeline for installation of Advanced Metering Infrastructure (AMI) system. Will the AMI system be installed for all water users, or just residential customers?	Section 3
Section 8D of the ITA (MGL Chapter 21) outlines the "criteria upon which the commission shall base its approval or disapproval of any proposed interbasin transfer of waters", including the "implementation of rate structures which reflect the costs of operation, proper maintenance and water conservation and encourage the same" (subsection (2)(c)). Section 9.1.3.5 of the DEIR recommends that North Reading conduct a rate study to develop a plan to establish water rates based on capital improvements, O&M costs and the costs to purchase water (presumably from the MWRA). Details of this study and a schedule for it to be conducted and implemented should be included in the FEIR.	Section 3
Provide the 2013 Drought Management Plan and the Water Use Restriction Bylaw. Specify the details of water use restrictions, including triggers for restrictions and any additional stages besides Stage I, as presented in Appendix E of the DEIR.	Section 3
In 1991, North Reading reported that all public buildings, with the exception of the police and fire department buildings, had been retro-fitted with water saving fixtures. Since that time, water on its public facilities recommended upgrades. North Reading plans to appropriate $26,000 at the fiscal year 2017 town meeting to complete these upgrades. The FEIR should include the copy of the Public Building Audit Report, documentation of the recommendations that have been implemented, and a schedule for those still to be implemented.	Section 3
The DEIR states that the residential water use. in gallons per capita per day (rgpcd), is on average about 67 rgpcd, which is higher than the ITA Performance Standard goal of 65 rgpcd. This is based on residential water use values listed in Table 4-31 of which, a few years are slightly lower than the actual residential water use values that MassDEP determined following a review of the town's data. Using the MassDEP-determined values for the years 2010 to 2014, the average is 69 rgpcd. The DEIR discusses water conservation measures the town is considering. However, in order to meet this Performance Standard, North Reading should be implementing a comprehensive residential conservation program that seeks to reduce residential water use through a retrofit, rebate or other similarly effective program for encouraging installation of household water saving devices, including faucet aerators, showerheads and toilets and through efforts to reduce outdoor water use. The DEIR makes many recommendations for water conservation (e.g. rebates for low flow fixtures, residential water use audits), but North Reading must state which of these it will actually implement, provide an approximate estimate of water use savings, and provide a timetable for implementation. The FEIR should present a prioritization for implementation based on expected water savings (including actions which are listed as 'Low Priority' for town in Table 5-1) to help guide the Town in future conservation efforts.	Section 3
Provide the URL(s) for North Reading's water conservation web page discussed on Page 3-29. Provide a timeline for the development of a water conservation public education plan, also mentioned on this page.	Section 3
The DEIR states that North Reading is planning to conduct water audits for non-residential users in Town, starting with the highest users in this category. What is the timetable for conducting these audits?	Section 3

Comment	Response Location
Section 9.3.3 states "Switching to the MWRA for a water source would reduce demand in the Ipswich River basin. On the other hand, sending a portion of the wastewater out of basin would reduce the amount of water returned to the basin." Actually, switching to MWRA (and eliminating the use of North Reading's local sources) would not reduce demand in the basin. Only a demand management program will do this. But it will reduce demand on the basin.	No Longer Applicable

TABLE 6-5
WRC RESPONSES TO NPC

Comment	Response Location
The WRC uses the EIR as its ITA application. We do this to provide streamlining of state review processes. Therefore, we are concerned about the statement on page 5 of NPC, indicating that the Town would apply for ITA approval after the issuance of the Final EIR certificate. If a proponent uses the EIR as its ITA application and provides all the information needed for ITA review through the MEPA process, once the final certificate on the project is issued, an additional application is not needed and the WRC can schedule the two public hearings required under the Act and proceed with the formal ITA decision-making process. If the information is not provided until after the MEPA process is completed, the timing for a WRC decision will be unnecessarily prolonged.	Noted
The FEIR should provide more information on Andover's system, including the current timing of the transfers from the Merrimack River and Fish Brook and describe the potential impacts to these streams and to Haggetts Pond, due to this increased transfer to North Reading. Page 4 of the NPC discusses the phasing of North Reading's proposed purchase, indicating that the Town would be purchasing up to 3.0 mgd after 2025. The FEIR should clarify if the 3.0 mgd represents the average or maximum amount to be transferred. The ITA regulates on capacity or maximum clay use, so in its ITA application, North Reading should be requesting what they have determined to be the maximum needed to address their maximum day demand, minus the already authorized 1.5 mgd transfer. The hydrologic analyses should be conducted on this amount and include the cumulative impacts of all past, authorized or proposed transfers on the Andover system.	Section 3
We also listed several issues that needed to be addressed in order to evaluate North Reading' s compliance with Criterion #3 of the ITA regulation s (Water Conservation). These comments still need to be addressed and any updated information should be provided (for example, documentation of water audits, leak detection programs, master mete r calibrations, rate studies, drought plan). In addition, WRC Staff is in the process of updating the ITA Performance Standards. North Reading's FEIR/ITA application should comply with the latest version available at the time of submittal.	Section 3
Review and provide responses to the EIR Scope/lnterbasin Transfer Act Application for Communities Seeking APPROVAL FOR WATER SUPPLY DEVELOPMENT.	Section 3, Section 6

6.7 TOWN OF ANDOVER

In a letter dated April 22, 2016, the Town of Andover provided comments to the DEIR. However, because of the changes to the scope detailed in the NPC, the comments are no longer relevant to this project.

6.8 IPSWICH RIVER WATERSHED ASSOCIATION (IRWA)

In a letter dated May 5, 2016, IRWA provided comments to the DEIR. Table 6-6 summarizes the IRWA questions and provides direction as to where in this document the responses can be found.

TABLE 6-6
IRWA RESPONSES TO NPC

Comment	Response Location
The Town must establish a private well bylaw that includes the same conditions as on the municipal water system which includes a strong enforcement program. Without such as well-enforced by-law, any water conservation conditions will be largely in effective as evidenced by the current situation.	Section 3
There must be a prohibition against future sewering "creep" without a new full environmental impact report. There should be additional conditions that any sewering be state of the art and include all currently available design features to prevent infiltration over the long term.	No Longer Applicable
The town must implement a robust and sustainable water demand, conservation and enforcement program for all residents, businesses and municipal uses including their golf course (Note the town is already a member of the Greenscapes Coalition which provides some of these services which could easily be enhanced to meet this condition.	Section 3
We strongly recommend against the surrendering of the Town's current registration and complete abandonment of the Town's wells as proposed in the EIR. While we certainly support the switch to MWRA water, we are extremely concerned about the loss of the well-head protection areas and the impact surrendering its registration would have on the Safe Yield established by DEP on the Ipswich River if this registration were removed from the calculus. As you know, there is a massive amount of water withdrawals not subject to the Water Management Act and the Safe Yield calculation, and this amount is increasing dramatically over time in the Ipswich. (We calculate that more than 3 MGD was withdrawn in the basin in 2015 by newer private wells alone.) This would mimic what was done in Reading and could be one of the best ways for the State to compensate for acknowledged shortcomings of the SMWI in the Ipswich.	Section 3, No Longer Applicable

6.9 MR. JOSE ALBUQUERQUE

In a letter dated December 11, 2018, Mr. Albuquerque, a resident of Andover, provided comments to the NPC. Table 6-7 summarizes Mr. Albuquerque's questions and provides direction as to where in this document the responses can be found.

TABLE 6-7
MR. JOSE ALBUQUERQUE RESPONSES TO NPC

Comment	Response Location
Even though the Town of Andover has been awarded numerous times for the water quality, our water distribution system is aging and requires maintenance. My comments to this change are that we are concerned that the Town of Andover is not capable of handling additional volume at this present time due to the fact they are not able to manage water operations such as the continuing issues of brown water and watershed management	Section 3
It is imperative to expand the existing Andover Water Commission that is currently composed of the Board of Selectmen to include North Reading Select Board representation as I suggested in the attached February 2018 email. It was proposed by North Reading Select Board but was rejected by Andover.	Section 1

6.10 MR. KEITH SAXON

In a letter dated December 11, 2018, Mr. Saxon provided comments to the NPC. Table 6-8 summarizes Mr. Saxon's questions and provides direction as to where in this document the responses can be found.

TABLE 6-8
MR. KEITH SAXON RESPONSES TO NPC

Comment	Response Location
Fish Brook/Merrimack River Water Intake: Item DPW-29 in Andover's most recent Capital Improvement Program (CIP) indicates the need for a new $15mm pump station intake to be constructed in fiscal year 2022. The published justification for this project is that "the current intake will not meet future water demand". This is not mentioned at all in the attached analysis memo. Certainly this is a project that is required due to the addition of 3.0 mgd for North Reading, and given its location at the confluence of Fish Brook and the Merrimack River, will have significant potential environmental impacts to wetland resource areas that needs to be included in the FEIR.	Section 3
Bancroft Pump Station – Capacity/Size/# of Pumps?: The Wright-Pierce analysis describes a conflict (2800 vs 3500 gpm; 1 or 2 pumps?) between the design capacity and hydraulic model provided by Andover's consultant Woodard & Curran. More importantly even the largest capacity of 5 mgd has been determined to "not have adequate capacity" to meet future demand with North Reading. There are currently no listed projects in Andover's 5-yr CIP to increase the capacity of this pump station. Certainly, if such a project is required to serve North Reading then it should be included in the FEIR with a review of environmental impacts. Further the FEIR should not be completed until answers to the basic question of the capacities of the pump(s) at this pump station and whether in fact there are 1 or 2 operational pumps in place can be provided.	Section 3
Transmission Mains Between WTP & Bancroft Pump Station: The analysis indicates that Andover is currently evaluating possible upgrades to the existing transmission mains to increase capacity in the system and that the hydraulic model will be updated when this information is available. Given how crucial the hydraulic model is to determine the actual feasibility of the selected option & needed infrastructure improvements, the FEIR should not be completed until this evaluation & updated information is provided. Much like the previously proposed water main upgrades in Reading under the DEIR, any needed water main improvements in Andover should be analyzed for environmental impacts in the FEIR.	Section 3
Prospect Hill Storage Tank Upgrade: The analysis indicates that if the 3.0 MG Prospect Hill Tank #2 is taken out-of-service there would be an inadequate volume to serve North Reading under typical operating conditions. It goes on to recommend a new larger tank to eliminate the deficiency. A new storage tank is not included in the CIP. Please note that this storage tank was out-of-service for cleaning in both 2010 and 2014, and AWWA recommends inspection every 5-years with cleaning as needed. So, this tank will be out of service in future. Thus, the FEIR should address whether this deficiency affects feasibility and any necessary upgrades from a needed new tank need to be evaluated for environmental impacts.	Section 3
Average Daily Demand / Max Daily Demand: The analysis indicates that 2016 Andover data was used to determine the current and future values. 2016 Andover is ADD is listed as 7.07 mgd. This figure does not match that provided to DEP in the 2017 WMA permit renewal application of 7.28 mgd. Even if the WMA figures are inflated to include water ultimately discharged back to Haggetts Pond or to the sewer (unknown if it does), the data indicate that 2016 was the second lowest of the past five years where ADD ranged from 7.02 to 7.77 mgd, with an average of 7.43 mgd. The analysis and the FEIR should match should use at least the average, if not the maximum ADD over the past five years for a better reflection of actual data, and thus more conservative analysis.	Section 3
Increased Pipe Velocities: The analysis indicated for the most likely scenario (i.e. utilization of two existing connections) that pipe velocities greater than 5-fps would be observed in Lowell Street to Greenwood Road and Woburn Street to Abbott Street segments where they haven't been seen before. Further the analyses indicate many other areas of 2-5 fps velocities. It needs to be demonstrated in the FEIR that the increased volume & velocities will not create a situation where the water quality for Andover and All Consumers is inadequate, substandard, and unavailable for consumption for significant portions of time.	Section 3

Comment	Response Location
The IMA attached to the NPC indicates that North Reading can purchase 2.4 mgd through 6/30/19 and then 2.6 mgd through 6/30/25. It then goes on to note state that the 2.6 mgd is dependent on the WMA and IBTA permits being amended. North Reading is currently only allowed 1.5 mgd. Given that the attached timeline for the amending the IBTA is basically at 6/30/19, why have this in there? Why is the last statement indicate only 2.6 mgd. The FEIR should make clear that North Reading did not violate the 1.5 mgd limit.	Section 1
WMA Permit for Andover: The WMA application in November 2017 did not include the population of North Reading being served by this source. The FEIR should document the need to amend this.	Section 3
NDPES WTP Discharge Permit: The Andover WTP already greatly exceeds EPA's proposed Aluminum discharge limit for the discharge of its filter backwash to Haggetts Pond. It is not likely that it would be able to meet the General WTP Permit discharge requirements and thus needs an individual permit. The FEIR should address whether Andover can obtain approval for this discharge (and thus be able to meet North Readings needs) as well as the environmental impacts of increasing this discharge via increased production to meet North Readings needs. There already exists a large underwater mound of aluminum containing solids in the pond.	Section 3
NPDES Storage Tank Overflow / Drains: None of Andover's water storage tanks have are permitted for their overflow drains direct to wetland resource areas and stormwater systems. This was identified in CWA suit 1:12-CV-10247-RBC Berberian vs Town-of-Andover and has not been addressed. Further EPA in its recent MS4 guidance indicated that such discharges require approval. The FEIR needs to confirm that Andover can legally provide water to North Reading and address the environmental impacts of presumed increased discharges from the increase in flows.	Section 3
Solids Discharge to GLSD: The Andover WTP discharges the solids removed from the flocculation & settling tanks to GLSD. More treated water means more solids generated. It is unclear whether the Andover WTP has or can get the approval to increase the discharge of these solids to GLSD or if the WWTP has the capacity to treat it. Again, the FEIR needs to address the feasibility of this increased discharge & the additional downstream environmental impact.	Not Applicable Section 3
The NPC indicates a $3M MassWorks Grant for the project: The FEIR scope thus should be broad based.	Noted.
Hazardous Materials Impacts – Andover Storage Tanks & WTP Sludges: RTN 3-30229 was issued to Andover Water Department for its discharge of heavy metal containing tanks solids to a downstream wetland during the removal of solids from the Bancroft Storage Tank in 2010. Andover's Chris Cronin indicated under Affidavit in Document #7 of the CWA suit 1:12-CV-10247-RBC Berberian vs Town-of-Andover, that any future tank cleaning would plan to utilize tight tanks to collect solids to prevent a reoccurrence of the a release to wetlands, however, to the best of my knowledge this did not happen when the Prospect Hill Tanks were cleaned in 2014 & 2016. Further the given the high levels of arsenic & other metals in the tank bottom solids at Bancroft, it is quite likely that tank bottom solids contaminated areas are present downstream of or in the vicinity of the Prospect Hill Tank, Bancroft Tank & Pump Station, and WTP. The FEIR should address the hazardous materials impacts to wetlands & soils from both the increased need to clean the tanks from increased flows for North Reading, and for any project related construction activities and/or upgrades are required in these locations.	Noted.
Unbilled Andover Public Facilities Water Use: WRC water management guidelines indicate that Public Facilities water usage should be tracked closely to help facilitate water conservation. Currently the water consumed by Andover's Public Building are not billed. These costs, for the 5-7% of Andover's water consumption, are simply absorbed into the overall Water Enterprise Cost. It does not seem appropriate for North Reading water users to in essence to subsidize by 33% this consumption from Andover's Public Facilities. The FEIR should address the environmental impacts of this as well as the feasibility of a Water Enterprise Fund to charge other users for someone else's consumption.	Noted.

6.11 MASSACHUSETTS DEPARTMENT OF ENVIRONMENTAL PROTECTION (MASSDEP)

In a letter dated May 6, 2016, MassDEP provided comments to the DEIR. MassDEP also provided comments to the NPC in a letter dated December 11, 2018. Tables 6-9 and 6-10 summarizes MassDEP's questions and provides direction as to where in this document the responses can be found.

TABLE 6-9
MASSDEP RESPONSES TO DEIR

Comment	Response Location
MassDEP commented on the ENF, stating that construction of pump stations or new physical interconnections between public water systems will require Distribution System Modification permitting by MassDEP (Permit Category BRPWS32). MassDEP further stated that if multiple facilities of this sort are needed, the Town of North Reading may combine some or all of the facilities into a single permit application rather than submitting a separate permit application for each facility. However, if "significant modifications", are required to the Town of Reading's water system (as described in MassDEP's DWP Policy 08-01, Substantial Modifications to A Public Water System That Require A Permit), a separate permit application must be submitted for the modifications to Reading's system, even if the design and/or construction are done by North Reading's contractors. Reading must have control over the design of changes to its water system, rather than North Reading. Water main replacement is generally not considered a substantial modification, unless at least 25 percent of a system is being replaced. Of the improvements listed in the DEIR (page 5-20), replacement of the inlet/outlet piping at the Auburn Street Tank is the one item that appears that it might require a permit. In a 2014 sanitary survey of the Reading water system, an issue was identified with stratification of the Auburn Street Tank that caused seasonal decreases of the chlorine residual - improvements made at the tank must be designed to improve this condition rather than exacerbate it.	Section 1, No Longer Applicable
For North Reading to change its source of water to the MWRA supply, it will have to evaluate whether corrosion control treatment is needed for the North Reading water system to remain in compliance with the Lead and Copper Rule. North Reading is currently required to conduct lead and copper monitoring once every three years. MassDEP will likely require at least one additional round of lead and copper monitoring when the switch over to the MWRA water occurs.	No Longer Applicable

Comment	Response Location
If North Reading abandons its municipal wells, then the wells will no longer be considered public water supply sources and will not be protected as public water supply sources under MassDEP programs, such as the Massachusetts Contingency Plan and Title 5. MassDEP will rescind its approval of the Zone II wellhead protection area for the wells, and the Interim Wellhead Protection Area for the Stickney Well. This means that certain areas in the Town will no longer be within a Water Supply Protection Area and will no longer be subject to the regulatory protections conferred by that designation. An area around Martins Pond and an area in the northern part of Town will no longer be within a Zone II wellhead protection area, and small areas in the southwest comer of the Town will no longer be within an Interim Wellhead Protection Area. However, Zone IIs that extend into North Reading for wells in neighboring communities will remain in effect; these include Zone Ils for public supply wells for the Town of Wilmington, the Town of Reading, and the Lynnfield Center Water District. Some areas in the northeast part of the Town will still be within Water Supply Protection Areas for the Town of Danvers' surface water sources. Protections provided at the municipal level by the Town of North Reading's aquifer protection zoning and non-zoning controls will thereafter remain in effect until the Town revises the boundaries of its overlay district.	No Longer Applicable
Based on North Reading's current Residential Gallons per Capita Day (RGPCD) and Unaccounted for Water (UAW) figures, the Water Management Program has questions about the water demands projected in the DEIR. Over the past five years, North Reading has reported a UAW percentage between 12 to 17 percent. Those percentages were calculated without submitting any documentation of Confidently Estimated Municipal Use (CEMU) to MassDEP for its review. According to the DEIR, North Reading completed a leak detection survey on the entire water distribution system in 2014 and then appeared to repair leaks in 2015 (North Reading needs to clarify the status of the leaks repaired as outlined in the section 3.9.4 and Table 5-1). Despite these repairs, North Reading still reported a 13.3 percent UAW for 2015. North Reading also reported an RGPCD of 70 for 2015. The DEIR used the 65 RGPCD and 10 percent UAW standards to project a future average daily use of 1.6 million gallons per day (mgd). In order to ensure the proposed purchased volume from MWRA is sufficient to meet future demand, North Reading should keep implementing their "best practices," as outlined in the DEIR section 3.9, for controlling residential water use and water loss. In addition, North Reading should consider conducting a water audit in accordance with the AWWA M36 Water Audits and Loss Control Program. North Reading also should start implementing a water conservation public education and outreach plan.	Section 3
Under existing conditions, there is no municipal collection system in the Town, and the Town's wastewater is managed through on-site (Title 5) disposal systems and a collection of larger on-site discharges for commercial facilities permitted through the MassDEP groundwater discharge permit program. The DEIR includes a needs analysis which evaluated a range of factors in determining the adequacy of the current wastewater management. This resulted in targeting four subareas in Town as needs areas where sewering alternatives would provide improved protection of water resources and public health. MassDEP generally concurs with the factors used in this analysis and their weighting; however, several issues should be addressed in finalizing this analysis in the FEIR: • Page 7-7: Final analysis should indicate the sources of information used to determine "ponding" impacts; • Page 7-11: The classification of frequent pumpers as those pumping more than once every two years may overestimate the number of systems at high risk. Conversely, if systems are pumped four or more times per year, they should be identified under the separate and more heavily weighted "failure" criterion. The final needs analysis should distinguish any failed systems, and consider an alternative threshold to define frequent pumpers; • Page 7-13: Final analysis should indicate sources of information used to determine depth to groundwater table; and • Page 7-15: Final analysis should indicate sources of information used to assign the depth to restrictive layer factor.	No Longer Applicable

Comment	Response Location
The FEIR also should address any needs the Town may have for adequately overseeing and managing the Town's on-site disposal systems. The DEIR clearly indicates that on-site systems will continue to be a main element of the long-term wastewater management plan. The FEIR should include a review of the town's resources to administer Title 5, to track septic system pumping and repairs, and use or participation in MassDEP's Community Septic Management Program.	No Longer Applicable
The DEIR includes a review of potential sites for groundwater discharge of treated wastewater, under the terms of a MassDEP Groundwater Discharge Permit. The DEIR concludes that there is no single site which can feasibly treat and dispose of the design flows for the 0.5 million gallons per day of wastewater. The main site identified is the DPW site, which the DEIR indicates can only accept, treat, and discharge u to 125,000 gallons per day, at a loading rate of 0.3 gallons per day per square foot (gpd/ft). MassDEP notes that this loading rate is substantially less than any facility operating under a typical groundwater discharge permit and is even less than loadings allowed under the Title 5 program, for wastewater with very limited treatment. The FEIR should expand on the discussion of why this site has such limitations. MassDEP also notes that potential discharge locations within Zone II areas are not prohibited for siting of groundwater discharge facilities, unless the travel time to the drinking water well is less than 6 months. The DEIR also makes minimal mention of the "Berry" site, which is the current location of a MassDEP Groundwater Discharge Permit with Edgewood Luxury Apartments. During permitting of the Berry site, a reserve allowance of 100,000 to 150,000 gpd for use by the Town was included into the design of the project. Further, the September 2008 CWMP recommended that the Town seek a MassDEP groundwater discharge permit for 200,000 gpd of flow at this site. The FEIR should confirm the capacity allotted to the Town and describe any potential use of this site to meet the wastewater needs. The 2008 CWMP also recommended use of the Hillview Country Club site and U.S Postal Service site; both are in, or close to, the identified needs areas. The FEIR should provide more detail on the merits of pursuing these sites as potential groundwater discharge sites.	No Longer Applicable
The recommended wastewater management plan includes conveying flows from the needs areas through the Town of Andover sewer system to the Greater Lawrence Sanitary District (GLSD) wastewater treatment facility for treatment and disposal, and expanded use of the wastewater treatment and disposal system serving the North Reading High School. As noted in the DEIR, there are considerable institutional hurdles to implementing the elements of the plan which involve conveyance of flows through the Town of Andover to GLSD, and only the initial steps have been taken to determine the feasibility and costs of proceeding with this plan. This plan may present the most cost-effective alternative; however, the information requested above should be presented in the FEIR to fully compare the costs and feasibility of the in-town options.	No Longer Applicable
The DEIR evaluation of wetlands impacts associated with the proposed water and wastewater alternatives is limited to acknowledgement of the project's potential impacts temporarily to wetland resources in North Reading and Andover. No wetlands impacts are anticipated within Reading. Since wetland resource impacts have not been identified specifically, the opportunity to comment is limited at this point. As this is a significant project in scope, it would be useful to consider alternative layouts and opportunities to avoid and minimize wetland resource impacts to the greatest extent in the FEIR. Even if the evaluation is still at a very conceptual level of detail at the FEIR stage, it would be possible to identify the wetland resources that would be impacted and estimate the extent of those impacts. This level of detail is typically required at the DEIR stage for most utility, roadway, and trail projects in MEPA reviews.	Section 4

Comment	Response Location
The wastewater GHG analysis compares the No Build alterative to the Recommended Plan, which proposes to discharge 500,000 gallons of the Town's wastewater to the Greater Lawrence Sanitary District for treatment. An essential purpose of the GHG analysis is to understand the mitigation measures that will be implemented to reduce emissions from the proposed project. However, as explained in the comments that follow, the GHG analyses for wastewater and water focus on demonstrating that the recommended plan is significantly more energy efficient. The DEIR does not include commitments to mitigation measures such as water conservation, xeriscaping on municipal properties, vehicle fleet replacement with energy efficient vehicles, and infiltration and inflow removal or evaluate the added reduction in emissions that could be accomplished by incorporating these measures. The GHG analysis did identify several energy efficiency improvements, such as the use of variable speed pumps, however. The results of the wastewater GHG analysis comparing the No Build and Recommended Plan are significantly affected by the inclusion of CH_4, a more potent GHG, in the equation for only the septic systems. A comparison of Table 9-8 to Tables 9-9 and 9-10 shows that removal of septic systems for the Recommended Plan has the single greatest effect on reducing GHG emissions from the Town's wastewater; septic systems are reported to have the highest GHG emissions of all sources considered, (18,395.28 tpd for No Build CO_2 emissions vs. 16,317.70 tpd CO_2 for the Recommended Plan with the DPW facility). As a result, the GHG analysis reports that emissions would be reduced by 75 percent with the recommended plan without additional mitigation.	No Longer Applicable

TABLE 6-10
MASSDEP RESPONSES TO NPC

Comment	Response Location
A MassDEP BRPWS29 permit (Chemical Addition Retrofit for System Serving More Than 3,300 People) will be required for construction of the chlorine feed stations; the design for both stations may be combined into a single permit application.	Done
The NPC states that “a storage analysis was conducted to determine if the tanks in the Andover system contain adequate storage volume over the next 20-year period to serve both Andover and North Reading’s needs.” If North Reading plans to eliminate some or all of its own water storage facilities, this will require a BRPWS32 permit from MassDEP (Distribution System Modification for System Serving More Than 3,300 People).	Done
The NPC proposes that once Andover is providing all of North Reading’s water supply, North Reading’s municipal wells will be downgraded from “Active” to “Emergency” status. The water treatment plants will remain operational for at least one year before the Town begins the process of decommissioning them. Emergency sources may only be used with MassDEP approval during a declared State of Water Supply Emergency. Water quality monitoring of emergency sources is not required until such time as their use is proposed to alleviate an emergency. MassDEP recommends that the pumps and valves of emergency wells be exercised on a regular basis to help ensure that the wells will be operational if an emergency arises. If the wells are to be downgraded to emergency status rather than formally abandoned, the proposed BRPWS36 permit (Abandonment of Water Source) will not be necessary.	Noted
MassDEP will require North Reading to evaluate whether the changeover from a blend of Andover water and well water to full use of Andover water will require corrosion control treatment for North Reading to remain in compliance with the Lead and Copper Rule. This evaluation must be submitted to MassDEP for review prior to implementation of the full changeover. North Reading is currently required to conduct lead and copper monitoring once every three years. A revised Lead and Copper Sampling Plan must be submitted to MassDEP for review and approval prior to the changeover. MassDEP will require at least semi-annual (twice per year) lead and copper monitoring during the 12 months after the changeover occurs and may require annual monitoring after that.	Section 3

Comment	Response Location
Andover will need to request an updated water needs forecast for their renewed WMA permit that includes both Andover and North Reading's water use to ensure that Andover's renewed permit authorization will be enough to supply North Reading.	Section 2
Both communities will need to develop plans to reduce their unaccounted-for-water rates toward the 10% performance standard. If reliable water needs forecasts cannot be developed prior to Andover's WMA permit renewal, a permit can be issued with an interim authorization pending better data and demand forecasts.	Section 3
Is North Reading seeking 2.6 MGD or 3.0 MGD? Clarify.	Section 1
The NCP says that North Reading's wells will be maintained as emergency backup supply sources and will be operated and maintained in accordance with the MassDEP guidelines. North Reading intends to maintain these sources and the two water treatment plants in full operational capacity for a minimum of one year following the transition to Andover water. Once the Town is satisfied that water quality has stabilized and operations are stable, North Reading will begin de-commissioning the existing water treatment plants and converting the wells to emergency sources. This appears to be a change from the original plan to join the MWRA. In the original plan, it appeared that North Reading intended to abandon its wells and retire the Water Management Act registration. The proponent should clarify whether this NPC implies a change in the future plans for North Reading’s existing wells and the associated Water Management Act registration.	Section 1
This project will need a new Interbasin Transfer permit (IBT) to increase the amount of water transferred across a river basin boundary (Merrimack to Ipswich) and a town boundary (Andover to North Reading). The IBT review process will include reviewing North Reading’s compliance with the Massachusetts Water Conservation Standards, including the performance standards for unaccounted-for water (no more than 10% of the water that enters the distribution system should be unaccounted for) and residential per capita day water use of no more than 65 gallons per person.	Section 3

6.12 MASSACHUSETTS DEPARTMENT OF FISHERIES AND WILDLIFE (MDFW)

In a letter dated December 17, 2018, MDFW provided comments to the NPC. Table 6-11 summarizes MDFW’s questions and provides direction as to where in this document the responses can be found.

TABLE 6-11
MDFW RESPONSES TO NPC

Comment	Response Location
All projects or activities proposed within Priority Habitat, which are not otherwise exempt pursuant to 321 CMR 10.14, require review through a direct filing with the Division for compliance with the MESA (321 CMR 10.18). At present, the materials provided are not of sufficient detail to allow for site-specific review of the proposed work. Any work located within existing paved roads is likely exempt pursuant to the MESA (321 CMR 10.14). However, other aspects of the Wastewater Changes, including but not limited to cross-country segments and work more than 10 feet from a paved road, would not be MESA-exempt and will likely require a MESA Checklist filing pursuant to 321 CMR 10.18. Therefore, we are unable to determine if any specific portion of the project will have state-listed species impacts sufficient to require a MESA Conservation & Management Permit pursuant to 321 CMR 10.23.	Noted

6.13 WATER SUPPLY CITIZENS ADVISORY COMMITTEE (WSCAC)

In a letter dated May 6, 2016, the WSCAC provided comments to the DEIR. Table 6-12 summarizes WSCAC's questions and provides direction as to where in this document the responses can be found.

TABLE 6-12
WSCAC RESPONSES TO NPC

Comment	Response Location
The establishment of a private well bylaw to regulate the proliferation of wells used primarily for outdoor irrigation.	Section 3
Establishment of a conservation-oriented, ascending-block water rate structure that covers the full cost of supplying the community with water including capital improvements, leak detection, and pipe rehabilitation. A seasonal rate to reflect the higher environmental impact of summer water use should be included. Fixed charges should be low enough so that they do not generate more than 10% of total water revenues, as base charges do not provide any incentive to conserve water.	Section 3
A vigorous residential water conservation program that includes rebates for efficient appliances, installation of low flow plumbing fixtures, and sensors for outdoor irrigation. The creation of an on-going public education campaign using town sponsored workshops, school programs and social media to promote the value of water.	Section 3

6.14 INTERBASIN TRANSFER ACT REFERENCES

The WRC indicated that they would accept the DEIR as a submittal for the ITA given that it addresses the scope items outlined in the ITA. Table 6-13 summarizes ITA scope requirements and provides direction as to where to find the responses within this report.

TABLE 6-13
ITA SCOPE REQUIREMENTS

Scope Requirement	Response Location
Summary of Project	
Project Name	Section 1
Location	Section 1
Proponent Name, Address, Phone Number	Section 1
Primary Contact's Name, Address, Phone Number, Fax Number, Email Address	Section 1
Description of The Proposed Interbasin Transfer	
Describe and explain the reasons for the proposed interbasin transfer	Section 1
Provide the approximate timetable for the proposed transfer, including the estimated commencement date and the estimated completion date.	Section 1
Where applicable, describe the existing transfer system, including out-of-basin conveyance capacity, storage capacity, withdrawal constraints or other limiting factors.	Section 1 Section 3
Describe, in detail, the proposed interbasin transfer, including the maximum capacity, in mgd of the transfer facilities and the expected average daily transfer. Provide supporting information showing how the capacity of the conveyance was determined. Describe any proposed changes in existing structures and/or changes in operating rules of the water supplier or changes in transfer constraints.	Section 1
Describe the operating schedule of the proposed interbasin transfer, including the time periods, amounts to be transferred and the duration of the transfer.	Section 1 Section 3
Provide the name, exact location and river basin of the source(s) of the proposed transfer of water, including the subbasin(s).	Section 3
List the communities, sections of communities, water districts or other areas that will use the water proposed to be transferred.	Section 1 Section 3
Provide a precise description of the location, including river basin, of the wastewater discharge point.	Section 3
List the known users of this and associated resources, including agricultural operations and nurseries, whose use could be affected by the proposed transfer.	Section 3
Include a map of appropriate scale that clearly and accurately illustrates the information requested in this section. Wherever possible, MASSGIS data layers should be used.	Section 3, Section 4
Other Permits Required	

Scope Requirement	Response Location
List the local, State or Federal agencies/commissions from which permits have been obtained or will be sought.	Section 1
Information Needed to Evaluate this Project Against the Seven Applicable Criteria of the Interbasin Transfer Regulations, 313 CMR 4.05	
That an environmental review pursuant to M.G.L. c. 30, §§61 and 62H, inclusive, has been complied with for the proposed increase.	Section 1 Section 3
That all reasonable efforts have been made to identify and develop all viable water supply sources in the receiving area of the proposed water supply interbasin transfer	Section 3
That all practical measures to conserve water have been taken in the receiving area	Section 3
That a comprehensive forestry management program which balances water yields, wildlife habitat and natural beauty on watershed lands of surface water supply sources, presently serving the receiving area and under control of the proponent has been implemented.	Section 3
That reasonable instream flow in the river from which the water is transferred is maintained.	Section 34
In the case of groundwater withdrawals, the results of pumping tests will be used to indicate the impact of the proposed withdrawal on static water levels, the cone of depression, the potential impacts on adjacent wells and lake and pond levels, and the potential to affect instream values as listed in 313 CMR 4.09(2)(g).	N/A
The Commission shall consider the impacts of all past, authorized or proposed transfers on streamflows, groundwater, lakes, ponds, reservoirs or other impoundments in the Donor Basin and relevant subbasins.	Noted
Mitigation	
Describe any proposed flow augmentation provisions, flow protection thresholds, or other measures proposed to protect instream flow.	Section 3
EO 385	
Provide information to demonstrate that this proposal seeks to minimize unnecessary loss or depletion of environmental quality and resources.	Section 3

7

SECTION 7

SECTION 61 FINDINGS

7.1 INTRODUCTION

M.G.L. c. 30, s. 61 requires that "[a]ll authorities of the commonwealth ... review, evaluate, and determine the impact on the natural environment of all works, projects or activities conducted by them and ... use all practicable means and measures to minimize [their] damage to the environment. ... Any determination made by an agency of the commonwealth shall include a finding describing the environmental impact, if any, of the project and a finding that all feasible measures have been taken to avoid or minimize said impact."

Each state agency that issues a permit for the North Reading New Water and Wastewater Solutions project shall issue a Section 61 Finding in connection with permit issuance, identifying mitigation that is relied upon to satisfy the Section 61 requirement. A proposed Section 61 Finding is provided for the North Reading New Water and Wastewater Solutions project, and a table of mitigation measures related to each Agency is included as part of each Section 61 Finding. All mitigation will be the responsibility of the Proponent.

7.2 ANTICIPATED STATE PERMITS AND APPROVALS

Table 7-1 identifies the Agencies that are expected to take Agency Action on the proposed project and, therefore, issue Section 61 Findings. It also identifies the Agency Actions anticipated to be required.

TABLE 7-1
AGENCY ACTIONS REQUIRED

Agency	Approval
North Reading Conservation Commission	Order of Conditions
EPA	NPDES Construction General Permit
MassDEP	Chemical Addition Retrofit of Water Systems Serving More than 3,300 People, Distribution System Modifications for System that Serves More Than 3,300 People
MassDOT	Application for Permit to Access State Highway
WRC	Inter Basin Transfer Act Application

7.3 ________________________ [AGENCY] – PROPOSED SECTION 61 FINDINGS

Project Name:	New Water and Wastewater Solutions
Project Location:	North Reading, Massachusetts
Proponent:	Mark Clark, Water Superintendent North Reading Department of Public Works 235 North Street, North Reading, MA 01864
EEA Number:	14975
Date Noticed in Monitor:	_________________ [Date]

The potential environmental impacts of the Project have been characterized and quantified in the ENF dated November 2012, the DEIR dated February 2016, and FEIR dated February 2020, which are incorporated by reference into this Section 61 Finding. Throughout the planning and environmental review process, the Proponent has been working to develop measures to mitigate significant impacts of the Project. With the mitigation proposed and carried out in cooperation with state agencies, the ____________________________ [Agency] finds that there are no significant unmitigated impacts.

The Proponent recognizes that the identification of effective mitigation, and implementation of that mitigation throughout the life of the Project, is central to its responsibilities under the

Massachusetts Environmental Policy Act (MEPA). The Proponent has accordingly prepared the annexed Table of Mitigation that specifies, for each potential state permit category, the mitigation that the Proponent will provide.

Now, therefore, ______________________________ [Agency], having reviewed the MEPA filings for the Project, including the mitigation measures itemized on Table 7-1, finds pursuant to M.G.L. C. 30, S. 61 that with the implementation of the aforesaid measures, all practicable and feasible means and measures will have been taken to avoid or minimize potential damage from the Project to the environment.

____
[Agency]

____
By:

____
[Date]

Table 7-2 describes the measures to be implemented to mitigate the effects of the Project related to the required ______________________________ [Agency] permits and the schedule for implementation.

TABLE 7-2
SUMMARY OF IMPACTS AND MITIGATION MEASURES

Subject Matter	Impact	Mitigation Measure and Cost	Schedule
Construction	Temporary impact to previously disturbed areas: Main Street and Central Street sites. Permanent impact to proposed chemical feed station site.	Overall Project Mitigation Commitments: • If ledge is encountered, the Contractor will conduct pre-blast surveys of all structures located within 400 feet of the site and follow all regulations and laws regarding the handling and use of explosives. • Refueling and storage of all construction equipment will be restricted to locations outside resource areas. Absorbent pads, shovels, and oil dry readily available during refueling. • Generators on site will be required to have sound attenuating exhaust systems. • Any water encountered will be pumped to a temporary sediment trap or basin or catch basin with sediment sock and silt sack. Cost included in overall project cost.	During Construction. During Construction. During Construction. During Construction.
Dust Control	Temporary impact to areas adjacent to construction activities.	Contractor will be required to wet impacted areas to reduce dust. Contractor will complete end-of-day street sweeping. Cost included in overall project cost.	During Construction. During Construction.
Greenhouse Gas Emissions	Overall reduction of GHG emission of approximately 9% per year.	Overall Project Mitigation Commitments: • Remove North Reading's wells and Water Treatment Plants from operation. Remove well pumps, pressure filtration system and ancillary equipment. • Contractors will be held to a no-idle restriction. • Proposed chemical feed station will use LED lighting.	Following Construction During Construction Following Construction Following Construction

Subject Matter	Impact	Mitigation Measure and Cost	Schedule
		• Proposed chemical feed station will not be a manned facility, reducing vehicle trips. Cost included in overall project cost.	
Flood Plain	Temporary impact to previously developed areas within the 100-year and 500-year flood plains associated with Central Street site.	Erosion control measures (silt sack, silt fence, hay bales) will be implemented in areas located within these water resource protection areas. The Contractor will abide by the terms and conditions in the Order of Conditions as determined by the North Reading Conservation Commission. Cost included in overall project cost.	During Construction.
Stormwater	Temporary impact to previously disturbed areas: Main Street and Central Street sites. Permanent impact to proposed chemical feed station site.	Existing Main Street drainage system and existing grade will remain. Drawings and specifications will include regulatory standards that the contractor must comply with such as the NPDES and Storm Water Pollution Prevention Plans (SWPPP). Cost included in overall project cost.	During Construction.
Traffic	Temporary Impact	Design plans will be developed in accordance with the Manual on Uniform Traffic Control Devices (MUTCD) and as required by the MassDOT permits The Contractor will abide by the terms and conditions outlined in the Highway Access Permits as determined by MassDOT. Cost included in overall project cost.	Prior to Construction. During Construction.
Water Resource Protection Areas	Temporary impact to previously developed areas within Town of North Reading Article 97 conservation land and MassDEP Zone II Wellhead Protection Area.	Erosion control measures (silt sack, silt fence, hay bales) will be implemented in areas located within these water resource protection areas. The Contractor will abide by the terms and conditions in the Order of Conditions as determined by the North Reading Conservation Commission. Cost included in overall project cost.	During Construction.
Wetlands	Temporary impact to previously developed areas within the 100-foot wetland buffer zones.	Erosion control measures (silt sack, silt fence, hay bales) will be implemented in areas located within these water resource protection areas. The Contractor will abide by the terms and conditions in the Order of Conditions as determined by the North Reading Conservation Commission. Cost included in overall project cost.	During Construction.

A

WRIGHT-PIERCE
Engineering a Better Environment

APPENDIX A

Intermunicipal Agreement

INTERMUNICIPAL AGREEMENT

BETWEEN

THE TOWN OF ANDOVER, MASSACHUSETTS

AND

THE TOWN OF NORTH READING, MASSACHUSETTS

FOR

POTABLE WATER SERVICE

2018-2117

THIS AGREEMENT entered into as of the 4th Day of June, 2018, by and between the Town of Andover, a municipal corporation within the County of Essex, Commonwealth of Massachusetts, acting through its Board of Selectmen, and the Town of North Reading, a municipal corporation within the County of Middlesex, Commonwealth of Massachusetts, acting through its Board of Selectmen.

WITNESSETH

WHEREAS, the Town of Andover has the authority to sell and supply potable water to the Town of North Reading under this intermunicipal agreement which provides the terms and conditions of sale, furnishing of water, payment for sale;

WHEREAS, the Town of North Reading has the authority to purchase said water under the terms and conditions of this agreement;

WHEREAS, the Towns deem it to be in the public interest for the Town of Andover to supply and sell, and for the Town of North Reading to receive and pay for potable water to supply its citizens; and

WHEREAS, both Towns have been authorized to enter into this agreement by vote of their respective Boards of Selectmen as evidenced by their signatures to the Agreement.

NOW THEREFORE in consideration of the mutual promises and covenants herein set forth, and in order to secure the services described below, the parties hereto, each binding itself, its respective representatives, successors, and assigns, to mutually agree as follows:

1. DEFINITIONS AND INTERPRETATIONS

1.1 Definitions

For all purposes of this Agreement, and any amendments or other changes thereto, the terms shall have the meanings set forth below.

A. **"Andover"** means the Town of Andover, in Essex County, Massachusetts, or its duly authorized agent.

B. "**DEP**" means the Department of Environmental Protection of the Commonwealth of Massachusetts.

C. **"Force Majeure Events"** means a consequence of any Acts of God, act of public enemy, laws, blockades, insurrections, riots, epidemics, landslides, lighting, earthquakes, fires, storms, floods, washouts, arrests and restraints of rulers and people, civil disturbances, labor strikes, power failures, explosions, breakage or accident to machinery, lines or pipe, failure of water supply, regulatory requirement, restriction or limitation, the binding order of any court or governmental authority which has been resisted in good faith by all reasonable legal means, and any other cause, whether of the kind herein enumerated or otherwise, not within the reasonable control of such party, and which act, omission or circumstance such party is unable to prevent or overcome by the exercise of due diligence.

D. "Maximum Daily Withdrawal" means the highest total volume of water measured in gallons or cubic feet at a metering station over any consecutive twenty-four (24) hour period during a calendar year.

E. "North Reading" means the Town of North Reading, in Middlesex County, Massachusetts, or its duly authorized agent.

F. "Tier 1 Water Rate" means the lowest per unit water rate charged by Andover to any water customer. As of the date of this Agreement, Andover uses a tiered rate structure, also known as an Increasing Block rate structure. Currently (in FY 2018), the lowest Tier 1 Water Rate equals $2.97 per hundred cubic feet (HCF). In the event Andover moves to a flat rate charge for water use, then the Tier 1 Water Rate shall be defined as equal to the flat rate charge for water use.

G. "Waterworks" means facilities for collection, storage, supply, distribution, treatment, pumping, metering, and transmission of water.

1.2 **Meanings and Construction**

This agreement, except where the context clearly indicates otherwise, shall be construed as follows:

A. Definitions include both singular and plural;

B. Pronouns include both singular and plural and include both genders.

1.3 Resolutions of Disputes

Any dispute arising under this agreement shall first be attempted to be resolved in a timely and mutually acceptable manner by the two parties. If the parties are unable to resolve the dispute, civil action may be taken by either party through a court of proper jurisdiction.

1.4 Governing Law

This Agreement shall be governed by the laws of the Commonwealth of Massachusetts.

2. GENERAL PROVISIONS

2.1 Obligations of the Parties

Both North Reading and Andover understand and agree to the following obligations, limitations, and commitments, in consideration of Andover's agreement to permit connection by North Reading to Andover's waterworks to supply North Reading with drinking water in exchange for payment and other consideration as specified in this agreement.

A. Consumption Quantities. North Reading's consumption of Andover's water shall be governed as follows:

1. Andover shall furnish (i) until June 30, 2019, subject to permitting, up to a maximum daily withdrawal of 2.4 million gallons; and (ii) thereafter, until June 30, 2025, subject to permitting and any necessary infrastructure upgrade, up to a maximum daily withdrawal of 2.6 million gallons; and (iii) thereafter, subject to permitting and any necessary infrastructure upgrade, up to a maximum daily withdrawal of 3.0 million gallons to North Reading through interconnections identified in section 2.1(E) of this Agreement. The amount of water North Reading draws on a daily basis up to the amounts described herein shall be within its sole discretion, except in the case of a Force Majeure as described in section 2.2 of this Agreement. Andover's ability and obligation to supply more than a daily maximum withdrawal of 2.6 million gallons is dependent upon the expansion of Andover's Water Management Act permit and approval of an amendment to North Reading's Interbasin Transfer Act permit.

2. North Reading shall retain all responsibility for (i) operation, maintenance, and use of its waterworks, (ii) compliance with applicable law, (iii) compliance with its obligations as stated in this Agreement, and (iv) distribution of water to its residents.

3. Nothing in this Agreement shall in any manner obligate or place any responsibility on Andover with regard to (i) the operation, maintenance or use of any of North Reading's equipment or property related in any way to potable water service, including but not limited to North Reading's waterworks, (ii) the distribution or delivery of water within the geographic boundaries of the Town of North Reading, and (iii) communications, billing, or any related activities involving North Reading water customers and residents relating to the provision of potable water.

B. Control of System Leaks and Wasteful Use. North Reading shall operate and maintain its waterworks connecting to that of Andover in accordance with customary practices and within the guidelines set forth below. North Reading shall take all reasonable measures to minimize the wasteful use of water within its service area. Should Andover impose restrictions on water use on its customers (e.g., sprinkling bans) through implementation of its Drought Management Plan or other demand management policies, bylaws, or rules and regulations in effect in the Town of Andover, North Reading shall conform its customers to such and impose the same restrictions on customers within its service area, including but not limited to any customers that qualify as one of the largest users of the two systems. The imposition of said restrictions shall be within the sole and exclusive discretion of Andover. Nothing in this

Agreement shall prevent North Reading from imposing its own restrictions above and beyond those imposed by Andover. The Town of North Reading as a whole shall not be considered a single large user for purposes of Andover's Drought Management Plan or any other demand management policies, by laws, or rules and regulations in effect in the Town of Andover. Andover shall not be liable for damages or otherwise in the implementation of Andover's Drought Management Plan or other demand management policies under the foregoing provisions.

C. Conformance to Law. Both North Reading and Andover shall abide by all applicable laws, rules, regulations, and bylaws of the United States, the Town of Andover, the Commonwealth of Massachusetts, and any political subdivision thereof having jurisdiction over the activities and obligations under this intermunicipal agreement insofar as such compliance is not lawfully superseded by the terms of this agreement.

D. Water Quality. Andover will guarantee that the quality of water supplied to North Reading will meet all State and Federal regulations at the point of delivery to North Reading. North Reading retains responsibility for water quality compliance beyond the point of delivery as described in Section 2.1(E). North Reading has all responsibility for water delivery and quality once the water crosses the town line between Andover and North Reading. The parties will comply with all applicable State and Federal rules and regulations relating to water quality, including but not limited to, rules and regulations of the Environmental Protection Agency and any other agency which regulates water quality within their respective borders.

E. Contract Service Area. Andover shall deliver water to North Reading at the following points of delivery:

1. The Andover/North Reading town line at Gould Road and Central Street.
2. The Andover/North Reading town line at Route 28; and/or.
3. Such other locations as the parties may agree to during the term of this Agreement.

F. Measurement of Flows. The measurement of water delivered to North Reading shall be undertaken by North Reading and Andover. Such flow measurements shall be made by approved metering devices owned by North Reading at locations determined by North Reading and approved by Andover. Meter readings shall be taken and reported to and confirmed by Andover on a monthly basis, and Andover shall have the right to have an agent present to read any meter at such time. All such metering devices shall be inspected and calibrated at least annually by North Reading. A copy of the inspection and calibration reports shall be filed at Andover's Water Department. Andover reserves the right to install metering at locations in Andover determined by Andover.

In the case of missing or inaccurate flow records, due to faulty metering device operation or other circumstances, an estimate of flow shall be made by the parties based on past records of a comparable period. The estimates shall be used by Andover to establish North Reading's payments to Andover for the period of missing or inaccurate data.

G. Construction of Connections. The parties shall work cooperatively to permit, design and construct any infrastructure improvements necessary to effectuate the purposes of this Agreement, with each party agreeing to bear the cost of the portion of such improvements that lie within its geographic borders, unless another method of apportionment is agreed to in writing by the parties. Any such costs shall be subject to appropriation. Except for capital costs assessed upon North Reading as part of the Tier 1 Rate, neither party has any obligation to pay any costs, including but not limited to design costs, for facilities in the other Town

H. Records, Accounts and Audits. Andover shall keep books of records and accounts, in which complete and accurate entries shall be made of all its transactions with North Reading.

I. Ownership of Connection Facilities. Each town shall own all waterworks on its side of the Town Line between Andover and North Reading.

J. Assignment of Users. North Reading's users of its waterworks shall be served by water facilities owned, operated and maintained by North Reading, unless there is written amendment to this Agreement.

K. Responsibility for System Operation and Maintenance. Andover assumes no responsibility for the operation and maintenance of waterworks constructed and owned by North Reading. Andover's waterworks shall be operated and maintained by Andover, and North Reading assumes no responsibility for the operation and maintenance of the same. Andover shall not be responsible or liable in any way for the Acts of God, or any other act or acts beyond its control which may, in any way, cause an interruption or discontinuance of the service provided for in this Agreement as described in Section 2.2. However, under such circumstances, Andover shall use its best efforts to restore normal service as soon as possible.

L. Andover as Sole Provider.

1. North Reading agrees that currently and, upon receipt of all required permits and approvals and construction of infrastructure upgrades providing for its right to take up to 3.0 million gallons per day, and compliance with all other terms of this Agreement, Andover shall become North Reading's sole third-party public water supplier; provided, however that Andover shall not be North Reading's sole water supplier if either or both parties are unable to secure any permits, approvals and/or appropriations needed to allow Andover to supply North Reading with the maximum daily withdrawal of 3.0 million gallons. Nothing herein shall be deemed to prevent the Town of North Reading from supplying its inhabitants with water from its own wells within the boundaries of the Town of North Reading.

2. Notwithstanding the previous section, North Reading shall be permitted to maintain one or more interconnections with other public water suppliers and/or to maintain its own water sources to obtain water in the event of a force majeure event or other circumstance in which Andover is unable or unwilling to supply North Reading with the maximum daily withdrawal amounts specified in Section 2.1(A)(1) of this Agreement. If North Reading obtains water from an alternate source including amounts in excess of 3.0 million gallons per day, then, to the extent permitted by law, North Reading hereby agrees to release, defend, indemnify and hold harmless Andover from any and all claims

and damages relating to or arising from North Reading's use of an alternate source of water, including but not limited to claims and damages relating to the difference in the chemical makeup between water supplied to North Reading by Andover and water supplied to North Reading by an alternate source.

3. The parties acknowledge and agree that North Reading's obligation to use Andover as its sole water supply source is limited to amounts up to the maximum daily withdrawal rate of 3.0 million gallons. If North Reading requires water in excess of 3.0 million gallons, it shall be permitted to obtain such amounts from other public water suppliers and/or its own wells, provided, however, that North Reading shall give Andover the option of meeting its demand prior to using such other sources.

4. If North Reading requires a supply of water in excess of 3.0 million gallons, it shall give Andover written notice specifying the number of gallons needed. If the parties do not reach an agreement for Andover to meet North Reading's demand within twelve (12) months of Andover's receipt of said notice, or if the parties are unable to obtain necessary permits or approvals or infrastructure improvements needed for Andover to meet North Reading's demand within twenty-four (24) months of Andover's receipt of said notice, North Reading is permitted to obtain such amounts from third party suppliers and/or its own wells. Any notice provided pursuant to this paragraph shall expire after six (6) years and the requirements of this paragraph shall be met again before North Reading enters into any agreement with a third-party which has an effective date more than six years after the date of North Reading's notice to Andover.

5. Any increase in North Reading's maximum daily withdrawal from Andover above 3.0 million gallons shall be subject to approval by votes of both Towns' boards of selectmen and shall be subject to any required permits and infrastructure improvements Notwithstanding the foregoing, but subject to subsection 2 of this section L, Andover shall remain North Reading's sole water supplier for 3.0 million gallons of water per day.

2.2 Impairment of Supply

A. Responsibility. The furnishing of water to North Reading under this Agreement shall not be impaired except in the case of a Force Majeure event which impacts Andover's ability to supply water to North Reading. Andover shall not be compelled to furnish the customary amounts of water to North Reading on a continuous basis during such event; provided, however, that any impairment of North Reading's supply due to a Force Majeure event that also affects Andover residents shall be shared proportionally based on usage.

B. Force Majeure Events. Neither Andover nor North Reading shall be liable for damages or otherwise for failure to perform any obligation under this agreement which failure is occasioned by a Force Majeure event. Such event affecting the performance of either Andover or North Reading, however, shall not relieve such other party of liability in the event of its negligence, intentional acts, or in the event of such party's failure to use due diligence to remedy the situation and remove the cause in an adequate manner and with all reasonable dispatch. Andover shall communicate the details of such events to North Reading, including the level/amount of flow restriction, the anticipated duration, and the remediation/management actions being taken, with as much advanced notice as possible, within a reasonable time and the two parties will remain in contact with each other throughout the duration of the event.

2.3 Notices and Communications

A. Any and all notices, communications, and acknowledgements pertaining to the terms and provisions of this agreement shall be conveyed by both electronic mail and U.S. mail or other customary mode of communication to the following officials or any successor officials:

Town Manager
Town Offices
36 Bartlet Street
Andover MA 01810
manager@andoverma.gov

Town Administrator
Town Hall
235 North Street
North Reading MA 01864
townadministrator@northreadingma.gov

B. Except in the case of an emergency or unforeseen event, prior to the implementation of any significant water related actions that may impact the provision of water to North Reading, such as supply interruptions, major maintenance, and quality issues, Andover shall provide North Reading with written e-mail and verbal notice of such pending action with as much advance notice as possible. In the case of system-wide water restrictions North Reading will be notified as soon as possible in accordance with the requirements of Section 6 "Public notification of state water supply conservation" of Andover's Water Restriction By-Law or such other law or regulation as may be in effect at the time.

C. Routine matters and issues will continue to be conveyed between Andover and North Reading's respective public works/water system operational personnel via customary modes of communication.

2.4 Future Projects

A. At the time of this Agreement, North Reading holds an Interbasin Transfer Act permit authorizing it to take a maximum of 1.5 million gallons per day (MGD) from the Town of Andover. The parties agree that they will work cooperatively during the term of this Agreement to obtain all permits and approvals needed to support an increase in North Reading's authorized withdrawal to the amounts set forth in Section 2.1(A)(1) of this Agreement, and North Reading agrees that it will submit an application to increase its Interbasin Transfer Act permit within thirty (30) days of a final decision on its Final Environmental Impact Report application. The parties further agree that this Agreement will automatically terminate five (5) years after any final decision denying any permit or approval needed by either party to enable Andover to supply North Reading with a maximum daily withdrawal at a rate of 2.6 million gallons or more and any credits still due North Reading at that time shall cease.

B. Nothing in this Agreement shall be construed as prohibiting North Reading from providing water purchased from Andover to the Town of Reading or any other community or purchaser on such terms and conditions as North Reading deems appropriate. If North Reading provides water purchased from Andover to the Town of

Reading or any other community or purchaser, then, to the extent permitted by law, North Reading hereby agrees to release, defend, indemnify and hold harmless Andover from any and all claims and damages relating to or arising from North Reading providing such water to the Town of Reading or any other community or purchaser.

C. At North Reading's election, Andover will work cooperatively with North Reading to facilitate North Reading's connection through Andover's sewer network to the Greater Lawrence Sanitary District sewer treatment facility. All costs for such application and implementation shall be subject to a separate agreement between Andover and North Reading.

D. Notwithstanding the provisions of paragraphs 2.4A, B, and C set forth above, the parties acknowledge and agree that neither party has any express or implied obligation to undertake such future projects other than as set forth in 2.4A, B and C, except an obligation to act in good faith in the manner specified herein.

3. PAYMENTS FOR SERVICES

3.1 North Reading Rate

A. For the first 10 years of this Agreement, North Reading shall pay Andover for its water use at a rate of 95% of Andover's Tier 1 Water Rate, provided that the annual increase in the rate charged to North Reading shall not exceed 2.5% for this 10 year period. For purposes of this provision, the 10 year rate with the annual increase not to exceed 2.5% will commence on July 1, 2017 and end on June 30, 2027.

B. For the remainder of the term of this Agreement, North Reading shall pay Andover for its water use at a rate of 95% of Andover's Tier 1 Water Rate.

3.2 Billing Cycle

Andover shall bill North Reading on a monthly basis. Billing shall be rendered to North Reading and become due and payable to the Water Treatment Plant, 397 Lowell Street, Andover MA 01810-4416 within thirty (30) days of being rendered. The North Reading payment will be made via Electronic Funds Transfer until such time as both parties agree to another method of payment.

3.3 Delinquent Bills

If water bills remain unpaid 30 days after the same shall be due, Andover's Tax Collector shall add thereto a penalty of one (1) percent per month. If the bills continue to remain unpaid sixty (60) days after they are due, the Tax Collector shall add interest charged on the original bill from its due date at the rate of one and one half (1 ½) percent per month. If the final date for payment before the imposition of a penalty or the charging of interest should fall on a Saturday, Sunday, or holiday, such payment may be received by the Andover Tax Collector on the next business day following such Saturday, Sunday or legal holiday and the Tax Collector shall receive such payment without imposing the one (1) percent penalty or the interest charges.

3.4 Bills over Sixty (60) Days Due

If North Reading fails to pay to Andover the amount of its bills within 60 days from the billing date, Andover may, at its discretion, give North Reading written notice of such delinquency. In the event that such written notice is given, North Reading shall have 60 days from the date of said notice to make full and complete payment of the bill, penalties and accrued interest. Unless bills are disputed by North Reading, the Town of Andover may terminate the provision of water to the Town of North Reading. Termination of the provision of water to North Reading shall not relieve North Reading of its responsibility to pay Andover for its proportionate share of expenses incurred by Andover for facilities used or planned for North Reading. North Reading shall have the right to make current all such billing and expense delinquencies in full including penalty and interest and upon doing so, the termination shall cease and this Agreement shall remain in full force and effect.

3.5 Right to Dispute Bills

North Reading may challenge the calculation of any bill by serving written objection prior to the date on which payment is due. Upon resolution of the dispute, an appropriate adjustment, if any will be made. If North Reading challenges its bill, it shall pay to Andover the portion of the bill that is undisputed or 67.5%, whichever is greater and the remaining portion shall be deposited into an interest bearing escrow account with an escrow agent agreed upon by Andover and North Reading until such time as the dispute is resolved. For purposes of determining percentages payable in the event of a dispute, the amount of the bill shall be the amount due after deducting any adjustments made pursuant to Section 3.6 of this Agreement. Funds held in escrow, including any interest added thereto, shall be disbursed by agreement of the parties or court order. Until such time as the dispute is resolved, North Reading shall not be subject to termination of service or any other penalties that apply to late payments.

3.6 Adjustments

A. Andover will reimburse North Reading's costs already incurred to join the Massachusetts Water Resources Authority ("MWRA"), up to $953,000, which costs will be reimbursed by Andover through credits to North Reading's water invoices, beginning on July 1, 2018 in the amount of $95,300 annually. Such credits shall be applied on a monthly basis in the amount of $7,941.66 per month, until the total amount of credits equals $953,000.

B. Andover agrees to set the effective rate of 95% of Andover Tier I Water Rate retroactively to July 1, 2017. For water used and paid for by North Reading during the fiscal year 2018, Andover will provide a refund of the excess amounts paid by North Reading based upon the difference between the amount paid at the rate established by the prior agreement and 95% of the Andover Tier I Water Rate at the time this Agreement is executed.

4. MISCELLANEOUS PROVISIONS

4.1 Status of Former Agreements

Except as provided in section 4.8 of this Agreement, and not including the Interim Period Agreement signed contemporaneously herewith, this Agreement supersedes all prior agreements for Andover to supply water to North Reading and it constitutes the entire contract between Andover and North Reading, provided, however, that Andover retains full rights and authority to enforce the provisions of any proceeding or currently existing agreement as they pertain to any outstanding indebtedness to Andover.

4.2 Incurring of Debt

Nothing in this Agreement shall be construed as to prevent either party thereto from incurring any debt deemed necessary to ensure the sufficiency of funds required to construct, maintain and operate their respective waterworks.

4.3 Severability

If any clause or provision of this Agreement or application thereof shall be held unlawful or invalid, no other clause or provision of this Agreement or its application shall be affected, and this Agreement shall be construed and enforced as if such unlawful or invalid clause or provision has not been contained herein.

4.4. Status of Legal Representatives

Each one of the benefits and burdens of this Agreement shall be binding upon the respective legal representatives, successors, and assigns of the parties hereto.

4.5 Amendment

This agreement may be amended from time to time by mutual consent of the parties and in accordance with the provisions of G.L. c. 40, sections 4 and 4A, or any other applicable law. Any such amendment to this agreement shall be executed and authorized with the same formality as this agreement.

Andover and North Reading shall meet on a regular and on-going basis and no less than once per Fiscal Year to review their performance under this Agreement and to discuss any issues that may arise during the Term. Andover and North Reading further agree that they will endeavor in good faith to negotiate any amendments that may be necessary or desirable to reflect any changes in circumstance or other matters arising during the Term of this Agreement.

4.6 Assignment

No assignment by North Reading of its rights or duties under this Agreement shall be binding on Andover, unless Andover consents to such an assignment in writing with the same formality as employed in the execution of this Agreement.

4.7 Waiver

Failure of either party hereto to exercise any right hereunder shall not be deemed a waiver of such party to exercise at some future time said right or rights or another right it may have hereunder.

4.8 Effective Date and Duration

This Agreement shall be in full force and effect from the date first written above, but only for such terms as authorized by Massachusetts law, and shall be binding on North Reading and Andover for the maximum period of time authorized by Massachusetts law, unless sooner terminated.

Notwithstanding the preceding sentence, the parties acknowledge that they have petitioned the General Court for legislation to authorize an agreement for the supply of water for a period of up to ninety-nine (99) years, in the form attached hereto as "Exhibit A". If said legislation is not enacted and made effective by approval of the Governor on or before August 15, 2018, this Agreement shall automatically terminate on that date. If said legislation is enacted and made effective by approval of the Governor on or before August 15, 2018, but it is not in the same form as Exhibit A, this Agreement shall automatically terminate seven (7) days after the effective date of the legislation.

If said Legislation is enacted in the same form as Exhibit A and made effective by approval of the Governor on or before August 15, 2018, the Board of Selectmen for each Town shall sign a ratification of this Agreement within fourteen (14) days thereof and this Agreement shall remain in effect for a period of ninety-nine years from the date of said ratification. Said ratification shall be authorized by each Town's Board of Selectmen simultaneously with their approval of this Agreement and this Agreement shall terminate if it is not ratified by both Boards of Selectmen within said fourteen (14) days.

The parties may agree, in writing, to extend the time for passage of the special legislation and/or ratification. If this agreement is terminated as a result of the failure of said legislation as set forth above or the failure of either party to execute a ratification thereafter, this Agreement shall terminate and shall not be considered an agreement for twenty-five (25) years or less and Andover shall continue to supply water to North Reading in accordance with the parties' June 26, 2015 Agreement, as amended by the First Amendment to Intermunicipal Agreement dated October 2, 2017.

Beginning in the Fiscal Year commencing on July 1, 2108, the parties shall meet on a regular and on-going basis to discuss a successor to this Agreement. The parties further agree that they will endeavor in good faith to negotiate a successor agreement to the extent permitted by law at the time.

4.9 Termination

This Agreement may be terminated upon a duly executed mutual agreement of both parties, in writing, executed and authorized with the same formality as this Agreement.

IN WITNESS WHEREOF, the Town of Andover, acting through its Board of Selectmen, and the Town of North Reading, acting through its Board of Selectmen have executed this agreement as of the day and year first above written.

Town of North Reading

_______________ Michael A. Prisco, Chairman

_______________ Kathryn M. Manupelli, Vice-Chairman

_______________ Stephen J. O'Leary, Clerk

_______________ Robert J. Mauceri

_______________ Andrew J. Schultz

Dated:_______________

Approved as to Form by:

_______________ Gregg J. Corbo, Town Counsel

Town of Andover

_______________ Alex J. Vispoli, Chair

_______________ Laura M. Gregory, Vice-Chair

_______________ Paul J. Salafia

_______________ Ann W. Gilbert

Andover/North Reading Water Supply Agreement

______________________________ Christian C. Huntress

Dated:______________

Approved as to Form by:

______________________________Thomas J. Urbelis, Town Counsel

Pursuant to Chapter 109 of the Acts of 2018, the North Reading Board of Selectmen, being duly authorized by a vote of the North Reading Board of Selectmen on 6/14/18 and the Andover Board of Selectmen, being duly authorized by a vote of the Andover Board of Selectmen on 6/18/18, hereby endorse and ratify this Agreement between North Reading and Andover

Town of North Reading

______________________________ Michael A. Prisco, Chairman

______________________________ Kathryn M. Manupelli, Vice-Chairman

______________________________ Stephen J. O'Leary, Clerk

______________________________ Robert J. Mauceri

______________________________ Andrew J. Schultz

Dated: 6/18/18

Town of Andover

______________________________ Alex J. Vispoli, Chair

______________________________ Laura M. Gregory, Vice-Chair

______________________________ Paul J. Salafia

______________________________ Ann W. Gilbert

______________________________ Christian C. Huntress

Dated: 6/18/18

EXHIBIT A

AN ACT AUTHORIZING THE TOWNS OF ANDOVER AND NORTH READING TO ENTER INTO AN AGREEMENT FOR THE SUPPLY OF POTABLE WATER.

Be it enacted by the Senate and House of Representatives in General Court assembled, and by the authority of the same, as follows:

SECTION 1. The towns of Andover and North Reading, acting through their boards of selectmen, may enter into an agreement for the supply of potable water from the town of Andover to the town of North Reading subject to such terms and conditions as the boards of selectmen agree upon.

SECTION 2. Notwithstanding section 4A of chapter 40 of the General Laws or any other general or special law to the contrary, any agreement entered into pursuant to this act may be for a term not to exceed 99 years, including any extension or renewal terms. An agreement entered into pursuant to this act shall be subject to all other applicable laws.

SECTION 3. This act shall take effect upon its passage.

H 4552

Chapter 109
of the Acts of 2018

THE COMMONWEALTH OF MASSACHUSETTS

In the One Hundred and Ninetieth General Court

AN ACT AUTHORIZING THE TOWNS OF ANDOVER AND NORTH READING TO ENTER INTO AN AGREEMENT FOR THE SUPPLY OF POTABLE WATER.

Be it enacted by the Senate and House of Representatives in General Court assembled, and by the authority of the same, as follows:

SECTION 1. The towns of Andover and North Reading, acting through their boards of selectmen, may enter into an agreement for the supply of potable water from the town of Andover to the town of North Reading subject to any terms and conditions agreed upon by those boards.

SECTION 2. Notwithstanding section 4A of chapter 40 of the General Laws or any other general or special law to the contrary, any agreement entered into pursuant to this act may be for a term not to exceed 99 years, including any extension or renewal terms. An agreement entered into pursuant to this act shall be subject to all other applicable laws.

SECTION 3. This act shall take effect upon its passage.

House of Representatives, June 6 , 2018.

Passed to be enacted, Robert A. DeLeo, Speaker.

In Senate, June 7 , 2018.

Passed to be enacted, Harriette L. Chandler , President.

June 13, 2018.

Approved,

at 2 o'clock and 51 minutes, P . M.

Charles D. Baker

Governor.

MINUTES OF BOARD OF SELECTMEN MEETING
MONDAY, JUNE 4, 2018

Chairman Prisco called the meeting to order at 5:03 p.m. in Room 14 at the Town Hall in the presence of members Mr. Schultz, Mr. Mauceri, Mr. O'Leary, and Town Administrator, Michael Gilleberto. Mrs. Manupelli was not present at the start of the meeting.

CALL TO ORDER OPEN SESSION
Chairman Prisco called to order the open session at 5:03 p.m.

The members recited the Pledge of Allegiance.

The Chairman States: "In accordance with the Open Meeting Law, the Board states for the record that this meeting is being recorded by NORCAM and may be recorded by other local media."

SIGN BANS
Town Treasurer, Maryann Mackay was in attendance.

MR. CHAIRMAN, I MOVE THAT THE BOARD TAKE THE FOLLOWING ACTION:

Voted: to approve the sale of the $8,118,932 3.00 percent General Obligation Bond Anticipation Notes (the "Notes") of the Town dated June 14, 2018, and payable June 14, 2019, to Jefferies LLC at par and accrued interest, if any, plus a premium of $91,664.

Further Voted: that in connection with the marketing and sale of the Notes, the preparation and distribution of a Notice of Sale and Preliminary Official Statement dated May 22, 2018, and a final Official Statement dated May 29, 2018, each in such form as may be approved by the Town Treasurer, be and hereby are ratified, confirmed, approved and adopted.

Further Voted: that the Town Treasurer and the Board of Selectmen be, and hereby are, authorized to execute and deliver a significant events disclosure undertaking in compliance with SEC Rule 15c2-12 in such form as may be approved by bond counsel to the Town, which undertaking shall be incorporated by reference in the Notes for the benefit of the holders of the Notes from time to time.

Further Voted: that we authorize and direct the Treasurer to establish post issuance federal tax compliance procedures in such form as the Treasurer and bond counsel deem sufficient, or if such procedures are currently in place, to review and update said procedures, in order to monitor and maintain the tax-exempt status of the Notes.

Further Voted: that each member of the Board of Selectmen, the Town Clerk and the Town Treasurer be and hereby are, authorized to take any and all such actions, and execute and deliver such certificates, receipts or other documents as may be determined by them, or any of them, to be necessary or convenient to carry into effect the provisions of the foregoing votes.

MOTION BY: MR. O'LEARY
SECONDED BY: MR. MAUCERI
VOTED: 4-0 (UNANIMOUS) (MRS. MANUPELLI ABSENT)

5:08 – Mrs. Manupelli Arrives

MWRA / ANDOVER WATER / WASTEWATER UPDATE
VOTE TO APPROVE NEXT STEPS
No discussion.

INTERMUNICIPAL AGREEMENT FOR POTABLE WATER WITH THE TOWN OF ANDOVER – VOTE TO APPROVE AND SIGN AGREEMENT
Mr. Gilleberto stated that the final version of the IMA between North Reading and Andover for potable water has been agreed upon by Andover and North Reading representatives. Mr. Schultz stated he does not think it is a perfect agreement, but he is trusting Andover will work in good faith regarding sewer and hopes everything is carried through; he will reluctantly vote for the agreement. Mrs. Manupelli thanks all involved and stated the sewer component is the reason she reconsidered her vote to go with Andover rather than MWRA. Mr. O'Leary stated he is happy a decision is being made. Mr. Mauceri stated this major decision will impact the Town for 99 years and thanks everyone who participated in the negotiations. Mr. Gilliberto stated the next step will be the need for Town Meeting approval of a 3 Million Dollar appropriation for construction for the connection with Andover or MWRA; this appropriation will give the Town latitude to pursue either option.

Mr. Prisco requested that Mr. Gilleberto let MWRA know that a decision has been made. Mr. O'Leary would like the Town of Reading informed also.

5:27 – Recess

5:28 – Reconvene

JUNE TOWN MEETING – VOTE RECOMMENDATIONS
Northeast Metropolitan Reginal Vocational Technical School Superintendent, David DiBarri, Finance Director, Jay Picone and School Committee Member Judy Dyment were in attendance to answer questions from the Board regarding Article 37, Establish Regional School District Stabilization Fund. It was stated that this fund will only be used for capital expenditures and they do not anticipate using it often. In response to Mrs. Manupelli, most of the communities are going through the process of approving the stabilization fund and a majority vote of 8

communities is needed. Mrs. Manupelli wanted confirmation that no additional funding from the Town will be requested.

Additional Articles were discussed.

MR. CHAIRMAN, I MR. O'LEARY MOVE TO ADJOURN.

SECONDED:	MR. SCHULTZ	
VOTED:	MR.O'LEARY	AYE
	MRS. MANUPELLI	AYE
	MR. SCHULTZ	AYE
	MR. MAUCERI	AYE
	MR. PRISCO	AYE

VOTE: 5-0 (UNANAMOUS)

ADJOURN: 5:59 p.m.

DATE

STEPHEN J. O'LEARY, CLERK

BOARD OF SELECTMEN
MONDAY, JUNE 4, 2018
SELECTMEN MEETING 4:00 P.M.
SELECTMEN'S CONFERENCE ROOM TOWN OFFICES, 3rd FLOOR
AGENDA

I. Call to Order– 4:00 P.M.

II. Opening Ceremonies – 4:00 P.M.
A. Moment of Silence/Pledge of Allegiance

III. Communications/Announcements/Liaison Reports – 4:05 P.M.

IV. Citizens Petitions and Presentations – 4:10 P.M.

V. Public Hearings – 4:15 P.M.
A. National Grid (10 minutes)
This hearing is on the petition of National Grid and Verizon New England requesting permission to locate poles, wires and fixtures, including the necessary sustaining and protecting fixtures, along and across the following public way: #25879021 – 10 Brook Street – National Grid proposes a pole relocation of pole 1252 to enable easier entry and exit to parking lot at 10 Brook Street. The location is approximately 12 feet southeast of where it exists now.

VI. Regular Business of the Board – 4:25 P.M.
A. North Reading Water Agreement – (15 minutes)
Board to consider voting on the approval of an inter-municipal agreement with North Reading for potable water service.

B. Rattlesnake Road Utility Petition – (10 minutes)
Board to consider providing an easement from the Town for the purposes of a push brace for Verizon New England Pole 3842.

C. 2018/2019 Board of Selectmen/Town Manager Goals and Objectives – (10 minutes)
Board to consider voting to adopt the 2018/2019 Board of Selectmen/Town Manager Goals and Objectives.

D. Board and Committee Appointment Process – (10 minutes)
Town Manager to provide an update on the Board and Committee appointment process and the Talent Bank process.

VII. Consent Agenda – 5:10 P.M.

A. **APPOINTMENTS** – (Town Manager)

That the following appointments by the Town Manager be approved:

DEPARTMENT/ COMMITTEE	NAME	POSITION	RATE/ TERM	DOH
Community Services/Recreation Division	Christopher Dempsey *v. Jessica Downing*	Recreation Coordinator	$60,230.04	6/11/18
Police Department	Michael Connor *v. Christopher Moore*	Sergeant	$91,656.47	6/10/18
DPW/Parks and Grounds Division	Bradley Cole	Seasonal Parks and Grounds	$13/hr	5/29/18

VII. Adjournment – 5:15 P.M.

If any member of the public wishing to attend this meeting seeks special accommodations in accordance with the Americans with Disabilities Act, please contact the Town Manager's Office at 978-623-8210 or by email at manager@andoverma.gov.

H 4552

Chapter 109
of the Acts of 2018

T H E   C O M M O N W E A L T H   O F   M A S S A C H U S E T T S

In the One Hundred and Ninetieth General Court

AN ACT AUTHORIZING THE TOWNS OF ANDOVER AND NORTH READING TO ENTER INTO AN AGREEMENT FOR THE SUPPLY OF POTABLE WATER.

Be it enacted by the Senate and House of Representatives in General Court assembled, and by the authority of the same, as follows:

SECTION 1. The towns of Andover and North Reading, acting through their boards of selectmen, may enter into an agreement for the supply of potable water from the town of Andover to the town of North Reading subject to any terms and conditions agreed upon by those boards.

SECTION 2. Notwithstanding section 4A of chapter 40 of the General Laws or any other general or special law to the contrary, any agreement entered into pursuant to this act may be for a term not to exceed 99 years, including any extension or renewal terms. An agreement entered into pursuant to this act shall be subject to all other applicable laws.

SECTION 3. This act shall take effect upon its passage.

House of Representatives, June 6 , 2018.

Passed to be enacted, Patrick J. Haddad , Speaker.

In Senate, June 7 , 2018.

Passed to be enacted, Harriette L. Chandler , President.

June 13, 2018.

Approved,

at 2 o'clock and 51 minutes, P . M.

Charles D. Baker

Governor.

B

APPENDIX B

DEIR & NPC Comments

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Executive Office of Energy and Environmental Affairs
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May 13, 2016

CERTIFICATE OF THE SECRETARY OF ENERGY AND ENVIRONMENTAL AFFAIRS
ON THE
DRAFT ENVIRONMENTAL IMPACT REPORT

PROJECT NAME	: New Water and Wastewater Solutions
PROJECT MUNICIPALITY	: North Reading
PROJECT WATERSHED	: Ipswich
EEA NUMBER	: 14975
PROJECT PROPONENT	: Town of North Reading
DATE NOTICED IN MONITOR	: March 23, 2016

As Secretary of Energy and Environmental Affairs, I hereby determine that the Draft Environmental Impact Report (DEIR) submitted on this project **adequately and properly** complies with the Massachusetts Environmental Policy Act (MEPA, M.G.L. c.30, ss.61-62I) and with its implementing regulations (301 CMR 11.00). The Proponent must prepare and submit for review a Final Environmental Impact Report (FEIR) in response to the Scope provided in this Certificate.

Comments generally support the alternatives North Reading has selected to meet long-term water and wastewater needs; however, significant additional information and analysis is required in the FEIR to clarify project elements, demonstrate that the Preferred Alternative can be implemented, and to identify potential environmental impacts.

Project Description

As described in the DEIR, the Town of North Reading (the Town) proposes to join the Massachusetts Water Resources Authority (MWRA) water system and implement of an in-town municipal wastewater collection, treatment, and disposal system. Currently, the Town's water supply is provided via local groundwater wells (0.96 million gallons per day (MGD)) and purchased water from the Town of Andover (1.5 MGD). The Town of Andover water supply is located within the Merrimack River Basin, thus this purchase is subject to an existing inter-basin transfer approval (IBTA). Wastewater treatment is currently provided by on-site Title 5 septic systems and six small-scale MassDEP-permitted wastewater treatment facilities that discharge to groundwater.

If approved, the Town will become a full-time member of the MWRA water system and the Town would discontinue drinking water withdrawals within the Ipswich River Basin, and convert the existing water supply to an emergency supply. Connections to the MWRA would be made via water infrastructure within the Town of Reading. Upon approval of membership and connection to the MWRA water system, the Town would voluntarily forfeit its current water withdrawal registration (0.96 MGD) to MassDEP.

Wastewater from the new collection system will flow to an existing collection system in the Town of Andover and ultimately be conveyed to the Greater Lawrence Sanitary District (GLSD) for treatment and disposal. Approximately 2,000 properties within the highest needs areas of the Town are proposed for connection to the GLSD; remaining properties will continue wastewater collection and treatment via on-site Title 5 systems or MassDEP-permitted wastewater treatment facilities.

Project Area

The project area consists of the Town, as well as selected areas within the Towns of Andover and Reading. The Town is 13.5 square miles has a approximate population of 15,000 people. Approximately 45 percent of land in Town is dedicated to residential uses and is generally characterized as a suburban community; the majority of land is zoned for residential uses. Town water supply infrastructure includes two water treatment plants, three water storage tanks, six water supply wells, three pumping stations, 80 miles of water mains, 750 fire hydrants, and approximately 4,600 water service connections and water meters. Approximately 16 percent (2.18 square miles) of the Town is covered by impervious area and 25 percent of the Town is classified as containing "very poorly drained" soil. The Town includes several surface waters that are listed on the Commonwealth's 303(d) list of impaired water bodies, most notable of which are Martins Pond, the Ipswich River and Martins Brook. Wetlands cover approximately 34 percent of the Town's land mass and are generally comprised of wooded swamps.

The Town is located in the Ipswich River Basin. The Ipswich River watershed provides drinking water to 14 communities and suffers from low flow conditions or events mostly attributable to water withdrawals for drinking water. According to the DEIR the Ipswich River has experienced repeated low-flow or no-flow periods, with upper river segments going dry in six of the last ten years. These events have resulted in fish kills and ecological damage. The Ipswich River has been listed as one of the most endangered rivers in the United States and is considered a "stressed basin" under the hydrologic criteria established by the Water Resources Commission (WRC).

Jurisdiction and Permitting

This project is subject to MEPA review and required the preparation of a mandatory EIR because it requires State Agency Actions and exceeds several MEPA EIR review thresholds including:

- New interbasin transfer of water of 1,000,000 or more gpd or any amount determined to be significant by the Water Resources Commission (301 CMR 11.03(4)(a)(2));
- Provided that the Project is undertaken by an Agency, New water service to a municipality or water district across a municipal boundary through New or existing pipelines, unless a disruption of service emergency is declared in accordance with applicable statutes and regulations (301 CMR 11.03(4)(a)(4));
- Construction of one or more New sewer mains ten or more miles in length (301 CMR 11.03(5)(a)(3)); and
- Provided that the project is undertaken by an Agency, New sewer service to a municipality or sewer district across a municipal boundary through New or existing pipelines, unless an emergency is declared in accordance with applicable statutes and regulations (301 CMR 11.03(5)(a)(4));

The project will require several Permits from MassDEP including: a Distribution System Modification Permit (BRP WS 32) and an Abandonment of a Water Source Permit (BRP WS 36). The project must undergo the Admission of New Community to Waterworks System (OP-10) from the MWRA. The project will also require approval in accordance with the Interbasin Transfer Act (ITA) (M.G.L. c.21 ss. 8B-D; 313 CMR 4.00). The project is also subject to the MEPA Greenhouse Gas (GHG) Emissions Policy and Protocol.

The project may require an Order of Conditions from the North Reading, Reading, and/or Andover Conservation Commissions (or in the case of an appeal, a Superseding Order of Conditions from MassDEP).

It is likely that the project will require Financial Assistance from the State Revolving Fund (SRF) for subsequent planning and construction of all or portions of the project. Therefore, MEPA jurisdiction for this project is broad and extends to all aspects of the project that are likely, directly or indirectly, to cause Damage to the Environment as defined in the MEPA regulations.

Environmental Impacts and Mitigation

The project includes the construction of new and/or rehabilitated water mains, sewer mains, and pump stations to collect and convey an estimated 503,000 gallons per day (gpd) of wastewater and 2.58 MGD of potable water. While the majority of these improvements are proposed within existing rights-of-way (ROW) there will likely be impacts to wetland resource areas, historical or archaeological resources, and/or contaminated soils or groundwater. The project is expected to provide a net benefit to water quality within the watershed through the elimination of septic systems near sensitive water bodies and reducing water withdrawals. Upon completion of the wastewater collection system the net change of flow into the Ipswich River Basin is estimated to increase by 0.21 MGD.

Proposed mitigation measures include the implementation of a robust water conservation plan to reduce Town-wide unaccounted for water (UAW) to 10% or less and reduce residential water use below 65 gallons per capita per day (gpcd) consistent with MWRA guidelines. New pump stations will be located outside of wetland resource areas and alternative trenching methods (such as direction drilling) will be used to avoid wetland impacts during construction or rehabilitation of new water and sewer mains. Work will be confined to paved areas within the ROW as feasible and appropriate erosion and sedimentation control best management practices (BMPs) will be used during construction. The Town will continue to work with both local historical commissions and the Massachusetts Historical Commission (MHC) to address potential impacts to historic or archaeological resources. Work in areas with potentially contaminated soils or groundwater will be conducted under the supervision of a Licensed Site Professional (LSP).

Review of the DEIR

Project Description and Permitting

The DEIR included a description of the proposed project, including a general description of the existing environment in accordance with 301 CMR 11.07(6)(g). Minimal information was provided on a site-specific basis due to the expansive project area. The DEIR generally indentified the relationship of the Preferred Alternative project to resource areas including water bodies, wetlands (as identified by the National Wetlands Inventory), *Estimated* and *Priority Habitat* per the Natural Heritage and Endangered Species Program (NHESP), open space, and properties or districts identified within the MHC *Inventory of Historic and Archaeological Assets of the Commonwealth.* The DEIR indicated that most infrastructure work will be constructed within rights-of-way (ROW) and are likely to be temporary or minor in nature. No pump stations are proposed within wetland resource areas.

The DEIR described applicable statutory and regulatory standards and requirements and listed potentially required State permits or State approvals and local permits associated with completion of the projects. The DEIR addressed consistency with the MWRA Policy *OP#10: Admission of New Community to MWRA Water System.*

The DEIR presented the water and wastewater system goals to guide the assessment of water and wastewater needs for the Town and to inform identification and analysis of project alternatives. Water system goals include: provide long-term, sustainable option(s) for water supply; reduce water system complexity; provide services to maintain existing and future commercial/industrial base; Manage capital and operations and maintenance (O&M) costs; and mitigate stress to the Ipswich River. Wastewater system goals include: improve surface and ground water quality; provide long-term sustainable option(s) for wastewater treatment and disposal; provide services to maintain existing and future commercial/industrial base; and address water quality impairments. The MWRA comment letter indicated that the Town's water supply proposal is consistent with the MWRA's goal to advance reasonable water system expansion.

Water Supply

The DEIR discussed the history of water withdrawal registration and permitting under the Water Management Act (WMA). The Town was historically permitted to withdraw greater amounts of water from the Ipswich River Basin; however, currently, the Town may only withdraw its registered volume of 0.96 MGD. The Town's four permitted groundwater sources include the Lakeside Boulevard, Route 125, Central Street, and Railroad Bed wells. The DEIR included historical water demand data between

2002 and 2014 which identifies withdrawals from Town sources and volumes purchased from Andover. The Town has historically purchased more water than it produces.

The Lakeside Boulevard wellfield consists of three individual wells located on Lakeside Boulevard in the northwest section of Town and the Route 125 wellfield consists of one well located approximately ½-mile away on the Town/Andover town line. Two of the Lakeside Boulevard wells are online; the remaining well is inactive due to poor source water quality. Water withdrawn from these wells are treated at a water treatment plan (WTP) located adjacent to the Lakeside Boulevard wellfield. The WTP was constructed in 1980 to remove iron and manganese from source water. While the WTP filter system is rated for a peak flow of 0.9 MGD, the DEIR indicated that the WTP can only produce 0.3 MGD before finished water quality becomes compromised.

The Railroad Bed wellfield consists of three individual wells (one primary well and two satellite wells) located on Martins Brook off Salem Street near the Wilmington town line. These wells were intended to be a temporary source upon contamination of the Stickney wellfield, but have remained in service since 1981. The primary well motor fails consistently every three years. Water withdrawn from the Railroad Bed wellfield is treated for iron and manganese at the West Village WTP. Similar to the Lakeside WTP, the West Village WTP is rated for a peak flow of 0.5 MGD, but only achieves a 0.3 MGD output before water quality is compromised.

The Central Street wellfield and pump station is the Town's original municipal water supply source and is located off Central Street along the Skug River near the Andover town line. It consists of a single well surrounded by well points with a maximum permitted withdrawal of 0.40 MGD. However, the DEIR indicated that the Town can only pump approximately 0.070 to 0.080 MGD because the well points have become clogged and some of the screens have failed. Following chemical treatment for pH adjustment, disinfection, and dental health the groundwater is blended with water from one of two Andover interconnections prior to discharge into the distribution system.

Iron and manganese levels have risen over time in the wells, requiring the construction of the WTPs and making the water more difficult to treat. Despite a treatment plant capacity of 1.8 MGD and permitted withdrawal rate of 0.96 MGD, the Town can only produce a maximum of 0.68 MGD, or 71 percent of its permitted capacity. Average annual pumped flows are lower at approximately 0.54 MGD, or 56 percent of the Town's permitted withdrawal.

The DEIR presented historical and current raw water data for the wells with regard to iron and manganese levels and finished water quality data for the two WTPs. The DEIR noted water quality issues with high water age in the middle of the distribution system due to lack of mixing. The Town completed an optimization study of the WTPs to identify water operation and maintenance needs and water quality, capacity and treatment needs. In general, the treatment plants and equipment were determined to be in fair to poor condition and would require significant capital investment. Improvements would not restore equipment to full capacity and the DEIR noted that the facilities are reaching the end of their typical useful life. Potential improvements would include, but are not limited to:

- Adjust backwash rate at the West Village WTP;
- Increase length of filter runs at both treatment plants;

- Increase well cleaning frequency;
- Check the media depth at the West Village WTP and add media as required;
- Increase frequency of lagoon cleaning at the Lakeside WTP;
- Upgrade the SCADA system at the West Village WTP;
- Evaluate changing the existing venture flow meters to magnetic flow meters; and
- Evaluate replacing the existing vacuum system at the Railroad Bed wellfield with submersible pumps and other improvements.

The interconnection agreement with the Town of Andover was issued under an IBTA in 1991. The municipal management of the IBTA system was established through an inter-municipal agreement (IMA). The IMA was renewed in 2015 for a maximum daily withdrawal of 1.5 MGD. Two interconnection points include an 8-inch main located on Central Street and 12-inch main located on Main Street, each near municipal boundaries. The Town maintains hard piped emergency interconnections with Middleton, Reading, Wilmington (two), and Lynnfield (two). Use of these connections requires temporary booster pumps due to differences in operating pressure. The average water purchased between 2008 and 2014 was 0.89 MGD.

The Town has three storage tanks, capable of storing a total of 3.405 MGD of water to meet peak hourly demand, firefighting needs, and emergencies. The DEIR described the current water distribution system, noting the age, material, and diameter of piping. While the service area is generally well looped, it consists of small diameter transmission piping. As part of the 2014 Water Master Plan the Town completed an evaluation of system pressure, pipeline velocity, headloss, looping, fire flow, water age and redundancy/reliability. The Town concluded that the system generally has adequate pressure, but areas with low velocities were identified which can lead to sediment deposition and water quality issues.

The DEIR included the results of a water supply needs analysis based upon existing water supply and usage and future water demand based on population growth and build-out. It assumed a 20-year planning period and based population and future water demand projections on the 2014 Water Master Plan. Population is projected to increase from 14,896 in 2013 to 17,408 in 2033. Historical water usage was reviewed to determine past water usage trends and characteristics. These data compared Average Day Demand (ADD) and Maximum Day Demand (MDD) between 2002 and 2014. ADD is the total water used over a year divided by 365 days and is useful for estimated total water demand (safe yield or permitted withdrawal). MDD is the maximum day water use that occurs over a given year and typically occurs during a prolonged high usage period. The DEIR indicated that MDD is the most critical water-use component used to evaluate a system as treatment, pumping, and transmission capacity must be adequate to provide the MDD. The DEIR averaged the ADD and MDD for the years 2008-2014. Average ADD was 1.41 MGD and average MDD was 2.29 MGD.

The DEIR also evaluated historical trends for residential and non-residential users. Average water usage between 2008 and 2014 by residential customers was 0.96 MGD, 0.07 MGD by commercial users, and 0.08 by institutional/industrial users. Average residential gpcd has fluctuated between 59.1 gpcd and 79.7 gpcd between 2002 and 2014, with an average of 67.1 gpcd. The recommended per capita use under the WMA is 65 gpcd for residential users and has been accepted as target volume by the MWRA. The Town's long-term goal is to reduce residential gpcd to 55. Water demand projections were based on a gpcd of 65. Non-residential water use has been on the decline since 2009 from a high of 0.21 MGD to a low of 0.10 MGD in 2013. The Town has assumed that this will be reversed due to planned growth. The analysis assumed that non-residential water demand (0.18 MGD) will be 80% of the maximum demand experienced over the past 12 years (0.22 MGD). To determine MDD in the future demand scenario the Town averaged the peaking factor (MDD/ADD ratio) for the past six years. As there was no upward or downward trend in these data, the average value (1.6) was used for the projections.

The DEIR described additional factors that influence water demand including municipal water use, UAW, and peak hourly demand. Confidentially Estimated Municipal Water Use (CEMU) (e.g., fire protection, flow testing, street cleaning, etc.) was estimated at 45.4 million gallons per year (MGY). Sources of UAW in Town include lost water from water main leaks, losses due to under and over registering water service and master meters and fire protection. The MWRA has adopted a performance standard of 10 percent for member communities. Historical UAW between 2002 and 2014 has ranged from 8.7 percent to 17.2 percent. This highest percentage occurred as recently as 2013. The analysis assumed a UAW of 10 percent consistent with MWRA's guideline. Total water demand includes:

	65 GPCD scenario	**50 GPCD scenario**
Residential ADD	1.13 MGD	0.87 MGD
Non-Residential ADD	0.19 MGD	0.19 MGD
CEMU	0.12 MGD	0.12 MGD
UAW	0.16 MGD	0.13 MGD
TOTAL ADD	**1.60 MGD**	**1.31 MGD**
TOTAL MDD	**2.58 MGD**	**2.11 MGD**

The DEIR concluded that assuming a MDD of 2.58 MGD and 1.5 MGD of water purchased from Andover the Town would experience a deficit between 0.379 MGD and 0.54 MGD. This deficit drops to 0.12 MGD if fully permitted water withdrawals from Town sources can be realized.

Water Supply Alternatives

The DEIR evaluated a series of alternatives to meet the Town's water supply goals including:

- A No-Build Alternative – this alternative considered impacts associated with maintaining current permitted groundwater withdrawals and purchased water from Andover. The DEIR noted that the projected MDD exceeds the capacity of existing sources. The Town expressed concerns about operational reliability of Andover's interconnection and lack of control over user rates. This alternative will not reduce withdrawals contributing to stressed conditions in the Ipswich River Basin. Increased iron and manganese levels have reduced water quality and been harder to treat, resulting in loss of water production.
- Water Conservation – this alternative includes water conservation measures to meet future demand without any increases to the Town's 0.96 MGD withdrawal rates. This goal requires reducing average daily water use to 25 gpcd, which is not considered achievable. All other alternatives include provisions to continue implementation of, and expand, water conservation.

- In-Town Alternatives – these alternatives are limited to ways the Town can meet water demand through groundwater or surface water withdrawals solely from sources within the Town. In these scenarios interconnection with Andover will be abandoned.
  - Groundwater Water Withdrawal– this alternative was dismissed as existing water withdrawals within the Ipswich River Basin are the major contributing factor to low flow periods. This alternative is not feasible due to withdrawal restrictions and conservation measures through WMA permit conditions.
  - Surface Water Withdrawal – this alternative considered water withdrawals from Martins Pond, Eisenhaures Pond, Bradford Pond and/or Swan Pond. Historical analyses of these ponds indicated that they have not been developed as water sources because they lack volume, are impaired (Martins Pond), are intrinsically connected to the Ipswich River, or serve as backup water sources for other communities (Swan Pond).
  - Optimizing Local Sources – this alternative focused on upgrading and replacing WTPs to meet water demand without utilizing outside resources. The Town dismissed this alternative because it would be a short-term solution and does not meet the Town's goals to reduce water system complexity and reliance on a stressed watershed. Optimization of existing equipment will not enable an increase in permitted withdrawals which is necessary to meet projected MDD.
- Out-of-Town Alternatives – these alternatives are limited to obtaining water from the sources outside of the Town to meet current and future water demand consistent with the IBTA.
  - Neighboring Community Interconnection – the DEIR evaluated eleven communities as alternative water sources for the Town. These communities were considered based on a 2.5 mile radius from the Town boundary based on feasibility of interconnection. Reading, Woburn, Wilmington, Wakefield, Peabody, and the Lynnfield Water District are MWRA customers, while Andover, Danvers, Middleton, Lynnfield Center Water District, North Andover and Tewksbury have local water sources. The DEIR described existing system characteristics and permitted withdrawal rates for each community. Based upon system capacities (surplus), physical interconnection feasibility, and permitting constraints, interconnection options to the MWRA system through Reading and Wilmington were advanced for additional analysis.
    - Connection to MWRA through Wilmington –This alternative is feasible but was dismissed because it would add complexity to operations for the Town of Wilmington; it would require blended water from local sources in Wilmington with MWRA water. Supplies in Wilmington are drawn from the Ipswich River Basin complicating the IBTA process and creating challenging infrastructure requirements to ensure that water was sourced from the Chicopee/Nashua River and not local sources in Wilmington.
    - **Connection to the MWRA through Reading (Preferred Alternative)** - this alternative consists of "wheeling" water through the Reading water distribution system into the Town. Because As Reading is an MWRA customer, it does not require management of a blended water supply. The MWRA has confirmed capacity to provide the Town's with 1.6 MGD of water on an annualized basis and the ability to meet the Town's MDD of 2.58 MGD.

- o Direct Connection to the MWRA – this alternative would include construction of a dedicated transmission main from the closest point in the MWRA system to North Reading (near the intersection of I-93 and I-95 in Reading). It would consist of six miles of pipe and construction of a booster pumping station. This alternative was dismissed due to significant construction impacts and cost.

The DEIR described potential upgrades to the Reading and Town water systems to achieve the Preferred Alternative. According to the DEIR, the Town of Reading provided a letter, dated November 4, 2014, indicating Reading's willingness to collaborate with the Town in its efforts to become an MWRA water customer and "wheel" MWRA water through their system. The Town used data collected on behalf of the Town of Reading and the MWRA to establish baseline conditions of Reading's water system to identify potential impacts of the Preferred Alternative. This evaluation considered a scenario that consisted to MDD for both systems plus fire flow assuming two MWRA connections. The following improvements in Reading's water system were identified:

- Auburn Street Tank – Replace inlet/outlet piping and replace piping from Auburn Street to Main Street;
- Reactivate 24-inch cross-country water main from Forest Street to Franklin Street;
- Woburn Street – replace piping from Summer Avenue to Linden Street;
- Linden Street – replace piping from Woburn Street to Lowell Street; and
- Franklin Street – replace 8-inch pipe from 24-inch cross-country main to Main Street.

MWRA water wheeled to the Town via Reading would be metered and withdrawal limits defined in the terms of MWRA's Water Supply Agreement with the Town. The MWRA Water Supply Agreement with Reading is specific to Reading's MWRA withdrawals, but does not constrain Reading's ability to wheel MWRA water to the Town. Comments from MassDEP indicated that for the Town to change its source water to the MWRA supply it will have to evaluate whether corrosion control treatment will be needed to remain in compliance with the Lead and Copper Rule and additional testing may be necessary.

Water Conservation

The DEIR described the Town's water conservation efforts including:

- A three-tier, increasing block water rate structure (up to 10,000 gallons per quarter, between 10,000 gallons and 22,500 gallons per quarter, and greater than 22,500 gallons per quarter). It has been recommended that the Town conduct a rate study to develop a rate plan that will establish water rates based on the anticipated capital improvements and O&M costs associated with the Preferred Alternative;
- A Drought Management Plan (updated in 2013);
- Adoption of a Water Use Restriction Bylaw and Water Use Restrictions Rules and Regulations (updated March 2014). The DPW enforces water use restriction policies;
- Town-wide water audit (proposed for 2017);
- Leak detection surveys (completed in 2014, repairs completed in 2015). It has been recommended that the Town continue leak detection efforts and conduct a system-wide survey every two years. This would be a requirement under MWRA regulations;

- Calibration of master and sub-master meters (11 meters across 6 sites completed in February 2016);
- Approved funding for an Advanced Metering Infrastructure (AMI) system to replace all meters in the distribution system and allow for remote reading;
- Reduce residential water use through facilitation of installation of water efficient plumbing fixtures, new metering equipment, conducting water use audits, and incentives for the installation of moisture based and rain shutoffs for irrigation systems;
- Improve non-residential water use by conducting water audits, starting with users with the highest water use;
- Audit of Public Building Water Use (December 2014, improvements pending funding in 2017); and
- Public outreach and education through the development of a Water Conservation Public Education Plan (WCPEP). Upon completion the Town plans to implement the WCPEP through: bill inserts; print media; social media; local newspapers; the Town website; elementary school programs, and public presentations for local interest groups (e.g., Chamber of Commerce, Rotary, etc.).

Water conservation measures are mandatory per the IBTA, MWRA OP#10 and other agreements. Water conservation efforts will be incorporated into the Preferred Alternative to meet the 10% UAW and residential 65 gpcd regulatory requirements.

Wastewater

As noted during the review of the EENF, MassDEP reviewed a Draft Comprehensive Wastewater Management Plan (CWMP) prepared by the Town in 2008. The Town has dismissed an option of connecting to the MWRA sanitary sewer system due to capacity issues within that system. MassDEP directly addressed this issue in a March 10, 2009 letter that was provided as an attachment to the MassDEP comment letter on the ENF. MassDEP acknowledged that an assessment of treatment alternatives that extend beyond the Ipswich River Basin was necessary due to the complexities and cost of long-term wastewater management.

The DEIR built upon information developed for the Draft CWMP and included an updated Needs Analysis, an expanded wastewater alternative analysis, and development of a long-term plan to address projected wastewater needs. The Town contains a total of 4,632 on-site sewage disposal systems, the vast majority of which are traditional septic systems (2,612). Additional system types include wastewater treatment facilities (WWTF), tight tanks, cesspools, bioclere systems, bio filter systems, and FAST systems. Due to incomplete records, 2,957 of the systems in Town are not known. The six WWTFs and their permitted flows include:

- Meadowview Care and Rehabilitation Center – 17,000 gallons per day (GPD);
- Edgewood Luxury Apartments (Berry Site) – 63,240 GPD;
- Greenbriar Condominiums – 40,000 GPD;
- Park Colony Condominiums – 26,000 GPD;
- North Reading High and Middle School – 17,500 GPD; and
- U.S. Postal Service – 16,000 GPD

The DEIR summarized data on the effectiveness of on-site wastewater disposal systems including an evaluation of documented septic system failures and rehabilitations and MassDEP violations. According to the DEIR, septic system failures are not localized in a single area, but water quality impairments in many of the Town's surface waters indicate poorly operating and failing septic systems. Furthermore, the DEIR indicated that almost all private WWTFs have experienced inconsistent compliance with their MassDEP groundwater discharge permits.

The wastewater needs analysis presented in the DEIR identified areas where existing conditions may cause a risk to public health, environmental resources, or financial burden. The DEIR described the assessment methodology used to identify and evaluate 16 Needs Study Areas, including the scoring factors (e.g., lot size, pump out frequency, within Zone II or interim wellhead protection area, etc.) and rationale for determination of weighting factors for each parameter. The highest weight factors were applied to properties with known septic system failure or rehabilitation, tight tanks, commercial or industrial water use, or proximity to impaired water bodies. An aggregate score was applied to each lot in Town based on the sum of its score in each risk category. Based on these scores four categories were created: Highest Risk (scores greater than 60); High Risk (scores between 40 and 60); Moderate Risk (scores between 20 and 40); and Low Risk (scores below 20). These data were then applied to GIS mapping of the Town.

The 16 Needs Study Areas were identified as follows:

1. Martins Pond
2. Lowell Road
3. Park Street
4. Concord Street
5. Route 28 South
6. Hillview
7. Central Street North
8. Eisenhaures Pond
9. High School
10. Department of Public Works (DPW)
11. Crestwood Drive
12. Mount Vernon
13. Marblehead Street
14. Orchard Drive
15. Thomson
16. Swan Pond

The DEIR described the characteristics of each Study Area. Based upon the risk scores and the top three scoring factors for individual lots within each Study Area overall need levels (high, medium, low, negligible) were established. Four Study Areas were identified for further analysis: Lowell Road, Martins Pond, Route 28 South, and Concord Street. These areas contain more than 900 parcels and are significantly impacting the environment through poorly performing on-site wastewater systems, experience challenges regarding the siting and replacement of existing systems, contain a number of the Town's commercial and industrial users, and contribute to poor water quality in adjacent wetlands and water bodies.

The DEIR considered the feasibility of providing municipal wastewater treatment to all parcels within these four areas. The DEIR also considered the feasibility of serving all the highest and high risk residential lots and all non-residential lots within these areas. These two scenarios were rejected for several reasons including cost, higher O&M costs, and potential system inefficiencies. Therefore, the DEIR evaluated a scenario that prioritizes the highest and high risk lots, non-residential lots, and provides wastewater service to lots adjacent to proposed sewer. Highest and high risk lots that were secluded or captured too many lower risk lots in order to connect were excluded. This approach captured the majority of lots within the four areas and included some high risk lots in the Park Street, DPW, and High School study areas.

The DEIR estimated future wastewater flows for both residential and commercial users. For residential users, wastewater flows were based on the water demand determined in the water needs analysis (2.71 persons per household and 65 gpcd). For commercial users, wastewater flows were based on average water use per non-residential lot (505 gpd). These values were assigned by lot type in the proposed service area to estimate total predicted flows (192,650 gpd residential, 159,580 gpd non-residential). The Town also applied a 10 percent safety factor to account for unexpected increases to wastewater flows and added an inflow/infiltration (I/I) allowance of 500 gpd/diameter mile. With consideration for all these factors, the total future wastewater flows was estimated at 503,000 gpd. The DEIR estimated future flows using MassDEP Title 5 flow rates for comparative purposes. Title 5 rates projected residential flow rates of 373,770 gpd and non-residential flow rates of 177,940 gpd. A similar I/I allowance (114,800 gpd) was added to these projections for a total predicted flow rate of 666,510 gpd. The Town indicated that these flow rates were considered to be overly conservative and used the 503,000 gpd rate for its planning purposes.

Wastewater Alternatives

The DEIR evaluated a series of alternatives to manage projected wastewater flows. Each alternative was assessed based on: the ability to serve customers in the designated needs areas, the ability to improve water quality in the Ipswich River Basin and Martin's Pond, and, as feasible, address downtown needs. These alternatives include:

- No-Build Alternative – this alternative assumes that the existing wastewater condition would remain largely unchanged over the next 20 years. Upgrades and replacement of existing on-site systems would continue to occur based on system failures or change in ownership. This alternative was not selected as it would not improve water quality due to failed or partially-performing septic systems. Also, if a connection to the MWRA water system proceeds while wastewater discharges continued in Town, the water balance in the Ipswich River Basin would change.
- Centralized Wastewater Collection System with NPDES Discharge - this alternative consists of construction of a wastewater collection system that discharges to a surface water body. It was dismissed as infeasible based on low likelihood of obtaining a surface water discharge permit to the Ipswich River due to the levels of treatment required, anti-degradation requirements, and lack of available dilution in the Ipswich River (and other surface waters).
- Centralized Wastewater Collection System with Groundwater Discharge Permit – this alternative evaluated potential groundwater discharge sites on large Town-owned and

privately owned parcels. The DEIR estimated minimum area required to site a groundwater discharge system capable of treating 503,000 gpd assuming typical technologies and application rates. The DEIR concluded that a 38-acre area would be necessary based on typical infiltration rates and a 13-acre area would be necessary using rapid infiltration rates. The DEIR selected lots for additional evaluation based on: minimum lot size, Town-owned, undeveloped or underdeveloped, and groundwater risk of moderate or below. No sites met these criteria. The Town expanded the evaluation to privately-owned lots and no feasible sites were found. Therefore, the alternatives analysis considered satellite treatment facilities that could treat a portion of wastewater flows (minimum flow of 50,000 gpd per facility). The alternatives analysis, using similar review criteria with a 5-acre project area, identified the DPW site as the only feasible location. This alternative could not process all projected wastewater flows but it was evaluated as part of a hybrid approach.

A WWTF on the DPW site would consist of a small treatment facility capable of a high level of treatment, such as a package membrane bioreactor (MBR) and a soil absorption system (SAS). Subsurface exploration of the DPW site was completed as part of the CWMP and a preliminary hydrogeological assessment estimated that the site could accommodate 125,000 to 175,000 gpd of wastewater on a 15 to 20 acre portion of the site. The DEIR noted that the available treatment area is less than that presented in the CWMP due to wetland and flood plain setback requirements, reducing available area to approximately 9.5 acres. The DEIR estimated that assuming an application rate of 0.3 gallons per sf, the site may be able to treat up to 125,000 gpd, but additional testing is necessary and the reserve SAS would need to be located on an adjacent site. This would provide a Town-owned facility which, with advanced tertiary treatment and disinfection, would improve water quality; however, it is located immediately adjacent to the Ipswich River which presents challenges for the construction and operation of the facility. Impacts include clearing of nine acres of forest, impacts to floodplain and the need to provide compensatory flood storage and shallow depths to groundwater. Treatment costs would double compared to a regional facility on a gpd basis.

- Individual and Shared/Decentralized Treatment Facilities – According to the DEIR, individual I/A systems provide improved water quality compared to septic systems, but less than that provided by municipal WWTFs. These systems cost 150% to 200% more, on average, than a traditional septic system. This alternative also considered cluster/decentralized systems that typically serve multiple properties with flows generally less than 10,000 gpd in total. The DEIR noted that while these systems can provide added water quality benefits and cost effectiveness, they are difficult to use when retrofitting neighborhoods. In addition, the Town expressed concerns with these types of facilities given their experience; WWTFs have struggled to meet water quality requirements set by their groundwater discharge permits from MassDEP. This alternative was dismissed.
- Water Reuse – this alternative considered the feasibility of using reclaimed water to reduce water consumption and dispose of wastewater. This alternative will require construction of a treatment plant to meet Class A reuse standards. The DEIR concluded that water reuse will be considered for the DPW treatment facility if it is advanced to the design stage.
- MWRA Wastewater Connection – this alternative considered a connection to the MWRA wastewater system via an interconnection through Wilmington or Reading. It would require the construction of new sewer mains to connect to Wilmington or Reading systems. The MWRA has indicated that it is not adding communities to its wastewater collection system

and that the system cannot accommodate additional flows without considerable mitigation and flow offsets (i.e., removal of 4 gpd of I/I per gpd of wastewater added). This alternative was dismissed as infeasible.

- South Essex Sewerage District (SESD) Connection – this alternative consists of a connection to the SESD located in Salem, MA. The SESD WWTF treats an average of 30 MGD and serves Salem, Peabody, Marblehead, Beverly, Danvers, and portion of Wenham and Middleton. It would require an approximately four-mile long sewer main through Middleton and Peabody along an abandoned railroad track. The hydraulic capacity of the SESDD Peabody /Salem interception is limited and cannot accept additional flows. Flows to the SESD secondary treatment plant are currently at hydraulic capacity requiring an additional secondary treatment system to be constructed to accommodate flows from the Town. Therefore, this option was dismissed based on cost, legal issues, and permitting challenges.
- Lynn Water and Sewer Commission (LWSC) Connection – this alternative consists of an connection to the LWSC which currently treats and disposes of wastewater from Lynn, Saugus, Swampscott, and Nahant. This alternative would require the construction of approximately 10.3 miles of new and/or upgraded sewer pipes, 8.3 miles of which would be through the Town of Lynnfield. According to the DEIR this alternative was dismissed because the LWSC WWTF does not currently have excess capacity and to create capacity the Town would have to pay to remove combined sewer overflows (CSOs) from the system.
- Greater Lawrence Sanitary District Connection – this alternative consists of sending wastewater flows to the GLSD WWTF for treatment. The GLSD WWTF treats and disposes of wastewater for six communities: Lawrence, Methuen, Andover, North Andover, Dracut, and Salem, New Hampshire. The facility has a design capacity of 52 MGD, but is currently treating and average of 30 MGD. The GLSD WWTF is a secondary activated sludge plant with disinfection. The Town's flows will account for less than 2% of the GLSD WWTF's average daily flows.
    - Connection to GLSD via North Andover – the nearest connection point is over four miles from needs areas and will require considerable upgrades to accommodate flows. This is a less desirable connection scenario than through Andover and will only be pursued if connection to Andover becomes infeasible.
    - **Connection to GLSD via Andover (Preferred Alternative)** – this alternative is capable of treating the Town's entire projected wastewater flows and will maximize the amount of wastewater constituents removed from the Ipswich River Basin. It will simplify and improve the reliability of wastewater management. Comments from Andover indicate that only limited discussion has occurred between Andover and the Town's consultant regarding use of Andover's wastewater collection system to convey flows to the GLSD WWTF.

The Preferred Alternative will require construction of approximately 2.2 miles of new and/or upgraded sewer pipes along Route 28 to the intersection of Wildwood Road and potential upgrades to pump stations. Connection will be made just downstream of the Morningside Drive pump station (PS-25). The proposed collection system will include:

- Approximately 5 miles 12-inch gravity sewer;
- Approximately 16 miles of 8-inch gravity sewer;

- Limited properties with in-home grinder pump stations served by low pressure sewers (LPS);
- Approximately 3 miles of 6-inch force main;
- Approximately 2 miles of 4-inch force main;
- One 503,000 gpd Central Pump Station; and
- Up to 5 smaller distributed pump stations.

The Preferred Alternative will require:

1. Construction of the wastewater collection system in Town;
2. An IMA with Andover to convey wastewater through Andover's system;
3. An agreement with the GLSD to treat the Town's wastewater;
4. Modification of the GLSD's service area to include the Town. This will require approval of the Massachusetts Legislature; and
5. Concurrence by the GLSD to allow the connection.

The DEIR described the proposed flow paths through the Andover collection system and improvements that may be required to accommodate the flows, including: replacement of smaller diameter pipes with larger diameter pipes between the Town connection point and Woburn Road; pipe lining within the portion of system between River Street and Red Spring Road, particularly in areas along the Shawsheen River; improvements to address pipe capacity issues approaching the final pump station (PS-5); and improvements to PS-5.

According to the DEIR, details of these improvements to the Andover collection system must be discussed further and mutually agreed upon as part of the IMA. The DEIR noted that Andover may also require additional work or funding to aid in the removal of I/I in the Andover system. The DEIR did not provide details on the scale and nature of this work.

In the Preferred Alternative all privately-owned WWTFs in Town, with the exception of the High and Middle School will be abandoned. The DEIR indicated that the School's WWTF is underutilized and underperforming. It is designed for an average daily flow of 17,500 gpd but current flows average less than 9,000 gpd. The groundwater discharge permit for the WWTF requires additional upgrades when the facility's annual average flow exceeds 80% of the facility's design flow (14,000 gpd). The Town intends to optimize this WWTF by adding up to 5,000 gpd of flow from the downtown area. This area includes several Town-owned facilities including: the Public Safety Building, Building at the Common, Putnam House, Damon Tavern, Flint Library, and the Batchelder School. This project will require an additional 2,600 feet of gravity sewer, 2,600 feet of force main and a submersible pump station. Total flow would increase to approximately 13,000 gpd. Optimization will provide a water quality benefit to the Ipswich River by removing existing septic systems adjacent to the Ipswich River.

The Preferred Alternative will include upgrades to existing septic systems in areas that will not be sewered. The Town will continue to enforce its public health regulations and educate homeowners on failing systems and available I/A technologies.

The Wastewater Preferred Alternative will export more water from the Ipswich River Basin compared to current conditions. The increase in water leaving the basin could negatively impact the low flow conditions of the basin. However, the Town indicated that this issue is mitigated by the importation of water from the Nashua and Chicopee River Basins via the proposed MWRA connection.

Interbasin Transfer Act

A connection to the MWRA's water supply requires an IBTA, as the Town is located in the Ipswich River basin and the MWRA's sources are located in the Chicopee and Nashua River basins. The DEIR included the donor basin analysis and supporting information for the IBTA review and approval process. This analysis was prepared in partnership with the MWRA. The DEIR described the MWRA water system including conveyance capacity, storage capacity, withdrawal constraints and discharges, and other limiting factors. The DEIR provided detailed data on the capacity of MWRA aqueducts and tunnels that transport flow from the Chicopee and Nashua River donor basins to downstream points of distribution. The Town would receive MWRA water via Reading; Reading is served by MWRA's Northern Intermediate High (NIH) Distribution system, which receives treated water from the MWRA's John J. Carroll Water Treatment Plan (JJCWTP), via the MetroWest tunnel, City Tunnel, and City Tunnel Extension. According to the DEIR, the maximum capacity of the JJCWP is 405 MGD. Currently, the water demand of communities served by the JJCWP is 185 MGD. The DEIR also stated that because MWRA's reservoirs are multi-year storage reservoirs with 477 billion gallons of storage, the variation in the Town's demand is of no significance to reservoir operations. The Furthermore, the collective demand of communities that have proposed to join the MWRA water system (Ashland, Southfield), plus projected water demand for all existing users by 2035, will not impact MWRA reservoir capacity, resident fisheries resources, or safe yield. The MWRA concurred with the conclusions of the donor basin analysis. Improvements to the NIH system include construction of a second meter and interconnection with Reading which will provide excess capacity for MWRA to deliver water to Reading to feed the Town and meet both average and peak demands.

The DEIR presented the results of the Ipswich River water balance assessment comparing existing conditions and conditions under the Preferred Alternative

	Existing Conditions	**Recommended Plan (Future Conditions)**
Sources - Approvals		
Local Source Registration (annual AVG)	**0.96 MGD**	**0.00 MGD**
Andover IBTA (Max Day)	**1.50 MGD**	**Emergency Only**
MWRA IBTA (Max Day)	**0.00 MGD**	**2.58 MGD**
Sources –Withdrawals		
Local Source Registration (annual AVG)	**0.52 MGD**	**0.00 MGD**
Andover IBTA (annual AVG)	**0.89 MGD**	**Emergency Only**
MWRA: ADD	**0.00 MGD**	**1.60[1] MGD**
MDD (IBTA)	**0.00 MGD**	**2.58 MGD**
Ipswich River Basin		
Total Withdrawal from Basin	**- 0.52 MGD**	**- 0.00 MGD**
Wastewater Generated	**+ 1.41 MGD[2]**	**+ 1.60 MGD[2]**
Wastewater Conveyed out of Basin	**- 0.00 MGD**	**- 0.503 MGD[3]**
Net Water Change to the Basin	**+ 0.89 MGD**	**+ 1.10 MGD**

1. **Assumes current well users are added to system, 65 gpcd, 10%UAW, maintain current trends in CEMU and Non-residential use. DEIR includes detailed analysis.**
2. **Assumes 100% of water use become wastewater discharge.**
3. **Assumes 0.503 MGD of wastewater is sent to GLSD under recommended plan.**

These data indicate that under both existing and the Preferred Alternative (Recommended Plan), more water is imported into the Ipswich River Basin than is exported out of the basin. More specifically, upon completion of the wastewater collection system with discharges to the GLSD, the net change of flow into the Ipswich River Basin is estimated to increase by 0.21 MGD. This increase may assist in the stabilization of base flows in the Ipswich River Basin, but is not significant enough to alter the existing balance within the basin. The DEIR stated that based on United States Geological Survey (USGS) data, the additional flow suggested in the water balance calculation represents an additional 0.32 cubic feet per second (cfs) on an average basis or a 60% increase in the 7Q10 base flow.[1] MassDEP concurred that the Preferred Alternative appears beneficial to the Ipswich River.

The WRC comment letter indicated that sufficient information was provided in the DEIR to demonstrate consistency of the Preferred Alternative with Criterion 2 of the ITBA regulations (i.e., all reasonable efforts have been made to identify and develop all viable sources in the receiving area of the proposed interbasin transfer). The WRC also noted that the DEIR included adequate information in support of the Local Water Resources Management Plan, required by the ITBA regulations (313 CMR 4.05(7)) and that no additional information is necessary to demonstrate compliance with this requirement. Additional information is required to fully evaluate the Preferred Alternative's consistency with other ITBA criteria and regulations.

[1] Seven-day, consecutive low flow with a ten year return frequency; the lowest stream flow for seven consecutive days that would be expected to occur once in ten years.

Land Alteration

The DEIR identified the location of open space compared to proposed improvements in the Town, Andover and Reading. It is unclear if areas identified as open space are, in fact, Article 97 lands or other types of open spaces not afforded additional regulatory protection. The DEIR indicated that water and wastewater pump stations in Town will be located outside of lands designated as open space. Projects in Andover will occur predominately within the paved ROW. However, one area of potential improvement includes the existing cross-country main located in open space adjacent to the Pomps Pond recreation area. Temporary construction impacts will be mitigated through erosion control BMPs. The DEIR did not identify any projects adjacent to open space within the Reading.

Wetlands

The DEIR indicated that the Preferred Alternative is not expected to have permanent impacts to wetlands or surface waters in Town. Some construction activities will occur within the 100-foot buffer zone to Bordering Vegetated Wetlands (BVW) and Land Under Water (LUW), or the 200-foot Riverfront Area. The DEIR also noted that the project will require several crossings of wetland resource areas. The Town intends to limit work to the existing ROW and permit each phase of work through an Order of Conditions with the North Reading Conservation Commission. Directional drilling may be used, where appropriate, in lieu of open trench construction. If directional drilling is used, access pits will be located outside wetland resource areas. Improvements in Andover are generally proposed within the paved ROW. As the flow path in Andover runs parallel to the Shawsheen River, pipe lining will be used to reduce impacts to wetland resource areas. If open cut construction is necessary, the Town will obtain approval from the Andover Conservation Commission in accordance with the Wetlands Protection Act. No projects in Reading will be located within or adjacent to wetland resource areas.

Stormwater

The DEIR indicated that the construction of new water or sewer mains is not anticipated to result in large new areas of impervious surfaces. New impervious area will be limited to pump station roofs and access driveways and is estimated to be less than 4,000 sf. To mitigate construction period stormwater runoff the Town will use erosion and sedimentation control BMPs. These BMPs should be developed consistent with those used in a Stormwater Pollution Prevention Plan (SWPPP) prepared in accordance with a National Pollutant Discharge Elimination System (NPDES) Construction General Permit.

Historic and Archaeological Resources

The DEIR identified historic resources included in MHC *Inventory of Historic and Archaeological Assets of the Commonwealth* or listed in the State Register of Historic Places within the Preferred Alternative project area. The DEIR noted that many of these resources are located outside the ROW. To avoid potential historic or archaeological impacts directional drilling or pipe jacking will be used along the Martins Brook Bridge on Route 28 in Town. Previous studies identified the DPW site as "archaeological sensitive and likely to contain archaeological sites associated with the Native American occupation of the North Reading area." Work in Andover is generally confined to the ROW and is not expected to impacts historic or archaeological resources. If sewer improvements are proposed at the Steven Street Bridge, trenchless technologies will be investigated to reduce potential impacts. Previous plans considered construction of a water pump station at the historically designated Lob's Pound Mill site in Reading. The Preferred Alternative will no longer include a water booster pump station at this location. Comments received from the Reading Historical Commission identified additional concerns about potential impacts to this site that should be addressed in the FEIR. Remaining work in Reading is proposed within the ROW and not expected to impact known historic or archaeological resources.

The Town will continue to coordinate and consult with local historical commissions and the MHC during the design of each phase. As requested by MHC, the Town should submit scaled project plans showing existing and proposed conditions to the MHC for review and comment for each phase of improvements or expansion projects, including wastewater treatment plan location(s), recharge areas, pump stations, equipment storage and materials staging areas, and cross-country water and/or sewer ROWs, as applicable. If above-ground construction (e.g., pump stations) is proposed in historic areas, they should be designed to be compatible and sensitive to the historic characteristics of the surroundings.

Rare Species

The DEIR identified two areas mapped as *Priority* and/or *Estimated Habitat* areas within Town per the most recent Natural Heritage and Endangered Species (NHESP) Atlas (13th edition). The proposed sewer collection system will not create impacts within these habitat areas. The DEIR also indicated that *Priority* and/or *Estimated Habitat* areas in Andover and Reading will not be affected by the proposed water or sewer improvements. The Town will limit construction to previously disturbed areas, such as paved roadways, to minimize potential impacts to rare species habitat.

Hazardous Materials

As part of the DEIR the Town reviewed the MassDEP Reportable Release Sites list generated in conjunction with the Massachusetts Contingency Plan (MCP). The DEIR summarized the release location, type, and compliance phase of the 28 sites located within Zone II wellhead protection areas (a total of 113 releases were documented in Town). The DEIR identified the location of those releases that had not achieved Response Action Outcomes (RAOs) under the MCP and have been Tier classified as part of the remediation process. The DEIR identified a number of underground storage tanks (USTs) near the proposed sewer network and a limited number of Activity and Use Limitation (AUL) sites. The DEIR noted that these areas of concern were generally not within the ROW. However, where excavation is proposed in the vicinity of potential contaminated areas, a Licensed Site Professional (LSP) will be consulted during design. The design will include provisions for a comprehensive soils management plan to ensure soils are tested, handled and disposed of in accordance with all applicable regulations. The design of any underground utility work near asbestos concrete (AC) pipes will include provisions for an asbestos management and abatement plan to ensure all asbestos materials as handled, stored, and disposed of in accordance with all applicable regulations.

Greenhouse Gas Emissions

The project is subject to the MEPA Greenhouse Gas Emissions Policy and Protocol ("the Policy"). The Policy requires projects to quantify GHG emissions and identify measures to avoid, minimize or mitigate such emissions. The DEIR included an analysis that estimated and quantified the direct and/or indirect CO_2 emissions associated with the project's stationary source energy usage (e.g., building energy use, process-related energy use, pump stations, etc.) and transportation-related emissions (mobile sources), as applicable. Unlike many projects reviewed under the Policy, water and wastewater treatment process energy loads and subsequent GHG emissions play a large role in the overall project's GHG emissions rather than the buildings that contain the facilities themselves. Therefore, the embedded energy in the treatment and distribution systems for pumping, treating, distributing, and possibly pressurizing water and wastewater was accounted for in the GHG analysis.

The GHG analysis compared GHG emissions associated with an established project baseline to GHG emissions associated with a final build condition that incorporates feasible mitigation measures to reduce GHG emissions. The Town met with representatives of MEPA, MassDEP and the Division of Energy Resources (DOER) to establish an appropriate baseline and analysis methodology. The GHG analysis that calculated and compared GHG emissions associated with: 1) a Baseline, or Business As Usual case (direct and indirect emissions from energy consumption based upon a typical pumping and treatment design and operations) and 2) the Preferred Alternative (direct and indirect emissions from energy consumption based upon the implementation of equipment and operations that achieve reduced GHG emissions compared to the Baseline). The DEIR evaluated GHG emissions under each major project alternative to allow for consideration of GHG impacts when selecting the Preferred Alternative.

Wastewater GHG Analysis

The DEIR compared the wastewater Preferred Alternative to the established GHG Baseline Case to identify opportunities to further reduce GHG emissions. The DEIR identified the CO_2 or CO_2 equivalent emission rates for the GHG emissions sources within the wastewater system (i.e., electricity, septic system methane (CH_4), biological processes, and fleet vehicles). Average energy use data for the GLSD WWTF were based upon MEPA and MassDEP guidance (1.7 kilowatt hours (kWh) of electricity per 1,000 gallons wastewater treated outside MWRA communities). Use data were also gathered on the number of septic systems and existing privately-owned WWTFs. The DEIR described the various assumptions used to calculate GHG emissions associated with septic systems, including analysis of fugitive methane emissions, septic waste treatment, and pump-out transportation emissions. Assumptions for pump stations were based on a conceptual design with assumed pump and motor efficiencies. The GHG analysis also analyzed a hybrid approach based on construction of a WWTF and SAS at the DPW site. This analysis considered both the GHG emissions associated with electricity to run the treatment plant and the loss of CO_2 sequestration associated with nine acres of clearing.

The Baseline GHG emissions (presented as CO_2) were estimated at 3,430.54 tons per year (tpy).[2] Of this total, methane emissions from septic systems are estimated at 3,357.14 tpy, the High School WWTF contributes 24 tpy, and private WWTF contribute 49.4 tpy.

[2] The DEIR presented emissions data in pounds per year. The GHG Policy requests that these data be provided in tons per year.

Estimated GHG emissions in the Preferred Alternative with a DPW WWTF were:

Emission Source	Total GHG emissions (tpy)
Septic Systems	2,350
High School WWTF	33.77
Pump Stations	117.80
DPW WWTF	258.69
GLSD WWTF	204.85
Fleet Vehicles	12.87
TOTAL	**2,977.98**

Estimated GHG emissions in the Preferred Alternative without a DPW WWTF were:

Emission Source	Total GHG emissions (tpy)
Septic Systems	2,350
High School WWTF	33.77
Pump Stations	117.80
GLSD WWTF	227.62
Fleet Vehicles	12.87
TOTAL	**2,742.06**

Based upon these estimates, the overall wastewater Preferred Alternative (i.e, without a DPW WWTF) shows a decrease in CO_2 emissions of 688.48 tpy, or 20%.

Water GHG Analysis

Similar to the wastewater GHG analysis, the water GHG analysis compared the water supply Preferred Alternative to the established GHG Baseline Case to identify opportunities to further reduce GHG emissions. The DEIR identified the CO_2 emission rates for the GHG emissions sources within the water system (i.e., electricity, chlorine treatment, natural gas, and fleet vehicles). Average energy use data for water treatment in MWRA communities were used and based on MEPA and MassDEP guidance (0.2 kWh of electricity per 1,000 gallons water treated). This average increases to 1.1 kWh per 1,000 gallons water treated outside of MWRA communities. Electrical and natural gas use data were gathered for the Town wells and average water purchased from Andover was determined to establish the Baseline Case. The water GHG analysis provided a comparative analysis of Town well GHG emissions using MEPA guidance for water treatment in non-MWRA communities and actual Town electrical bills. Data from electrical bills were higher than the MEPA guidance figures and therefore used in the analysis as a conservative approach. Emissions associated with treatment of water purchased from the Town Andover were calculated using MEPA averages for non-MWRA communities. Assumptions for pump stations were based on a conceptual design with assumed pump and motor efficiencies.

Estimated GHG emissions in the Baseline Case were:

Emission Source	Total GHG emissions (tpy)
Town wells (electricity and natural gas)	294.19
Purchased water from Andover	177.94
Chemical production	13.32
Fleet Vehicles	51.50
TOTAL	**536.95**

Estimated GHG emissions in the Preferred Alternative were:

Emission Source	Total GHG emissions (tpy)
MWRA	57.12
Pump Stations	41.25
Fleet Vehicles	28.47
TOTAL	**126.84**

Based upon these estimates, the overall water Preferred Alternative shows a decrease in CO_2 emissions of 410.11 tpy, or 76%.

Efficiency Measures

The DEIR acknowledged that use of electricity for water and wastewater treatment and conveyance is a large component of the GHG emissions for the project. Therefore, the Preferred Alternative will include the use of high-efficiency pumps, blowers, motors and variable-speed drives for the pump stations. Programmable logic controls (i.e., SCADA systems) will also allow for improved efficiency in operations of systems components. The Town will also include photovoltaic (PV) systems in the final construction of the pumping stations. The DEIR indicated that approximately 200 sf of available area for PV at the water booster and main wastewater pumping station. Use of PV could provide approximately 20kWh per day to offset conventional electrical demand. Treatment of both water and wastewater under the Preferred Alternative will occur at facilities that are not under the direct control of the Town. However, each of these facilities has a history of implementing energy efficiency measures to reduce overall treatment GHG emissions.

Public Participation

The State's Revolving Fund (SRF) regulations require the Town to conduct a minimum of one public meeting and one public hearing for this project. The DEIR included a discussion of the Town's public participation program activities completed and proposed to date. Public participation efforts exceeded the minimum standards set by the SRF regulations.

Construction Period

The Town has targeted a MWRA connection date of July 2019 for water service, with an approximately two-year construction period between June 2017 and June 2019 to complete system upgrades. Water treatment plants/wells are proposed for decommissioning in 2020-2021. The wastewater projects have a longer implementation period, with permitting and agreements preceding design and construction of system improvements in Andover (2021-2025) and five phases of design and construction of the system in Town (2025-2034). Water system capital costs are estimated at $17,130,000, with a 20-year cost to be determined.

Preliminary scheduling for the wastewater projects include the completion of an IMA with Andover and an agreement with the GLSD (2018-2020), sewer improvements in Andover (construction 2023-2025), improvements in the Route 28 and Concord Street Study Areas (construction 2027-2029), improvements in the Lowell Street Study Area (construction 2030-2031), improvements in the Martins Pond Sewer Area (construction 2033-2034), and improvements in the Park Street Sewer Area (construction 2033-2034). Wastewater system capital costs are estimated at $68,700,000, with a 20-year cost of $89,100,000.

The DEIR indicated that construction-related impacts will be eliminated or mitigated through the incorporation of minimally invasive construction techniques and BMPs. The Town will prepare and implement a traffic management plan to facilitate adequate traffic controls, detours, and police details during construction. Project timing will be determined on a project-by-project basis to allow for coordination with local residents and business to minimize construction impacts such as utility interruption, and traffic and noise impacts.

Conclusion

The DEIR is generally responsive to the Scope and provides a comprehensive overview of the project. It includes an alternatives analysis including context for the project design and capacity, a GHG analysis, and addressed proposed project consistency with MWRA OP#10. However, additional work must be undertaken by the Town to ensure that the Preferred Alternatives are feasible and that potential environmental impacts have been fully disclosed. These issues are outlined in the Scope described below.

Based on a review of the DEIR, the Scope for the DEIR, comments letters and consultation with State Agencies, I have determined that the DEIR adequately and properly complies with MEPA and its implementing regulations. The MEPA regulations indicate that a Draft EIR can be determined adequate, even if certain aspects of the Project or issues require additional description or analysis in a final EIR, provided that it is generally responsive to 301 CMR 11.07 and the Scope.

SCOPE

General

The FEIR should follow Section 11.07 of the MEPA regulations for outline and content, as modified by this Scope. Additional recommendations provided in this Certificate may result in a modified design that enhances the project's ability to avoid, minimize, or mitigate Damage to the Environment. The FEIR should discuss steps the Town has taken to further reduce the impacts of the project since the filing of the DEIR, or, if certain measures are infeasible, the FEIR should discuss why these measures will not be adopted.

Project Description and Permitting

The FEIR should include a detailed description of the project and describe any changes to the project since the filing of the DEIR. The FEIR should include a discussion of permitting requirements associated with the project, the results of any pre-permitting coordination meetings held with State Agencies, and how the project will be constructed in accordance with applicable regulatory performance standards. The FEIR should clarify if the Town will be seeking State or federal funding sources for design and construction of the project.

The FEIR should include updated site plans for existing and post-development conditions at a legible scale to clearly illustrate project activity and infrastructure, environmental resource areas and environmental impacts. In particular, the materials provided in the DEIR were not at a suitable scale to evaluate environmental impacts associated with work within ROWs or construction of the proposed pump stations. The FEIR should provide graphics at a legible scale for each new or modified pump station that detail existing environmental conditions (wetlands, Article 97 lands, historical and archaeological resources, and MCP-regulated sites/USTs/AULs) and a conceptual design and location of the pump station. The FEIR should include a standard conceptual ROW cross-section depicting the proposed location of water or sewer mains to clarify if work will be completed within paved areas or roadway shoulders.

Land Alteration

The FEIR should identify Article 97 lands within the Town, Andover, and Reading to confirm that the project will not directly impact, or require takings for easements, these protected properties.

Comments from MassDEP and the Ipswich River Watershed Association (IRWA) identify concerns about the fate of currently protected water supply lands if the Town's current water withdrawal registration is forfeited and wells are abandoned. MassDEP indicated that it will rescind its approval of the Zone II wellhead protection area for the wells and the Interim Wellhead Protection Area (IWPA) for the Stickney Well. While Zone IIs related to wells in neighboring towns will continue to extend into Town, those associated with decommissioned Town wells will no longer be subject to the regulatory protections conferred by that designation. The FEIR should identify those areas that would no longer be encumbered by Town well Zone IIs and discuss if the Town will also revise the boundaries of its aquifer protection zoning to reflect the elimination of these Zone IIs.

The FEIR should address how former water supply protection properties will be managed in the Preferred Alternative and discuss whether land currently within Zone1 may be sold or transferred.

Water Supply

The FEIR should discuss the feasibility and potential benefits of seeking an IBTA from the Merrimack River Basin and "wheeling water" through Andover. While this would require potential changes to Andover's WMA permit it may provide economic benefits compared to the Preferred Alternative. The FEIR should discuss consistency of this alternative with stated project goals and potential impacts to the Ipswich River Basin water balance.

The FEIR should provide additional discussion of converting the interconnection with Andover to an emergency-only supply in the Preferred Alternative. The FEIR should discuss why this interconnection must be maintained and discuss implications for permitting, the IBTA, and the current or any future IMA. The comment letter from the Town of Andover indicates that it is not supportive of acting as an emergency backup water supply for the Town. Furthermore, Andover noted that such a connection is not hydraulically possible and identified challenges with water quality due to the differences in water chemistry between Andover's and the MWRA's finished water. The FEIR should address alternative emergency water supply needs and provide an update on any meetings with Andover officials to discuss the Preferred Alternative.

The Preferred Alternative includes the forfeiture of the Town's local sources upon confirmation of a stable MWRA connection. The FEIR should discuss how decommissioning of abandoned wells will be conducted in a manner consistent with MassDEP's *Guidelines for Public Water Systems.*

Finally, the FEIR should specifically discuss how the Preferred Alternative will be consistent with the goals of the State's Sustainable Water Management Initiative (SWMI).

Wastewater

MassDEP comments indicated that it generally concurs with the factors used to develop the wastewater needs analysis. However, the FEIR should address the comments from MassDEP and include a revised analysis, as necessary. The FEIR should discuss the Town's ongoing need to manage remaining on-site disposal systems. Specifically, the FEIR should address: identification of Town resources to administer Title 5; track septic system pumping and repairs; and use or participation in MassDEP's Community Septic Management Program.

As requested by MassDEP, the FEIR should provide additional analysis of the groundwater discharge alternative at the DPW site. The Town should review site limitations that informed the assumption of a 0.3 gpd/sf loading rate, as MassDEP noted that this loading rate is substantially less than any facility operating under a typical groundwater discharge permit. The Town should consult with MassDEP regarding the loading rate prior to submitting the FEIR. If consultation results in a change in the loading rate, the Town should re-analyze discharge treatment capabilities. The FEIR should identify site constraints and describe consultation with MassDEP.

The FEIR should respond to MassDEP's comments regarding a potential reserve allowance of 100,000 to 150,000 gpd at the Berry Site (Edgewood Luxury Apartments) that was included in the project design. The FEIR should confirm the capacity allotted to the Town and describe and analyze potential use of this site to meet wastewater needs. Finally, the FEIR should discuss the feasibility of using the Hillview Country Club and U.S. Postal Service sites for groundwater discharge, including conceptual treatment capacities, relationship to identified needs areas, and any constraints that may preclude their incorporation into the Town's wastewater management plan. The potential cost and environmental impacts of these aforementioned in-Town treatment options should be provided to allow for comparison to the Preferred Alternative.

The DEIR indicated that the privately-owned WWTFs in Town will be abandoned under the Preferred Alternative. The FEIR should discuss how these WWTFs will be decommissioned, included the entity responsible for the cost and implementation of decommissioning.

It is clear from comments submitted by Andover that the Town must initiate meaningful discussion between the two parties to ensure the feasibility of the Preferred Alternative. Without a commitment by Andover to allow the Town to convey its wastewater through the Andover collection system, it is unclear how the Preferred Alternative can proceed. The FEIR must either a) include a commitment by Andover to agree in principle to the Preferred Alternative and outline issues that must be addressed by both communities prior to construction of the Preferred Alternative (i.e., impacts to Andover's infrastructure, potential cost and/or fees, etc.) or b) identify another alternative that meets the Town's wastewater needs that does not require approval by Andover. If a revised Preferred Alternative is proposed in the FEIR, the FEIR must include a comprehensive analysis of potential environmental impacts of all of its components, a revised donor basin analysis (if necessary) and an updated discussion of project impacts to the Ipswich River Basin. Furthermore, if a revised Preferred Alternative is proposed the Town must meet with the MEPA office, MassDEP and the WRC prior to submitting the FEIR to discuss the appropriate level of detail necessary in the review document to ensure comprehensive review.

Interbasin Transfer

The FEIR should include direct responses, with supporting data or graphics as necessary, to address the comments submitted by the WRC. I hereby incorporate these comments by reference into this Certificate.

The FEIR should identify potential opportunities to ensure that the project maximizes potential benefits to the Ipswich River Basin. In particular, I note the comments from the IRWA regarding limiting future backsliding away from current and proposed net benefits to the watershed due to the expanded use of private irrigation wells in Town. The FEIR should address comments from the IRWA and the Water Supply Citizens Advisory Committee (WSCAC) pertaining to establishment of a private well bylaw, requirements for additional sewer expansion, and water conservation measures. The FEIR should indicate if a bylaw and additional water conservation will be adopted and, if not, describe why they are not feasible. The FEIR should also discuss potential impacts on the established Safe Yield on the Ipswich River associated with how surrendering the Town's water withdrawal registration.

Wetlands and Waterways

If wetland crossings are required within the ROW, the FEIR should identify these locations (with supporting graphics as necessary) and indicate how impacts to wetlands will be avoided, minimized and mitigated. The FEIR should explain how the project will be designed to comply with applicable performance standards in the wetlands regulations (310 CMR 10.00) and demonstrate that alteration of wetland resource areas can be either avoided or minimized. The FEIR should identify stream crossings along the project route and the nature of the crossing (i.e., bridge span, culvert, etc.). The FEIR should note if culvert upgrades or other modifications to existing stream crossings will be required (or if new crossings are proposed) and confirm that new construction or modifications will meet MassDEP stream crossing requirements. Finally, I strongly encourage the Town to consider placing critical infrastructure outside of flood-prone areas to the maximum extent practicable.

Greenhouse Gas Emissions

The FEIR should include an updated GHG analysis to reflect changes to the Preferred Alternative and to address comments submitted by MassDEP. All GHG emissions should be presented in tons per year rather than pounds per day, consistent with the GHG Policy. MassDEP's comments focused on the high rate of fugitive methane emissions assigned to septic systems within the analysis. The FEIR should provide greater detail on the source of septic system emissions rates and assumptions made in the calculation of their potential GHG impact. The analysis should also reevaluate whether methane emissions and pelletization of sludge should be included in the GHG emissions calculations for the GLSD WWTF and whether methane emissions should be incorporated into the GHG emissions from the optimized High and Middle School WWTF. The FEIR should either provide revised calculations with a discussion of assumptions or explain the rationale for their omission from the analysis. The FEIR should also revisit the incorporation of GHG emissions from chemical production in the water treatment Baseline Case depending on whether these emissions are already accounted for in the average water treatment energy use for MWRA communities. Finally, the FEIR should consider the potential energy reduction measures attributable to water conservation measures. Reducing overall water demand and wastewater generation will further reduce project-related GHG emissions.

The FEIR should discuss energy efficiency measures implemented by the GLSD and MWRA to clarify how these systems independently focus on GHG emissions. The FEIR should discuss these energy efficiency measures in terms of systems equipment, operations, and water conservation initiatives. The FEIR should discuss how the proposed infrastructure and operations within the Town will be designed in a manner consistent with MWRA and GLSD sustainability goals.

The FEIR should provide additional analysis on potential PV systems to offset pumping station electrical costs, particularly at the Central Pump Station. The FEIR should compare potential PV generation to the overall electrical demand of the Central Pump Station and the five smaller pump stations. Potential PV generation should be estimated based upon not only available roof area of the pump houses, but also available area around these facilities for ground-mounted units. The FEIR should include conceptual site plans, especially for the Central Pump Station site, to allow for an assessment of

PV system feasibility and sizing. The DOER and MEPA are available to assist the Town in identifying appropriate resources to calculate potential project cost, payback periods, return on investment, and rebates or utility incentives. The Town should consider both first-party and third-party ownership/lease scenarios. The FEIR should state assumptions with regard to available area for PV equipment, efficiencies, etc. The Town should set up a pre-filing meeting to discuss assumptions and modeling protocols with DOER, MassDEP and the MEPA Office in advance of preparing the FEIR to assist in these modeling efforts.

Hazardous Waste

The FEIR should identify properties regulated under the MCP, locations of USTs and the presence of AULs to the project routes in Reading and Andover to identify potential for interaction with contaminated soil and groundwater. The FEIR should discuss hazardous waste mitigation measures to be implemented during the construction period within these communities.

Historic and Archaeological Resources

The FEIR should respond to the concerns raised by the Reading Historical Commission comment letter. It is unclear if construction is proposed in the vicinity of the Lob's Pound Mill archaeological site. The FEIR should describe the proposed work in this location, potential impacts and identify measures to avoid, minimize or mitigate impacts to archaeological resources.

Construction Period

The FEIR should discuss project staging and how staging areas will be identified and operated to avoid or minimize environmental impacts. The FEIR should discuss how water and/or wastewater services will be maintained during the construction period. Given the potential construction-related impacts near sensitive resources such as wetlands, endangered species habitat, or Article 97 lands, the DEIR should discuss post-construction mitigation measures for these areas with regard to re-seeding, revegetation, or other restoration efforts within the project corridor.

The FEIR should discuss measures to mitigate the construction period impacts of diesel emissions to the maximum extent feasible. This mitigation may be achieved through the installation of after-engine emission controls such as diesel oxidation catalysts (DOCs) or diesel particulate filters (DPFs). Construction equipment should use ultra low sulfur diesel (ULSD) fuel in off-road engines.

The DEIR proposed the sewering of the Martins Pond Study Area as the fourth phase of construction. Based on water quality concerns of Martins Pond, the FEIR should provide additional discussion on how construction phasing was determined to ensure that maximum benefit is achieved in the initial project phases.

Mitigation and Section 61 Findings

The FEIR should include a separate chapter summarizing proposed mitigation measures. The FEIR should include draft Section 61 Findings for each anticipated State Agency Action. The FEIR should contain clear commitments to implement these mitigation measures, estimate the individual costs of each proposed measure, identify the parties responsible for implementation, and a schedule for implementation.

In order to ensure that all GHG emissions reduction measures adopted by the Proponent in the Preferred Alternative are actually constructed or performed, I require proponents to provide a self-certification to the MEPA Office indicating that all of the required mitigation measures, or their equivalent, have been completed. Specifically, I will require, as a condition of a Certificate approving an FEIR, that following completion of construction the Proponent provide a certification to the MEPA Office signed by an appropriate professional (e.g., engineer, architect, transportation planner, general contractor) indicating that the all of the mitigation measures proposed in the FEIR have been incorporated into the project. Alternatively, the Proponent may certify that equivalent emissions reduction measures that collectively are designed to reduce GHG emissions by the same percentage as the measures outlined in the FEIR, based on the same modeling assumptions, have been adopted. The certification should be supported by plans that clearly illustrate where GHG mitigation measures have been incorporated. The commitment to provide this self-certification in the manner outlined above should be incorporated into the draft Section 61 Findings included in the FEIR.

Responses to Comments

The FEIR should contain a copy of this Certificate and a copy of each comment letter received. In order to ensure that the issues raised by commenters are addressed, the FEIR should include direct responses to comments to the extent that they are within MEPA jurisdiction in a separate Response to Comments section of the FEIR. This directive is not intended to, and shall not be construed to, enlarge the scope of the FEIR beyond what has been expressly identified in this Certificate.

Circulation

The Proponent should circulate the FEIR to those parties who commented on the ENF and/or the DEIR, to any State Agencies from which the Proponent will seek permits or approvals, and to any parties specified in section 11.16 of the MEPA regulations. A copy of the DEIR should be made available for review in the Reading, North Reading and Andover public libraries. To save paper and other resources, the Proponent may circulate copies of the DEIR to commenters other than State Agencies in a digital format (e.g., CD-ROM, USB drive) or post to an online website. Appendices to the hard copy FEIR's may also be provided on CD-ROM or USB drive. However, the Proponent should make available a reasonable number of full hard copies to accommodate those without convenient access to a computer to be distributed upon request on a first come, first served basis. The Proponent should send a letter accompanying the digital copy or identifying the web address of the online version of the FEIR indicating that hard copies are available upon request, noting relevant comment deadlines, and appropriate addresses for submission of comments. The FEIR submitted to the MEPA office should include a digital copy of the complete document.

May 13, 2016
Date

Matthew A. Beaton

Comments received:

4/1/2016	Massachusetts Historical Commission
4/5/2016	Town of Reading Historical Commission
4/19/2016	Massachusetts Water Resources Authority
4/21/2016	Water Resources Commission
4/22/2016	Town of Andover Department of Municipal Services
5/5/2016	Ipswich River Watershed Association
5/6/2016	Massachusetts Department of Environmental Protection – Northeast Regional Office (MassDEP-NERO)
5/6/2016	Water Supply Citizens Advisory Committee

MAB/HSJ/hsj

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MEPA

The Commonwealth of Massachusetts
William Francis Galvin, Secretary of the Commonwealth
Massachusetts Historical Commission

April 1, 2016

Secretary Matthew A. Beaton
Executive Office of Energy & Environmental Affairs
Attn: Holly Johnson, MEPA Unit
100 Cambridge Street, Suite 900
Boston, MA 02114

Dear Secretary Beaton:

RE: North Reading Water Supply and Wastewater Management Plan, North Reading and Reading, MA. MHC# RC.53336. **EEA #14975.**

Staff of the Massachusetts Historical Commission have reviewed the Draft Environmental Notification Form (DEIR), received March 25, 2016, for the project referenced above and have the following comments.

The MHC proposes to review phased water supply and wastewater management projects as they are designed. Project planners should submit scaled project plans showing existing and proposed conditions to the MHC for review and comment for each phase of improvements or expansion projects, including wastewater treatment plant location(s), recharge areas, pump stations, equipment storage and materials staging areas and cross-country water and/or sewer right-of-ways.

If the project requires federal funding, licensing, permits or approvals, such as use of State Revolving Fund funding administered by the Massachusetts Department of Environmental Protection, then the MHC will continue to review the project pursuant to Section 106 of the National Historic Preservation Act of 1966, as amended (36 CFR 800) in consultation with the involved federal agencies.

DEIR Section 9.3.8 (pg 9-18) and Figures 8-2, and 9-1 to 9-3 discuss and show preliminary project impact areas in relation to historic resources included in the MHC's Inventory of Historic and Archaeological Assets of the Commonwealth. Project planners should continue to consult the Inventory of Historic and Archaeological Assets of the Commonwealth for identified historic and archaeological properties. The MHC notes that the project does not currently include impacts at the Lob Pound Mill Site (MHC # REA.HA.1) on the Ipswich River off Mill Street at the Reading/North Reading border or the North Reading Department of Public Works property.

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www.sec.state.ma.us/mhc

Project planners should continue to consider feasible design and locational considerations that meet the engineering requirements, while also seeking to avoid or minimize impacts to historic and archaeological properties and areas. Proposed above-ground construction (e.g. pump stations) in historic areas should be designed to be compatible and sensitive to the historic characteristics of the surroundings. Design elements for new construction in historic areas should consider size, scale, massing, height and materials in developing the specifications, and also consider vegetative screening to minimize visual effects. The MHC encourages project planners to continue to consult with the North Reading and Reading Historical Commissions as project planning proceeds.

The MHC looks forward to reviewing the information requested above and to continued consultation to avoid, minimize or mitigate adverse effects to significant historic and archaeological resources.

These comments are offered to assist in compliance with Section 106 of the National Historic Preservation Act of 1966, as amended (36 CFR 800), and/or Massachusetts General Laws, Chapter 9, Sections 26-27C (950 CMR 71) and MEPA (301 CMR 11). If you have questions or require additional information please contact Jonathan K. Patton at this office.

Sincerely,

Brona Simon

Brona Simon
State Historic Preservation Officer
Executive Director
State Archaeologist
Massachusetts Historical Commission

xc: Paul Brinkman, Wright-Pierce
Mark Clark, North Reading Water Department
George Zambouras, Reading Engineering Department
DEP-NERO, BRP
North Reading Historical Commission
North Reading Historic District Commission
Reading Historical Commission

Town of Reading
16 Lowell Street
Reading, MA 01867-2683

HISTORICAL COMMISSION
historical@ci.reading.ma.us
(781) 942-6661
Fax (781) 942-6071

April 5, 2016

Matthew A. Beaton, Secretary of Energy and Environmental Affairs
Executive Office of Energy and Environmental Affairs
Attn: MEPA Office, Holly Johnson, Analyst
EEA No. 14975
100 Cambridge Street, Suite 900
Boston MA 02114

Re: **Reading Historical Commission's Comments to Draft Environmental Impact Report for the Town of North Reading's Water Supply Source – EEA# 14975**

Dear Secretary Beaton and Ms. Johnson:

The Reading Historical Commission (RHC) submits these comments in response to North Reading's recently filed Draft Environmental Impact Report (DEIR) regarding that town's long-term water supply and wastewater management systems (EEA# 14975). RHC continues to have concerns about and objection to any significant adverse impacts of this proposed project upon the Town of Reading's historic Lob's Pound Mill archeological site. This historic site is registered and included on Reading's Inventory of Historic Sites, and is included on the Massachusetts Historical Commission's Inventory of Historical and Archeological Assets (Lob's Pound Mill MHC# REA.HA.1). Earlier in the process, RHC had submitted a comment letter to representatives of both towns, Reading and North Reading, concerning this proposed project. Attached, please find a copy of that letter, to be attached to and incorporated as a part of this comment letter.

With respect to the water supply component of this project, North Reading proposes a connection to Reading's water supply system on Reading's property at the intersection of its border with North Reading and the Ipswich River at the Mill Street Bridge. North Reading initially proposed to also construct an associated water pump station at this location, and RHC is pleased to note North Reading now intends to locate that pump station on other property elsewhere in that town. Nonetheless, the water connection on this site still necessitates significant invasive construction work to make the connection, as well as to run a major water main directly through the archeological site and across the Ipswich River into North Reading in the area of the Mill Street Bridge.

As we noted in our earlier attached letter, this is the site of Reading's former 1890's waterworks plant. And most significantly, this is also the historic Lob's Pound Mill site; an extremely precious and important archeological landmark as the location of Reading's seventeenth century saw mill and gristmill. This mill enabled the provision of food and building materials to Reading's earliest settlers, and operated continuously from 1690 through 1892. It was instrumental in originally settling the north end of Reading, and it's a priceless and treasured historic asset to the RHC and to the Town of Reading. We note that a depiction of the Lob's Pound Mill holds a prominent place on the Reading Town Seal.

In addition to the historical significance of this site as referenced above, it also contains many remaining significant archeological features reflecting its important history including original granite foundation blocks and walls, sluiceways and remains of canals, flumes and mill ponds associated with the mill and 1890's waterworks plant. Several *significant* archeological features are located around and within the existing roadway area, including granite foundation blocks that today are integrated into the foundation of the Mill Street Bridge. In addition, numerous significant historical records and artifacts associated with the Lob's Pound Mill and waterworks plant remain in the RHC's archives, documenting and preserving the site's significance and wondrous place in the history of Reading, the Commonwealth and New England. Among these records are eighteenth and nineteenth century deeds, wills, maps, mill utilization records, genealogical history records, meeting notes, sketches, drawings and photos.

MHC noted in its 1/27/16 comment letter concerning this DEIR (attached) that any consideration of this alternative for a water supply connection to North Reading should include MHC consultation. We note that this review process regarding a designated MHC Historical and Archaeological Asset, as well as further MEPA review, is required per M.G.L. c. 30, ss. 61-62I, M.G.L. c, 9, ss. 26-27c, as well as MEPA regulations, 301 CMR 11.00.

RHC acknowledges with appreciation that North Reading has removed this site from consideration to locate its new water pump station associated with this project. However, it remains vitally important that the integrity of this site and its archeological features not be disturbed, undermined, adversely impacted or jeopardized by any other activity related to this project. This includes the proposed new water connection and new water main line running into North Reading through this site. Contrary to the assertion in the DEIR (at Section 9.3.8) that any remaining impact to archeological resources would be minimal where construction will occur in existing roadway areas and any remaining historic sites are houses, barns or other structures located off the right of way, RHC submits that assertion is not accurate. The roadway, and in particular the Mill Street Bridge, contain invaluable archeological features and aspects that are integral to the site's historical/archeological significance. These certainly would be adversely impacted by any construction within the roadway or visible water mains hanging from, along or under the bridge. North Reading representatives recently suggested in response to this issue that it is a common practice to tunnel any new pipes underneath the site and under the Ipswich River into North Reading, a suggestion that RHC whole-heartedly supports.

We urge you to consider this information and the sanctity and importance of this treasured historic and archaeological site. We understand this process contemplates additional meetings to seek to avoid, minimize or mitigate adverse effects to significant historic/archeological resources. RHC believes the potential threat of such adverse impacts upon this historic archeological site remains significant. We respectfully request that RHC representatives may attend and participate in such meetings as this process proceeds.

If you should have any questions or if we can provide any further information or assistance, please do not hesitate to contact us. Thank you for your consideration.

Sincerely,

Carl Mittnight

Carl Mittnight, Chair
on behalf of the Reading Historical Commission

CC: Brona Simon, Executive Director, Massachusetts Historical Commission (MHC)
Jonathan K. Patton, Archaelogist/Preservation Planner, MHC
Paul Brinkman, Senior Project Engineer, Wright-Pierce (Consultant to NRWD)
James Hoyt, Wright-Pierce

North Reading Board of Selectmen
Mark Clark, North Reading Water Department
North Reading Historical Commission
Martin Weiss, Chair, North Reading Conservation Commission

Bob LeLacheur, Reading Town Manager
Jean Delios, Reading Community Planning Department
George Zambouras, Reading Engineering Department
Brian F. Sullivan, Chair, Reading Conservation Commission
Reading Board of Selectmen
Reading Historical Commission

Attachments: (2)

Town of Reading
16 Lowell Street
Reading, MA 01867-2683

HISTORICAL COMMISSION
historical@ci.reading.ma.us
(781) 942-6661
Fax (781) 942-6071

December 14, 2015

To: Bob LeLacheur, Reading Town Manager
Jean Delios, Reading Community Planning Department
George Zambouras, Reading Engineering Department
Mark Clark, North Reading Water Department
Brian F. Sullivan, Chair, Reading Conservation Commission
Martin Weiss, Chair, North Reading Conservation Commission
Paul Brinkman, Senior Project Engineer, Wright-Pierce (Consultant to NRWD)
Brona Simon, Executive Director, MHC, Massachusetts Historical Commission
North Reading Board of Selectmen
Reading Board of Selectmen
North Reading Historical Commission
Reading Historical Commission

Re: **North Reading's Water Supply Source DEIR Process and Preserving Reading's Historic Lob's Pound Mill Archeological Site**

The Reading Historical Commission (RHC) writes to Reading and North Reading Town representatives, to communicate our grave concerns and objection to their further consideration of the vicinity of the historic Lob's Pound Mill site as a viable water connection and/or pump station location in furtherance of North Reading's efforts to improve and enhance its drinking water supply sources.

RHC recently became aware that the Town of North Reading is considering several alternative means to improve and enhance that Town's drinking water supply sources. We understand North Reading is currently proceeding with a DEIR review process in support of its efforts. As we understand the current status of this effort, North Reading considers as the most viable and favorable water source alternative, a connection to Reading's water supply system and a pump station on or near Reading's property at the intersection of its border with North Reading and the Ipswich River at the Mill Street bridge. This Reading property, both north and south of the Ipswich River, is the site of Reading's former 1890's waterworks plant, which was located on Reading-owned property south of the Ipswich River. And most significantly, it is also the historic Lob's Pound Mill site; an extremely precious and important archeological landmark as the location of Reading's seventeenth century saw mill and gristmill. The mill straddled the Ipswich River, with a substantial portion located on Reading-owned property north of the River; property that remains owned by the Town of Reading today. This mill enabled the provision of food and building materials to Reading's earliest settlers, and operated continuously from 1690 through 1892. It was instrumental in originally settling the north end of Reading, and it's an invaluable and treasured historic asset to the RHC and to the Town of Reading. We note that a depiction of the Lob's Pound Mill holds a prominent place on the Reading Town Seal.

Years ago, the RHC submitted the Lob's Pound Mill site to the Massachusetts Historical Commission (MHC) for nomination as a significant archeological site under the National Register of Historic Places Inventory Nomination process in accordance with Massachusetts General Laws. The nomination was accepted, and is referenced as #RC.53336. Accordingly, the site is eligible for Archeological Landmark status in accordance with MGL Chapter 9, sections 26 and 27. In addition to the historical significance of this site as referenced above, it also contains many remaining significant archeological features *reflecting* its important history including original granite foundation blocks and walls, sluiceways and remains of canals, flumes and mill ponds associated with the mill and 1890's waterworks plant. In addition, numerous significant historical records and artifacts associated with the Lob's Pound Mill and waterworks plant remain in the RHC's archives, documenting and preserving the site's significance and wondrous place in the history of Reading, the Commonwealth and New England. Among these records are eighteenth and nineteenth century deeds, wills, maps, mill utilization records, genealogical history records, meeting notes, sketches, drawings and photos. The MHC notes that any consideration of this alternative for a water supply connection to North Reading on this site must have MHC review.

For these reasons, it is vitally important that the integrity of this site and its features not be disturbed, adversely impacted, undermined or jeopardized by any activity, including this public works water supply project currently being considered by the towns of Reading and North Reading. We urge you to consider this information and the sanctity and importance of this treasured historic and archaeological site. Please halt any further consideration of this site and its vicinity for this proposed project. Surely, there must be other alternative locations or options, which would not risk or threaten a vulnerable, irreplaceable and priceless historic asset.

If you should have any questions or if we can provide any further information or assistance, please do not hesitate to contact us. Thank you for your consideration.

Sincerely,

Carl Mittnight

Carl Mittnight, Chair
on behalf of the Reading Historical Commission

The Commonwealth of Massachusetts
William Francis Galvin, Secretary of the Commonwealth
Massachusetts Historical Commission

January 27, 2016

James Hoyt
Project Engineer
Wright-Pierce
40 Shattuck Road, Suite 305
Andover, MA 01810

RE: North Reading Water Supply and Wastewater Management Plan, North Reading and Reading, MA. MHC# RC.53336. EEA #14975.

Dear Mr. Hoyt:

Staff of the Massachusetts Historical Commission (MHC) have reviewed the letter submitted regarding the public meeting associated with preparation of the Draft Environmental Impact Report (DEIR), received January 22, 2015, for the project referenced above.

Staff of the MHC are unable to attend the proposed public meeting. A paper hardcopy of the DEIR, with plans and figures sized no larger than 11" x 17" format, should be submitted to the MHC for review and comment when it is filed with the MEPA office.

Please find enclosed a copy of comments on the project prepared by the Reading Historical Commission received by the MHC for your consideration during the preparation of the DEIR. The historic property referenced in the RHC's comments is included in the MHC's Inventory of Historic and Archaeological Assets as the Lob's Pound Mill (MHC # REA.HA.1). The MHC looks forward to consultation to avoid, minimize or mitigate adverse effects to significant historic and archaeological resources as project planning proceeds.

These comments are provided to assist in compliance with Section 106 of the National Historic Preservation Act of 1966, as amended (36 CFR 800) and Massachusetts General Laws, Chapter 9, Sections 26-27C (950 CMR 71) and MEPA (301 CMR 11). If you have questions, please contact me at this office.

Sincerely,

Jonathan K. Patton
Archaeologist/Preservation Planner
Massachusetts Historical Commission

xc w/o encl: Paul Brinkman, Wright-Pierce
Mark Clark, North Reading Water Department
Reading Historical Commission

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MASSACHUSETTS WATER RESOURCES AUTHORITY

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Frederick A. Laskey
Executive Director

Telephone: (617) 242-6000
Fax: (617) 788-4899
TTY: (617) 788-4971

April 19, 2016

Matthew A. Beaton, Secretary
Executive Office of Energy and Environmental Affairs
100 Cambridge St, Suite 900
Attn: MEPA Office, Holly Johnson
Boston, MA 02114

Subject: EOEEA # 14975, Draft Environmental Impact Report
Town of North Reading, MA

Dear Secretary Beaton:

The Massachusetts Water Resources Authority appreciates the opportunity to comment on North Reading's Draft Environmental Impact Report (DEIR) on water and wastewater solutions.

North Reading is seeking approval to join the MWRA as a fully supplied MWRA community and to withdraw 1.6 mgd on an average annual basis and 2.58 million gallons on a maximum day. Water from MWRA would replace North Reading's groundwater withdrawals in the Ipswich River Basin as well as the town's water purchases from the Andover Water System. As proposed in the DEIR, water from MWRA would be conveyed to North Reading via wheeling through Reading.

North Reading's proposal is consistent with MWRA's goal to advance reasonable water system expansion. MWRA is in a strong position to serve communities since the demand in our Water Service area is considerably below our reservoirs' Safe Yield. There has been a dramatic reduction in MWRA water system use from 330 mgd in the late 1980s to 200 mgd today. The DEIR presented MWRA's detailed donor basin analysis: the analysis demonstrates that water may be supplied to North Reading without adverse impact on the MWRA system, existing users, and the rivers downstream of MWRA's reservoirs. MWRA's analysis considered cumulative demands of North Reading and other potential new communities, as well as population and employment growth in the existing MWRA service area.

Not only is MWRA water supply more than adequate, robust infrastructure exists to serve North Reading, as other new communities at the level of demand contemplated. MWRA is in the process of constructing redundancy improvements to its Northern Intermediate High (NIH) System which serves Reading, Wilmington, Stoneham, Wakefield, Winchester, and Woburn (Reading and Stoneham are fully supplied, whereas the other communities are partially served by MWRA and use MWRA in combination with local sources). The NIH improvements provide redundancy, and enhance reliability, flow and pressure for both existing communities and MWRA water system expansion to the north, such as North Reading. As part of NIH improvements, MWRA is constructing a second meter and interconnection with Reading that will provide excess capacity for MWRA to deliver water to Reading to feed North Reading to meet both average and peak demands.

MWRA water wheeled to North Reading via Reading would be metered and withdrawal limits defined in the terms of MWRA's Water Supply Agreement with North Reading: MWRA's Water Supply Agreement with Reading referenced in the DEIR only pertains to Reading's withdrawals from MWRA for the Town of Reading's needs and would not constrain Reading's ability to wheel MWRA water to North Reading.

MWRA supply to North Reading will have a positive effect on local water sources. Use of MWRA's large multi-year reservoirs to reduce or replace withdrawals from local sources can be part of an effective regional water management approach to reduce or replace withdrawals from local sources in highly flow altered communities such as North Reading and is consistent with the State's Sustainable Water Management Initiative.

As the DEIR notes, MWRA's Operating Policy 10, *Admission of New Community to MWRA Water System,* requires the adoption of effective demand measures by the Community. #OP.10 encourages communities to have a water conservation plan that adheres to the Commonwealth's Water Conservation Standards. To this end, MWRA has a number of water conservation and efficiency programs to help sustain North Reading's water conservation efforts and facilitate the water conservation goals noted in the DEIR. MWRA's leak detection regulations require MWRA water served communities to complete a leak detection survey of their entire distribution system at least once every two years and repair water leaks that are detected. MWRA has a task-order contract that provides high quality leak detection services at a reasonable cost that has been bid taking advantage of the large volume of work anticipated throughout the regional system. MWRA also has a Local Water System Assistance Program (LWSAP) that communities have used to fund meter replacement and program upgrades. Further, MWRA supplies water conservation public education and low-flow shower heads, low-flow faucet aerators, and leak detection dye tablets at no cost to member communities and individual customers within the service area. In terms of water quality, the MWRA Board of Directors recently approved an enhancement to the LWSAP to provide up to $100 million in 10-year zero interest loans to communities solely for efforts to fully replace lead service lines.

On the Wastewater side, the DEIR indicates that North Reading's wastewater management needs are 503,000 gallons per day on an average daily flow basis. The DEIR also indicates that a wastewater discharge to the Greater Lawrence Sanitary District was found to be the most feasible out of town solution for North Reading. Regarding the alternative to discharge wastewater to MWRA, the DEIR cites MWRA's Policy OP#11, *Admission of New Community to MWRA Sewer System and Other Requests for Sewer Service To Locations Outside MWRA Sewer Service Area.* To offset new flow from outside the service area, OP#11 requires that for every gallon of wastewater added by the new community, the new community must pay for the removal of 4 gallons per day (gpd) of inflow in the transporting community or further downstream. To date, MWRA has not had requests for sewer service from outside the service area of the 503,000 gpd magnitude presented in North Reading's DEIR, and indeed, the inflow removal program associated with a 503,000 gpd discharge would be large and likely difficult to accomplish. However, historically there have been smaller connections from outside the service area that have satisfied OP#11 requirements and as noted in the DEIR, MWRA does provide sewer service to a complex straddling the North Reading and Wilmington town line, which is connected to MWRA via the municipal sewer of Reading at the Reading/Wilmington town line.

We look forward to continued coordination with North Reading, state agencies, and interested parties regarding North Reading's entry into the MWRA Waterworks system. If you have any questions, please do not hesitate to contact Pam Heidell, Policy and Planning Manager, at 617 788 1102.

Sincerely,

Marianne Connolly

Marianne Connolly
Senior Program Manager
Env. Review and Regulatory Compliance

cc:

Pam Heidell, MWRA
Joseph Favaloro, MWRA Advisory Board
Michael Gilleberto, North Reading
Paul Brinkman, Wright-Pierce
Rob Williamson, Wright-Pierce

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THE COMMONWEALTH OF MASSACHUSETTS

WATER RESOURCES COMMISSION

100 CAMBRIDGE STREET, BOSTON MA 02114

April 21, 2016

RECEIVED
APR 21 2016
MEPA

Matthew Beaton, Secretary
Executive Office of Energy and Environmental Affairs
Attention: Holly Johnson, MEPA Office
EOEA #14975
100 Cambridge Street
Boston, MA 02114

Dear Secretary Beaton:

The Water Resources Commission (WRC) staff has reviewed the DEIR/Interbasin Transfer Act (ITA) Application for Town of North Reading's New Water & Wastewater Solutions Project. The DEIR discusses a proposal to obtain water supply from the Massachusetts Water Resources Authority (MWRA), an action that represents a change in operating rules by the MWRA, triggering the Interbasin Transfer Act (ITA).

In 1991, the WRC approved a request from North Reading to supplement its water supply through the purchase of additional water from the City of Andover. Page 3-15 of the DEIR states that this "permit" was issued by the "MassDEP (formerly the Water Resources Commission)". Please note that the WRC still exists and is a separate entity from MassDEP. Although MassDEP is a member of the WRC, it is the WRC, not the MassDEP, that administers the ITA. An ITA approval is not technically a permit, but a decision with the force of law.

The DEIR describes the conditions required by the WRC as part of its 1991 ITA approval. Since that time, the WRC has adopted Performance Standards that outline exactly what sort of measures and documentation must be in place in order to demonstrate compliance with the criteria of the Act and its regulations. The Performance Standards and the Scope to address ITA issues in an EIR (which list the Performance Standards) were provided to the Town's consultant in 2012 and should be addressed fully in the FEIR, following the guidance in this letter.

Because of our 1991 review of North Reading's ITA request to purchase water from Andover, we are aware of the lack of viable sources in North Reading and the surrounding in-basin area. Since 1991, many studies of the Ipswich River Basin have been conducted (some funded by the WRC) that support the need for supplementing water supply with an out-of basin source. In 1991, the WRC concluded that North Reading had made all reasonable efforts to identify and develop all viable sources in the receiving area of the proposed interbasin transfer. We know of no additional viable in-basin water supply sources having become available since that time.

The DEIR states (page 9-39) that the recommended plan requires the formal decommissioning of North Reading's local sources and the forfeiture of the existing withdrawal registration. As a result, North Reading would not withdraw any water from the Ipswich River basin; it would obtain 100% of its water supply from the MWRA. The reasons for this are deteriorating water quality and increased treatment costs, as well as the need to replace the aging water supply infrastructure, at great expense. In addition, the new requirements of the Water Management Act, administered by MassDEP, will make it more difficult to obtain the quantity of water supply, above its current registered amount, that the Town needs to meet the public health and safety needs of its customers. One of the basic requirements of the ITA is that local water supply sources are used to the maximum extent possible prior to obtaining permission to transfer water from out of basin. However, given all of these conditions, coupled with the well documented flow-depleted condition of the Ipswich River Basin, **the WRC has all the information it needs to evaluate North Reading's current proposal against Criterion 2 of the ITA regulations**: That all reasonable efforts have been made to identify and develop all viable sources in the receiving area of the proposed interbasin transfer.

The information provided in support of the Local Water Resources Management Plan, required by the ITA regulations, 313 CMR 4.05(7), is comprehensive and well presented **and no further information is needed to demonstrate compliance with this requirement.**

However, in order to fully evaluate this request against other criteria of the ITA and its regulations, the WRC requires that North Reading provide the following additional information in its FEIR.

Water Loss Control and Accountability

- The ITA Performance Standards require that unaccounted-for water (UAW) should be 10% or less. North Reading does not meet the ITA Performance Standard for UAW. The FEIR should discuss how the Town intends to better account for water use and describe its water loss control program. This program should be described in detail and be as specific as possible, listing the actions that have been implemented or are scheduled to be implemented in the very near future. Section 9.1.3.2 discusses plans to appropriate funds at Town Meeting in FY17 for a water system audit to identify the causes of UAW. Water audits are an important first step of water loss control and help to categorize losses from a system. Will this water audit be conducted according to the American Water Works Association methodology (M-36) or other similar methodology? A description of the method for the water audit and any proposed validation of the audit should be provided in the FEIR. The FEIR should also provide an update on the status of the Town Meeting appropriation.

- The DEIR states that the last leak detection survey was conducted in 2014. The report from this survey must be provided and should include a description of the methodology used (this can be provided electronically or, if it is available on-line, a link can be provided). Section 9.1.3.3 recommends that leak detection surveys should be conducted every two years. We suggest that the results and recommendations of the water audit be reviewed prior to scheduling the next leak detection survey, to assure that water loss control activities are best focused and prioritized. If an additional leak detection survey is to be scheduled, the schedule for this survey should be provided in the FEIR. If the survey is conducted prior to the submittal of the FEIR, the survey report should also be provided, if completed. If the report has not been completed at the time of the FEIR submittal, the FEIR should list the schedule for completion.

- Provide documentation of the master meter and sub-master meter calibration conducted in February 2016 and described on page 9-5. It is stated that 11 meters across six sites were calibrated. What percentage of the master and sub-master meters did this calibration cover? The DEIR recommends conducting master and sub-master meter calibrations on an annual basis. Annual master meter calibration is also a requirement of the ITA Performance Standards. Does the Town commit to annual master meter calibration?

- Provide a timeline for installation of Advanced Metering Infrastructure (AMI) system. Will the AMI system be installed for all water users, or just residential customers?

Water Rates

- Section 8D of the ITA (MGL Chapter 21) outlines the "criteria upon which the commission shall base its approval or disapproval of any proposed interbasin transfer of waters", including the "implementation of rate structures which reflect the costs of operation, proper maintenance and water conservation and encourage the same" (subsection (2)(c)). Section 9.1.3.5 of the DEIR recommends that North Reading conduct a rate study to develop a plan to establish water rates based on capital improvements, O&M costs and the costs to purchase water (presumably from the MWRA). Details of this study and a schedule for it to be conducted and implemented should be included in the FEIR.

Drought Management Planning

- Provide the 2013 Drought Management Plan and the Water Use Restriction Bylaw. Specify the details of water use restrictions, including triggers for restrictions and any additional stages besides Stage 1, as presented in Appendix E of the DEIR. (These can be provided electronically or, if it is available on-line, a link can be provided.)

Public Facilities

- In 1991, North Reading reported that all public buildings, with the exception of the police and fire department buildings, had been retro-fitted with water saving fixtures. Since that time, water fixtures have become more efficient, and a water audit was conducted by North Reading in 2014 on its public facilities recommended upgrades. North Reading plans to appropriate $26,000 at the fiscal year 2017 town meeting to complete these upgrades. The FEIR should include the copy of the Public Building Audit Report, documentation of the recommendations that have been implemented, and a schedule for those still to be implemented (this can be provided electronically or, if it is available on-line, a link can be provided).

Residential Water Use

- The DEIR states that the residential water use, in gallons per capita per day (rgpcd), is on average about 67 rgpcd, which is higher than the ITA Performance Standard goal of 65 rgpcd. This is based on residential water use values listed in Table 4-3, of which, a few years are slightly lower than the actual residential water use values that MassDEP determined following a review of the town's data. Using the MassDEP-determined values for the years 2010 to 2014, the average is 69 rgpcd. The DEIR discusses water conservation measures the town is considering. However, in order to meet this Performance Standard, North Reading should be implementing a comprehensive residential conservation program that seeks to reduce residential water use through a retrofit, rebate or other similarly effective program for encouraging installation of household water saving devices, including faucet aerators, showerheads and toilets and through efforts to reduce outdoor water use. The DEIR makes many recommendations for water conservation (e.g. rebates for low flow fixtures, residential water use audits), but North Reading must state which of these it will actually implement, provide an approximate estimate of water use savings, and provide a timetable for implementation. The FEIR should present a prioritization for implementation based on expected water savings (including actions which are listed as 'Low Priority' for town in Table 5-1) to help guide the Town in future conservation efforts.

- Provide the URL(s) for North Reading's water conservation web page discussed on Page 3-29. Provide a timeline for the development of a water conservation public education plan, also mentioned on this page.

Non-Residential Water Use

- The DEIR states that North Reading is planning to conduct water audits for non-residential users in Town, starting with the highest users in this category. What is the timetable for conducting these audits?

Other Comments

- Section 9.3.3 states "Switching to the MWRA for a water source would reduce demand in the Ipswich River basin. On the other hand, sending a portion of the wastewater out of basin would reduce the amount of water returned to the basin." Actually, switching to MWRA (and eliminating the use of North Reading's local sources) would not reduce demand **in** the basin. Only a demand management program will do this. But it will reduce demand **on** the basin.

Sewering North Reading's wastewater to the Greater Lawrence Sewer District, if no water is concurrently being pumped out through the use of North Reading's local sources, will have a neutral impact on the basin. For the areas not being sewered, discharge of water from an out of basin source (i.e. the MWRA) via septic systems will be an environmental plus for the water quantity of the Ipswich River Basin.

The ITA Chapter 21 §8D(3) requires that all required information has been provided and that the MEPA process is complete, before the WRC can move forward with its public hearing and decision making process. We hope that North Reading will use the FEIR to fully respond to our request for additional information, so that the ITA process can commence once the final EIR certificate has been issued on this project. If all the required information has been provided through the MEPA process, the WRC will then have 60 days to hold the two required public hearings. A decision on the ITA request must be made 60 days after the completion of the final public hearing held by the WRC. We look forward to the completion of the MEPA process and the commencement of the formal ITA decision making process.

Thank you for the opportunity to comment.

Sincerely,

Kathleen M. Baskin

Kathleen Baskin, P.E.
Executive Director

cc: Water Resources Commission
ecc: Richard Carnevale, North Reading
Paul Brinkman, Wright Pierce
Vandana Rao, EEA
Michele Drury, DCR
Erin Graham, DCR
Anne Carroll, DCR
Nathaniel Tipton, DCR
Nancy Baker, MassDEP, NERO
Kevin Brander, MassDEP, NERO
Duane LeVangie, MassDEP
Shi Chen, MassDEP
James Persky, MassDEP, NERO
Eric Worrell, MassDEP, NERO
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TOWN OF ANDOVER, MASSACHUSETTS

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DEPARTMENT OF MUNICPAL SERVICES
WATER TREATMENT PLANT
397 LOWELL STREET 01810 -4416

April 22, 2016

Mr. Matthew A. Beaton, Secretary
Executive Office of Energy and Environmental Affairs
Attn: MEPA Office
Holly Johnson, EEA # 14975
100 Cambridge Street, Suite 900
Boston, MA 02114

Re: Draft Environmental Impact Report
North Reading Water and Wastewater Solutions

Dear Secretary Beaton:

The Town of Andover appreciates the opportunity to comment on the Draft Environmental Impact Report (DEIR) for North Reading's Water and Wastewater Solutions published in MEPA office *The Environmental Monitor* on March 23, 2016.

The DEIR addresses long-term water supply and a public wastewater management system for the Town of North Reading. The proposed water and wastewater management plans are to (1) seek membership with the MWRA for the town's water supply, thereby discontinuing daily purchases of finished water from the Town of Andover and maintaining the interconnection between the two towns for emergency service only; and (2) route the flow of 0.5 million gallons (MDG) of wastewater per day through the Town of Andover to the Greater Lawrence Sanitary District.

Water

Andover takes exception to the statement in the second paragraph on page 1-2 that the water supply from Andover presents challenges to North Reading; and under occasions of high demand the flow through the interconnections has been restricted, resulting in the Town [North Reading] being unable to meet the water needs of its citizens. There was only one event when the flow of water to North Reading was decreased. This occurred in July 2010 when excessive high demand, beyond the control of both towns, required Andover to request North Reading to throttle back the flow through the interconnection on Main Street to 30 percent of its capacity. This was done for a period of approximately 18 hours. Flow through the interconnection at Gould Road/Central Street never decreased.

Please clarify the statement in the last two sentences of the second paragraph on p. 5-2; "On days of maximum demand, the supply deficit is made up from purchases from Andover. The excess supply purchases *may* exceed the Town's existing Interbasin Transfer Act permit limitations." The projected maximum day demand of 2.58 MGD ***will*** exceed the Town's existing ITBA permit limitations. Andover is currently permitted to provide up to 1.5 MGD. Any volume of water greater than 1.5 MGD cannot be purchased from Andover, or the ITBA permit limitations will be exceeded.

Andover takes exception to the statements in the fifth paragraph of p. 5-2 concerning the operational reliability of Andover's interconnection with North Reading. North Reading owns and operates the interconnection; Andover controls the water supplied to this connection. Interruptions of a water supply to ***any*** end-user could be impacted due to events outside the control of the supplier, such as supply interruptions from pipe breaks, hydraulic restrictions, or other system outages. Such events are not exclusive to the interconnections between Andover and North Reading. Also, we disagree with the statements in the same paragraph regarding the water rates that Andover charges its customers. North Reading currently pays the same water rate that Andover charges all its water customers; and future increases in the water rates were established in the signed IMA between the two towns. North Reading could be subject to higher user rates by any supplier it chooses to purchase water from, including the MWRA. This is true for any customers purchasing a commodity or being serviced by a utility, including water.

In the discussion regarding Out of Town Alternatives (see p. 5-13 of Section 5.1.4), and Andover's ability to provide a long-term water supply to North Reading, it is stated that "Andover has the capacity to provide North Reading's ADD but is unable to meet the projected MDD of 2.58, without modifying their WMA Permit." Why did the DEIR not address the possibility of North Reading seeking an ITBA permit to withdraw water from the Merrimack River, and "wheeling water" through Andover? Or, make an ITBA request as well as seek a WMA permit modification to increase Andover's withdrawal from the Merrimack River for the purpose of supplying water to North Reading?

Andover has meet with the Town of North Reading to discuss the possibility of supplying water to North Reading to meet all its current and forecasted needs. Similar to the MWRA option, improvements to both Andover's and North Reading's distribution systems would be required; however, it could be a more economically viable option, taking into account water rate structure and system improvements, for North Reading to continue to purchase water from Andover.

On p. 5-13, the statement is made that Reading's water system maintains emergency connections with neighboring water supply systems in Wakefield and Auburn. Is this correct? Auburn is located in central Massachusetts.

The ENF Certificate requires the DEIR to discuss plans regarding how the Town of North Reading will maintain an emergency water supply (refer to page 6, "Water Supply"). Statements within the DEIR present the idea that once connected to MWRA, North Reading plans to maintain the interconnection with Andover for the purpose of providing the backup emergency water supply. The DEIR, however, fails to provide detail on whether or not this concept been discussed with Andover; or whether or not there is a regulatory requirement for Andover to provide an emergency backup water supply. Will North Reading continue to maintain their interconnections with Middleton, Lynnfield, and Wilmington? If yes, why would the connection to Andover be needed?

If North Reading and Andover were to mutually agree to maintain the 2 interconnections for the purpose of emergency back-up water supply, the DEIR fails to address the need for an IMA agreement between the two communities; outlining the responsibilities for the interconnections and water supply in the event of an emergency. The DEIR only includes a statement in Section 5.2.1.5 on p. 5-24, that the existing IMA with Andover will not be renewed when it expires on July 1, 2019.

Additionally, the statement is made in the second paragraph of p. 5-24, "by maintaining an emergency connection with Andover, an emergency connection between Andover and Reading may result and allow Reading to fully abandon their local sources." This statement is again repeated in the third paragraph of p. 9-71 of the DEIR. Andover is not interested in becoming an emergency backup water supply for the Town of Reading. It is not hydraulically possible; and the difference in the water chemistry between Andover's treatment process for finished water and the MWRA's finished water (i.e., Andover uses chlorine for disinfection and MWRA uses chloramines) would cause serious water quality issues.

Furthermore, the DEIR does not detail what the status of the WRC-approved ITBA permit would be if North Reading continues to maintain interconnections with Andover for the purposes of emergency backup water supply. On page 9-39 there is one simple statement that, "the connection to Andover under an existing IBTA will serve as the emergency source satisfying the MassDEP and MWRA requirements for maintaining emergency sources." Additionally, the DEIR does not include a discussion on how the project will be consistent with the goals of the state's Sustainable Water Management Initiative (SWMI).

Wastewater

Only limited discussion has taken place between Andover and North Reading's consultant on whether Andover is amenable to sharing its wastewater collection system so that wastewater from North Reading may flow to GLSD. At the request of the consultant, Andover provided plans of our collection system highlighting suspected areas that would need improvement, and responded to smaller requests for additional information. There has not been open discussion between the governing bodies of both towns. The DEIR does not address whether there is a regulatory requirement for Andover to provide additional collection capacity for North Reading. Comments below address Andover's concerns.

On p. 8-22 the statement that Andover's population is 35,000 and that many of which are served by sewer collection system in town is incorrect. According to the 2010 federal census, the population in Andover is 33,000. The percentage of the population served by GLSD is 65%. Andover will require North Reading to conduct a full downstream system analysis to determine how many miles of system upgrade would be needed to accommodate the increased wastewater flows from North Reading.

In Section 8.5 on p. 8-23 there is discussion regarding a central pump station to be sited at the town line with Andover to collect the wastewater flow from North Reading and pump the wastewater to a connection point within the Andover system. Andover requests that the pump station be adequately sized to accommodate additional flow from streets in the South Main Street area of Andover including, but not limited to Patriot Drive, Colonial Drive and Gould Road neighborhoods.

In addition to the fees and compensation North Reading will be required to pay GLSD discussed in the last paragraph of p. 8-25; North Reading will incur costs on a per volume basis for the conveyance of wastewater through Andover. Additionally, An IMA would need to be prepared and approved by both communities for the conveyance of wastewater through Andover.

The DEIR does not adequately address the ENF requirements relating to the Construction Period (see p. 12 of the ENF). The DEIR needs to detail project construction phasing and sequencing, the availability of project staging areas, potential time of year constraints, etc. The DEIR requires a discussion of how water and/or wastewater services will be maintained during the construction period to all customers. This discussion is of interest to the Town of Andover, as North Reading will be connecting to Andover's wastewater conveyance system.

In the discussions regarding Projected Title 5 Flow Evaluation (see pp. 7-40 and 7-42), references are made to MWRA's requirements for Title 5 wastewater flow analysis and flow analyses for connection to MWRA's system. If a connection to MWRA's system by North Reading is not a viable option, why is their standard used in the evaluation, and not an industry standard, or a value recommended by GLSD?

In the fifth paragraph of p. 8-24, the statement is made that the downstream flow of wastewater from Andover's Morningside Drive pump station to the final pump station located off York Street is in a southerly direction. This is incorrect. The flow from south Andover toward York Street is in a *northerly* direction.

In the first sentence of the first full paragraph on p. 8-25, reference is incorrectly made to, "The flow path from River Road to Red Spring Road…" "River Road" should be corrected to "River Street."

Thank you for the opportunity to comment. If you have any questions regarding these comments, please do not hesitate to contact me at (978) 623-8350; or via email at ccronin@andoverma.gov.

Sincerely,

Christopher M. Cronin

Christopher M. Cronin
Director, Municipal Services

cc: Jim McSurdy, Water Treatment Plant Superintendent
Morris B. Gray, Jr., Water/Sewer Division Superintendent
Karen Martin, Environmental Compliance Coordinator

IPSWICH RIVER
WATERSHED
ASSOCIATION
The Voice of the River
P.O. Box 576
Ipswich, MA 01938

May 5, 2016

Matthew Beaton, Secretary
Executive Office of Energy and Environmental Affairs
Attention: Holly Johnson, MEPA Analyst
100 Cambridge Street, Suite 900
Boston, MA 02114

RE: DEIR for the Town of North Reading-EOEEA #14975

Dear Secretary Beaton:

Thank you for the opportunity to provide comments on the DEIR for the Town of North Reading. The Ipswich River Watershed Association's mission is to protect the Ipswich River and its watershed region for people and nature. We represent the 21 communities located within the watershed, the 350,000 people and businesses that rely on it for their drinking water every day and our more than 1000 members. As such, we have been following and working with the Town of North Reading's water and wastewater planning project closely and are pleased to provide the following comments on the Draft EIR currently before you.

I note that many other commenters have provided excellent statements of fact relative to this project so will not repeat them here. As you are aware, the Ipswich River is one of the most flow stressed basins in the Commonwealth due primarily to municipal ground water withdrawals. The impact of groundwater withdrawals is most acute in the headwaters region where North Reading is located. Although the problem has been improved due to the cessation of withdrawals from the Town of Reading, the flows in the upper watershed are still deplorable, particularly in the Martin's Brook sub-basin in which North Reading's withdrawals are. In fact, conditions in Martin's Brook have declined dramatically in recent years due to the upgrade of the Town of Wilmington's wells in Martins and Lubbers Brook sub-basins and the subsequent dramatic increase in withdrawals at these locations. Hence, we are particularly concerned with the outcome in North Reading and view this project as a once in a lifetime opportunity to begin repairing the negative impact of groundwater withdrawals on the Ipswich River.

We appreciate and generally support the proposed purposes of the project and applaud North Reading for acknowledging the detrimental impact of groundwater withdrawals on the river and proposing to improve the situation. This said, as is normally the case with projects such as this, the devil is in the details and we respectfully request that you strongly condition any permit approvals to both prevent any future backsliding and improve current conditions in the river to the extent feasible. As you may know, the recently adopted SWMI regulations were a step backward for the Ipswich in that 88% of the withdrawals in the Ipswich are registered-only hence exempt from any regulation, an additional 28 years of permitted withdrawals were grandfathered under the new baseline provisions, and the new regulations could actually allow for the weakening of current permits which are now currently the strongest in the state, among others. During and following the SWMI process, state officials recognized these facts and acknowledged that something different (than the WMA regulations) will be needed to address the chronic flow problems in the Ipswich. This is one such opportunity so we sincerely hope that any permit will do as much as it can to address the long standing and unacceptable impact to the Ipswich River that the state has been unable to do in its collective legislative and regulatory processes.

Before I provide my specific comments, I would like to put them into context based on the only other comparable experience we have in the Ipswich: the adjacent Town of Wilmington's recent Comprehensive Water Resource Management Planning/EIR and IBTA permitting process. While we supported the Wilmington project, its outcome had some undesired impacts that are relevant here. As you know, one of the proposed benefits of the project was to replace the town's contaminated wells in Maple Meadow Brook with MWRA water which would have a net benefit to the Ipswich. Instead, the Town upgraded its Brown's crossing well field and when combined with their other active wells, all of which are in the Ipswich basin, they can still meet 100% of the town's needs without supplementing with MWRA water at all such that they purchased zero water for the initial years following approval of the plan. While they have since begun to purchase some MWRA water at our prodding, it is relatively insignificant and not timed to when it could benefit the river the most. While Wilmington is not required to purchase more MWRA water than it is currently under their IBTA permit because they have not reached the additional sewering thresholds which would have triggered the requirement, the result of the transfer of withdrawals from Maple Meadow to Martin's and Lubbers sub-basins has been devastating to those sub watersheds. In all but one year since the upgrades, Martin's and Lubbers Brooks have been pumped dry for months. In fact, Martins Brook has been documented to flow backwards towards the town wellfield before going dry in each of these dry-brook periods. Thus, my comments are focused on preventing any unforeseen consequences such as occurred in Wilmington and doing everything possible to benefit the Ipswich River when conditioning this project.

We recognize that the current situation in North Reading has a net benefit to the Ipswich River because its in-basin withdrawals continue to decline, an increasing amount of North Reading's water is imported from the Merrimack Basin via the Town of Andover and 100% of the wastewater is deposited in the Ipswich River Basin. Ideally, the town would cease withdrawing from its in-basin wells and continue to import water from outside the basin (provided donor basins can support that without environmental harm) which would provide the maximum benefit to the river. While we recognize the town's desire to address its long standing wastewater challenges and acknowledge the water quality impacts of the current wastewater

P.O. Box 576 • 143 County Road • Ipswich, MA 01938 • 978.412.8200 • Fax: 978.412.9100

situation, we would have preferred that the town and its consultants pursued a localized wastewater solution more vigorously. Given the availability of current technologies, a decentralized, localized solution seemed feasible to us. This said, we understand the complexities as well as cost considerations that caused the alternatives analysis to result in a centralized solution that will export the wastewater to the Greater Lawrence facility.

Although the proposed project purports to provide a net benefit to the Ipswich River, that benefit could easily evaporate and even be reversed unless permit conditions specifically ensure that to be the case in perpetuity. For example, although the town is only proposing to export a specific amount of wastewater at this time, what's to prevent increased sewering in the future? Also, sewer lines are notoriously subject to groundwater infiltration which typically increases over time. Even more important is the cultural attitudes towards outdoor water use in North Reading and the recent explosion in the number of private wells in the community which could easily wipe out any planned for gain. Much of the residential development in the community is on relatively large lots with sizable lawn areas. The town has historically had a relatively high amount of outdoor water use and is at the higher end in the watershed in terms of the percent of households using "traditional" lawn care (high summertime watering, installed underground irrigation systems, use of lawn care services, application of fertilizers/pesticides/herbicides). Although the town has implemented conservation measures to stay within their registration and water import volume restrictions imposed by Andover which has decreased their reported municipal water use to close to the state standards in recent years, we feel that can be almost entirely explained by the explosion of private wells in the community. For example, more than 600 irrigation wells have been installed just in the last 12 years largely to get around the towns water restrictions. As such, the town has a strong potential to backslide on its commitment to maintain a net positive impact on the river in the current DEIR. Moreover, the relatively high cost of MWRA water could further incentivize the installation of private wells. The permit must imposed strong conditions to change the current cultural norm with regard to the use of water in North Reading else the town will continue to negatively impact the water balance in the river, especially over time.

We would like to offer the following specific comments in addition to the comments already provided by the Water Resources Commission which we endorse here:

1. The town must establish a private well bylaw that includes the same conditions as on the municipal water system which includes a strong enforcement program . Without such a well-enforced by-law, any water conservation conditions will be largely ineffective as evidenced by the current situation;
2. There must be a prohibition against future sewering "creep" without a new full environmental impact report. There should be additional conditions that any sewering be state of the art and include all currently available design features to prevent infiltration over the long term;
3. The town must implement a robust and sustainable water demand, conservation and enforcement program for all residents, businesses and municipal uses including their

golf course [Note the town is already a member of the Greenscapes Coalition which provides some of these services which could easily be enhanced to meet this condition.]

4. We strongly recommend against the surrendering of the town's current registration and complete abandonment of the town's wells as proposed in the EIR. While we certainly support the switch to MRWA water, we are extremely concerned about the loss of the well-head protection areas and the impact surrendering its registration would have on the Safe Yield established by DEP on the Ipswich River if this registration were removed from the calculus. As you know, there is a massive amount of water withdrawals not subject to the Water Management Act and the Safe Yield calculation, and this amount is increasing dramatically over time in the Ipswich. [We calculate that more than 3 MGD was withdrawn in the basin in 2015 by newer private wells alone.] This would mimic what was done in Reading and could be one of the best ways for the State to compensate for acknowledged shortcomings of SWMI in the Ipswich.

On behalf of the natural environment and the 350,000 people and businesses that depend on the Ipswich River for their quality of life every day, thank you for considering my comments.

Sincerely,

Wayne Castonguay
Executive Director

P.O. Box 576 • 143 County Road • Ipswich, MA 01938 • 978.412.8200 • Fax: 978.412.9100

MassDEP
Commonwealth of Massachusetts
Executive Office of Energy & Environmental Affairs

Department of Environmental Protection

Northeast Regional Office • 205B Lowell Street, Wilmington MA 01887 • 978-694-3200

May 6, 2016

Matthew A. Beaton, Secretary
Executive Office of
Energy & Environmental Affairs
100 Cambridge Street
Boston MA, 02114

Attn: MEPA Unit

Dear Secretary Beaton:

The Massachusetts Department of Environmental Protection (MassDEP) has reviewed the Draft Environmental Impact Report (DEIR) submitted by the Town of North Reading to change the Town's water supply sources from municipal wells and the Town of Andover to the Massachusetts Water Resources Authority (MWRA) through a new connection in the Town of Reading, which will require an inter-municipal agreement. Improvements to the Reading water system, and cleaning, lining, or replacement of existing water mains will be needed. The Town's interconnection with the Andover water system will be maintained for potential emergency use. The Town's wells will be abandoned and the Water Management Act Registration for the wells retired. The Town of North Reading estimates that the projected average daily demand is 1.6 million gallons per day (mgd) and the maximum daily demand is 2.58 mgd.

The DEIR also proposes to change some of the municipality's wastewater treatment from septic systems and small onsite wastewater treatment systems to the Greater Lawrence Sanitary District (GLSD). Septic systems will be retained in areas outside the needs areas and the onsite wastewater treatment system at the North Reading High School is planned to be optimized and will capture wastewater from the center of North Reading. The DEIR reports that about 0.503 mgd of wastewater would be discharged through a connection in the Town of Andover that will require an inter-municipal agreement. The wastewater project will require about 25 miles of sewer, six pump stations, and a low pressure sewer for a limited residential area.

The Town of North Reading proposes to undertake and complete the water project in advance of the wastewater changes. The tentative schedule in the DEIR indicates that the target date for the MWRA connection is July 2019, with construction during the two, preceding years. Wastewater design and construction is proposed to be phased with Phase 1 construction from 2023-2025 and the last, Phase 4 construction from 2033-2034.

Drinking Water

As described in Section 4 of the DEIR, the Town of North Reading has allowed several maintenance issues with its water system infrastructure, (treatment plants, pump stations, and wells) to accumulate. As a result, several facilities are in simultaneous need of repair or replacement. Well yields have gradually dropped off over time, which is common for Massachusetts overburden wells, especially in areas like North Reading that have elevated levels of naturally occurring iron, resulting in plugging of the formation or well screen.

At the time of the ENF, North Reading had not yet determined a preferred means to get the MWRA water to the North Reading water distribution system. The DEIR now states that the "final recommended alternative" (p. 5-18) is to wheel the MWRA water through the Town of Reading's municipal water system, rather than for North Reading to directly interconnect to the MWRA system. This means that in addition to modifications that may need to be made to North Reading's distribution system to accommodate the MWRA water, modifications also may have to be made to Reading's water system to allow that much water to be conveyed through its water mains to one or more interconnections with the North Reading water distribution system.

MassDEP commented on the ENF, stating that construction of pump stations or new physical interconnections between public water systems will require Distribution System Modification permitting by MassDEP (Permit Category BRPWS32). MassDEP further stated that if multiple facilities of this sort are needed, the Town of North Reading may combine some or all of the facilities into a single permit application rather than submitting a separate permit application for each facility. However, if "significant modifications" are required to the Town of Reading's water system (as described in MassDEP's DWP Policy 08-01, *Substantial Modifications To A Public Water System That Require A Permit*), a separate permit application must be submitted for the modifications to Reading's system, even if the design and/or construction are done by North Reading's contractors. Reading must have control over the design of changes to its water system, rather than North Reading. Water main replacement is generally not considered a substantial modification, unless at least 25 percent of a system is being replaced. Of the improvements listed in the DEIR (page 5-20), replacement of the inlet/outlet piping at the Auburn Street Tank is the one item that appears that it might require a permit. In a 2014 sanitary survey of the Reading water system, an issue was identified with stratification of the Auburn Street Tank that caused seasonal decreases of the chlorine residual — improvements made at the tank must be designed to improve this condition rather than exacerbate it.

For North Reading to change its source of water to the MWRA supply, it will have to evaluate whether corrosion control treatment is needed for the North Reading water system to remain in compliance with the Lead and Copper Rule. North Reading is currently required to conduct lead and copper monitoring once every three years. MassDEP will likely require at least one additional round of lead and copper monitoring when the switch over to the MWRA water occurs.

If North Reading abandons its municipal wells, then the wells will no longer be considered public water supply sources and will not be protected as public water supply sources under MassDEP programs, such as the Massachusetts Contingency Plan and Title 5. MassDEP will rescind its approval of the Zone II wellhead protection area for the wells, and the Interim Wellhead Protection Area for the Stickney Well. This means that certain areas in the Town will no longer be within a Water Supply Protection Area, and will no longer be subject to the regulatory protections conferred by that designation. An area around Martins Pond and an area in the northern part of Town will no longer be within a Zone II wellhead protection area, and small areas in the southwest corner of the Town will no longer be within an Interim Wellhead Protection Area. However, Zone IIs that extend into North Reading for wells in neighboring communities will remain in effect; these include Zone IIs for public supply wells for the Town of Wilmington, the Town of Reading, and the Lynnfield Center Water District. Some areas in the northeast part of the Town will still be within Water Supply Protection Areas for the Town of Danvers' surface water sources. Protections provided at the municipal level by the Town of North Reading's aquifer protection zoning and non-zoning controls will thereafter remain in effect until the Town revises the boundaries of its overlay district.

Water Management Act

The Water Management Program has reviewed the DEIR submitted by the Town of North Reading to investigate the alternative drinking water supply sources and wastewater disposal options. The DEIR is in response to the Certificate issued on the Environmental Notification Form (ENF) regarding North Reading's water supply alternatives analysis and address how the preferred alternative would meet the approval criteria outlined in the MWRA's Policy #OP-10. The DEIR also presented the water supply needs analysis and outlined the water conservation measures that North Reading has implemented.

Based on North Reading's current Residential Gallons per Capita Day (RGPCD) and Unaccounted for Water (UAW) figures, the Water Management Program has questions about the water demands projected in the DEIR. Over the past five years, North Reading has reported a UAW percentage between 12 to 17 percent. Those percentages were calculated without submitting any documentation of Confidently Estimated Municipal Use (CEMU) to MassDEP for its review. According to the DEIR, North Reading completed a leak detection survey on the entire water distribution system in 2014 and then appeared to repair leaks in 2015 (North Reading needs to clarify the status of the leaks repaired as outlined in the section 3.9.4 and Table 5-1). Despite these repairs, North Reading still reported a 13.3 percent UAW for 2015. North Reading also reported an RGPCD of 70 for 2015. The DEIR used the 65 RGPCD and 10 percent UAW standards to project a future average daily use of 1.6 million gallons per day (mgd). In order to ensure the proposed purchased volume from MWRA is sufficient to meet future demand, North Reading should keep implementing their "best practices," as outlined in the DEIR section 3.9, for controlling residential water use and water loss. In addition, North Reading should consider conducting a water audit in accordance with the AWWA M36 Water Audits and Loss Control Program. North Reading also should start implementing a water conservation public education and outreach plan.

Table 9-3 of the DEIR indicates that there will be an additional 1.1 mgd of water being imported to the Ipswich River Basin under the proposed alternative water supply source and wastewater disposal option. MassDEP concurs that the proposed alternative water supply source and wastewater disposal option would appear beneficial to stream flow in the Ipswich River.

Wastewater

The DEIR evaluates a number of different approaches to wastewater management in the Town, including continued use of on-site systems, in-town alternatives for wastewater treatment and disposal through one or more MassDEP groundwater discharge facilities, and options for conveying wastewater flows to regional wastewater treatment and disposal facilities outside of the town.

Needs Analysis

Under existing conditions, there is no municipal collection system in the Town, and the Town's wastewater is managed through on-site (Title 5) disposal systems and a collection of larger on-site discharges for commercial facilities permitted through the MassDEP groundwater discharge permit program. The DEIR includes a needs analysis which evaluated a range of factors in determining the adequacy of the current wastewater management. This resulted in targeting four subareas in Town as needs areas where sewering alternatives would provide improved protection of water resources and public health. MassDEP generally concurs with the factors used in this analysis and their weighting; however, several issues should be addressed in finalizing this analysis in the FEIR:

- Page 7-7: Final analysis should indicate the sources of information used to determine "ponding" impacts;
- Page 7-11: The classification of frequent pumpers as those pumping more than once every two years may overestimate the number of systems at high risk. Conversely, if systems are pumped four or more times per year, they should be identified under the separate and more heavily weighted "failure" criterion. The final needs analysis should distinguish any failed systems, and consider an alternative threshold to define frequent pumpers;
- Page 7-13: Final analysis should indicate sources of information used to determine depth to groundwater table; and
- Page 7-15: Final analysis should indicate sources of information used to assign the depth to restrictive layer factor.

The four subareas identified for sewering in the Needs Analysis are further refined in the DEIR to exclude those locations within each subarea where on-site systems are continuing to perform adequately, and where other factors supporting sewering are not uniform throughout the entire subarea. The final recommended needs areas targeted for sewering are largely the industrial and commercial areas within the Town, and the areas surrounding Martin's Pond, which is identified as impaired by excess algal growth and turbidity in *MassDEP's Year 2014 Integrated List of Waters*. The estimated design flows from the areas targeted for sewering is approximately 0.5 million gallons per day (MGD).

The FEIR also should address any needs the Town may have for adequately overseeing and managing the Town's on-site disposal systems. The DEIR clearly indicates that on-site systems will continue to be a main element of the long-term wastewater management plan. The FEIR should include a review of the town's resources to administer Title 5, to track septic system pumping and repairs, and use or participation in MassDEP's Community Septic Management Program.

Centralized Collection with Groundwater Discharge Permit Alternative

The DEIR includes a review of potential sites for groundwater discharge of treated wastewater, under the terms of a MassDEP Groundwater Discharge Permit. The DEIR concludes that there is no single site which can feasibly treat and dispose of the design flows for the 0.5 million gallons per day of wastewater. The main site identified is the DPW site, which the DEIR indicates can only accept, treat, and discharge up to 125,000 gallons per day, at a loading rate of 0.3 gallons per day per square foot (gpd/ft^2). MassDEP notes that this loading rate is substantially less than any facility operating under a typical groundwater discharge permit, and is even less than loadings allowed under the Title 5 program, for wastewater with very limited treatment. The FEIR should expand on the discussion of why this site has such limitations. MassDEP also notes that potential discharge locations within Zone II areas are not prohibited for siting of groundwater discharge facilities, unless the travel time to the drinking water well is less than 6 months.

The DEIR also makes minimal mention of the "Berry" site, which is the current location of a MassDEP Groundwater Discharge Permit with Edgewood Luxury Apartments. During permitting of the Berry site, a reserve allowance of 100,000 to 150,000 gpd for use by the Town was included into the design of the project. Further, the September 2008 CWMP recommended that the Town seek a MassDEP groundwater discharge permit for 200,000 gpd of flow at this site. The FEIR should confirm the capacity allotted to the Town, and describe any potential use of this site to meet the wastewater needs. The 2008 CWMP also recommended use of the Hillview Country Club site and U.S Postal Service site; both are in, or close to, the identified needs areas. The FEIR should provide more detail on the merits of pursuing these sites as potential groundwater discharge sites.

Recommended Plan

The recommended wastewater management plan includes conveying flows from the needs areas through the Town of Andover sewer system to the Greater Lawrence Sanitary District (GLSD) wastewater treatment facility for treatment and disposal, and expanded use of the wastewater treatment and disposal system serving the North Reading High School. As noted in the DEIR, there are considerable institutional hurdles to implementing the elements of the plan which involve conveyance of flows through the Town of Andover to GLSD, and only the initial steps have been taken to determine the feasibility and costs of proceeding with this plan. This plan may present the most cost-effective alternative; however, the information requested above should be presented in the FEIR to fully compare the costs and feasibility of the in-town options.

Wetlands

The DEIR evaluation of wetlands impacts associated with the proposed water and wastewater alternatives is limited to acknowledgement of the project's potential impacts temporarily to wetland resources in North Reading and Andover. No wetlands impacts are anticipated within Reading. Since wetland resource impacts have not been identified specifically, the opportunity to comment is limited at this point. As this is a significant project in scope, it would be useful to consider alternative layouts and opportunities to avoid and minimize wetland resource impacts to the greatest extent in the FEIR. Even if the evaluation is still at a very conceptual level of detail at the FEIR stage, it would be possible to identify the wetland resources that would be impacted and estimate the extent of those impacts. This level of detail is typically required at the DEIR stage for most utility, roadway, and trail projects in MEPA reviews.

Greenhouse Gas Emissions

The wastewater GHG analysis compares the No Build alterative to the Recommended Plan, which proposes to discharge 500,000 gallons of the Town's wastewater to the Greater Lawrence Sanitary District for treatment. An essential purpose of the GHG analysis is to understand the mitigation measures that will be implemented to reduce emissions from the proposed project. However, as explained in the comments that follow, the GHG analyses for wastewater and water focus on demonstrating that the recommended plan is significantly more energy efficient. The DEIR does not include commitments to mitigation measures such as water conservation, xeriscaping on municipal properties, vehicle fleet replacement with energy efficient vehicles, and infiltration and inflow removal or evaluate the added reduction in emissions that could be accomplished by incorporating these measures. The GHG analysis did identify several energy efficiency improvements, such as the use of variable speed pumps, however.

The results of the wastewater GHG analysis comparing the No Build and Recommended Plan are significantly affected by the inclusion of CH_4, a more potent GHG, in the equation for only the septic systems. A comparison of Table 9-8 to Tables 9-9 and 9-10 shows that removal of septic systems for the Recommended Plan has the single greatest effect on reducing GHG emissions from the Town's wastewater; septic systems are reported to have the highest GHG emissions of all sources considered, (18,395.28 tpd for No Build CO_2 emissions vs. 16,317.70 tpd CO_2 for the Recommended Plan with the DPW facility). As a result, the GHG analysis reports that emissions would be reduced by 75 percent with the recommended plan without additional mitigation.

The population served by septic systems and BOD_5 load per person have direct effects on the CO_2 equivalent emissions from septic tanks. The septic system equation for methane is significantly affected by population, (#3, page 9-30), whereas the CO_2 emissions formula for the wastewater treatment process for CO_2 is influenced by wastewater influent rate. Based on the limited information about the equations used, it is not clear that these emissions calculations are directly comparable. It also is unclear why the influent rate of 450,000 gpd was used instead of 500,000 gallons, the volume proposed to be discharged to the treatment works.

Because septic systems generally are not considered to be significant sources of GHG emissions, it is requested that the assumptions in the fugitive emissions computation be reconsidered in the FEIR. The population served by septic systems also should be validated and/or cross-checked by another method, such as by multiplying the number of septic systems in North Reading by the average number of people per household in the town. Consideration also should be given to the BOD_5 load in the equation used to compute fugitive CH_4 emissions. The default value used can be traced from the 2008 EPA source (identified in the DEIR, page 9-30) back to a 1991 & 1993 study by Metcalf and Eddy. Given that the data go back more than 20 years, it is requested that this value be reconsidered for accuracy in current wastewater treatment practices. If there are other values or a range of values, it is requested that fugitive emissions be recomputed and the results explained.

The GHG analysis has made assumptions about CH_4 in the wastewater treatment plants that should be given further consideration in the FEIR. It is reported that GLSD uses both aerobic treatment and anaerobic digestion, which indicates that both CO_2 and CH_4 are generated at the facility. However, only CO_2 emissions are calculated from the wastewater proposed to be discharged to GLSD[1]. It is requested that the FEIR revise the GHG analysis to include CH_4 or explain the rationale for excluding this emission. In addition, anaerobic digestion does not remove sludge, which is to be pelletized on site. The pelletization process requires electricity that has not been taken into account. It also does not appear that CH_4 was included in the analysis of the package MBR wastewater facility serving the high school and middle school or the private treatment works. The analysis assumed that methane is captured at the school's treatment plant, but there is no further explanation of how this is accomplished, or to show that CH_4 emissions would be negligible. By excluding methane and possibly N_2O from the wastewater treatment facilities, the emissions reductions associated with the recommended plan is larger than if CH_4 was accounted for in the analysis.

The calculation of CO_2 for the biological treatment processes at the private wastewater treatment systems used 108,537 gpd; however, the analysis of CO_2 emissions from electricity used 90,548 gpd (Table 9-5) as the maximum daily flow for the period. Why are the daily flows different in both calculations?

The DEIR reports the high and middle school treatment plant processes are estimated at 12,300 gpd, and the CO_2 emissions from treatment of the wastewater are calculated to be 9.86 lbs. This contrasts with each septic system in the Town, which would release 4.24 lbs of CO_2, based on 18,395.28 lbs of CO_2 per day (calculation #3, page 9-30 and Table 9-6, page 9-24) divided by the estimated 4,337 septic systems in North Reading. Even though CH_4 is significantly stronger source of GHG emissions, these results are surprising. Generally, septic systems are not considered to be a significant source of GHG emissions. However, the total 18,395.28 lbs of CO_2/day for existing septic systems (Table 9-6) is more than 10 times higher than the amount of emissions for water treatment of the Town's existing water sources, which are reported to be 1,720.092 lbs of CO_2/day (Table 9-13), despite the fact that water is provided to facilities that have small wastewater treatment systems in addition to households on septic systems.

The GHG emissions associated with distribution of water, water treatment facilities, and maintenance of the system in North Reading were evaluated for No Build and the Recommended Plan to receive 1.6 MGD of water from the MWRA. As with the wastewater analysis, a number of assumptions about the system were made in the GHG emissions calculations.

[1] GLSD's energy use corresponds reasonably well with the assumptions on electricity use in the calculations, and energy use is expected to continue to decrease with the addition of anaerobic digestion at the wastewater treatment facility.

The baseline CO_2 emissions (estimated at 1,720 lbs CO_2/day) were computed using MEPA average of 1.1 KWh to treat 1,000 gallons. The baseline CO_2 also was calculated using this MEPA average for the water from Andover in addition to the electricity bill for the North Reading facilities at Central Street, Railroad Bed, Lakeside, and Route 125. The emissions estimate by the second method is 2,483.63 lb CO_2/day, which is almost 1.5 times greater than using the MEPA average value. Because this higher value is reported to be more conservative, it was used in the analysis. In addition, CO_2 emissions for natural gas use and chemical production were added to the baseline for a total of 2,942 lbs/day of CO_2.

The recommended plan is based solely on the MEPA average value of 0.2 kWh per 1,000 g for the MWRA. Therefore, for comparability, it appears that using MEPA averages only for the energy and emissions embedded in water analysis. The addition of chemical production to the baseline has the effect of making the recommended plan much more energy efficient. Unless it is clear that the MEPA average energy value includes the energy used to produce chemicals, this value should be eliminated from the No Build alternative for comparability.

The MassDEP appreciates the opportunity to comment on this proposed project. Please contact Duane.LeVangie@state.ma.us, at (617)-292- 5706 for guidance on Water Management Act issues, James.Persky@state.ma.us , at (978-694-3227 for information on drinking water issues, and Kevin.Brander@state.ma.us , at (978) 694-3236 for further information on the wastewater issues, and Mike.Dibara@state.ma.us at (508) 767-2885 for the GHG analyses and energy usage at water and wastewater facilities. If you have any general questions regarding these comments or the GHG analyses, please contact Nancy.Baker@state.ma.us , MEPA Review Coordinator at (978) 694-3338.

Sincerely,

John D. Viola
Deputy Regional Director

cc: Brona Simon, Massachusetts Historical Commission
Pam Heidill, MWRA
Michele Drury, DCR,
Kathleen Baskin, EEA
Duane LeVangie,Shi Chen, MassDEP-Boston
Mike DiBara, MassDEP-CERO
Eric Worrall, Rachel Freed, Jessica Kenny, Kevin Brander, Tom Mahin, Jim Persky, MassDEP-NERO

WS CAC
WATER SUPPLY CITIZENS ADVISORY COMMITTEE
to the Mass. Water Resources Authority

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May 6, 2016

Matthew Beaton, Secretary
Executive Office of Energy and Environmental Affairs
Attention: Holly Johnson, MEPA Analyst
100 Cambridge Street, Suite 900
Boston, MA 02114

RE: DEIR for the Town of North Reading-EOEEA #14975

Dear Secretary Beaton:

Thank you for the opportunity to provide comments on the DEIR for the Town of North Reading.

The Water Supply Citizens Advisory Committee (WSCAC) is advisory to the MWRA on water policy, programs and projects. Our interest in this project is two-fold: Our first priority is water quality and source water protection in the DCR-MWRA reservoir and drinking water distribution system. Secondly, we explore all MWRA water system expansion requests to ensure that the donor basin can safely provide the water and that conditions in the receiving basin merit the transfer.

North Reading is seeking full admission to the MWRA water system to purchase up to 2.58 MGD. In the DEIR's Water Needs Summary, the town notes a deficit of between 0.379 and 0.54 0 MGD based on a future maximum daily demand (MDD) of 2.58 MGD. North Reading currently holds a registration for their local wells of 0.96 MGD and they purchase up to 1.5 MGD from the Town of Andover to meet a current demand of 1.44 MGD.

In addition to the town's described need for additional water to address future growth, North Reading describes the town's water system including water treatment buildings and equipment as being in fair to poor condition. The two water treatment plants have recently only been able to produce at 71% capacity. North Reading says it would like to reduce system complexity and control costs. They note that they are interested in minimizing stress to the Ipswich River and want to provide a sustainable, long-term potable water supply solution for the town.

After reviewing various in-basin options including purchasing additional water from neighboring communities, the town is choosing to purchase MWRA water as the best way to meet their long-term goals. North Reading intends to forfeit its local sources registration upon confirmation of a MWRA water connection. This will provide a neutral impact to the Ipswich River.

A portion of MWRA water sold to North Reading will be sewered out of basin to the Greater Lawrence Sewer District. Most of the town will remain on private septic systems. It is noted that the connection with Andover in the Merrimack basin will remain as an emergency back-up supply.

MWRA's successful reduction in withdrawals from its resources has made some small amount of additional taking seem to be approvable. It's enabling act sets out requirements that must be met including that a community applying to purchase water has experienced contamination of its local sources. This is not the case with North Reading.

Requirements under the Interbasin Transfer Act state that local sources are to be used to the maximum extent possible before requesting to transfer water from out of basin. According to the DEIR and 1991 comments from the Water Resources Commission, there is a lack of viable local and in-basin sources to meet projected future water demands. It is North Reading's low water quality, increased treatment costs and the high costs of replacing deteriorating infrastructure that play a major role in the decision to join the MWRA.

It is important to note that in 2003 MassDEP issued North Reading a Modified Water Withdrawal Permit that included restrictions on seasonal water use to limit withdrawals from the Ipswich River, outdoor watering restrictions during low flow periods in the river, and regulation of private irrigation wells. Rather than work with these restrictions, North Reading surrendered its Water Management Act permit in 2008. There has been a dramatic increase in the installation and use of private wells. Any purported benefit to the environment from this proposed transfer will be at risk without regulations and conditions placed on the use of private wells.

Despite a lack of viable local and in-basin sources and the ability of MWRA to transfer water to North Reading without negative impact to existing ratepayers, WSCAC believes that with a strong demand management program, metering upgrade to address unaccounted for water, and a robust water conservation plan, there can be a substantial difference in the amount of water needed.

We recommend the following be addressed in the FEIR concerning the designation of town funds and dates of implementation:

- The establishment of a private well bylaw to regulate the proliferation of wells used primarily for outdoor irrigation.
- Establishment of a conservation-oriented, ascending-block water rate structure that covers the full cost of supplying the community with water, including capital improvements, leak detection, and pipe rehabilitation. A seasonal rate to reflect the higher environmental impact of summer water use should be included. Fixed charges should be low enough so that they do not generate more than 10% of total water revenues, as base charges do not provide any incentive to conserve water.

- A vigorous residential water conservation program that includes rebates for efficient appliances, installation of low flow plumbing fixtures, and sensors for outdoor irrigation. The creation of an on-going public education campaign using town sponsored workshops, school programs and social media to promote the value of water.

MWRA's contract communities are encouraged, not required to adhere to the state's Water Conservation Standards. Admission to the MWRA water system should not result in the lessening of outdoor use controls. The Quabbin and Wachusett Reservoirs, although storing a great deal of water, should be restricted to uses that require potability, with wasteful uses severely restricted.

In closing, WSCAC believes that the state has not done enough to require and coordinate headwater communities in the Ipswich to work together to improve streamflows before interbasin transfers are permitted. We remain concerned that the provision of MWRA water in this case can potentially work to discourage the actions needed by headwater communities to plan and implement for the health of the Ipswich River.

Thank you for the opportunity to comment.

Sincerely,

Lexi Dewey

Executive Director, WSCAC

The Commonwealth of Massachusetts
Executive Office of Energy and Environmental Affairs
100 Cambridge Street, Suite 900
Boston, MA 02114

Charles D. Baker
GOVERNOR

Karyn E. Polito
LIEUTENANT GOVERNOR

Matthew A. Beaton
SECRETARY

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http://www.mass.gov/eea

December 21, 2018

CERTIFICATE OF THE SECRETARY OF ENERGY AND ENVIRONMENTAL AFFAIRS
ON THE
NOTICE OF PROJECT CHANGE

PROJECT NAME	: New Water and Wastewater Solutions
PROJECT MUNICIPALITY	: North Reading
PROJECT WATERSHED	: Ipswich
EEA NUMBER	: 14975
PROJECT PROPONENT	: Town of North Reading
DATE NOTICED IN MONITOR	: November 21, 2018

Pursuant to the Massachusetts Environmental Policy Act (MEPA, M.G.L. c. 30, ss. 61-62I) and Section 11.10 of the MEPA regulations (301 CMR 11.00), I hereby determine that this project continues to ***require*** a Final Environmental Impact Report (FEIR). The Proponent must prepare and submit for review a Final Environmental Impact Report (FEIR) in response to the revised Scope provided in this Certificate. The Notice of Project Change (NPC) identifies a change to the Preferred Alternative for water supply and indicates that development of wastewater disposal treatment alternatives have not advanced. Additional study is necessary to develop wastewater alternatives. The Town of North Reading (Town) has requested that the FEIR be limited to the water supply component of the project. The Scope for the FEIR has been revised to reflect changes in the project and the Preferred Alternative for water supply. To address wastewater, the Town must file a subsequent NPC when planning has advanced. Upon review of the NPC, a Certificate will be issued with a revised Scope for a Supplemental EIR.

Original Project Description

The Town's current water supply is provided by groundwater wells (0.96 million gallons per day (MGD)) within the Ipswich River Watershed and supplemented with water purchased from the Town of Andover (1.5 MGD). The Town of Andover's water supply is located within the Merrimack River Basin, thus this purchase is subject to an existing Interbasin Transfer Act (ITA) approval. The Ipswich

River has been listed as one of the most endangered rivers in the United States and is considered a "stressed basin" under the hydrologic criteria established by the Water Resources Commission (WRC).

The original Preferred Alternative for water supply solution consisted of joining the Massachusetts Water Resources Authority (MWRA) water system and purchasing 2.6 MGD to meet demand. Once connected to the MWRA system, the Town would discontinue drinking water withdrawals within the Ipswich River Basin, and convert the water supply from the Town of Andover to an emergency supply. Connections to the MWRA would be made via water infrastructure within the Town of Reading. Once the water supply from the MWRA system was secured, the Town intended to voluntarily forfeit its water withdrawal registration (0.96 MGD) to the Massachusetts Department of Environmental Protection (MassDEP).

The MWRA alternative would have required improvements to the Reading water distribution system, including enlarging, cleaning and lining water mains in Reading; increasing inlet and outlet pipe sizes from the Auburn Street Tank in Reading; and constructing a new water booster pump station.

The original project included implementation of a municipal wastewater collection, treatment and disposal system for approximately 2,000 properties within the highest need areas of the Town. Remaining properties would continue wastewater collection and treatment via existing on-site Title 5 systems or six small-scale wastewater treatment facilities that would discharge to groundwater. The Draft EIR (DEIR) proposed that wastewater from the Town would flow to an existing collection system in the Town of Andover and ultimately be conveyed to the Greater Lawrence Sanitary District (GLSD) for treatment and disposal.

Project Change

As described in the NPC, the Town is no longer proposing to join the MWRA water system and instead proposes to purchase the entirety of its water supply from the Town of Andover. Comments submitted on the DEIR by the Town of Andover indicated that Andover was capable of supplying North Reading with its long term water needs. Andover provides the majority (61-78% based on data from 2009-2017) of the Town's water supply. As a result, infrastructure improvements associated with the project change are significantly reduced compared to the MWRA alternative. Since the issuance of the DEIR Certificate on May 13, 2016, the Town and Andover have entered into a 99-year Intermunicipal Water Supply and Purchase Agreement (IMA). The IMA was executed in June 2018 and states that, subject to permitting and necessary infrastructure upgrades, Andover will supply up to a maximum daily withdrawal of 2.4 MGD to the Town through June 30, 2019, a maximum of 2.6 MGD through June 30, 2025, and a maximum of 3.0 MGD thereafter.

The project change will require the installation of two chlorine booster chemical injection stations at two interconnection locations to ensure adequate chlorine residual within the Town's distribution system. The Central Street chemical feed station will be constructed on the site of an existing pump station. The Main Street chemical feed station will be located at one of three sites near an existing interconnection and meter vault. Two of the three proposed locations for the Main Street chemical feed station are commercial properties and one is a residential property on Cogswell Road.

The water supply component of the project has advanced ahead of the wastewater project and therefore, as indicated in the Certificate on the Environmental Notification Form (ENF) issued on December 7, 2012, the Town has requested that review of wastewater disposal alternatives through MEPA be addressed subsequent to completion of MEPA review for the water supply component.

Project Site

North Reading is located in the Ipswich River Basin. The Ipswich River watershed provides drinking water to 14 communities and, according to the DEIR, has experienced repeated low-flow or no-flow periods. Upper river segments have gone dry in six of the last ten years. These events are associated with water withdrawals for drinking water and have resulted in fish kills and ecological damage. The Town of Andover is located within the Merrimack River Watershed. Andover's water supply is supported by Haggett's Pond, a 220-acre Class A surface water supply, and 1,422 acres of watershed area. Water is diverted to Haggett's Pond from Fish Brook and the Merrimack River. Andover's distribution systems consists of three pressure zones (1) the West High zone, (2) the Central Low zone and (3) the East High zone. The East High zone serves eastern areas of Andover and North Reading.

Environmental Impacts and Mitigation

The project change proposes to increase water withdrawals from the Merrimack River Watershed by 1.5 MGD for a total of 3.0 MGD. The project change will significantly reduce construction impacts associated with water main improvements for the original project. No historical impacts are anticipated as a result of the project change. Greenhouse Gas (GHG) emissions are expected to decrease significantly. As noted by MassDEP, reducing groundwater withdrawals within the Town will benefit streamflow and habitat conditions within the Ipswich River Watershed.

Jurisdiction and Permitting

The original project was subject to MEPA review and required the preparation of a mandatory EIR because it required State Agency Actions and exceeded several EIR review thresholds including:

- New interbasin transfer of water of 1,000,000 or more gpd or any amount determined to be significant by the Water Resources Commission (301 CMR 11.03(4)(a)(2))
- Provided that the Project is undertaken by an Agency, New water service to a municipality or water district across a municipal boundary through New or existing pipelines, unless a disruption of service emergency is declared in accordance with applicable statutes and regulations (301 CMR 11.03(4)(a)(4));
- Construction of one or more New sewer mains ten or more miles in length (301 CMR 11.03(5)(a)(3)); and
- Provided that the project is undertaken by an Agency, New sewer service to a municipality or sewer district across a municipal boundary through New or existing pipelines, unless an emergency is declared in accordance with applicable statutes and regulations (301 CMR 11.03(5)(a)(4));

The project, as proposed in the NPC, exceeds the EIR threshold at 301 CMR 11.03(4)(a)(2). It requires approval in accordance with the ITA (M.G.L. c.21 ss. 8B-D; 313 CMR 4.00) and several water supply permits from MassDEP including a Chemical Addition Retrofit of Water Systems Serving More than 3,300 People. It may also require an Abandonment of a Water Source Permit. The project is subject to the MEPA GHG Emissions Policy and Protocol.

The Town will receive $3 million from a MassWorks Grant to support the project. Because the Town is receiving Financial Assistance from the Commonwealth for the project, MEPA jurisdiction is broad and extends to all aspects of the project that are likely, directly or indirectly, to cause Damage to the Environment, as defined in the MEPA regulations. The project change does not alter jurisdiction of the project.

Review of the NPC

The NPC provides a project background, description of existing conditions in the project area, a project description and plans, and project-related impacts. No chemical feed stations are proposed within wetland resource areas. The NPC included the results of a Hydraulic Analysis Memo which provided details regarding the capacity of the Andover water system to serve the Town. The analysis spanned a 20-year period and identified existing and proposed storage, supply and treatment capacity. The NPC included a copy of the IMA which authorizes the sale and supply of potable water to the Town from Andover.

Water Supply

As noted earlier, the Town's purchase of water from Andover is subject to an IMA and the ITA because it will increase the amount of water transferred across a river basin boundary (Merrimack to Ipswich) and a town boundary (Andover to North Reading). Water is supplied to the Town via two interconnections located on Main Street and Central Street along the municipal boundary of the two towns. The Main Street connection is the primary connection and includes a meter and isolation valve. The Central Street connection includes a pump station with chemical addition, meter, and isolation valve. Flows to these locations were modeled under future Maximum Daily Demand (MDD) conditions up to 3.0 MGD. The hydraulic analysis evaluated the impacts to Andover's system based on three interconnection scenarios:

1. Flow through two existing connections at Main Street and Central Street (Preferred Alternative).
2. Flow through a single connection at Main Street only.
3. Flow through the two existing connections at Main Street and Central Street in conjunction with a proposed third connection located at Jenkins Road.

The hydraulic analysis evaluated system pressures, pipe velocities, storage tank filling and draining characteristics and estimated fire flow. The results of the modeling analysis suggest that system pressures and pipe velocities for the Preferred Alternative under future MDD conditions decrease but are generally comparable to existing conditions. Tank storage analysis indicated that tank levels remain generally comparable to existing conditions. However, each of Andover's pressure zones is deficient in storage redundancy should the largest tank be taken out-of-service. The Town of Andover indicated that they will be addressing storage needs as part of their long-term capital planning. The fire flow analysis indicated that the Central Street location does not meet the required 3,500 fire flow under existing or future conditions. The increased flow to the Town is expected to be directed through the Main Street interconnection.

As described in the NPC, the Town's municipal wells will be downgraded from Active to Emergency status. The water treatment plants will remain operational for at least one year before the Town begins the process of decommissioning. Emergency sources may only be used with MassDEP approval during a declared State of Water Supply Emergency. Water quality monitoring for emergency sources is not required until and unless they are needed for an emergency. MassDEP recommends that the pumps and valves of emergency wells be exercised on a regular basis to ensure that the wells will be operational if an emergency arises. If the wells are to be downgraded to emergency status rather than formally abandoned, an Abandonment of Water Source Permit from MassDEP will not be necessary.

MassDEP comments support the project change because it will reduce water withdrawals in the head waters of the Ipswich River Basin, which has been classified as a Groundwater Withdrawal Category 5. Andover's surface water sources, including the Merrimack River, are far less hydrologically-stressed and better able to support the Town's water demand. Haggett's Pond has a total capacity of 1 billion gallons with a maximum depth of 35-40 feet. The safe yield of the pond is 1.1 MGD with a drawdown capacity of 6-feet. Haggett's Pond is supplemented with water diverted from Fish Brook and the Merrimack River which is chlorinated beforehand. The Town of Andover diverts water approximately 215 days per year.

Andover is authorized to withdraw 8.51 MGD from the Merrimack River Basin in accordance with its Water Management Act (WMA) registration and permit. Compliance with this volume is based on the average day withdrawal over a year. Comments from MassDEP indicate that since 1990, the highest average day demand for Andover, not including water sold to the Town and other water systems[1], was 6.22 MGD in 2013. The highest average day demand for the Town since 1990 was 1.59 MGD in 2016. Andover authorized volume appears sufficient to supply the Town and remain in compliance with the WMA. Andover's Water Treatment Plan (WTP) has a reported design capacity of 24 MGD. Raw water is pumped from Haggett's Pond through the WTP utilizing four low-lift pumps. Raw water passes through an ozone system for oxidation and disinfection followed by chemical addition for coagulation, pH adjustment, oxidation and disinfection. The chemically treated water then enters a rapid mixing system followed by flocculation and sedimentation. The water is then filtered and disinfected before being pumped into the distribution system. Water for North Andover and portions of Andover is pumped to the Bancroft reservoir. As described in the NPC, the Town of Andover is in the process of replacing the pumps at the WTP which pump water to the Bancroft Reservoir, a concrete water storage tank with a capacity of 6 million gallons.

Rare Species

Comments from the Division of Fisheries and Wildlife's Natural Heritage and Endangered Species Program (NHESP) indicate that Merrimack River is mapped habitat for Shortnose Sturgeon (*Acipenser brevirostrum*), Atlantic Sturgeon (*Acipenser oxyrinchus*) and the Bald Eagle (*Haliaeetus*

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[1] Andover has several emergency connections to neighboring communities include North Andover (2 connections), Tewksbury (3 connections), and Lawrence (3 connections).

leucocephalus). NHESP comments indicate that the inter-basin transfer should not result in impacts to state-listed species.

Construction

The Town must comply with MassDEP's Solid Waste and Air Quality Control regulations, pursuant to M.G.L. Chapter 40, Section 54, during construction. All construction activities should be undertaken in compliance with the conditions of all State and local permits. Contractors will be required to use Ultra Low Sulfur Diesel Fuel (ULSD) for motorized equipment and comply with anti-idling provisions (310 CMR 7.11).

SCOPE

General

The FEIR should include a detailed description of the proposed project. This description should include: a project history, a description of the overall project scope, a discussion of key planning initiatives and reports completed to date regarding water supply planning and wastewater management, and project objectives and goals. The FEIR should quantify all environmental impacts associated with the water supply project, including impacts associated with water system infrastructure upgrades in the Town of Andover.

Wastewater planning will be addressed in a subsequent NPC which will include a Scope for a Supplemental EIR. Additional analysis of wastewater is not required in this Scope; however, the Town should describe the status of planning, identify any significant developments and provide a schedule for development of alternatives and filing with MEPA.

The FEIR should follow Section 11.07 of the MEPA regulations for outline and content, as modified by this Scope. The FEIR should include a description of the existing environment including North Reading and Andover in accordance with 301 CMR 11.07(6)(g). The FEIR should describe proposed conditions for each project alternative to allow for an accurate assessment of potential environmental impacts including, but not limited to, the location of water, the proposed locations of pump stations and other related equipment. These descriptions should encompass all areas of potential project impact, including areas beyond the boundaries of North Reading.

The FEIR should clearly demonstrate that the Town has sought to avoid, minimize and mitigate Damage to the Environment to the maximum extent feasible. The FEIR should include a detailed description of the project and describe any changes to the project since the filing of the NPC. The FEIR should include a discussion of permitting requirements, the results of any consultation with State Agencies, and how the project will be constructed in accordance with applicable regulatory performance standards.

Land Alteration

The FEIR should identify Article 97 lands within the Town of Reading and Andover to identify any direct impacts to Article 97 lands or need for easements. If wells are abandoned, the FEIR should address how former water supply protection properties will be managed and whether land currently within the Zone 1 may be sold or transferred. If the wells will be abandoned, I highly encourage the town to preserve the land.

Interbasin Transfer

Comments from the WRC identify outstanding information needed to demonstrate that the Town has taken all practical measures to conserve water in the receiving area (Criterion 3). The FEIR must include all information necessary to complete the Interbasin Transfer approval process. Comments from WRC include a general scope for the FEIR. I strongly recommend that the Town meet with the WRC prior to the submission of the FEIR to ensure that all Scope items specific to this project are addressed so that the WRC process, including a public hearing, can be initiated. The FEIR should include direct responses, with supporting data or graphics as necessary. I hereby incorporate WRC's comments by reference into this Certificate.

The ITA review process will include reviewing North Reading's compliance with the Massachusetts Water Conservation Standards, including the performance standards for unaccounted-for water (no more than 10% of the water that enters the distribution system should be unaccounted for) and residential per capita day water use of no more than 65 gallons per person. As identified in WRC's comment letter on the DEIR, North Reading does not meet the ITA Performance Standards for UAW or residential water use in gallons per capita per day (rgcd). The FEIR should discuss how the Town will improve its accounting of water use and describe its water loss control program. In addition, the FEIR should identify water conservation measures the Town will implement (e.g., rebates for low flow fixtures, residential water use audits), a timeline for implementation and an estimate of reductions.

The FEIR should include additional information on Andover's water system. It should identify the current timing of the diversions from the Merrimack River and Fish Brook and describe the potential impacts to these resources and Haggett's Pond associated with the increased water withdrawal. The FEIR should identify whether the increased supply of water to North Reading will increase the frequency of water diversions from the Merrimack River or Fish Brook. The FEIR should identify the percentage of usable capacity of Haggett's Pond that will be transferred to North Reading. The FEIR should include the applicable reservoir and/or drought management plan for Haggett's Pond.

Water Supply

The FEIR should clearly identify any deficiencies in Andover's water system, including any water quality issues. It should identify measures proposed to resolve any deficiencies, identify the party responsible for implementation and provide a schedule for implementation. In addition, the FEIR should identify proposed improvements to Andover and North Reading's distribution systems, including upgrading transmission mains and associated environmental impacts.

The FEIR should clarify whether North Reading will abandon its wells and retire its WMA registration. If the Town intends to abandon the wells, the FEIR should address consistency of the decommissioning with MassDEP *Guidelines for Public Water Systems*.

Greenhouse Gas Emissions

The project is subject to the MEPA Greenhouse Gas Emissions Policy and Protocol ("the Policy"). The Policy requires projects to quantify carbon dioxide (CO_2) emissions and identify measures to avoid, minimize or mitigate such emissions. The Town will be required to quantify the direct and/or indirect CO_2 emissions associated with the project's stationary source energy usage (e.g., building energy use, process-related energy use, pump stations, etc.) and transportation-related emissions (mobile sources), if applicable. To facilitate this evaluation, the GHG analysis should include a comparison of CO_2 emissions associated with an established project baseline to estimated CO_2 emissions associated with a final build condition that incorporates feasible mitigation measures to reduce CO_2 emissions.

The FEIR should include a GHG analysis that calculates and compares GHG emissions associated with: 1) a Baseline, or Business As Usual case (direct and indirect emissions from energy consumption based upon a typical pumping and treatment design and operations) and 2) the proposed Preferred Alternative (direct and indirect emissions from energy consumption based upon the implementation of equipment and operations that achieve reduced GHG emissions compared to the Baseline). The GHG analysis should specifically evaluate proposed pumping and treatment equipment and/or operations protocols to determine if indirect GHG emissions can be reduced compared to the Baseline case. The Town should identify the model or methodology used to analyze GHG emissions, clearly state modeling assumptions, and explicitly note which GHG reduction measures have been modeled and will be implemented within the system.

Mitigation/Draft Section 61 Findings

The FEIR should include a separate chapter summarizing proposed mitigation measures. The FEIR should include draft Section 61 Findings for each anticipated State Agency Action. The FEIR should contain clear commitments to implement these mitigation measures, estimate the individual costs of each proposed measure, identify the parties responsible for implementation, and a schedule for implementation in a tabular format.

Responses to Comments/Circulation

The FEIR should contain a copy of this Certificate and a copy of each comment letter received. In order to ensure that the issues raised by commenters are addressed, the FEIR should include direct responses to comments to the extent that they are within MEPA jurisdiction. This directive is not intended, and shall not be construed, to enlarge the scope of the FEIR beyond what has been expressly identified in this certificate.

The Town should circulate the FEIR to those parties who commented on the EENF, DEIR, NPC, and to any State Agencies from which the Town will seek permits or approvals, and to any additional parties specified in section 11.16 of the MEPA regulations. To save paper and other resources, the Town may circulate copies of the FEIR to commenters other than State Agencies in a digital format (e.g., CD-ROM, USB drive) or post to an online website. However, the Town should make available a reasonable number of hard copies to accommodate those without convenient access to a computer to be distributed upon request on a first come, first served basis. The Town should send a letter accompanying the digital copy or identifying the web address of the online version of the FEIR indicating that hard copies are available upon request, noting relevant comment deadlines, and addresses for submission of comments. The FEIR submitted to the MEPA office should include a digital copy of the complete document. A copy of the FEIR should be made available for review at the Eastham public library.

December 21, 2018
Date

Matthew A. Beaton

Comments received:

11/22/2018	Massachusetts Historical Commission (MHC)
12/07/2018	Water Resources Commission (WRC)
12/11/2018	Keith Saxon
12/11/2018	Jose Albuquerque
12/11/2018	Massachusetts Department of Environmental Protection – Northeast Regional Office (MassDEP – NERO)
12/17/2018	Massachusetts Division of Fisheries and Wildlife – Natural Heritage and Endangered Species Program (NHESP)

MAB/EFF/eff

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RECEIVED

NOV 22 2018

MEPA

November 19, 2018

The Commonwealth of Massachusetts

William Francis Galvin, Secretary of the Commonwealth
Massachusetts Historical Commission

Patrick Bowers
North Reading Department of Public Works
235 North Street
North Reading, MA 01864

Dear Mr. Bowers:

RE: North Reading Water Supply and Wastewater Management Plan, North Reading and Reading, MA.
MHC# RC.53336. **EEA #14975.**

Staff of the Massachusetts Historical Commission (MHC) have reviewed the Notice of Project Change (NPC), received October 22, 2018, for the project referenced above.

The MHC notes that the project has been modified and multiple project alternatives are under consideration. Project planners should submit the Final Environmental Impact Report (FEIR) and scaled project plans showing existing and proposed conditions for the preferred project alternative to the MHC for review and comment. Project plans should show each phase of improvements or expansion projects, including treatment plant location(s), recharge areas, pump stations, equipment storage and materials staging areas and cross-country water and/or pipeline right-of-ways. The MHC encourages project planners to continue to consult with the North Reading Historical Commission as project planning proceeds.

Project planners should continue to consult the Inventory of Historic and Archaeological Assets of the Commonwealth for identified historic and archaeological properties. Feasible designs and locations that meet the engineering requirements, while also seeking to avoid or minimize impacts to historic and archaeological properties and areas should be considered. Design elements for new construction in historic areas should consider size, scale, massing, height and materials in developing the specifications, and also consider vegetative screening to minimize visual effects.

If the project requires federal funding, licensing, permits or approvals, such as use of State Revolving Fund funding administered by the Massachusetts Department of Environmental Protection, then the MHC will continue to review the project pursuant to Section 106 of the National Historic Preservation Act of 1966, as amended (36 CFR 800) in consultation with the involved federal agencies.

The MHC looks forward to reviewing the information requested above and to continued consultation to avoid, minimize or mitigate adverse effects to significant historic and archaeological resources.

These comments are offered to assist in compliance with Section 106 of the National Historic Preservation Act of 1966, as amended (36 CFR 800), and/or Massachusetts General Laws, Chapter 9, Sections 26-27C (950 CMR 71) and MEPA (301 CMR 11). If you have questions or require additional information please contact Jonathan K. Patton at this office.

Sincerely,

Brona Simon

Brona Simon
State Historic Preservation Officer
Executive Director
State Archaeologist
Massachusetts Historical Commission

xc: Secretary Matthew A. Beaton, EEA, Attn: MEPA Unit
North Reading Historical Commission
North Reading Historic District Commission
Brianna Wentworth, Wright-Pierce

THE COMMONWEALTH OF MASSACHUSETTS
WATER RESOURCES COMMISSION
100 CAMBRIDGE STREET, BOSTON MA 02114

December 7, 2018

Matthew Beaton, Secretary
Executive Office of Energy and Environmental Affairs
Attention: Erin Flaherty, MEPA Office
EOEA #14975
100 Cambridge Street
Boston, MA 02114

Dear Secretary Beaton:

Staff for the Water Resources Commission (WRC) has reviewed the Notice of Project Change (NPC) for the Town of North Reading's New Water and Wastewater Solutions project. Staff has met with the Town several times as they have explored their water and wastewater options, the last time being in June 2017. With this NPC, North Reading is proposing to purchase additional water from Andover, rather than the MWRA, as originally proposed in the Draft Environmental Impact Report (EIR). North Reading is located in the Ipswich River basin and Andover's water supply sources are from the Merrimack River basin. Therefore this potential purchase is subject to the Interbasin Transfer Act (ITA).

The WRC uses the EIR as its ITA application. We do this to provide streamlining of state review processes. Therefore, we are concerned about the statement on page 5 of NPC, indicating that the Town would apply for ITA approval after the issuance of the Final EIR certificate. If a proponent uses the EIR as its ITA application, and provides all the information needed for ITA review through the MEPA process, once the final certificate on the project is issued, an additional application is not needed and the WRC can schedule the two public hearings required under the Act and proceed with the formal ITA decision-making process. If the information is not provided until after the MEPA process is completed, the timing for a WRC decision will be unnecessarily prolonged.

In 1991, the WRC approved a request from North Reading to supplement its water supply through the purchase of additional water from Andover. Currently, North Reading is able to transfer up to 1.5 mgd from Andover under the ITA. In the 27 years that have passed, our hydrologic analyses have improved, and conditions within the donor basin and demands on Andover's water supply system may have changed. Therefore the FEIR should provide more information on Andover's system, including the current timing of the transfers from the Merrimack River and Fish Brook and describe the potential impacts to these streams and to Haggerts Pond, due this increased transfer to North Reading. Page 4 of the NPC discusses the phasing of North Reading's proposed purchase, indicating that the Town would be purchasing up to 3.0 mgd after 2025. The FEIR should clarify if the 3.0 mgd represents the average or maximum amount to be transferred. The ITA regulates on capacity or maximum day use, so in its ITA application, North Reading should be requesting what they have determined to be the maximum needed to address their maximum day demand, minus the already authorized 1.5 mgd transfer. The hydrologic analyses should be conducted on this amount and include the cumulative impacts of all past, authorized or proposed transfers on the Andover system. I strongly urge North Reading and Andover to meet with

WRC staff to discuss the operation of Andover's water supply sources and the potential analyses needed for ITA review. They should contact Michele Drury at 617-626-1366 to set up a meeting at the earliest possible time, prior to development of the FEIR. I have attached a generic scope for ITA issues to be addressed in an EIR for a water supply interbasin transfer, but the hydrologic analyses in the donor basin will need to be tailored for Andover's system. North Reading and Andover should refer to 313 CMR 4.09(2)(g), found at https://www.mass.gov/files/documents/2018/03/27/313cmr4.pdf, for the types of information required for these hydrological analyses. In addition, copies of the FEIR (electronic preferred, unless otherwise indicated) must be sent to the distribution list at the end of the attached scope.

In our comments on the DEIR, we discussed the reasons North Reading provided to demonstrate compliance with Criterion #2 of the ITA regulations (Use and Development of Viable In-basin Sources). These included water quality and water quantity issues, as well as the costs of replacing its aging water supply infrastructure. We concluded that the DEIR provided all the information the WRC needs to evaluate North Reading's current proposal against this Criterion. We also listed several issues that needed to be addressed in order to evaluate North Reading's compliance with Criterion #3 of the ITA regulations (Water Conservation). These comments still need to be addressed and any updated information should be provided (for example, documentation of water audits, leak detection programs, master meter calibrations, rate studies, drought plan). In addition, WRC Staff is in the process of updating the ITA Performance Standards. North Reading's FEIR/ITA application should comply with the latest version available at the time of submittal. Again we urge North Reading to provide responses to all ITA issues in the FEIR.

Thank you for the opportunity to comment. If you have any questions, please feel free to call me at 617-626-1248 or Michele Drury at 617-626-1366.

Sincerely,

Vandana Rao, PhD
Executive Director

cc: Water Resources Commission
Michele Drury, DCR
Erin Graham, DCR
Viki Zoltay, DCR
Anne Carroll, DCR
Duane LeVangie, MassDEP
Michelle Craddock, DER
Todd Richards, DFW
Amy Coman-Hoenig, NHESP
Lauren Glorioso, NHESP
David Pierce, DMF
Mark Clark, North Reading
Patrick Bower, North Reading
Amy Coppers Constantino, Wright-Pierce

THE COMMONWEALTH OF MASSACHUSETTS
WATER RESOURCES COMMISSION

EIR Scope/Interbasin Transfer Act Application for Communities Seeking

APPROVAL FOR WATER SUPPLY DEVELOPMENT

Under the Interbasin Transfer Act

The MEPA regulations, 301 CMR 11.03, require a mandatory Environmental Impact Report (EIR) for transfers considered "significant" under the Interbasin Transfer Act (ITA). The Water Resources Commission (WRC) uses the EIR as its ITA application. This scope outlines the information required for ITA review and should be incorporated into the EIR. Wherever possible, the applicant should provide this information in an electronic format.

This scope is only for that portion of the EIR that pertains to the INTERBASIN TRANSFER ACT. There may be other issues which need to be addressed in the EIR for a particular project. The MEPA program should be contacted to determine a comprehensive scope.

The Interbasin Transfer Act governs the transfer of water and wastewater between river basins within the Commonwealth. Any water transferred out of a river basin, either for water supply or wastewater treatment purposes, is no longer available to replenish the "donor" basin's rivers, aquifers, lakes or wetlands. The purpose of the Act is to assure that if an interbasin transfer does occur, the resources of the donor basin are not adversely impacted.

An interbasin transfer of water supply is any transfer of surface or ground waters of the Commonwealth for use and disposal outside of its river basin of origin. The following scope outlines issues to be addressed in the EIR for "significant" water supply transfers. Consultation with DCR's Office of Water Resources (617-626-1366) is strongly recommended to tailor this scope to a specific proposal.

SUMMARY OF PROJECT

- Project Name
- Location
- Proponent Name, Address, Phone Number, Email Address
- Primary Contact's Name, Address, Phone Number, Email Address

DESCRIPTION OF THE PROPOSED INTERBASIN TRANSFER

- Describe and explain the reasons for the proposed water supply interbasin transfer.
- Provide the approximate timetable for the construction of the proposed transfer facilities, including the estimated commencement date and the estimated completion date.
- Where applicable, describe the existing transfer system, including out-of-basin conveyance capacity, storage capacity, withdrawal constraints or other limiting factors.
- Describe, in detail, the proposed interbasin transfer, including the maximum capacity, in millions of gallons per day (mgd), of the transfer facilities and the expected average daily volume of transfer. Provide supporting information showing how the capacity of the conveyance was determined. Describe any proposed changes in existing structures and/or changes in operating rules of the water supplier or changes in transfer constraints.
- Describe how the transfer supports the long-range water resources planning of the applicant.
- Describe the operating schedule of the proposed interbasin transfer, including the time periods, amounts to be transferred and the duration of the transfer.
- Provide the name, exact location and river basin of the source(s) of the proposed transfer of water, including the subbasin(s).
- List the communities, sections of communities, water districts or other areas that will use the water proposed to be transferred.
- Provide a precise description of the location, including river basin, of the wastewater discharge point.
- List the known users of this and associated resources, including agricultural operations and nurseries, whose use could be affected by the proposed transfer.
- Include a map of appropriate scale that clearly and accurately illustrates the information requested in this section. Wherever possible, MASSGIS data layers should be used.

OTHER PERMITS REQUIRED

- List the local, State or Federal agencies/commissions from which permits have been obtained or will be sought

INFORMATION NEEDED TO EVALUATE THIS PROJECT AGAINST THE EIGHT CRITERIA OF THE INTERBASIN TRANSFER REGULATIONS, 313 CMR 4.09(3)

Below, in **bold** the criteria for approval of an interbasin transfer are listed, as they appear in the regulations (313 CMR 4.09(3)). Unless otherwise noted, the applicant must respond to all points listed under each criterion.

1. That an environmental review pursuant to M.G.L. c. 30, §§61 and 62H, inclusive, has been complied with for the proposed increase.

- Information needed for Interbasin Transfer review should be provided within the context of the EIR.
- Provide a copy of the ENF, including copies of comments received.
- When issued, provide a copy of the Secretary of Environmental Affairs' certificate stating that the EIR properly complies with MEPA and its regulations.

2. That all reasonable efforts have been made to identify and develop all viable sources in the receiving area of the proposed interbasin transfer

Viable Source means a water source or wastewater service alternative that meets the current regulatory requirements of the permitting authorities, and is environmentally sound, technologically feasible and cost-effective. For water supply transfers, Viable Source means a source which can provide drinking water that meets the current water quality standards and water management requirements promulgated by the Department of Environmental Protection or other regulatory agency, and which can be used while preserving reasonable instream flow using the same criteria provided to evaluate impacts on the donor basin listed in 313 CMR 4.09(3)(e). For transfers of water supply, receiving area means the area into which the water is transferred for use, and is thereby receiving the water supply service.

Describe in detail the efforts made to identify and develop all viable sources in the receiving area. Discuss water supply alternatives considered, but rejected. State reasons for rejection. The discussion should include:

- Assessment of the development of abandoned (temporary or permanent), existing and potential in-basin water supply sources. Clearly and accurately locate these sources on a map of appropriate scale.
- A list and summary of studies and reports evaluating in-basin sources in the receiving area. Copies of studies should be made available upon request.
- A description of the costs of developing existing and proposed in-basin sources in the receiving area.
- If cost is a reason given for rejection of an inbasin source, compare these costs with the production costs recently incurred elsewhere in the Commonwealth for similar water supply sources. Refer to the Performance Standards, available from DCR's website: https://www.mass.gov/files/documents/2017/08/31/Performance%20Standards%20Guidance%20Document.pdf for guidance on comparing costs.
- Describe the impact on in-basin streamflow that would result from the development of any viable in-basin sources in the receiving area. Refer to 313 CMR 4.09(3)(c).
- Discuss the feasibility of obtaining additional water supply from water supply agencies in cities, towns or districts within the same basin as the receiving area. Are interconnections in place? If not, are such interconnections feasible?

3. That all practical measures to conserve water have been taken in the receiving area

- Describe the current water loss control program, including the latest water audit, as specifically as possible, listing the actions that have been implemented or are scheduled to be implemented in the very near future. The ITA Performance Standards require that unaccounted-for water (UAW) should be 10% or less. Describe the amount of unaccounted-for water (in gallons and percent) in the receiving area for the past five (5) years. Describe on-going programs to reduce or keep the amount of unaccounted-for water at reasonable levels (less than 10%).
- Describe the current leak detection and system repair program. Discuss the methodology used (refer to the Interbasin Transfer Act Performance Standards, available from DCR's website: http://www.mass.gov/eea/docs/dcr/watersupply/intbasin/finalps.pdf). What was the date of the

most recent leak detection survey? Describe the on-going meter installation, maintenance, and replacement program. State the percentage of the system that is metered. Provide documentation of the annual master meter calibration program and a description of that program. Provide data to show that all permanent water supply services (including public buildings) in the receiving area are metered.

- Section 8D of the ITA (MGL Chapter 21) requires the "implementation of rate structures which reflect the costs of operation, proper maintenance and water conservation and encourage the same" (subsection (2)(c)). Describe the current rate structure. Refer to Appendix C of the Performance Standards, available from DCR's website: http://www.mass.gov/eea/docs/dcr/watersupply/intbasin/finalps.pdf: (1) Does the rate structure reflect the cost of operation, proper maintenance, proposed capital improvements and water conservation. Does it encourage water conservation? If so, how? (2) Is the rate flat, increasing or decreasing? Is it charged according to water use, or some other method? (3) Are the revenues from sales of water dedicated in an enterprise account or is some other accounting procedure used? Describe.
- How often are customers billed? Is billing based on actual meter readings? Provide an example of the bill sent to customers.
- Provide the existing contingency plan(s) for adequately handling water supply emergencies, such as contamination of water supply sources or seasonal or drought related shortages of water supply. (See 313 CMR 4.02for a definition of 'contingency plan'.) Explain, if not stated in the plan, how and when water use will be curtailed, when trigger points require action, which water users will be reduced by what measures, and over what period of time, what emergency sources will be utilized, such as interconnections with nearby communities, reactivated sources or new emergency sources.
- Do all public buildings under the control of the proponent have low flow plumbing fixtures? Describe the types of fixtures in these buildings.
- When was the last water audit of public facilities? Provide a copy of the report. Has a system-wide water audit ever been conducted? When? Provide a copy of the report.
- Describe any past or current programs to supply low flow plumbing fixtures to residential customers. What is the residential gallons per capita per day (gpcd) figure for the water supply system? What is the overall gpcd for the system? Provide the Annual Statistical Reports, required by DEP, for the past five years.
- If residential gpcd is greater than 65, describe the comprehensive residential water conservation program that is or will be implemented to reduce this use. If this program is not in place, describe the timetable for implementation. Refer to the Performance Standards.
- Describe the current and proposed public information programs to promote water conservation, the use of water conserving devices, and industrial and commercial recycling and reuse. These programs should include a program which identifies, ranks and works with all commercial, industrial and institutional customers according to amount used in order to determine areas where the greatest potential for water savings exists, should be in place. Are public education programs on-going or intermittent? Explain.
- Describe the measures in place to protect the water supply sources currently serving the receiving area that meet the requirements of the Department of Environmental Protection published in 310 CMR 22.20 and Wellhead Protection regulations 310 CMR 22.21. Include in this description all watershed or aquifer lands (Zones 1 and 2), even if not under the direct

control of the water supply agencies.

4. That a comprehensive forestry management program which balances water yields, wildlife habitat and natural beauty on watershed lands of surface water supply sources, presently serving the receiving area and under control of the proponent has been implemented.

- If the community does not have surface water sources, this criterion is not applicable. If the community does, describe existing and proposed watershed forestry management programs on watershed lands currently serving the receiving area and under the control of the proponent. Submit a copy of any applicable forestry watershed plans. Refer to the Interbasin Transfer Performance Standards for the information to be included in a Forestry Management Plan.

5. That reasonable instream flow in the river from which the water is transferred is maintained.

This part should describe the hydrologic characteristics of the river basin from which the water is to be diverted and any interdependent ground water regimen.

- Describe the proposed operating schedule for the interbasin transfer. This description should include variations throughout the seasons, the months, and the hours during a 24 hour period.
- Provide the hydrologic information and analyses, as appropriate, listed in 313 CMR 4.09(2)(g) 1-4.

6. In the case of groundwater withdrawals, the results of pumping tests will be used to indicate the impact of the proposed withdrawal on static water levels, the cone of depression, the potential impacts on adjacent wells and lake and pond levels, and the potential to affect instream values as listed in 313 CMR 4.09(2)(g)

- If the proposed source is a ground water source, the pumping test for this source should be used to collect site-specific data to evaluate the effects of the project on instream-flow related resources.
- Provide the DEP-approved pumping test report to DCR's Office of Water Resources.
- If not included in the pumping test report, the following information should also be provided:
  - A map of appropriate scale of the site clearly showing test wells, observation wells, and the location of geological cross-sections
  - Pre-pumping test groundwater elevation contour map
  - End of pumping test groundwater elevation contour map
  - Geologic cross-sections including pre- and end of pumping test groundwater levels
  - Documentation of the groundwater model, if used, describing input and output data, model calibration, water balance data, characterization of water sources to the pumping wells.

7. The Commission shall consider the cumulative impacts of all past, authorized or proposed transfers on streamflows, groundwater, lakes, ponds, reservoirs or other impoundments in the Donor Basin and relevant subbasins.

- List and describe the impact of all past, authorized and other proposed transfers on the streamflow in the donor basin. This would include analysis of any water supply sources or sewer systems that have been recently developed or approved and therefore not captured by the historic hydrographs, consideration of any water supply sources in the new source approval or Water Management Act permitting processes, sewering plans under development, etc.

MITIGATION

- Describe any proposed flow augmentation provisions, flow protection thresholds, or other mitigation measures proposed to protect instream flow. This should include incorporation of any known stream flow threshold(s) (for example, from federal or state law, previous IBT decision, or DEP requirement) into the proposed operating regimen.

EO 385

Provide information to demonstrate that this proposal seeks to minimize unnecessary loss or depletion of environmental quality and resources.

Electronic copies (unless otherwise specified) of all Interbasin Transfer EIRs should be sent to the following people. This is only a listing of those people who will be reviewing the EIR specifically under the Interbasin Transfer Act and is not meant to be all inclusive.

Vandana Rao Executive Director Water Resources Commission EOEEA 100 Cambridge Street Boston, MA 02114 Vandana.rao@mass.gov	Michelle Craddock DFG Division of Ecological Restoration 251 Causeway Street Boston, MA 02114 michelle.craddock@mass.gov
Michele Drury (3 bound copies in addition to the electronic copy) DCR Office of Water Resources 251 Causeway Street Boston, MA 02114 Michele.drury@mass.gov	David Pierce Division of Marine Fisheries 251 Causeway Street Boston, MA 02114 david.pierce@mass.gov
Duane LeVangie DEP 1 Winter Street Boston, 02108 duane.levangie@mass.gov	DMF Annisquam River Marine Fisheries Field Station 30 Emerson Ave. Gloucester, MA 01930
Todd Richards DFW 1 Rabbit Hill Road Westborough, MA 01581 Todd.richards@mass.gov	The Public Libraries of the affected communities in both the donor and receiving basin One bound copy each
Amy Coman-Hoenig/Lauren Glorioso NHESP DFG 1 Rabbit Hill Road Westborough, MA 01581 amy.coman@mass.gov lauren.glorioso@mass.gov	

December 11, 2018

Secretary Matthew Beaton
Executive Office of Environmental Affairs
Attn: MEPA Office
Erin Flaherty, EEA#14975
100 Cambridge Street, Suite 900
Boston, MA 02114

Secretary Beaton: – Please find attachments and comments related to EEA#14975 for your review. There is nothing more fundamental to life than water. We need water to drink, take a shower and flush a toilet.

Even though the Town of Andover has been awarded numerous times for the water quality, our water distribution system is aging and requires maintenance. My comments to this change are that we are concerned that the Town of Andover is not capable of handling additional volume at this present time due to the fact they are not able to manage water operations such as the continuing issues of brown water and watershed management.

It puts the environment and residents at risk with potential negative impacts. Here are some examples attached where we have expressed our concerns.

Finally, it is imperative to expand the existing Andover Water Commission that is currently composed of the Board of Selectmen to include North Reading Select Board representation as I suggested in the attached February 2018 email. It was proposed by North Reading Select Board but was rejected by Andover.

Thank you for your time and opportunity to provide comments.

Sincerely,

Jose L. Albuquerque

Jose Albuquerque
197 Greenwood Road
Andover, MA 01810

Please find a sampling of photos posted on a number of social media sites posted by Andover residents related to the ongoing brown/discolored water issues and complaints from all sections of Andover (i.e. Shawsheen, downtown area, West Andover, etc).

12/5/18

12/5/18

11/25/18

11/11/18

9/26/18

8/25/18

From: Stacey & Joe
Sent: Monday, September 03, 2018 6:08 PM
To: Alexander J. Vispoli <avispoli@andoverma.gov>; Laura Gregory <laura.gregory@andoverma.us>; Christian Huntress <chris.huntress@andoverma.us>; Paul J. Salafia <psalafia@andoverma.gov>; annie.gilbert@andoverma.us
Cc: Andrew Flanagan <aflanagan@andoverma.gov>; Michael.Lindstrom@andoverma.us; fincom@andoverma.gov; eugenie.moffitt@andoverma.us
Subject: Follow up on Discoloration Water Update

Dear Board of Selectmen - Thank you for including discolored/brown water as part of the 8/20 BOS meeting. As mentioned by Woodard and Curran, we agree that manganese is an essential nutrient for humans and animals. However, the public deserves to know that overexposure can cause serious health issues, which my wife and I spoke about briefly at this meeting.

Long term exposure to manganese can cause toxicity to the nervous system and Parkinson's like symptoms especially in children, seniors and pregnant mothers. In recent studies, children exposed to high levels of manganese have experienced learning difficulties including ADD, hyperactivity, and memory issues. It is true that there are currently no enforceable federal water standards for manganese. However, EPA has established a secondary standard of 0.05 mg/L to address aesthetics issues like discoloration, odor and taste. This Drinking Water Health Advisory does not mandate a standard for action, but rather it provides practical guidelines for addressing non-regulatory concentrations of the contaminant in water that are expected to be without adverse effects on both health and aesthetics.

https://www.mass.gov/files/documents/2016/08/nr/mangorsg.pdf

It is a disservice that our Municipal Services Director and consultants were not able to produce and provide the residents and taxpayers more information other than one reading taken on 8/15 during the discoloration period, which began in late June and lasted through mid-August, while not fully explaining manganese's associated health effects. We would like to request that all of their readings taken at the water treatment plant along with Town and School properties as pointed out at the meeting be made available on our website. Moreover, we advocate for robust testing going forward that will include resident participation, so we can better understand what is happening at our homes, particularly since the Municipal Services Director and the consultants stated that it would take as many as 20 years to fix it due to hundreds of miles of cast iron pipe that requires replacement or upgrade.

As we pointed out at the BOS meeting, the Town should further provide details and timelines on the 29 identified water projects mentioned in the following presentation that are critical to eliminating the discoloration and manganese problem across our Town, which will cost a projected $35 million. This was part of the water tier rate discussions that occurred in 2016.

https://andoverma.gov/DocumentCenter/View/855/Preliminary-Comprehensive-Water-and-Sewer-Rate-Evaluation-FY-2017---FY-2021-PDF?bidId=

As Water Commissioners, the suggestion of installing a filtration system is simply not the answer as some residents in our community may not be able to afford it and, more importantly, the gold standard should be clear and clean water that does not smell or stains clothes. Residents should not have to buy bottled water to use when brushing their teeth or for regular consumption because it is discolored from the faucet.

We are happy to know that the readings taken at our kitchen faucet on 8/23/18 were below the secondary standards. Fortunately, the last time we saw or had brown water was the morning of 8/21 and we have not seen any discoloration since that time. However, it would have been nice to know what the levels were when the water actually looked like iced tea. We would like to continue to participate in the testing now that we have baseline readings for both iron and manganese. Managing safe levels of manganese in drinking water is important step in both preserving our water distribution system and proper water treatment, which is paramount.

Thank you for your attention to this matter.

Best,
Stacey & Joe Albuquerque

From: Joe Albuquerque
Date: August 16, 2017 at 4:26:47 PM EDT
To: philip dipietro <philip.dipietro@state.ma.us>, philip.dipietro@massmail.state.ma.us
Subject: Ledge Road Landfill Request SOOC Additional Comments - DEP File #090-1281

Mr. Dipietro – First, thank you for the site visit on 08/03/17 and the opportunity for our 10 resident group to speak and discuss wetlands and storm water concerns related to the landfill appeal on order of conditions.

We feel it is very important that this landfill closure project and any post-closure use recommendations are done right from design to construction, which is why we felt obligated to appeal the Conservation Commission's decision. It is vital to protect the watershed and our Town's drinking water that serves a population of 48,000 including North Reading. In fact, in a recent Town survey conducted by the Conservation Commission, when it came to natural resources, residents' main concern was protecting water, especially the water overlay district (WPOD). Please note that the closure project at Ledge Road is located within the WPOD. Residents feel it should have even more protection. For more details, please click here for Andover Townsman Article published on 07/13/17.

This overlay district, defined in Section 8.1 of Andover's Zoning By-Law, was instituted "to preserve and protect surface and ground water resources in the Fish Brook/Haggetts Pond Watershed Protection Overlay District (WPOD) for the health, safety and welfare of its people", and ''to protect the community from detrimental use and development of land and waters within the WPOD". The WPOD includes all the lands which create the catchment or drainage areas of Fish Brook or Haggetts Pond as part of their natural or man-made drainage system. The existing landfill is a large plateau extending north to south from Ledge Road to a wetland floodplain connected to Fish Brook. According to Town of Andover's response letter (click here) to Kinder Morgan's Tennessee Gas Pipeline, Fish Brook is a tributary to Haggetts Pond, the primary source of drinking water for Andover. Both water bodies are "Class A" drinking water sources.

Why would we not classify the proposed and permanent DPW materials handling facility area as detrimental use and a high impact development as it relates to surface and ground water resources within the WPOD as defined in our Town's By-Laws too? This new facility shall include excess materials such as asphalt, street sweepings and catch basin cleanings, occasional on-site fueling as well as potential snow removal and storage location, which are not permitted in the Town's WPOD, storage of seasonal equipment and supplies plus a staging area for Town projects.

We would be remiss if we did not pass along the following information and attached documents:

- Please click here to view (starts at to 2 hr, 5 min until 2 hr, 8 min using Internet Explorer and at 126:20 to 128:00 if Google Chrome) video that shows CDM declaring that there are no drums or industrial waste at the landfill during the 3/7 Conservation Commission. This is concerning as they have not addressed drums fully in their remediation plans during capping/closing of the landfill.

- The first document called Ledge Road Landfill highlights Greenwood drainage, existence of a drum in the vernal pool and flooding that occurred earlier this past April.

- The other attachment called Landfill Environmental Issues consists of several photos.

- The first 2 slides dated 02/27/16 shows a lack of any appropriate controls (i.e. hay bales) to prevent catch basin cleanings storage pile with its contaminants from running off into adjacent active soccer field last year after a rainstorm.

- Remaining slides dated 06/24/17 reveals DPW working in an approximate 8 foot hole at the former Ledge Road and Greenwood intersection, where they were pumping water from it into a trench that was flowing directly into the nearby wetlands at the landfill site near the easement. If this work was an emergency, there should still have been controls in place for this construction activity to be performed.

These photos and actions (or lack thereof) present a disregard for the health/safety/welfare of the residents, wetlands and WPOD. We hope you understand and share our concerns and reservations after reviewing these materials. This is why it is critical to have a detailed operations plan as well as addressing potential stormwater impacts for the DPW materials handling area now instead of at the time of the post-closure use permit and NPDES Phase II MS4 general permit for the Town of Andover, respectfully. For the purpose of 401a water quality review, we would like to submit the attached original appeal as well as recent comments from Mr. Saxon to CDM responses.

It is our understanding that the DPW is considered the designated responsible individual for operations at Ledge Road in accordance with the 1973 DPH ruling to officially close it as an active dump. We are apprehensive of this new facility area next to our drinking water as the DPW does not consistently follow applicable laws and implement environmental controls at the landfill within the WPOD. Furthermore, CDM has yet to perform a full review of project alternatives to reduce or eliminate this high development impact, especially now that a new Town Yard with storage materials bins will be built at Campanelli Drive, which is right off River Road exit on Route 93.

Thank you again for your time.

Sincerely,
Joe Albuquerque
10 resident group representative
staceyandjoe@comcast.net


02/27/2016


SWEEPINGS
02/27/2016


06/24/2017


06/24/2017


06/24/2017

June 5, 2018

Ms. Rachel Freed, Deputy Regional Director
Bureau of Water Resources
Northeast Regional Office
Massachusetts Department of Environmental Protection
205B Lowell Street
Wilmington, MA 01887

Re: Ledge Rd Landfill – 10 Ledge Road – Andover MA
Application Transmittal #X272333
DEP Wetlands File #90-1281
USACOE File #NAE-2016-02013

Dear Ms. Freed,

I am writing on behalf of myself, and the 10-citizen group, that submitted comments last August regarding the WQC. **We are desperate for your help and assistance in protecting our local environment, safe drinking water, and compliance with the environmental statutes & regulations we thought were in place to protect us.**

We would have liked to submit an appeal of this WQC based what we perceive to be noncompliance with the 314 CMR 9 requirements for ORW areas and meeting the Stormwater Standards. Nevermind, the definitions under said regulations for "Activity" (including future expansions-overflow-overtopping), "Discharge of Dredged Materials" (including runoff), "Illicit Discharge", and "LHUPPL" -- all which we both know and can reasonably anticipate will occur with the new & expanded DPW yard given their historical operations. All while knowing that simple practicable alternatives exist to a DPW yard in our drinking water supply watershed which we thought was required to be identified and evaluated under 314 CMR 9.06.

Alas, we are simple residents, without the resources & time to prepare a detailed comprehensive response including certified mail et al to multiple parties, while knowing that the Town and its consultant are willing to spend any amount to say & do anything to counter our concerns versus actually addressing them. But most of all, it seems clear to us, that no matter how detailed, comprehensive, or warranted that our concerns are, that they won't be addressed by DEP staff as we have raised & submitted significant questions/points and did not ever receive a single response from DEP addressing them or even discussing them despite several attempts to communicate by phone or through email. Our last contact was in August 2017 all while DEP continued to meet with the Town & their consultants on an ongoing basis.

<u>This is incredibly discouraging and why we are desperately asking for your help in any way you can.</u>

We know from experience that we cannot count on or trust our own Town's environmental related staff (Conservation Commission or Board of Health) to help us when it comes to town operations, and thus why we need the DEP to step in & help us where they can.   And yes we know that Mr. Fournier is a former DEP staff member, with many friends still within DEP, but the ongoing environmental & operational performance of the DPW is abysmal (see listings & photo's below) – which we cannot afford to have that in our drinking water supply watershed going forward.

Please help us. Please meet with us. Please explain or review why the detailed points/concerns we have raised for the 401WQC and SOC apparently have no merit. And at the very least please explain how this site will be independently verified and made to fully comply with the regulation to safeguard the environment.

Thank You,

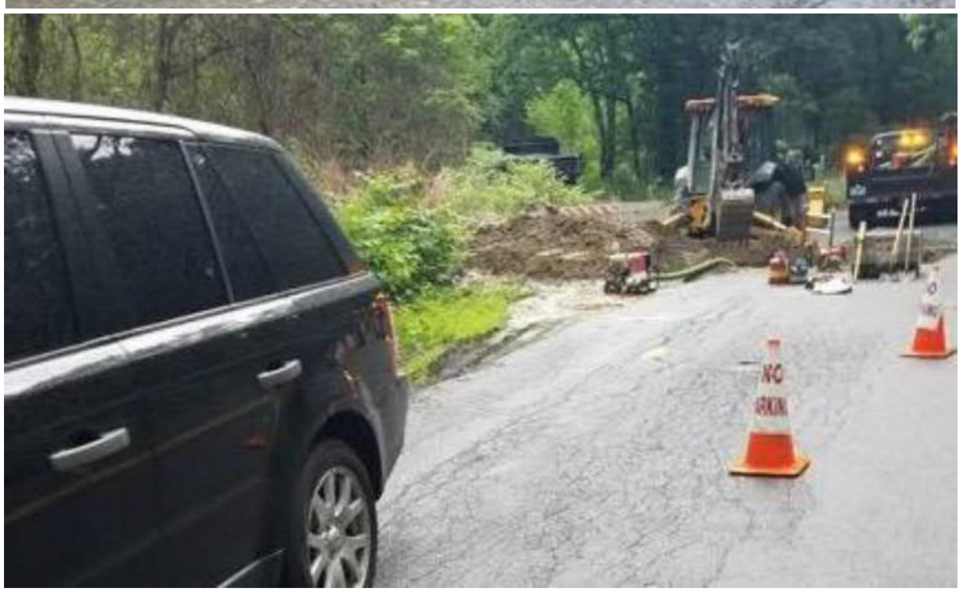
Jose L. Albuquerque

Jose L. Albuquerque (As Member & Representative of 10-citizen group)
197 Greenwood Rd
Andover, MA 01810
(978) 470-8149
staceyandjoe@comcast.net

2018 – Ongoing/Historically: DPW cannot manage the landfill site. The gate is almost always left open – resulting in uncontrolled dumping of materials.

2018 – Ongoing (and at least since 2015): Landfill site has contained floating drums and dozens of tires dumped in the wetland and land area within the fence of the Ledge Rd & Greenwood Rd intersection. Instead of removing these materials they have been left there despite numerous resident complaints, and instead the wetland has been treated with mosquito-cide.

6/24/2017 – Photo of Town DPW staff pumping “mud”/sediment laden water into the ORW wetlands downgradient of the Ledge Rd / Greenwood Road Intersection without any sedimentation control (“dirt bag”, settling tank, etc)



2010-Ongoing: A dumping ground and/or landfill is known to exist in the West Fire Station parcel (between Chandler, Ledge, & Greenwood). DPW has done some limited excavation of extent. This is just east of Ledge Rd landfill. However, this site has not been placed within DEP’s solid waste or MCP review process for closeout/cleanup. Residents reported this to DEP’s John Morey at least 2 if not 3-yrs ago but no action taken at all (due to friendship with Marc Fournier?).

2008 – 2017: DPW claims and reports to DEP every six months that they removed bridges to limit access to landfill site arsenic as required under MCP IRA. Truth however is that one bridge was never removed at all, while the other was simple broken up & dumped directly into Fish Brook our ORW drinking water supply.

2013/2014 – Aerial Photo of Ledge Rd Landfill showing illicit discharges of ?? to landfill and downstream ORW wetlands. Was this catch basin cleanings(CBC), street sweeping(SS), water tank sludges residues? All to be dumped again on top of landfill and with gravel base – liquids will continue to drain into downstream ORW wetlands or vernal pool. Mr. Fournier publicly discussed on 5/30/18 at our library how CBC and SS contain significant trash, oil, and organic debris which will all be brought to the landfill site and its drainage.

2010 – Water Tank Cleaning – Video. Heavy metal containing drinking water sludges cleaned out from water tank are dumped to storm drain & downstream wetland. Same 401WQC consulting firms call this a one-time inadvertent incident, when in fact it happened for three straight days here, and at the other water tanks in town. Results in MCP site on Bancroft Road. NOA results in NON where DEP requests records on where this sludge was disposed. Town DPW never provides information and the Town is never fined from EPA, DEP, or local Conservation Commission for this incident. At least some of this heavy metal laden sludge was dumped at Ledge Rd landfill per MCP records for this release.

https://www.youtube.com/watch?v=4qudUn-RTM8
Wetland Dirty Water Andover

December 11, 2018

Secretary Matthew Beaton
Executive Office of Environmental Affairs
Attn: MEPA Office
Erin Flaherty, EEA#14975
100 Cambridge Street
Suite 900
Boston, MA 02114

RE: NPC North Reading Water Supply Plan – EOEEA #14975

Dear Secretary Beaton,

I appreciate the opportunity to provide comments on this important water supply planning for North Reading (ENF# 14975). The project change to 100% long-term supply from Andover versus the MWRA is significant as well as removal of the wastewater planning component. I am very concerned that the FEIR needs to adequately address the impacts of this change within Andover as the much of the details are still yet to be determined as described in the Notice of Project Change.

Thus I have the following comments, points-of-information, and suggestions for how these can be addressed in the FEIR.

CAPACITY/CAPABILITY OF ANDOVER WATER SYSTEM TO SERVE NORTH READING

The purpose of NPC Attachment 6 – Hydraulic Analysis Memo is to analyze the ability & capacity of the Andover water system to provide the needed water for North Reading which the NPC states is feasible. There are, however, both unknowns that are stated or that are simply missing in the analysis that create some questions as to the systems true capability but more importantly the environmental impacts of any necessary upgrades within Andover need to be addressed in the FEIR.

a) Fish Brook/Merrimack River Water Intake: Item DPW-29 in Andover's most recent Capital Improvement Program (CIP) indicates the need for a new $15mm pump station intake to be constructed in fiscal year 2022. The published justification for this project is that "*the current intake will not meet future water demand*". This is not mentioned at all in the attached analysis memo. Certainly this is a project that is required due to the addition of 3.0 mgd for North Reading, and given its location at the confluence of Fish Brook and the Merrimack River, will have significant potential environmental impacts to wetland resource areas that needs to be included in the FEIR.
b) Bancroft Pump Station – Capacity/Size/# of Pumps?: The Wright-Pierce analysis describes a conflict (2800 vs 3500 gpm; 1 or 2 pumps?) between the design capacity and hydraulic model provided by Andover's consultant Woodard & Curran. More importantly even the largest capacity of 5 mgd has been determined to "not have adequate capacity" to meet future demand with North Reading. There are currently no listed projects in Andover's 5-yr CIP to increase the capacity of this pump station. Certainly if such a project is required to serve North Reading then it should be included in the FEIR with a review of environmental impacts. Further the FEIR should not be completed until answers to the basic question of the capacities of the pump(s) at

this pump station and whether in fact there are 1 or 2 operational pumps in place can be provided.

c) Transmission Mains Between WTP & Bancroft Pump Station: The analysis indicates that Andover is currently evaluating possible upgrades to the existing transmission mains to increase capacity in the system and that the hydraulic model will be updated when this information is available. Given how crucial the hydraulic model is to determining the actual feasibility of the selected option & needed infrastructure improvements, the FEIR should not be completed until this evaluation & updated information is provided. Much like the previously proposed water main upgrades in Reading under the DEIR, any needed water main improvements in Andover should be analyzed for environmental impacts in the FEIR.

d) Prospect Hill Storage Tank Upgrade: The analysis indicates that if the 3.0 MG Prospect Hill Tank #2 is taken out-of-service there would be an <u>inadequate volume</u> to serve North Reading under typical operating conditions. It goes on to recommend a new larger tank to eliminate the deficiency. A new storage tank is not included in the CIP. Please note that this storage tank was out-of-service for cleaning in both 2010 and 2014, and AWWA recommends inspection every 5-years with cleaning as needed. So this tank will be out of service in future. Thus the FEIR should address whether this deficiency affects feasibility and any necessary upgrades from a needed new tank need to be evaluated for environmental impacts.

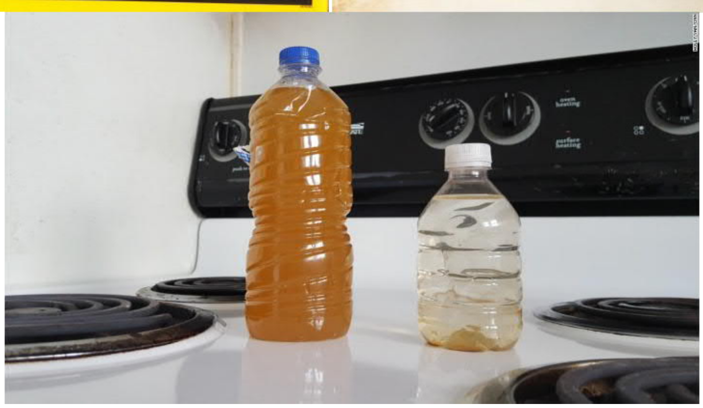
e) Average Daily Demand / Max Daily Demand: The analysis indicates that 2016 Andover data was used to determine the current and future values. 2016 Andover is ADD is listed as 7.07 mgd. This figure does not match that provided to DEP in the 2017 WMA permit renewal application of 7.28 mgd. Even if the WMA figures are inflated to include water ultimately discharged back to Haggetts Pond or to the sewer (unknown if it does), the data indicate that 2016 was the second lowest of the past five years where ADD ranged from 7.02 to 7.77 mgd, with an average of 7.43 mgd. The analysis and the FEIR should match should use at least the average, if not the maximum ADD over the past five years for a better reflection of actual data, and thus more conservative analysis.

BROWN WATER / WATER QUALITY

The public health and safety needs of ALL consumers of the Andover Public Water Supply are critical, really the whole point of providing a public water supply. In 2018, however, the Andover residents have been plagued with excessive and recurring water quality issues from “Brown Water” attributed primarily to increased pipe velocities. There have been literally hundreds of posts to social media of complaints including many with photos. More importantly many residents have reported ongoing and multiple incidents of “brown water” (40+ days, every single morning, etc) to the point where they cannot use the water for dishwashing, clotheswashing, brushing their teeth, and certainly not consumption. North Reading’s Water Superintendent even has attributed the source of some its “brown water” issues to the supply from Andover. See link below to article in Eagle Tribune this August where Andover DPW Director Chris Cronin places the cause of these issues on increased velocities due to summertime demand.

https://www.eagletribune.com/news/merrimack_valley/andover-says-brown-tap-water-is-nothing-to-worry-about/article_26a5cb49-0a4f-56ab-850c-bd483090670a.html

a) Increased Pipe Velocities: The analysis indicated for the most likely scenario (i.e. utilization of two existing connections) that pipe velocities greater than 5-fps would be observed in Lowell Street to Greenwood Road and Woburn Street to Abbott Street segments where they haven't been seen before. Further the analyses indicate many other areas of 2-5 fps velocities. It needs to be demonstrated in the FEIR that the increased volume & velocities will not create a situation where the water quality for Andover and All Consumers is inadequate, substandard, and unavailable for consumption for significant portions of time.



IBTA & OTHER PERMITTING CONCERNS

The FEIR should address the following permitting concerns to ensure that the Andover System can reliably provide the 3.0mgd to North Reading as well as make sure that any environmental impacts are indentified and mitigated/minimized.

a) The IMA attached to the NPC indicates that North Reading can purchase 2.4 mgd through 6/30/19 and then 2.6 mgd through 6/30/25. It then goes on to note state that the 2.6 mgd is dependent on the WMA and IBTA permits being amended. North Reading is currently only allowed 1.5 mgd. Given that the attached timeline for the amending the IBTA is basically at 6/30/19, why have this in there? Why is the last statement indicate only 2.6 mgd. The FEIR should make clear that North Reading did not violate the 1.5 mgd limit.
b) WMA Permit for Andover: The WMA application in November 2017 did not include the population of North Reading being served by this source. The FEIR should document the need to amend this.

c) NDPES WTP Discharge Permit: The Andover WTP already greatly exceeds EPA's proposed Aluminum discharge limit for the discharge of its filter backwash to Haggetts Pond. It is not likely that it would be able to meet the General WTP Permit discharge requirements and thus needs an individual permit. The FEIR should address whether Andover can obtain approval for this discharge (and thus be able to meet North Readings needs) as well as the environmental impacts of increasing this discharge via increased production to meet North Readings needs. There already exists a large underwater mound of aluminum containing solids in the pond.

d) NPDES Storage Tank Overflow / Drains: None of Andover's water storage tanks have are permitted for their overflow drains direct to wetland resource areas and stormwater systems. This was identified in CWA suit 1:12-CV-10247-RBC Berberian vs Town-of-Andover and has not been addressed. Further EPA in its recent MS4 guidance indicated that such discharges require approval. The FEIR needs to confirm that Andover can legally provide water to North Reading and address the environmental impacts of presumed increased discharges from the increase in flows.

e) Solids Discharge to GLSD: The Andover WTP discharges the solids removed from the flocculation & settling tanks to GLSD. More treated water means more solids generated. It is unclear whether the Andover WTP has or can get the approval to increase the discharge of these solids to GLSD or if the WWTP has the capacity to treat it. Again the FEIR needs to address the feasibility of this increased discharge & the additional downstream environmental impact.

MISCELLANEOUS POINTS

a) The NPC indicates a $3mm MassWorks Grant for the project: The FEIR scope thus should be broad based.

b) Hazardous Materials Impacts – Andover Storage Tanks & WTP Sludges: RTN 3-30229 was issued to Andover Water Department for its discharge of heavy metal containing tanks solids to a downstream wetland during the removal of solids from the Bancroft Storage Tank in 2010. Andover's Chris Cronin indicated under Affidavit in Document #7 of the CWA suit 1:12-CV-10247-RBC Berberian vs Town-of-Andover, that any future tank cleaning would plan to utilize tight tanks to collect solids to prevent a reoccurrence of the a release to wetlands, however, to the best of my knowledge this did not happen when the Prospect Hill Tanks were cleaned in 2014 & 2016. Further the given the high levels of arsenic & other metals in the tank bottom solids at Bancroft, it is quite likely that tank bottom solids contaminated areas are present downstream of or in the vicinity of the Prospect Hill Tank, Bancroft Tank & Pump Station, and WTP. The FEIR should address the hazardous materials impacts to wetlands & soils from both the increased need to clean the tanks from increased flows for North Reading, and for any project related construction activities and/or upgrades are required in these locations.

https://www.youtube.com/watch?v=4qudUn-RTM8

Link to Video Bancroft Tank Cleanout

c) Unbilled Andover Public Facilities Water Use: WRC water management guidelines indicate that Public Facilities water usage should be tracked closely to help facilitate water conservation. Currently the water consumed by Andover's Public Building are not billed. These costs, for the 5-7% of Andover's water consumption, are simply absorbed into the overall Water Enterprise Cost. It does not seem appropriate for North Reading water users to in essence to subsidize by 33% this consumption from Andover's Public Facilities. The FEIR should address the environmental impacts of this as well as the feasibility of a Water Enterprise Fund to charge other users for someone else's consumption.

I can be reached directly at 781-454-5330 or at ksaxon@aol.com if you have any questions and/or need additional information regarding my comments.

Thank You,

Keith Saxon

15 Wethersfield Drive

Andover, MA 01810

MassDEP
Commonwealth of Massachusetts
Executive Office of Energy & Environmental Affairs

Department of Environmental Protection

Northeast Regional Office • 205B Lowell Street, Wilmington MA 01887 • 978-694-3200

December 11, 2018

Matthew A. Beaton, Secretary
Executive Office of
Energy & Environmental Affairs
100 Cambridge Street
Boston MA, 02114

RE: North Reading
New Water and Sewer Solutions
Entire Town
EEA # 14975

Attn: MEPA Unit

Dear Secretary Beaton:

The Massachusetts Department of Environmental Protection (MassDEP) has reviewed the Notice of Project Change (NPC) submitted by the Town of North Reading to change the Town's water supply sources. MassDEP provides the following comments.

In the DEIR, the Town of North Reading was proposing to change its water supply sources from municipal wells and the Town of Andover to the Massachusetts Water Resources Authority (MWRA) through a new connection in the Town of Reading. The NPC now proposes that instead of connecting to the MWRA water supply, North Reading will purchase all of its water from the Town of Andover. The NPC will eliminate the need for water improvements in Reading to allow the MWRA water to be "wheeled" through the Reading municipal water system to the North Reading border. North Reading is now proposing to postpone the wastewater improvements that were included in the project. At some point in the future when the wastewater plans are more fully defined, the Town will submit a Supplemental FEIR that addresses them.

Drinking Water

According to the NPC, North Reading originally proposed to obtain its water from MWRA rather than Andover because it had been told by Andover that Andover would not be able to supply North Reading's maximum day demand of 2.5 million gallons per day (MGD) over the 20-year planning period, and that Andover could not provide a permanent water supply solution to North Reading's water needs. The Town of Andover provided comments on the DEIR that stated that Andover did in fact have sufficient treatment and distribution system capacity to meet North Reading's water needs. Given that Andover already provided from 61 to 78 percent of North Reading's annual water supply from 2009 to 2017 (based on data in North Reading's Annual Statistical Reports submitted to MassDEP), the infrastructure improvements needed for North Reading to purchase all its water from Andover are less than those that would be needed to obtain its water from MWRA. North Reading and Andover entered into a 99-year Inter-municipal Water Supply and Purchase Agreement in June 2018.

The NPC proposes that North Reading will implement booster chlorination at its two interconnections with Andover, in order to maintain an adequate chlorine residual throughout the Town. The chlorination will likely be done using hypochlorite, which is presently used at North Reading's municipal wells. A chlorination feed will be installed at the location of the existing Central Street pump station. A new chlorine feed station will be built adjacent to the Main Street interconnection, with the exact location yet to be determined. As noted in the NPC, a MassDEP BRPWS29 permit (Chemical Addition Retrofit for System Serving More Than 3,300 People) will be required for construction of the chlorine feed stations; the design for both stations may be combined into a single permit application.

The NPC states that "a storage analysis was conducted to determine if the tanks in the Andover system contain adequate storage volume over the next 20-year period to serve both Andover and North Reading's needs." If North Reading plans to eliminate some or all of its own water storage facilities, this will require a BRPWS32 permit from MassDEP (Distribution System Modification for System Serving More Than 3,300 People).

The NPC proposes that once Andover is providing all of North Reading's water supply, North Reading's municipal wells will be downgraded from "Active" to "Emergency" status. The water treatment plants will remain operational for at least one year before the Town begins the process of decommissioning them. Emergency sources may only be used with MassDEP approval during a declared State of Water Supply Emergency. Water quality monitoring of emergency sources is not required until such time as their use is proposed to alleviate an emergency. MassDEP recommends that the pumps and valves of emergency wells be exercised on a regular basis to help ensure that the wells will be operational if an emergency arises. If the wells are to be downgraded to emergency status rather than formally abandoned, the proposed BRPWS36 permit (Abandonment of Water Source) will not be necessary.

MassDEP will require North Reading to evaluate whether the changeover from a blend of Andover water and well water to full use of Andover water will require corrosion control treatment for North Reading to remain in compliance with the Lead and Copper Rule. This evaluation must be submitted to MassDEP for review prior to implementation of the full changeover. North Reading is currently required to conduct lead and copper monitoring once every three years. A revised Lead and Copper Sampling Plan must be submitted to MassDEP for review and approval prior to the changeover. MassDEP will require at least semi-annual (twice per year) lead and copper monitoring during the 12 months after the changeover occurs, and may require annual monitoring after that.

Water Management Act

The Water Management Program finds that this NPC shifting North Reading's water demand to the Andover water supply system will result in reducing water withdrawals in the head waters of the Ipswich River Basin, which has been classified as a Groundwater Withdrawal Category 5, our most impacted category. The project proposes shifting North Reading's demand to surface water sources including the Merrimack River, which is far less hydrologically stressed and much better able to support North Reading's water demand.

Andover is currently authorized to withdraw 8.51 MGD from the Merrimack River Basin in accordance with its Water Management Act (WMA) registration and permit. Compliance with this volume is based on the average day withdrawal over a year. Since 1990, the highest average day demand for Andover, subtracting out water sold to North Reading and much smaller amounts sold to other water systems, was 6.22 MGD in 2013. The highest average day demand for North Reading since 1990 was 1.59 MGD in 2016. Therefore, Andover's currently authorized volume appears to be sufficient to supply North Reading's water needs and remain in compliance with the WMA.

However, WMA permits in the Merrimack River Basin are scheduled to be renewed in 2022. The renewed permit volumes will be based on water needs forecasts prepared by the Department of Conservation and Recreation Office of Water Resources (DCR) for the upcoming permit period through 2034. Andover will need to request an updated water needs forecast for their renewed WMA permit that includes both Andover and North Reading's water use to ensure that Andover's renewed permit authorization will be enough to supply North Reading.

Both Andover and North Reading currently have unaccounted-for-water rates that are substantially above the 10% performance standard outlined in the Massachusetts Water Conservation Standards of July 2018 (https://www.mass.gov/files/documents/2018/09/11/ma-water-conservation-standards-2018.pdf), which might make it difficult for DCR to develop reliable water needs projections at this time. Both communities will need to develop plans to reduce their unaccounted-for-water rates toward the 10% performance standard. If reliable water needs forecasts cannot be developed prior to Andover's WMA permit renewal, a permit can be issued with an interim authorization pending better data and demand forecasts.

All WMA permit renewals may include revised or new permit conditions as outlined in the WMA regulations (310 CMR 36.00).

The DEIR had stated that the maximum daily flow that North Reading would be seeking to meet future demand would be 2.6 MGD. In the NPC, this has been increased to 3.0 MGD.

The Intermunicipal Water Supply and Purchase Agreement between Andover and North Reading states that after June 30, 2025 (at which time any necessary infrastructure upgrades will have been made), Andover will supply North Reading up to a maximum daily volume of 3.0 MGD.

The NCP says that North Reading's wells will be maintained as emergency backup supply sources and will be operated and maintained in accordance with the MassDEP guidelines. North Reading intends to maintain these sources and the two water treatment plants in full operational capacity for a minimum of one year following the transition to Andover water. Once the Town is satisfied that water quality has stabilized and operations are stable, North Reading will begin de-commissioning the existing water treatment plants and converting the wells to emergency sources.

This appears to be a change from the original plan to join the MWRA. In the original plan, it appeared that North Reading intended to abandon its wells and retire the Water Management Act registration. The proponent should clarify whether this NPC implies a change in the future plans for North Reading's existing wells and the associated Water Management Act registration.

This project will need a new Interbasin Transfer permit (IBT) to increase the amount of water transferred across a river basin boundary (Merrimack to Ipswich) and a town boundary (Andover to North Reading). The IBT review process will include reviewing North Reading's compliance with the Massachusetts Water Conservation Standards, including the performance standards for unaccounted-for water (no more than 10% of the water that enters the distribution system should be unaccounted for) and residential per capita day water use of no more than 65 gallons per person.

The MassDEP appreciates the opportunity to comment on this proposed project. Please contact Duane.LeVangie@state.ma.us, at (617) 292- 5706 for guidance on Water Management Act issues, and James.Persky@state.ma.us , at (978) 694-3227 for information on drinking water issues. If you have any general questions regarding these comments, please contact me at John.D.Viola@mass.gov or at (978) 694-3304.

Sincerely,

This final document copy is being provided to you electronically by the Department of Environmental Protection. A signed copy of this document is on file at the DEP office listed on the letterhead.

John D. Viola
Deputy Regional Director

cc: Brona Simon, Massachusetts Historical Commission
Eric Worrall, Rachel Freed, Tom Mahin, Jim Persky, MassDEP-NERO
Duane LeVangie, MassDEP-Boston

MASSWILDLIFE

DIVISION OF
FISHERIES & WILDLIFE

1 Rabbit Hill Road, Westborough, MA 01581
p: (508) 389-6300 | f: (508) 389-7890
MASS.GOV/MASSWILDLIFE

December 17, 2018

Matthew A. Beaton, Secretary
Executive Office of Energy and Environmental Affairs
Attention: MEPA Office
Erin Flaherty, EEA No. 14975
100 Cambridge Street
Boston, Massachusetts 02114

Project Name:	*New Water and Wastewater Solutions – North Reading*
Proponent:	*Town of North Reading*
Location:	*Interbasin Transfer – Haggerts Pond (Andover); Wastewater – townwide (North Reading)*
Document Reviewed:	*Notice of Project Change*
EEA No.:	*14975*
NHESP No.:	*18-38264*

Dear Secretary Beaton:

The Natural Heritage & Endangered Species Program of the Massachusetts Division of Fisheries & Wildlife (the "Division") has received and reviewed the *Notice of Project Change* (NPC) for the proposed *New Water and Wastewater Solutions – North Reading* Project (the Project) and would like to offer the following comments regarding state-listed species and their habitats.

The current NPC request that the inter-basin transfer from Andover to North Reading be separated from the wastewater treatment aspect that was previously subject to a single draft Environmental Impact Report. The Division has no objection should MEPA elect to allow this request.

INTERBASIN TRANSFER

The water source for the transfer is Haggerts Pond, which sources water from the Fish Brook and the Merrimack River. The Merrimack River is mapped the following state-listed rare species have been found in the vicinity of the site:

Scientific Name	*Common Name*	*Taxonomic Group*	*State Status*
Haliaeetus leucocephalus	Bald Eagle	Vertebrate: Bird	Threatened
Acipenser oxyrinchus	Atlantic Sturgeon	Vertebrate: Fish	Endangered*
Acipenser brevirostrum	Shortnose Sturgeon	Vertebrate: Fish	Endangered*

The species listed above are protected under the Massachusetts Endangered Species Act (MESA) (M.G.L. c. 131A) and its implementing regulations (321 CMR 10.00). State-listed wildlife are also protected under the state's Wetlands Protection Act (WPA) (M.G.L. c. 131, s. 40) and its implementing regulations (310 CMR 10.00). Fact sheets for most state-listed rare species can be found on our website (www.mass.gov/nhesp).

*The Shortnose and Atlantic Sturgeon are federally listed and protected pursuant to the U.S. Endangered Species Act (ESA, 50 CFR 17.11) implemented by the National Marine Fisheries Service.

Based on our current understanding of these species and their ecology, the inter-basin transfer should not result in impacts to state-listed species.

WASTEWATER CHANGES IN NORTH READING

Portion of the town of North Reading are mapped as *Priority* and *Estimated* Habitat in the *Massachusetts Natural Heritage Atlas*. These species and habitats are protected pursuant to the Massachusetts Endangered Species Act (MGL c.131A) and its implementing regulations (MESA; 321 CMR 10.00).

All projects or activities proposed within *Priority Habitat*, which are not otherwise exempt pursuant to 321 CMR 10.14, require review through a direct filing with the Division for compliance with the MESA (321 CMR 10.18). At present, the materials provided are not of sufficient detail to allow for site-specific review of the proposed work. Any work located within existing paved roads is likely exempt pursuant to the MESA (321 CMR 10.14). However, other aspects of the *Wastewater Changes*, including but not limited to cross-country segments and work more than 10 feet from a paved road, would not be MESA-exempt and will likely require a MESA Checklist filing pursuant to 321 CMR 10.18. Therefore, we are unable to determine if any specific portion of the project will have state-listed species impacts sufficient to require a MESA Conservation & Management Permit pursuant to 321 CMR 10.23.

As project elements move forward to preliminary design, we recommend that the Proponents are in direct contact with the Division to address state-listed species concerns, as avoidance and minimization of impacts to state-listed species and their habitats is likely to expedite endangered species regulatory review. We also note that field surveys for state-listed species may be part of our review of impacts and such field surveys may be time-sensitive relative to the annual cycle of the target species.

The Division will not render a final until all required application materials have been submitted to the Division. If you have any questions about this letter, please contact Misty-Anne Marold, Senior Endangered Species Review Biologist, at (508) 389-6356 or misty-anne.marold@state.ma.us. We appreciate the opportunity to comment on this project.

Sincerely,

Thomas W. French

Thomas W. French, Ph.D.
Assistant Director

cc: Town of North Reading Select Board
Town of North Reading Planning Board
Town of North Reading Conservation Commission

C

APPENDIX C

MassWorks Grant Information

Attachment 5: MassWorks Grant

North Reading – Water Infrastructure Improvements Project – $3,000,000

Details of the Grant. What was the Justification?

- The Town of North Reading will replace water mains and construct a new pump station to meet the current and future needs of the town. The MassWorks award will enable the redevelopment of the former J.T. Berry State Hospital site. The town of North Reading sold the property to Pulte Homes through a partnership with the Commonwealth, through the Open for Business initiative, an effort to help municipalities create value through its real estate portfolios. The sale and infrastructure upgrades, in coordination with efforts to rezone the site as a 40R Smart Growth District and designating it as a 43D Local Expedited Permitting Site, will result in the construction of a new, 450-unit housing development, Martins Landing. The project is also consistent with the Metropolitan Area Planning Council's MetroFutures Plans, and may unlock an additional 250-units of housing and up to 43,000-square-feet of new retail space. (From the MassWorks Website)

The date the Town applied for the grant.

- We initially applied in August 2017. Following that, in October 2017, we sent MassWorks updated information to let them know Andover as a water source was now a possibility and we would be evaluating that. The original application was for an MWRA project. The update for considering Andover is a separate Attachment (see Attachment 6).

The date the grant was issued?

- The official award letter is dated March 15, 2018

Does the Town need to provide matching funds?

- There is no formal match required, but we provided information about the town's expected investments and town investment is a consideration in award decisions

Were there any constraints/restrictions to the use of the funds?

- North Reading was asked for a project budget at the time of application, and we are now being asked for a revised project budget for the pre-contract so we can document any changes we expect from the time of application. The funds are expected to be used for the activities specified. There is also a restriction on how much can be spent on design:
    - From MassWorks: "Pre-construction costs, such as design and engineering, [are] eligible grant expenses… However, no more than 10% of the total grant requested can be used for pre-construction costs.EOHED expects communities to have plans for covering the cost of pre-construction activities, such as surveying, permitting, and design/engineering, as these items would need to start prior to MassWorks contracting, for projects to be able to advance to construction in the upcoming construction season."

Is there a schedule that the funds need to be expended?

- North Reading has not been given a deadline for when the funds need to be spent. However, MassWorks has been asking for an update on which fiscal years we expect to incur expenses so they can do their own financial planning. We have not yet been able to answer this – Planning is awaiting information from DPW once he knows more about the project updates. Currently, we can’t incur any expenses since our contract has not been signed. Our next step is for the town to return the pre-contract, have MassWorks approve the new scope/activities/timeframe, then sign the contract, then start drawing down the expenses. Our latest communication with MassWorks indicated we would be finishing the project June 2020.

How does the Town receive the $$?

- Once the pre contract is sent in and our contract finalized, and work begins, we will submit reimbursement requests to MassWorks by the 15th of each month.

Are there any reporting requirements or follow-up required of the Town?

- There will in all likelihood be a final report required once the work is done, and potentially at other milestones. However, we have received information about that yet (it is expected that this will be detailed in our contract).

Attachment 6: Notification to MassWorks of Potential Change in Project

From: Danielle McKnight
Sent: Tuesday, October 24, 2017 1:53 PM
To: Kreuter, Erica (SEA) (erica.kreuter@state.ma.us)
Cc: Michael P. Gilleberto; Andrew Lafferty
Subject: North Reading MassWorks application - updated information

Dear Erica:

Thank you for speaking to me yesterday about potential changes to North Reading's water infrastructure project as outlined in our 2017 MassWorks application. As I mentioned, North Reading is considering an alternative water source to the MWRA connection described in our application. At this time, either project (Andover or MWRA) would be anticipated to be completed at the same time, in July 2020.

North Reading submitted an application to the MassWorks program requesting $3 million in infrastructure improvements needed to expand the town's water system and ensure an increased future supply sufficient to support projected development needs, including a privately developed, 450-unit residential project. The application specifically requested funds to offset the infrastructure costs of connecting to the MWRA system. MWRA water would completely replace the current water supply, provided by a combination of the Town's aging wells and water from the Town of Andover.

When the Town began exploring alternatives for potable water in 2014, the Town of Andover indicated that it was unable to provide North Reading with 100% of North Reading's water needs. The Town began modeling an interconnection with the MWRA through the Town of Reading as a means to obtain 100% of its potable water. Andover is now indicating a willingness and ability to provide 100% of North Reading's water. The reasons for North Reading now exploring the potential of Andover as the sole water source for North Reading are listed below:

- There are already two existing water connections between Andover and North Reading
- No pumping is required
- No permitting or property acquisition will be necessary
- There is a capital cost saving of approximately $6.8 Million (vs. MWRA). Total project costs for Andover are currently <u>estimated</u> at $3.1 million; however the Town is engaged in further analysis of the Andover alternative as is described below.
- Avoidance of a $7.68 Million MWRA buy-in cost (there is no buy-in or connection cost for the Andover solution)
- Lower average annual water rate increase (1.2% vs 4%) than MWRA
- Any infrastructure costs in Andover will be funded by Andover
- There will be no wheeling charges

At its October Town Meeting, North Reading appropriated funds to further evaluate the potential Andover water supply solution. A final decision will be made in April 2018. Following this decision, the project timeline is anticipated to be as follows:

If the Andover solution is selected, the town will need to make upgrades to its current system (2019-2020, cost of $2,825,000) and construct a booster chlorination station (2019-2020, cost of $1,150.000). The Andover work is anticipated to be complete by July 2020, with the exception of the decommissioning of North Reading's wells, expected to be done following completion of the work over a two-year period at a cost of $600,000. The MWRA project also now projected to be complete in July 2020. At the time the MassWorks application was submitted, the project was projected to be completed in June 2019. With the additional analysis required to look at the Andover option, this timeframe has been adjusted.

Thank you for considering our application, including this supplementary information. If we can provide any further information on our project, please do not hesitate to contact me.

Danielle McKnight, AICP
Town Planner/Community Planning Administrator
235 North Street
North Reading, MA 01864
978.357.5206
dmcknight@northreadingma.gov

Article 17 Reappropriate Previously Approved Funding for Water Distribution and Supply Infrastructure

To see if the Town will vote to amend the votes taken pursuant to Article 14 of the June 5, 2017 Spring Annual Town Meeting and Article 12 of the October 2, 2017 Fall Annual Town Meeting, by changing the purpose of the borrowing authorized by said votes to also include authorization to borrow funds for the purpose of designing and constructing water system improvements in North Reading and Andover to facilitate interconnection with the Andover water system, including but not limited to the development of design plans for the project, the preparation of bid documents, the oversight of permitting and actual construction of such improvements, and everything incidental or related thereto; or what it will do in relation thereto.

Sponsor: Board of Selectmen

Description...
This article would change the purpose of previously authorized borrowing to construct a potable water supply interconnection with the Massachusetts Water Resources Authority by authorizing the funds to be used for other water supply purposes.

Recommendations ...
Selectmen: Recommendation to be made at Town Meeting.
Finance Committee: Recommendation to be made at Town Meeting.

Article 18 Appropriate Funds for Water Distribution and Supply Infrastructure

To see if the Town will vote to raise by taxation and appropriate, appropriate and transfer from unexpended funds remaining in Warrant Articles of previous years, appropriate by transfer from available funds, and/or borrow a sum of money to supplement amounts appropriated pursuant to Article 14 of the June 5, 2017 Spring Annual Town Meeting and Article 12 of the October 2, 2017 Fall Annual Town Meeting or the purpose of construction associated with a long-term potable water supply solution for the Town, including but not limited to the development of design plans for the project, the preparation of bid documents, the oversight of permitting, actual construction of such improvements, and that to meet this appropriation, the Town Treasurer, with the approval of the Board of Selectmen, be authorized to borrow a sum or sums of money pursuant to Massachusetts General Laws Chapter 44 Section 7 or Section 8, or any other enabling authority, and to issue bonds or notes of the Town therefor, and that any premium received by the Town upon the sale of any bonds or notes approved by this vote, less any such premium applied to the payment of the costs of issuance of such bonds or notes, may be applied to the payment of costs approved by this vote in accordance with M.G.L. Chapter 44, Section 20, as amended, thereby reducing the amount authorized to be borrowed to pay such costs by a like amount; or what it will do in relation thereto .

Sponsor: Board of Selectmen

Description...
This article would authorize additional funds, if necessary, for costs associated with a long-term potable water supply solution.

Recommendations ...
Selectmen: Recommendation to be made at Town Meeting.
Finance Committee: Recommendation to be made at Town Meeting.

TOWN of NORTH READING
Massachusetts

Town Clerk's Office

Barbara Stats, *MMC/CMMC*
Town Clerk

TOWN OF NORTH READING
ANNUAL TOWN MEETING
NORTH READING HIGH SCHOOL
JUNE 4, 2018

Article 18 Appropriate Funds for Water Distribution and Supply Infrastructure

To see if the Town will vote to raise by taxation and appropriate, appropriate and transfer from unexpended funds remaining in Warrant Articles of previous years, appropriate by transfer from available funds, and/or borrow a sum of money to supplement amounts appropriated pursuant to Article 14 of the June 5, 2017 Spring Annual Town Meeting and Article 12 of the October 2, 2017 Fall Annual Town Meeting or the purpose of construction associated with a long-term potable water supply solution for the Town, including but not limited to the development of design plans for the project, the preparation of bid documents, the oversight of permitting, actual construction of such improvements, and that to meet this appropriation, the Town Treasurer, with the approval of the Board of Selectmen, be authorized to borrow a sum or sums of money pursuant to Massachusetts General Laws Chapter 44 Section 7 or Section 8, or any other enabling authority, and to issue bonds or notes of the Town therefor, and that any premium received by the Town upon the sale of any bonds or notes approved by this vote, less any such premium applied to the payment of the costs of issuance of such bonds or notes, may be applied to the payment of costs approved by this vote in accordance with M.G.L. Chapter 44, Section 20, as amended, thereby reducing the amount authorized to be borrowed to pay such costs by a like amount; or what it will do in relation thereto .

Sponsor: Board of Selectmen
Description...
This article would authorize additional funds, if necessary, for costs associated with a long-term potable water supply solution.
Recommendations ...
Selectmen: Recommendation to be made at Town Meeting.
Finance Committee: Recommendation to be made at Town Meeting.

A TRUE COPY ATTEST:
Barbara Stats
Barbara Stats, Town Clerk
NORTH READING, MA 01864

ARTICLE 18 -- APPROPRIATE FUNDS FOR WATER DISTRIBUTION AND SUPPLY INFRASTRUCTURE

I move that the Town appropriate the total sum of three million dollars ($3,000,000) for water distribution and supply infrastructure construction and costs related thereto as specified in Article 18 of the Warrant; and as funding therefor, to authorize the Treasurer, with the approval of the Board of Selectmen, to borrow said sum under and pursuant to MGL Chapter 44 Sections 7 or 8, or any other enabling authority, and to issue bonds and notes of the Town therefor; while the bonds issued hereunder shall be general obligation bonds of the Town, it is anticipated that this borrowing shall be repaid from the Water Enterprise Fund; further, that the Board of Selectmen is authorized to pursue federal, state, or other grant funding, the proceeds of which may be allocated towards said projects; and further that any premium received by the Town upon the sale of any bonds or notes approved by this vote, less any such premium applied to the payment of the costs of issuance of such bonds or notes, may be applied to the payment of costs approved by this vote in accordance with MGL Chapter 44, Section 20, thereby reducing the amount authorized to be borrowed to pay such costs by a like amount, and further to authorize the Board of Selectmen to take any other action necessary to carry out this project. *[S.O'Leary] [Requires 2/3 vote]*

Board of Selectmen unanimously recommends.
Finance Committee unanimously recommends.

Voice vote on motion under Article 18: ***UNANIMOUS***

A TRUE COPY ATTEST:
Barbara Stats
Barbara Stats, Town Clerk
NORTH READING, MA 01864

D

APPENDIX D
Pre & Post Development Plans

GENERAL NOTES

1. THE OWNER WILL BE RESPONSIBLE FOR OBTAINING THE PERMITS LISTED IN THE SUPPLEMENTARY OR SPECIAL CONDITIONS. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO BE FAMILIAR WITH THE APPLICABLE PROVISIONS OF EACH PERMIT AS THEY APPLY TO THE WORK PRIOR TO BIDDING AND ABIDE BY THOSE PROVISIONS DURING CONSTRUCTION. COPIES OF ALL OBTAINED PERMITS ARE AVAILABLE FOR REVIEW FROM THE OWNER. ALL OTHER PERMITS ARE THE RESPONSIBILITY OF THE CONTRACTOR.
2. THE OWNER SHALL BE RESPONSIBLE FOR OBTAINING ALL NECESSARY RIGHTS OF WAY AND EASEMENTS. THE CONTRACTOR SHALL VERIFY THAT THE NECESSARY EASEMENTS HAVE BEEN SECURED BY THE OWNER. IT IS THE RESPONSIBILITY OF THE CONTRACTOR TO BE FAMILIAR WITH THE APPLICABLE PROVISIONS OF EACH EASEMENT AS THEY APPLY TO THE WORK PRIOR TO BIDDING AND ABIDE BY THOSE PROVISIONS DURING CONSTRUCTION. COPIES OF ALL RIGHTS_OF_WAY AND EASEMENTS ARE AVAILABLE FOR REVIEW FROM THE OWNER.
3. THE CONTRACTOR IS RESPONSIBLE FOR MAINTAINING TRAFFIC FLOW AT ALL TIMES. CONTRACTOR SHALL INSTALL AND MAINTAIN TRAFFIC CONTROL SIGNS IN ACCORDANCE WITH THE MUTCD AND ALL STATE AND LOCAL REGULATIONS. THE CONTRACTOR IS REQUIRED TO SUBMIT A TRAFFIC CONTROL PLAN TO THE OWNER PRIOR TO COMMENCING CONSTRUCTION. THE POLICE DEPARTMENT AND FIRE DEPARTMENT ARE TO BE NOTIFIED AT LEAST 24-HOURS IN ADVANCE OF ANY STREET CLOSING OR DETOUR. REFER TO SPECIFICATION SECTION 01570.
4. CONTRACTOR SHALL COMPLY WITH ALL APPLICABLE REGULATIONS OF THE OCCUPATIONAL SAFETY AND HEALTH ADMINISTRATION (OSHA).
5. CONTRACTOR SHALL COMPLY WITH THE COORDINATION REQUIREMENTS AND RELATED COSTS, IF ANY, AS SPECIFIED IN SPECIFICATION SECTION 01050.
6. CONTRACTOR SHALL NOTE THAT, IN GENERAL, ALL EXISTING CONDITION INFORMATION ON THE DRAWINGS ARE SHOWN WITH A LIGHTER LINE WEIGHT AND WITH A SLANTED TYPE TEXT.

EXISTING SITE CONDITIONS

1. THE LOCATIONS OF UNDERGROUND UTILITIES AND STRUCTURES, AS SHOWN ON THE DRAWINGS, ARE APPROXIMATE AND MAY NOT BE COMPLETE. THE LOCATION OF EXISTING UNDERGROUND UTILITIES ARE BASED ON PREVIOUS CONSTRUCTION DESIGN PLANS, WHICH ARE AVAILABLE FOR INSPECTION AT THE ENGINEER'S OFFICE. NO GUARANTEE IS MADE THAT UTILITIES OR STRUCTURES WILL BE ENCOUNTERED WHERE SHOWN, OR THAT ALL UNDERGROUND UTILITIES AND STRUCTURES ARE SHOWN. ALL LOCATIONS AND SIZES OF EXISTING UTILITIES AND STRUCTURES SHALL BE VERIFIED IN THE FIELD WITH TEST PITS AS REQUIRED PRIOR TO BEGINNING CONSTRUCTION OF NEW FACILITIES OR PIPING THAT MAY BE AFFECTED. THE CONTRACTOR WILL REALIGN NEW PIPE LOCATIONS AS REQUIRED TO CONFORM TO EXISTING LINES AND AS APPROVED BY THE ENGINEER.
2. BELOW GRADE UTILITY INFORMATION IS BASED ON INFORMATION PROVIDED BY EACH UTILITY. LOCATION OF PUBLIC UTILITIES SHOWN IS ONLY APPROXIMATE AND MAY NOT BE COMPLETE. PRIVATE UNDERGROUND UTILITIES SUCH AS, BUT NOT LIMITED TO, SEWER LINES, WATER LINES AND BURIED ELECTRICAL SERVICE ENTRANCES ARE NOT SHOWN. THE CONTRACTOR SHALL ASCERTAIN THE LOCATION AND SIZE OF EXISTING UTILITIES IN THE FIELD WITH THE RESPECTIVE UTILITY COMPANY REPRESENTATIVE PRIOR TO COMMENCING WORK. REFER TO SPECIFICATION SECTION 01050. ADDITIONAL TEST PITS, BEYOND THOSE SHOWN, MAY BE REQUIRED. UTILITY CONTACTS ARE AS FOLLOWS:

ELECTRIC:
READING MUNICIPAL LIGHT DEPARTMENT
230 ASH STREET
READING, MA 01867
(617) 775-3992

WATER/SEWER/DRAIN:
NORTH READING DEPARTMENT OF PUBLIC WORKS
235 NORTH STREET
NORTH READING, MA 01864
(978) 664-1713

TELEPHONE/CABLE:
VERIZON
50 SYLVAN ROAD
WALTHAM, MA 02451
(978) 995-9524

NATURAL GAS:
NATIONAL GRID
326 BALLARDVALE STREET
WILLMINGTON, MA 01887
(978) 807-8168

COMCAST:
5 OMNI WAY
CHELMS FORD, MA 01824
(781) 281-7742

DIGSAFE:
DIG SAFE SYSTEM, INC
11 UPTON DRIVE
WILLMINGTON, MA 01887
CALL 811 OR 888-DIG-SAFE

3. HAZARDOUS ENVIRONMENTAL CONDITIONS HAVE BEEN IDENTIFIED WITHIN THE AREA OF WORK. REFER TO SPECIFICATION SECTION 00800-SC-5-06. IF THE PRESENCE OF ADDITIONAL HAZARDOUS ENVIRONMENTAL CONDITIONS ARE DISCOVERED, THE CONTRACTOR SHALL NOTIFY THE OWNER AND THE ENGINEER IMMEDIATELY. ALL ACTIVITIES, HANDLING AND DISPOSAL OF HAZARDOUS ENVIRONMENTAL CONDITIONS AND MATERIALS SHALL BE IN ACCORDANCE WITH OSHA, FEDERAL, STATE, AND LOCAL REGULATIONS.

SITE DEMOLITION

1. REFER TO THE EXISTING SITE PLAN, FOR ADDITIONAL INFORMATION REGARDING EXISTING FACILITIES. REFER TO THE LAYOUT DRAWING FOR LIMITS OF WORK.
2. REFER TO ARCHITECTURAL, STRUCTURAL, PROCESS, MECHANICAL, PLUMBING, INSTRUMENTATION AND ELECTRICAL DRAWINGS FOR SPECIFIC INFORMATION REGARDING DEMOLITION AND REMOVAL.
3. REFER TO SPECIFICATION SECTION 01010A, WHICH CONTAINS INFORMATION ON CONSTRAINTS OF CONSTRUCTION SEQUENCING.
4. DEMOLISH/REMOVE EXISTING PIPING AS REQUIRED FOR CONSTRUCTION OF NEW FACILITIES. ALL PIPING, EQUIPMENT AND MATERIALS TO BE DEMOLISHED AND/OR REMOVED FROM SERVICE SHALL BE COORDINATED WITH THE OWNER AND ENGINEER BEFORE COMMENCING THAT WORK. EXISTING PIPING THAT NEEDS TO BE REMOVED TO CONSTRUCT THE NEW FACILITIES, BUT IS TO REMAIN, SHALL BE REINSTALLED/REPLACED AS NEEDED. EXISTING PIPES AND CONDUIT DESIGNATED AS "ABANDONED" MAY BE REMOVED IF THE CONTRACTOR SO CHOOSES. IF ABANDONED PIPE CONFLICTS WITH NEW SITE PIPING OR FACILITIES, THEN A PORTION OF THE ABANDONED PIPE SHALL BE REMOVED, AND THE NEW ENDS OF ABANDONED PIPE CAPPED OR PLUGGED WITH CONCRETE.
5. ALL EXISTING PIPING AND UTILITIES WHICH ARE BENEATH PROPOSED STRUCTURES, AND ARE TO BE ABANDONED, SHALL BE REMOVED TO A MINIMUM OF 5-FEET OUTSIDE OF THE STRUCTURE. PIPE AND UTILITIES BENEATH PROPOSED STRUCTURES THAT ARE TO REMAIN SHALL BE CONCRETE ENCASED, UNLESS OTHERWISE INDICATED. REFER TO THE STRUCTURAL DRAWINGS FOR DETAILS.
6. SEVERING OF EXISTING UTILITIES FOR ABANDONMENT, OR REMOVAL OF A SEGMENT FROM SERVICE, SHALL BE PERFORMED IN SUCH A MANNER AS TO ALLOW THE REMAINING ACTIVE SEGMENT TO CONTINUE IN ITS INTENDED SERVICE. CAP ACTIVE SEGMENTS WITH APPROPRIATE FITTINGS, JOINT RESTRAINT, ETC. TO ENSURE THEIR INTEGRITY. PLUG ENDS OF ABANDONED PIPE SEGMENTS WITH CONCRETE UNLESS SPECIAL CIRCUMSTANCES DICTATE PLUGGING ABANDONED PIPES WITH BLIND FLANGES, RESTRAINED MECHANICAL JOINT PLUGS, ETC. AS APPROPRIATE.
7. THE CONTRACTOR SHALL BE RESPONSIBLE FOR REMOVING AND DISPOSING OF ALL DEMOLISHED PIPING, EQUIPMENT AND MATERIALS. DISPOSAL SHALL BE IN ACCORDANCE WITH ALL STATE AND LOCAL REGULATIONS. THE OWNER RESERVES THE RIGHT TO RETAIN ANY SUCH PIPING, EQUIPMENT AND MATERIALS DESIGNATED FOR DEMOLITION. SUCH MATERIALS TO BE RETAINED SHALL BE PROPERLY STORED IN AN ON-SITE LOCATION. COORDINATE LOCATION AND MATERIALS TO BE SALVAGED WITH THE OWNER/ENGINEER. REFER TO SPECIFICATION SECTION 02050A.
8. THE CONTRACTOR SHALL KEEP A RECORD OF DEMOLITION AS PART OF THE PROJECT RECORD DOCUMENTS IN ACCORDANCE WITH SPECIFICATION SECTION 01720.
9. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE APPROPRIATE DISPOSAL OF FLOWS RESULTING FROM PRECIPITATION AND GROUNDWATER DEWATERING OPERATIONS.

SITE CLEARING, GRUBBING AND GRADING

1. STRIPPING OF TOPSOIL (LOAM) SHALL BE IN ACCORDANCE WITH SPECIFICATION SECTION 02115. REFER TO THE LAYOUT AND GRADING DRAWINGS FOR LIMIT OF WORK AND STRIPPING.
2. CONTRACTOR SHALL MINIMIZE CLEARING OPERATIONS. CLEARING AND GRUBBING SHALL BE IN ACCORDANCE WITH SPECIFICATION SECTION 02110. CLEARING LIMITS SHALL BE AS INDICATED ON THE DRAWINGS, BUT AT ALL TIMES WITHIN EXISTING ROAD RIGHTS_OF_WAY AND PROPERTY LINES ON STATE OR COUNTY_OWNED PROPERTY OR EASEMENTS. ALL CLEARING AND GRUBBING MATERIAL SHALL BE THE PROPERTY OF THE CONTRACTOR AND SHALL BE DISPOSED OF AT A SITE PROVIDED BY THE CONTRACTOR IN COMPLIANCE WITH ALL STATE AND LOCAL LAWS.
3. THE CONTRACTOR SHALL FOLLOW ALL ENDANGERED SPECIES ACT 4(D) RULES REGARDING THE NORTHERN LONG EARED BAT. THIS INCLUDES AVOIDANCE OF TREE REMOVAL DURING THE MONTHS OF JUNE AND JULY. CONTRACTOR SHALL PLAN ACCORDINGLY.
4. CONTRACTOR SHALL PROVIDE PROPER EROSION CONTROL AND DRAINAGE MEASURES IN ALL AREAS OF WORK, AND CONFINE SOIL SEDIMENT TO WITHIN THE LIMITS OF EXCAVATION AND GRADING. PRIOR TO BEGINNING EXCAVATION WORK, EROSION CONTROL FENCE SHALL BE INSTALLED AT THE DOWN GRADIENT PERIMETER OF THE ACTUAL LIMITS OF GRUBBING AND/OR GRADING, AND AS SHOWN ON THE DRAWINGS. EROSION CONTROL MEASURES SHOWN ON THE DRAWINGS ARE A MINIMUM, CONTRACTOR SHALL TAKE ALL OTHER NECESSARY MEASURES. EROSION CONTROL FENCE SHALL ALSO BE INSTALLED AT THE DOWN GRADIENT PERIMETER OF THE TOPSOIL STOCKPILES. ALL DISTURBED EARTH SURFACES SHALL BE STABILIZED IN THE SHORTEST PRACTICAL TIME AND TEMPORARY EROSION CONTROL DEVICES SHALL BE EMPLOYED UNTIL SUCH TIME AS ADEQUATE SOIL STABILIZATION HAS BEEN ACHIEVED. TEMPORARY STORAGE OF EXCAVATED MATERIAL SHALL BE STABILIZED IN A MANNER THAT WILL MINIMIZE EROSION. ALL INSTALLED EROSION CONTROL FACILITIES SHALL BE REMOVED AT THE END OF THE PROJECT. REFER TO SPECIFICATION SECTION 02270.
5. ALL STORM DRAINAGE INLETS SHALL BE PROTECTED BY CATCH BASIN SILT SACKS TO PREVENT ENTRY OF SEDIMENT FROM RUNOFF WATERS DURING CONSTRUCTION. CONTRACTOR SHALL BE RESPONSIBLE FOR THE REMOVAL AND DISPOSAL OF ALL COLLECTED SEDIMENT, AND THAT WHICH COLLECTS IN THE STORM DRAIN SYSTEM. REFER TO THE CIVIL DETAIL DRAWINGS.
6. THE GEOTECHNICAL DATA REPORT FOR THE PROJECT SITE IS INCLUDED IN APPENDIX A AND IS DESCRIBED IN SPECIFICATION SECTION 00800 (SUPPLEMENTAL CONDITIONS).
7. CONTRACTOR SHALL CONTROL DUST ON THE CONSTRUCTION SITE TO A REASONABLE LIMIT, AS DETERMINED BY THE ENGINEER, AND AS OUTLINED IN SPECIFICATION SECTION 01562.
8. CONTRACTOR SHALL NOT TRACK OR SPILL EARTH, DEBRIS OR OTHER CONSTRUCTION MATERIAL ON PUBLIC OR PRIVATE STREETS AND PLANT DRIVES. THE CONTRACTOR SHALL BE RESPONSIBLE FOR THE IMMEDIATE ASSOCIATED CLEAN UP.
9. ALL CATCH BASINS, MANHOLES, VALVE PITS, VALVE BOXES AND OTHER BURIED FACILITIES WITH SURFACE ACCESS SHALL BE ADJUSTED TO MATCH FINAL GRADES, UNLESS OTHERWISE INDICATED.
10. THE CONTRACTOR SHALL NOT HAVE ANY RIGHT OF PROPERTY IN ANY MATERIALS TAKEN FROM ANY EXCAVATION. SUITABLE EXCAVATED MATERIAL MAY BE INCORPORATED IN THE PROJECT, WITH EXCESS MATERIAL DISPOSED OF AT A LOCATION PROVIDED BY THE CONTRACTOR. THESE PROVISIONS SHALL IN NO WAY RELIEVE THE CONTRACTOR OF OBLIGATIONS TO PROPERLY DISPOSE OF AND REPLACE ANY MATERIAL DETERMINED BY THE ENGINEER TO BE UNSUITABLE FOR BACKFILLING. THE CONTRACTOR SHALL DISPOSE OF UNSUITABLE AND EXCESS MATERIAL IN ACCORDANCE WITH THE APPLICABLE SECTIONS OF THE CONTRACT DOCUMENTS.
11. CONTRACTOR SHALL REMOVE AND REPLACE, OR REPAIR, ALL CURBS, SIDEWALKS, PAVEMENT AND OTHER ITEMS DAMAGED BY CONSTRUCTION ACTIVITIES TO AT LEAST THEIR ORIGINAL CONDITION, TO THE SATISFACTION OF THE OWNER AND ENGINEER.
12. WHERE EXISTING PAVEMENT IS REMOVED AND REPLACED, MATCH EXISTING GRADES TO THE EXTENT POSSIBLE. COORDINATE FINE GRADING WITH THE ENGINEER.
13. ALL ROAD AND DRIVE CROSS SLOPES SHALL PITCH 1/4-INCH PER FOOT MINIMUM. ALL PAVED SURFACES SHALL PITCH 1% UNLESS OTHERWISE NOTED. REFER TO THE CIVIL DETAIL DRAWINGS.
14. ALL NON-ROADWAY AREAS THAT ARE EXCAVATED, FILLED, OR OTHERWISE DISTURBED BY THE CONTRACTOR SHALL BE LOAMED, GRADED, LIMED, FERTILIZED, SEEDED AND MULCHED, UNLESS OTHERWISE NOTED. THE TOP 4-INCHES OF SOIL SHALL BE LOAM. REFER TO SPECIFICATION SECTION 02485, LANDSCAPING/LOAM AND SEED.

CIVIL SITE LAYOUT

1. THE CONTRACTOR SHALL BE RESPONSIBLE FOR MAINTAINING THIS PROVIDED LAYOUT INFORMATION THROUGHOUT THE COURSE OF CONSTRUCTION. REPORT ANY LAYOUT DISCREPANCIES IMMEDIATELY TO THE ENGINEER.
2. REFER TO THE SITE PIPING AND SITE GRADING DRAWINGS FOR ADDITIONAL LAYOUT INFORMATION.
3. CONTRACTOR SHALL EXCAVATE TEST PITS, WHERE NECESSARY, PRIOR TO CONSTRUCTION LAYOUT AND RESULTS REPORTED TO THE ENGINEER FOR REVIEW FOR CONFORMANCE TO THE PLANS. TEST PITS ARE REQUIRED WHERE SHOWN ON THE PLANS AND AS DIRECTED BY THE ENGINEER.
4. THE LOCATIONS AND LIMITS OF ALL ON-SITE WORK AND STORAGE AREAS SHALL BE REVIEWED/COORDINATED WITH, AND ACCEPTABLE TO, THE OWNER AND ENGINEER. THE CONTRACTOR SHALL LIMIT ACTIVITIES TO THESE AREAS.
5. THE CONTRACTOR SHALL BE RESPONSIBLE FOR RE-ESTABLISHING AND RESETTING ALL EXISTING PROPERTY MONUMENTATION DISTURBED BY CONSTRUCTION. THIS WORK SHALL BE DONE BY A LAND SURVEYOR REGISTERED IN THE STATE OF MASSACHUSETTS, AT NO ADDITIONAL COST TO THE OWNER.
6. WRITTEN DIMENSIONS SHALL PREVAIL. DO NOT SCALE DISTANCES FROM THE DRAWINGS. REPORT ANY DISCREPANCIES IMMEDIATELY TO THE ENGINEER.
7. BOLLARD LOCATIONS SHOWN ARE APPROXIMATE. COORDINATE BOLLARD LOCATIONS WITH THE ENGINEER. REFER TO THE CIVIL DETAIL DRAWINGS.
8. CONTRACTOR SHALL RESTRIPE ALL PARKING SPACES DISTURBED BY CONSTRUCTION TO MATCH EXISTING CONDITIONS.
9. ALL ELEVATIONS REFER TO THE NAVD 88 (GEOID12A) DATUM. ORIENTATION IS GRID NORTH ON THE MASSACHUSETTS STATE PLANE MAINLAND COORDINATE SYSTEM. PROJECT BENCH MARK IS SHOWN ON THE DRAWINGS AND IS DERIVED FROM TBM 5880A AND TBM 5880B. CONTRACTOR SHALL VERIFY BENCHMARK ELEVATIONS PRIOR TO USING IN CONSTRUCTION.
10. WETLAND BOUNDARIES DELINEATED BY CARON ENIRONMENTAL IN OCTOBER 2019. WETLANDS FLAGS SURVEYED BY DOUCET SURVEY.
11. CONTRACTOR SHALL BE RESPONSIBLE FOR LAYOUT OF ALL PROPOSED WORK AS SHOWN ON THE DRAWINGS AND REPORT ANY LAYOUT DISCREPANCIES IMMEDIATELY TO THE ENGINEER.

CIVIL SITE PIPING

1. PROCESS FLOW DIAGRAM AND PIPING LEGEND ARE ON THE PROCESS DRAWINGS. THE PROCESS PIPING SCHEDULE AND ADDITIONAL PIPING NOTES ARE LOCATED IN SPECIFICATION SECTION 15050.
2. ALL PIPE LINES SHALL SLOPE UNIFORMLY BETWEEN ELEVATIONS INDICATED ON THE DRAWINGS. NO CRESTS IN PIPING WILL BE PERMITTED. CONCRETE THRUST BLOCKS OR OTHER ACCEPTABLE RESTRAINT SYSTEM IS REQUIRED ON ALL FITTINGS ON PRESSURE PIPE. WHERE A RESTRAINED JOINT SYSTEM IS USED, THE NUMBER OF PIPES WITH RESTRAINED JOINTS ON EITHER SIDE OF THE FITTING SHALL BE DESIGNED TO REFLECT THE PROJECT SOIL CONDITIONS AND PEAK SURGE PRESSURE IN THE PIPING SYSTEM. SEE THE CIVIL DETAIL DRAWINGS FOR THRUST BLOCK DETAILS. PROVIDE ALL BENDS (HORIZONTAL AND VERTICAL) AS REQUIRED TO MEET THE GRADES AND ALIGNMENT INDICATED ON THE DRAWINGS.
3. THE CONTRACTOR SHALL ASCERTAIN THE LOCATION AND SIZE OF EXISTING PIPING AND UTILITIES IN THE FIELD BY TEST PIT EXCAVATION PRIOR TO COMMENCING INSTALLATION OF ANY OF THE NEW PIPING AFFECTED. WHERE NEW PIPE CONNECTS TO EXISTING PIPING OR STRUCTURAL PENETRATION, CONTRACTOR SHALL VERIFY ELEVATION BY TEST PIT, AS REQUIRED, PRIOR TO INSTALLATION OF ANY OF THE ASSOCIATED/AFFECTED NEW PIPING. IDENTIFIED CONFLICTS WITH EXISTING PIPING AND UTILITIES WILL BE REVIEWED WITH THE ENGINEER PRIOR TO COMMENCING INSTALLATION. THE HORIZONTAL ALIGNMENT OF NEW PIPING MAY BE ADJUSTED IN THE FIELD SUBJECT TO PRIOR REVIEW AND ACCEPTANCE OF THE ENGINEER.
4. ALL PRESSURIZED PIPES (I.E. PLANT WATER, CITY WATER, SOLUTION LINES, HEAT, ETC.) INSTALLED BENEATH STRUCTURES SHALL BE ENCASED IN CONCRETE. SEE STRUCTURAL DRAWING FOR DETAILS.
5. ALL BURIED CONNECTIONS TO STRUCTURES SHALL HAVE SLEEVE TYPE FLEXIBLE CONNECTIONS APPROXIMATELY 4-FEET FROM THE STRUCTURES. ALL SLEEVE TYPE COUPLINGS ON PRESSURE LINES SHALL BE RESTRAINED (SOLID SLEEVE). REFER TO SPECIFICATION SECTION 15088.
6. PROVIDE CAST OR DUCTILE IRON WALL CASTINGS, OR GALVANIZED STEEL PIPE SLEEVES, FOR ALL PIPE PENETRATIONS MADE THROUGH CONCRETE FOUNDATIONS, WALLS AND SLABS. ALL WALL SLEEVES AND WALL CASTINGS SHALL HAVE WATERSTOPS. SEE PROCESS, MECHANICAL AND STRUCTURAL DRAWINGS FOR LOCATIONS OF PENETRATIONS. NEW PENETRATIONS THROUGH EXISTING STRUCTURE WALLS SHALL BE BY CORING MACHINE AND LINK-TYPE SEALS, UNLESS OTHERWISE INDICATED. OPENINGS TO BE COMPATIBLE WITH REQUIRED PIPING AND STANDARD LINK SEAL SIZES. SEE PROCESS DETAIL DRAWINGS. REFER TO SPECIFICATION SECTION 15092.
7. TRENCH INSULATION SHALL BE USED WHERE DEPTH OF COVER IS LESS THAN 5-FEET. REFER TO THE CIVIL DETAIL DRAWINGS FOR THE TRENCH INSULATION DETAIL.
8. TRENCH INSULATION SHALL BE USED WHEN THERE IS LESS THAN 2-FEET BETWEEN THE SEWER OR FORCE MAIN AND A CULVERT. REFER TO THE CIVIL DETAIL DRAWINGS FOR THE TRENCH INSULATION DETAIL.
9. MANHOLES ARE 4-FEET IN DIAMETER UNLESS OTHERWISE NOTED. THE TOP OF MANHOLE FRAMES SHALL BE SET FLUSH WITH FINISH GRADE, UNLESS OTHERWISE NOTED ON DRAWINGS. SEWER MANHOLE INVERTS SHOWN ON THE DRAWINGS ARE TO THE INSIDE FACE OF THE MANHOLE.
10. PIPES WITHIN VALVE PITS (MANHOLES) SHALL BE SUPPORTED 12-INCHES ABOVE BOTTOM OF MANHOLE ON ADJUSTABLE PIPE SADDLE SUPPORTS, IN ACCORDANCE WITH SPECIFICATION SECTION 15094, UNLESS OTHERWISE INDICATED.
11. REFER TO SPECIFICATION SECTION 02200 FOR PIPE AND STRUCTURE BEDDING AND BACKFILL REQUIREMENTS.
12. COMPACTION TESTS WILL BE PERFORMED IN ACCORDANCE WITH SPECIFICATION SECTION 02200. ANY SETTLEMENT OCCURRING WITHIN ONE-YEAR OF FINAL COMPLETION OF THE WORK SHALL BE CORRECTED BY THE CONTRACTOR AT NO ADDITIONAL COST.
13. OPEN TRENCHES OUTSIDE OF THE ROADWAY MAY BE LEFT OPEN IF THE CONTRACTOR PROVIDES ADEQUATELY SAFE BARRICADING AND LIGHTS.
14. IN THOSE INSTANCES WHERE POWER OR TELEPHONE POLE SUPPORT IS REQUIRED, THE CONTRACTOR SHALL PROVIDE A MINIMUM 48-HOUR NOTICE TO THE RESPECTIVE UTILITY POLE OWNER. NO ADDITIONAL PAYMENT WILL BE PROVIDED FOR TEMPORARY BRACING OF UTILITIES.
15. WHERE NEW PIPING IS TO BE CONNECTED TO EXISTING PIPING, THE CONTRACTOR SHALL FURNISH AND INSTALL ALL ADAPTERS, FITTINGS, AND ADDITIONAL PIPE AS REQUIRED TO COMPLETE THE CONNECTION. CONTRACTOR SHALL VERIFY LOCATION, ELEVATION, ORIENTATION AND MATERIAL OF CONSTRUCTION. TEST PITS SHALL BE USED AS REQUIRED.
16. ALL EXISTING UTILITIES ENCOUNTERED DURING CONSTRUCTION ARE TO REMAIN IN SERVICE UNLESS OTHERWISE NOTED ON THE CIVIL EXISTING CONDITIONS AND DEMOLITION PLAN. ANY EXISTING UTILITIES DAMAGED DURING CONSTRUCTION SHALL BE REPAIRED BY THE CONTRACTOR AT NO ADDITIONAL COST TO THE OWNER.
17. CONTRACTOR SHALL BE RESPONSIBLE FOR REMOVAL AND DISPOSAL OF ALL DEMOLITION MATERIALS IN ACCORDANCE WITH SPECIFICATION SECTION 02050.
18. WHERE POSSIBLE, WATER LINES SHOULD BE INSTALLED OVER WASTEWATER OR SLUDGE LINES. A MINIMUM SEPARATION OF 18-INCHES BETWEEN THE BOTTOM OF THE WATER LINE AND THE TOP OF THE WASTEWATER OR SLUDGE LINE SHALL BE MAINTAINED, IF POSSIBLE. WHERE A WATER LINE CROSSES UNDER A WASTEWATER OR SLUDGE LINE, A FULL LENGTH OF PIPE SHALL BE CENTERED ABOVE THE WATER LINE SO THAT BOTH JOINTS WILL BE AS FAR FROM THE WATER LINE AS POSSIBLE.
19. ALL STRUCTURES AND PIPELINES LOCATED ADJACENT TO ANY TRENCH EXCAVATION SHALL BE PROTECTED AND FIRMLY SUPPORTED BY THE CONTRACTOR UNTIL THE TRENCH IS BACKFILLED. DAMAGE TO ANY SUCH STRUCTURES CAUSED BY OR RESULTING FROM THE CONTRACTOR'S OPERATIONS SHALL BE REPAIRED AT THE CONTRACTOR'S EXPENSE. ALL UTILITIES REQUIRING REPAIR, RELOCATION OR ADJUSTMENT AS A RESULT OF THE PROJECT SHALL BE COORDINATED THROUGH THE OWNER.
20. PIPING ON THE SITE PIPING PLAN HAS BEEN SHOWN BROKEN FOR CLARITY ONLY. PIPE BREAKS DO NOT INDICATE RELATIVE ELEVATIONS OF PIPING.
21. ELECTRICAL CONDUIT RUNS ARE INDICATED ON THE ELECTRICAL DRAWINGS AND ARE SHOWN IN DASHED/PHANTOM LINEWEIGHT ON THE CIVIL DRAWINGS FOR CONVENIENCE. CONTRACTOR IS RESPONSIBLE FOR ALL COORDINATION, EXCAVATION AND BACKFILLING REQUIRED FOR THE ELECTRICAL CONDUITS, AND SHALL FURNISH AND INSTALL ELECTRICAL MANHOLES AND HANDHOLES. COORDINATE THE LOCATION OF THE ELECTRICAL MANHOLES AND HANDHOLES, AND THE REQUIRED OPENING SIZES, WITH THE ELECTRICAL CONTRACTOR.

CIVIL ABBREVIATIONS

&	AND	MH	MANHOLE
∅, DIA	DIAMETER	MIN	MINIMUM
#, NO	NUMBER	MW	MONITORING WELL/MUNICIPAL WATER
APP'D	APPROVED	N	NORTH
ASL	ASH SLURRY	NGVD	NATIONAL GEODETIC VERTICAL DATUM
ATE	AERATION TANK EFFLUENT	N/A	NOT AVAILABLE/APPLICABLE
BLDG	BUILDING	NTS	NOT TO SCALE
CB	CATCH BASIN	OD	OUTSIDE DIAMETER
CEN	CENTER	PC	PERFORATED CLAY
CFS	CUBIC FEET PER SECOND	PSF	POUNDS PER SQUARE FOOT
CI	CAST IRON	PSI	POUNDS PER SQUARE INCH
CL	CENTERLINE	PS	PRIMARY SLUDGE
CMP	CORRUGATED METAL PIPE	PT	POINT OF TANGENCY
CO	CLEANOUT	PVC	POLYVINYL CHLORIDE
CONC	CONCRETE	PW	PROCESS WATER
COR	CORNER	RAS	RETURN ACTIVATED SLUDGE
CW	CITY WATER	RCP	REINFORCED CONCRETE PIPE
CY	CUBIC YARD	RD	ROOF DRAIN
DEMO	DEMOLITION	REQ'D	REQUIRED
DMH	DRAIN MANHOLE	S	SLOPE, SEWER
DI	DUCTILE IRON	SBP	SECONDARY BY-PASS
DR	DRAIN	SCC	SECONDARY CONTAINMENT CONDUIT
DWG	DRAWING	SD	STORM DRAIN
EDR	ELECTRICAL DRAIN	SF	SQUARE FEET
EL	ELEVATION	SMH	SANITARY SEWER MANHOLE
EMH	ELECTRIC MANHOLE	SQ	SQUARE
FFE	FINISHED FLOOR ELEVATION	STA	STATION
FM	FORCE MAIN	T, XFMR	TRANSFORMER
FS	FOAM SPRAY	TBM	TEMPORARY BENCH MARK
FT	FEET	THK	THICKNESS
G	GAS	TOS	TOP OF STRUCTURE
HYD	HYDRANT	TYP	TYPICAL
IN	INCH	UD	UNDERDRAIN
INF	INFLUENT	UG	UNDERGROUND
INV	INVERT	UGE	UNDERGROUND ELECTRIC
LBS	POUNDS	VC	VITRIFIED CLAY
MAX	MAXIMUM	W/	WITH
MH	MANHOLE		

CIVIL LEGEND

EXISTING | PROPOSED

EXISTING		PROPOSED
	PROPERTY/ROW LINE	
	SETBACK LINE	
	EASEMENT LINE	
	CENTERLINE	
	EDGE OF PAVEMENT	
	CURBING	
	EDGE OF GRAVEL	
122	INDEX CONTOUR	124
	INTERMEDIATE CONTOUR	
	BUILDING	
	STONEWALL	
	TREELINE	
	CHAIN LINK FENCE	
	STOCKADE FENCE	
	BARB WIRE FENCE	
	RETAINING WALL	
	GUARDRAIL	
UGE	UNDERGROUND ELECTRIC	UGE
OHE	OVERHEAD ELECTRIC	OHE
	FLOOD PLAIN	
	IRON PIPE/REBAR	
	DRILLHOLE	
	MONUMENT	
	SURVEY CONTROL POINT	
124.6	GRADE SPOT ELEVATION	132.5
SMH	SEWER MANHOLE	SMH
DMH	DRAINAGE MANHOLE	DMH
CB CB	CATCH BASIN	CB CB
EMH	ELECTRIC MANHOLE	EMH
TMH	TELEPHONE MANHOLE	TMH
	PIPE REDUCER	
	SHUTOFF VALVE	
	CURB STOP	
	YARD HYDRANT	
	HYDRANT	
	UTILITY POLE	
	UTILITY POLE W/ GUY	
	UTILITY POLE W/ LIGHT	
	LIGHT POLE	
	BOLLARD	
	FLAGPOLE	
	CONIFEROUS TREE	
	DECIDUOUS TREE	
	SHRUB	
	EDGE OF WATER	
	STREAM	
	EDGE OF WETLANDS	
	WETLANDS	
	DRAINAGE FLOW	
	DRAINAGE SWALE	
	PAVEMENT MARKINGS	
	SIGN	
	TEMPORARY BENCH MARK	
TP-2	TEST PIT	
B-3	TEST BORING	
P-4	TEST PROBE	
MW-5	MONITORING WELL	
	LIMIT OF WORK	
	SILT FENCE	
	RIPRAP	
	RAILROAD	
	MATCHLINE	
	ROCK OUTCROP	
	ITEM TO BE DEMOLISHED	
	CONCRETE SIDEWALK	
	CONCRETE PAD	
	PAVEMENT	
8"S	SEWER	8"S
4"FM	SEWER FORCE MAIN	4"FM
4"G	GAS	4"G
8"W	WATER	8"W
15"SD	STORM DRAIN	15"SD
6"UD	UNDERDRAIN	6"UD
12" CMP	CULVERT	12" CMP
128.11	PIPE SPOT ELEVATION	128.11
6"XX	CULVERT/UNDERDRAIN	6"XX
6"XX	PIPING	6"XX
30"XX	LARGE DIA PIPING (18"+)	30"XX
6"XX (AB)	PIPE PREVIOUSLY ABANDONED	
6"XX	PIPING TO BE DEMOLISHED	
6"XX	PIPING TO ABANDON	
	STONE & MOWING STRIP AREAS	
	TEST PIT	

"XX" DENOTES PIPE DESCRIPTION

NO	SUBMISSIONS/REVISIONS	APP'D	DATE
	60% DESIGN SUBMITTAL	R.WIL	02-20

DESIGNED BY: P.QUE/B.JON
CAD COORD.: B.JON
CAD: R.BOU
CHECKED BY:
DATE:
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DATE:
PROJECT NO.: 14296

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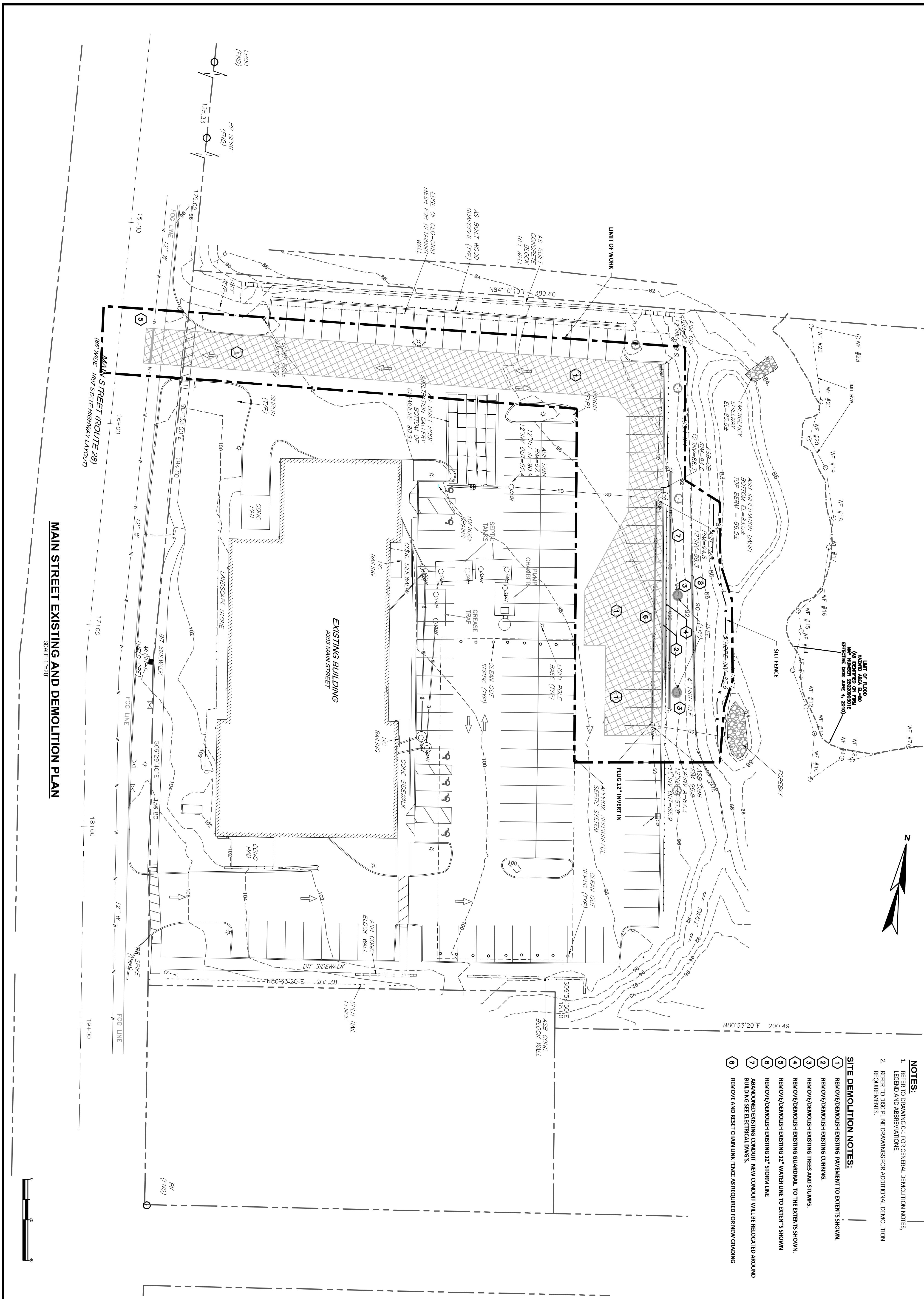
TOWN OF NORTH READING, MASSACHUSETTS
CHEMICAL FEED STATIONS

GENERAL NOTES, LEGEND AND ABBREVIATION

DRAWING
C-1

NOT TO SCALE



DRAWING C-2

TOWN OF NORTH READING, MASSACHUSETTS
CHEMICAL FEED STATIONS

MAIN STREET EXISTING AND DEMOLITION PLAN

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CAD: B.JON
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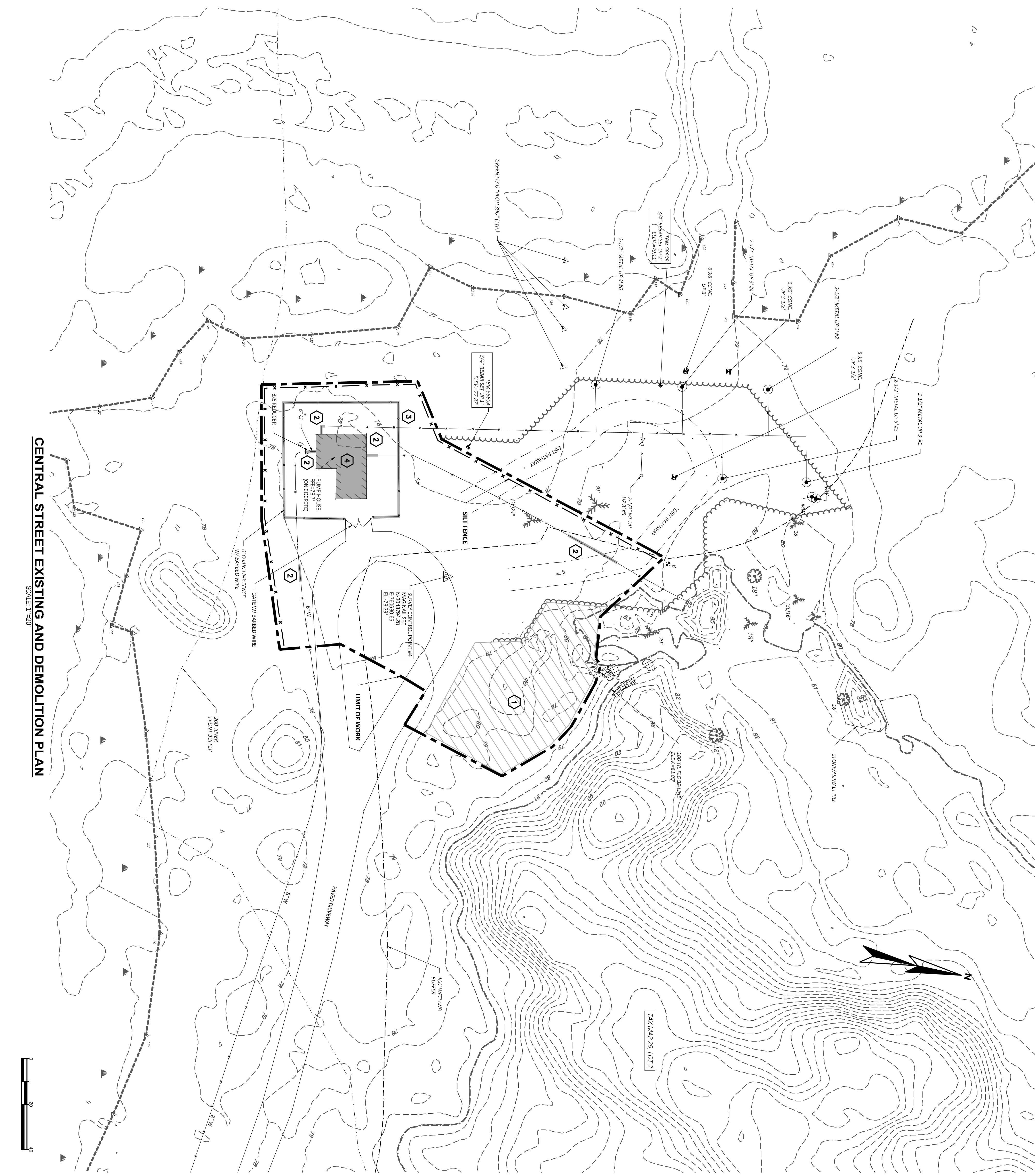


NOTES:

1. REFER TO DRAWING C-1 FOR GENERAL DEMOLITION NOTES, LEGEND AND ABBREVIATIONS.
2. REFER TO DISCIPLINE DRAWINGS FOR ADDITIONAL DEMOLITION REQUIREMENTS.

SITE DEMOLITION NOTES:

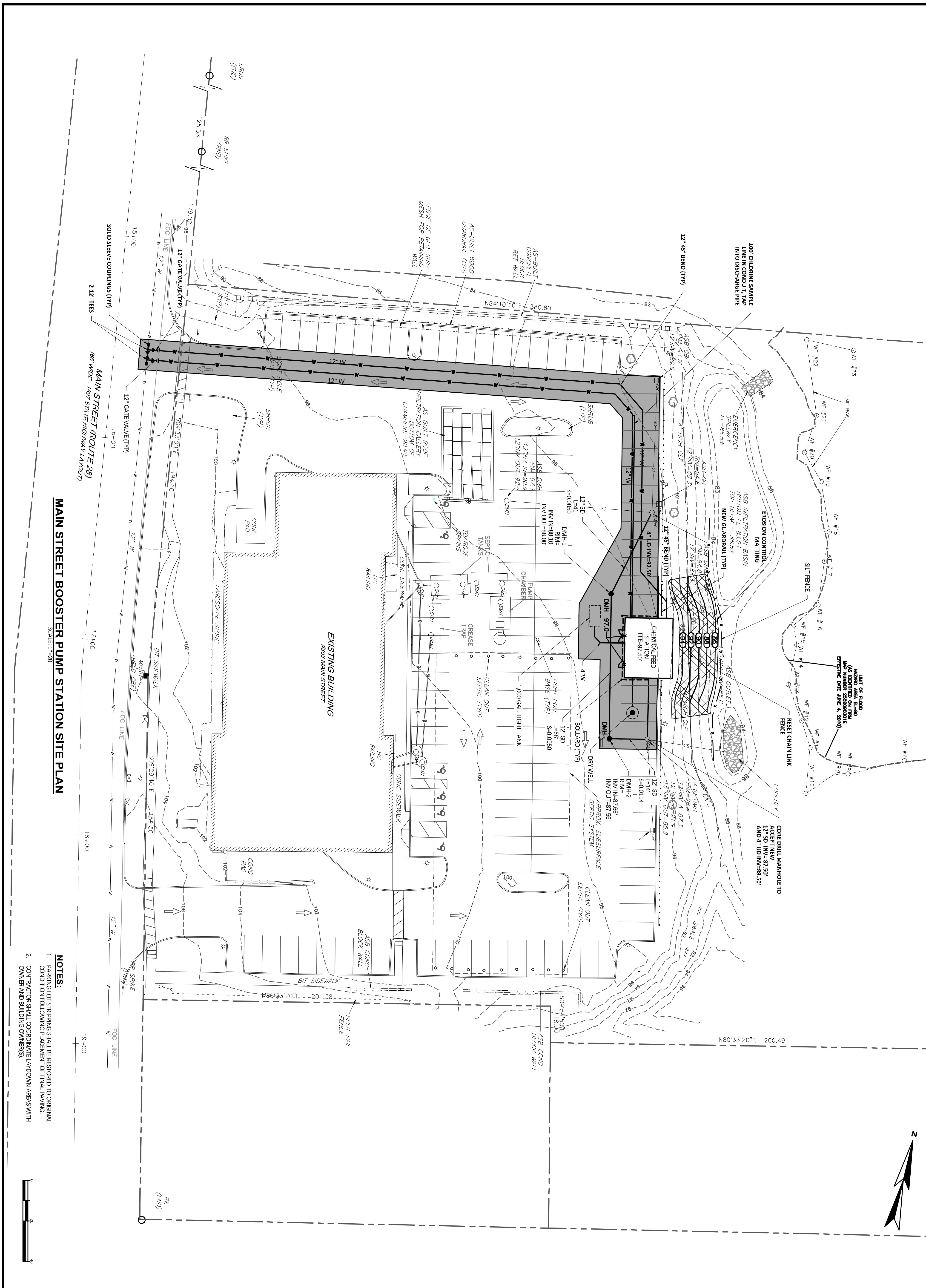
1. REMOVE/DEMOLISH EXISTING TREES AND STUMPS TO EXTENT SHOWN.
2. REMOVE/DEMOLISH EXISTING WATER LINE TO EXTENTS SHOWN.
3. REMOVE/DEMOLISH EXISTING CHAIN LINK FENCE.
4. REMOVE/DEMOLISH EXISTING PUMP HOUSE IN IT'S ENTIRETY.

DRAWING C-3	TOWN OF NORTH READING, MASSACHUSETTS CHEMICAL FEED STATIONS	WRIGHT-PIERCE Engineering a Better Environment	FEIR PERMIT SUBMITTAL	DESIGNED BY: P.QUE/B.JON	NO / SUBMISSIONS/REVISIONS / APP'D / DATE
	CENTRAL STREET EXISTING AND DEMOLITION PLAN	888.621.8156 | www.wright-pierce.com		CAD COORD: B.JON	60% DESIGN SUBMITTAL / R.WIL / 02-20
				CAD: B.JON	
				CHECKED BY:	
				DATE:	
				APPROVED BY:	
				DATE:	
				PROJECT NO: 14296	

NOT TO SCALE

J:\ENG\MA\NORTHREADING\14296-CHEMFEEDSTATION\DRAWINGS\CIV\14296-CS-MAIN STREET SITE PLAN.DWG | MainStSite Plan(1) | 1:10.12364677 | ---- | 2/6/2020 2:42:01 PM | RICHARD.BOURGET

LAST SAVED BY: RICHARD.BOURGET 2/6/2020 2:37 PM



DRAWING C-4	
TOWN OF NORTH READING, MASSACHUSETTS CHEMICAL FEED STATIONS	WRIGHT-PIERCE Engineering a Better Environment 888.621.8156 | www.wright-pierce.com
MAIN STREET BOOSTER PUMP STATION SITE PLAN	FEIR PERMIT SUBMITTAL

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PROJECT NO: 14296

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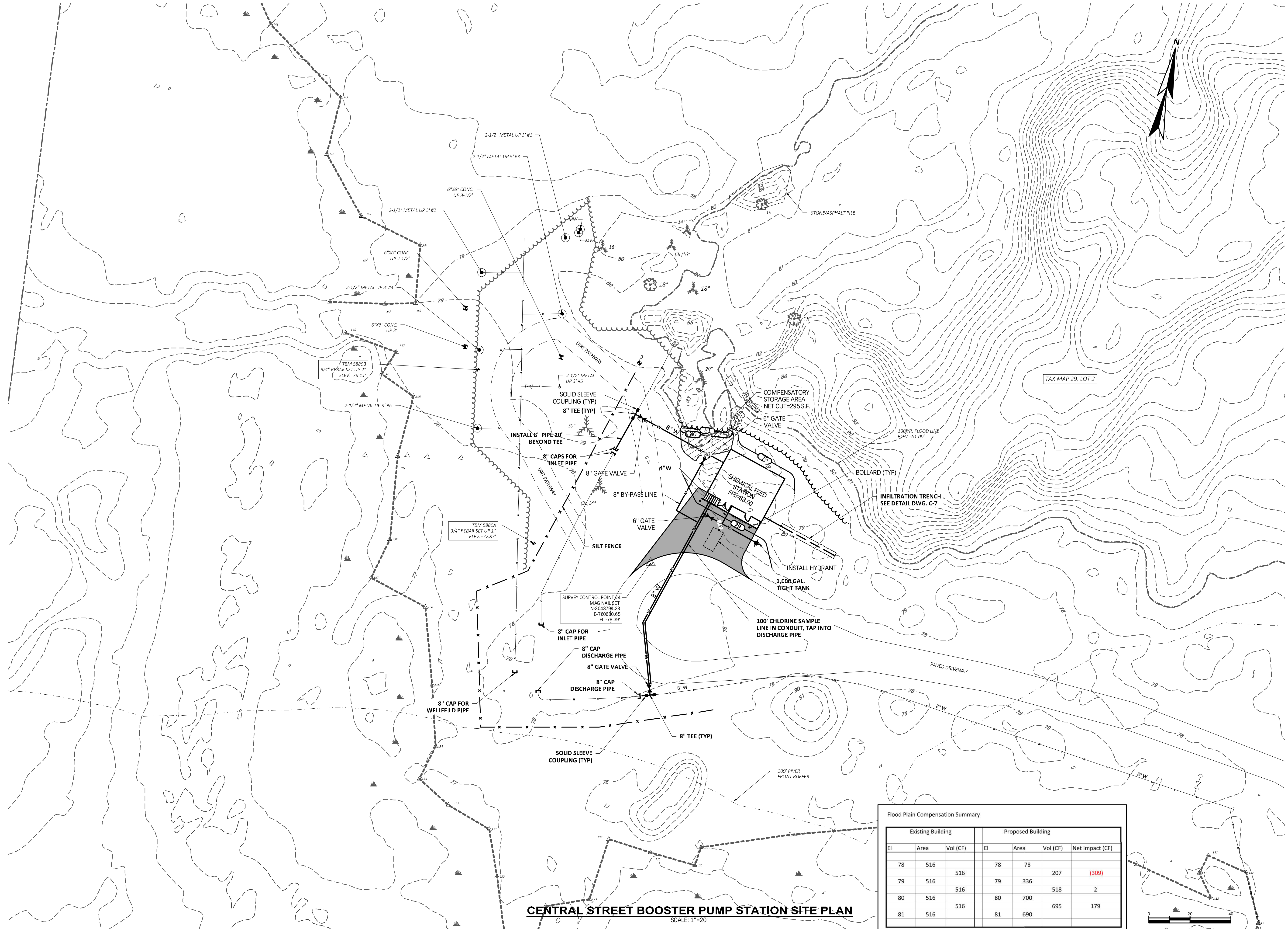
NOT TO SCALE



Flood Plain Compensation Summary

Existing Building			Proposed Building			
El	Area	Vol (CF)	El	Area	Vol (CF)	Net Impact (CF)
78	516		78	78		
		516			207	(309)
79	516		79	336		
		516			518	2
80	516		80	700		
		516			695	179
81	516		81	690		

CENTRAL STREET BOOSTER PUMP STATION SITE PLAN
SCALE: 1"=20'

0 20 40

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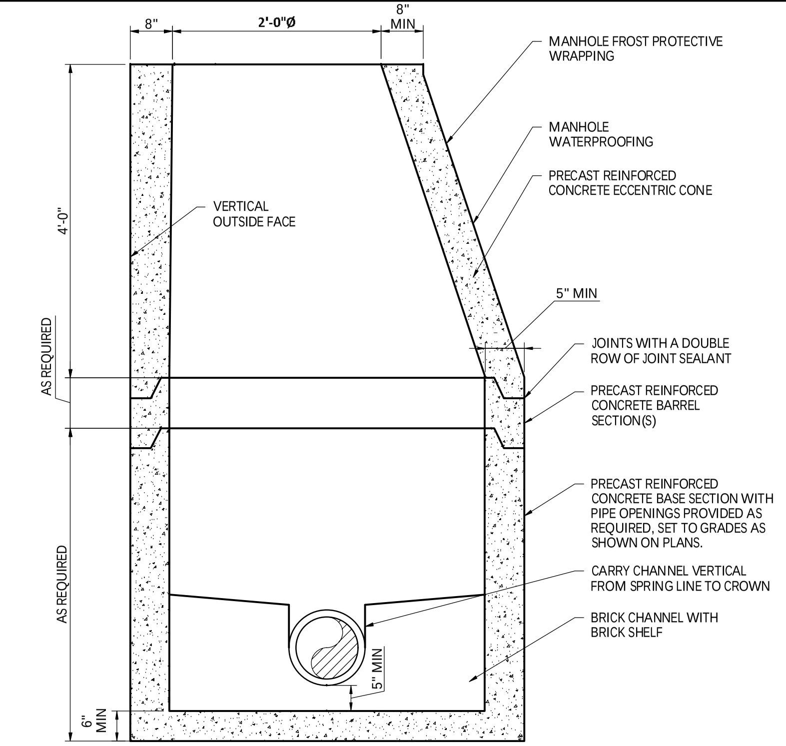
TOWN OF NORTH READING, MASSACHUSETTS
CHEMICAL FEED STATIONS

CENTRAL STREET BOOSTER PUMP STATION SITE PLAN

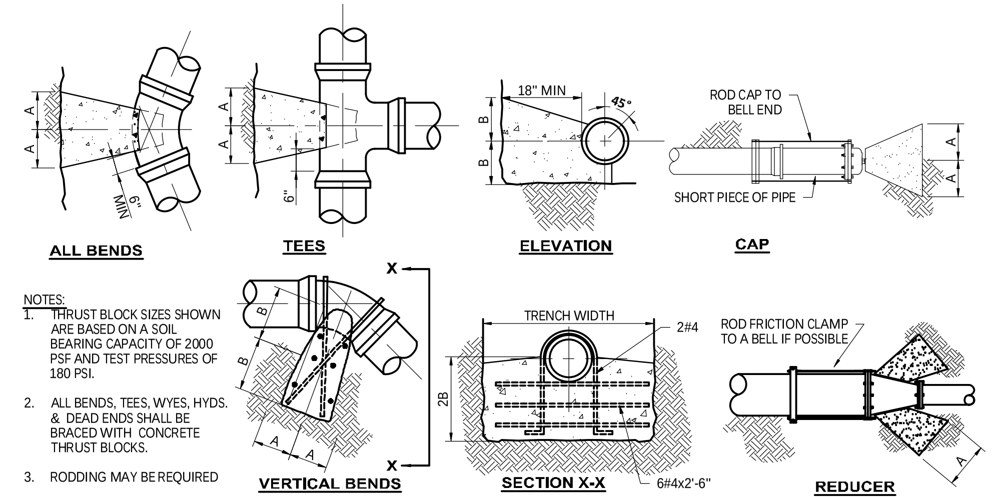
DRAWING
C-5

NOT TO SCALE



NOTES:
1. MANHOLE CHANNELS REQUIRING A CHANGE IN DIRECTION ARE TO BE BUILT ON A SMOOTH CURVE OF THE LONGEST POSSIBLE RADIUS. IF SIDE PIPES ENTER CHANNEL, SHAPE TO RECEIVE ADDED SIDE FLOW.
2. USE A FLAT SLAB TOP MANHOLE WHEN THE HEIGHT DIFFERENCE BETWEEN THE HIGHEST INVERT AND RIM IS LESS THAN 6'-0" AND WHEN MANHOLE DIAMETER IS GREATER THAN 4'-0".

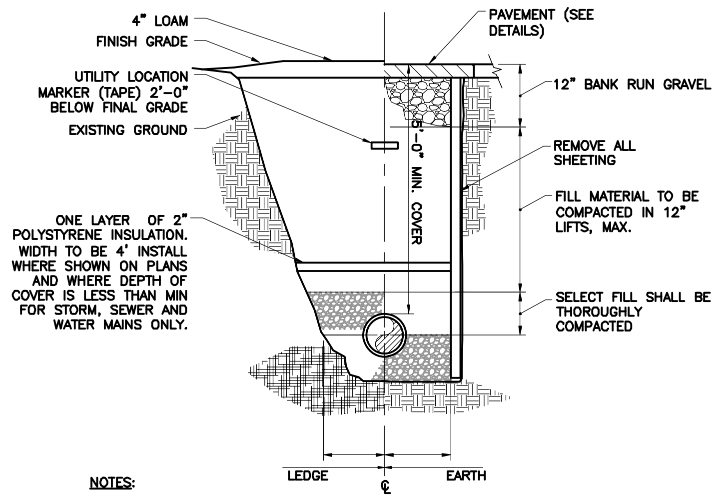
TYPICAL 4-FT MANHOLE
SCALE: "NTS"



NOTES:
1. THRUST BLOCK SIZES SHOWN ARE BASED ON A SOIL BEARING CAPACITY OF 2000 PSF AND TEST PRESSURES OF 180 PSI.
2. ALL BENDS, TEES, WYES, HYDS. & DEAD ENDS SHALL BE BRACED WITH CONCRETE THRUST BLOCKS.
3. RODDING MAY BE REQUIRED

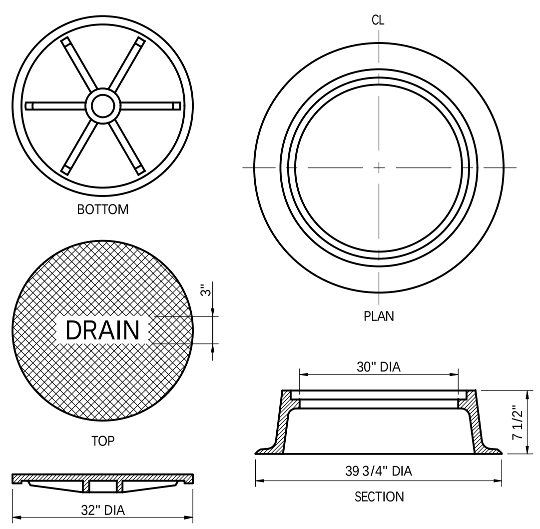
PIPE SIZE	90° BEND		45° BEND		22 1/2° BEND		11 1/4° BEND		TEE		VERTICAL BEND (DOWN)		PLUG		REDUCER	
	A	B	A	B	A	B	A	B	A	B	A	B	A	B	A	B
4"	15"	12"	12"	9"	9"	6"	6"	6"	12"	12"	24"	21"	12"	12"	12"	12"
6"	15"	12"	12"	9"	9"	6"	6"	6"	12"	12"	24"	21"	12"	12"	12"	12"
8"	20"	15"	14"	12"	9"	9"	9"	6"	18"	12"	33"	24"	14"	14"	18"	12"
10"	21"	21"	18"	15"	15"	9"	9"	9"	20"	18"	40"	27"	16"	16"	20"	18"
12"	27"	24"	23"	15"	15"	12"	12"	9"	25"	18"	48"	30"	18"	18"	25"	18"
16"	37"	30"	30"	21"	21"	15"	13"	12"	32"	24"	57"	36"	22"	22"	32"	24"

THRUST BLOCKS
NTS

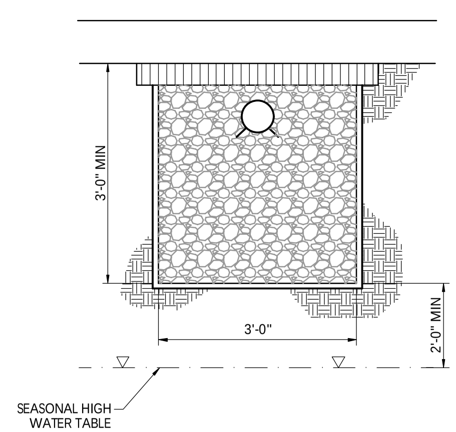


NOTES:
1. TOWN OF NORTH READING MAY REQUIRE FLOWABLE FILL AT ITS DISCRETION.
2. FOR LOCATION WHERE LEDGE IS NOT ENCOUNTERED IN TRENCH, PIPE CAN BE LAY ON UNDISTURBED EARTH, OR ON SAND BEDDING CONSISTENT WITH AWWA GUIDELINES.
3. FOR LOCATIONS WHERE LEDGE IS ENCOUNTERED, SAND BEDDING SHALL BE A MINIMUM OF 12" THINK UNDER PIPE.
4. FILL MATERIAL SHALL BE COMPACTED TO 95% PROCTOR DENSITY.
5. SEE THE TOWN OF NORTH READING STREET OPENING CONSTRUCTION STANDARDS FOR TRENCH BACKFILLING AND PAVEMENT RESTORATION.

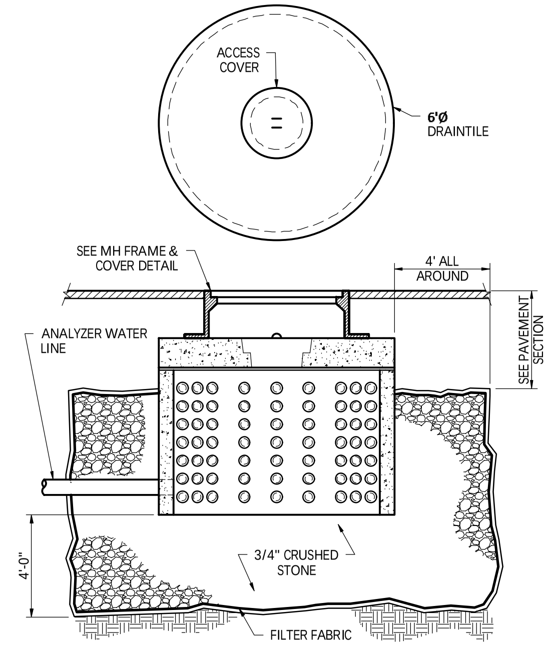
WATER MAIN TRENCH DETAIL
NTS



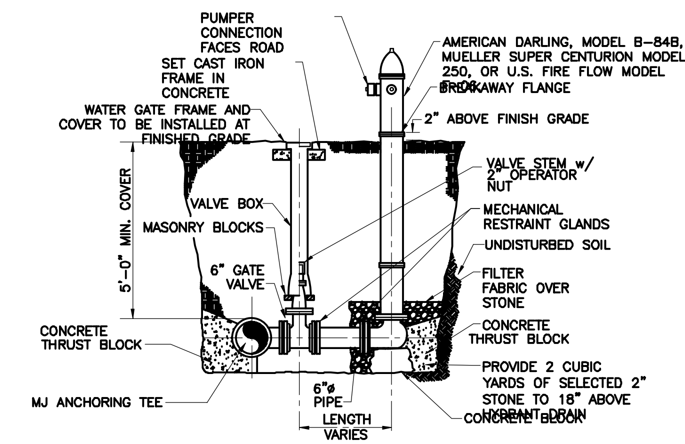
DRAIN MANHOLE STANDARD COVER AND FRAME
SCALE: NTS



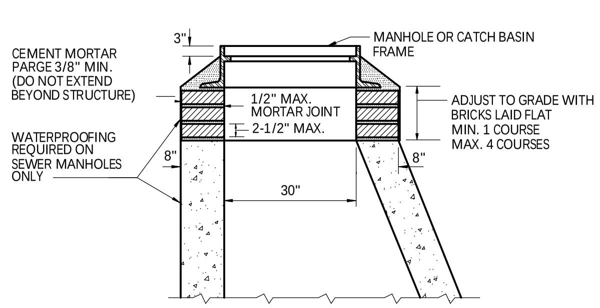
INFILTRATION TRENCH DETAIL
SCALE: NTS



DRYWELL DETAIL
SCALE: "NTS"

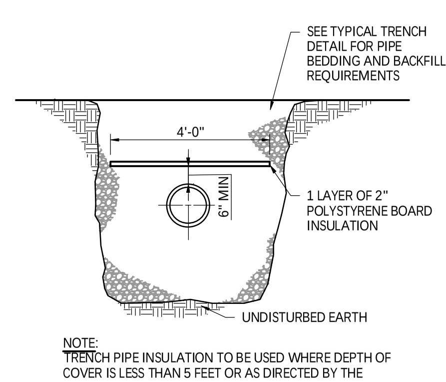


TYPICAL HYDRANT CONNECTION
SCALE: NTS



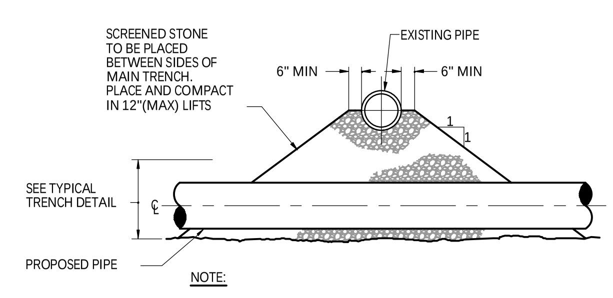
MANHOLE FRAME INSTALLATION
NTS

ALL MANHOLES ARE TO BE POLY WRAPPED FOR FREEZE PROTECTION.



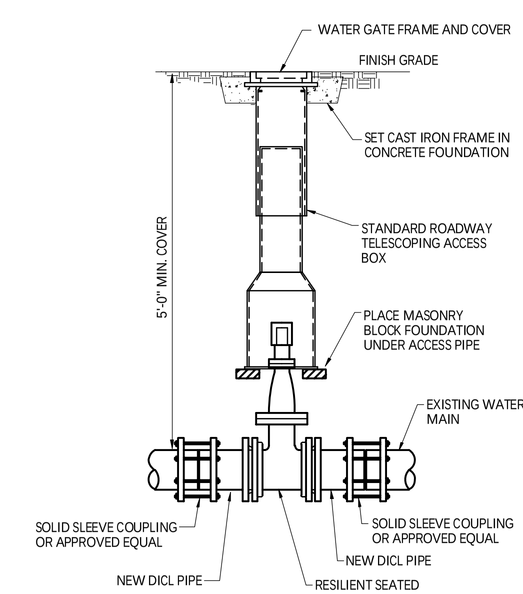
NOTE:
TRENCH PIPE INSULATION TO BE USED WHERE DEPTH OF COVER IS LESS THAN 5 FEET OR AS DIRECTED BY THE ENGINEER

TRENCH PIPE INSULATION
SCALE: NTS



NOTE:
1. JOINTS SHALL BE A MINIMUM 10' EITHER SIDE OF CROSSING.

PIPE CROSSING
NTS



GATE VALVE DETAIL
NTS

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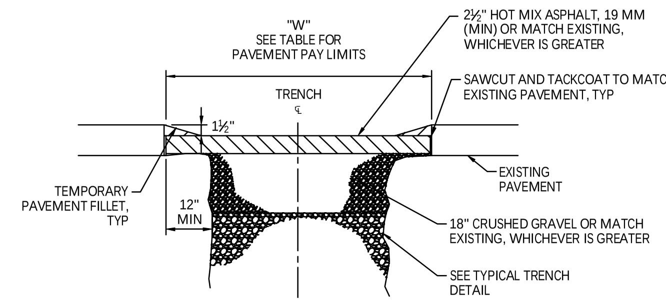
TOWN OF NORTH READING, MASSACHUSETTS
CHEMICAL FEED STATIONS

DETAILS I

DRAWING
C-6

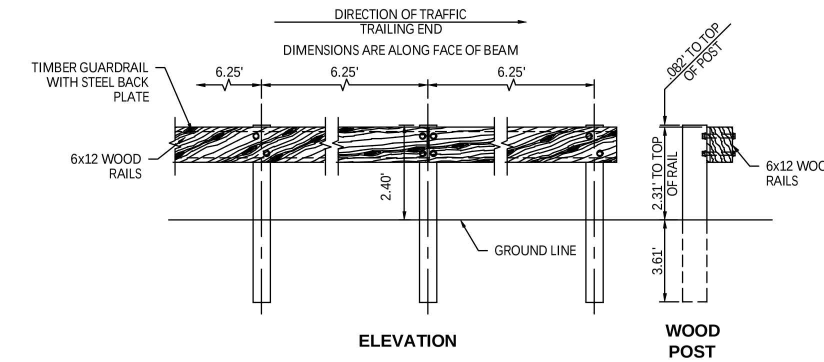
NOT TO SCALE



PAVEMENT PAY LIMITS	
PIPE I.D.	"W" (FOR 0' - 10' DEEP)
6" - 15"	7'-0"
16" - 21"	8'-0"

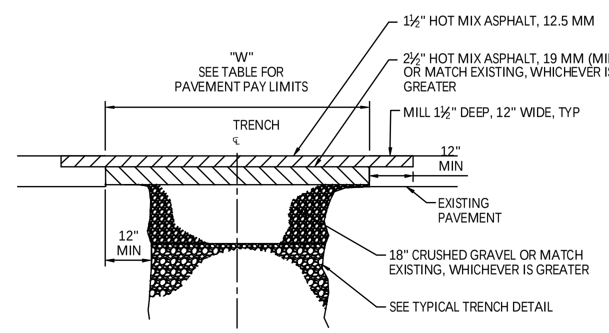
"W" SHALL BE INCREASED BY 1'-0" FOR TRENCHES 10' - 15', AND BY 2'-0" FOR TRENCHES 15' - 20' DEEP.

INITIAL TRENCH PAVING
SCALE: NTS

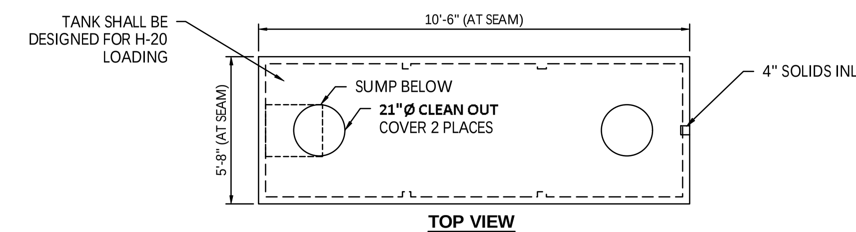


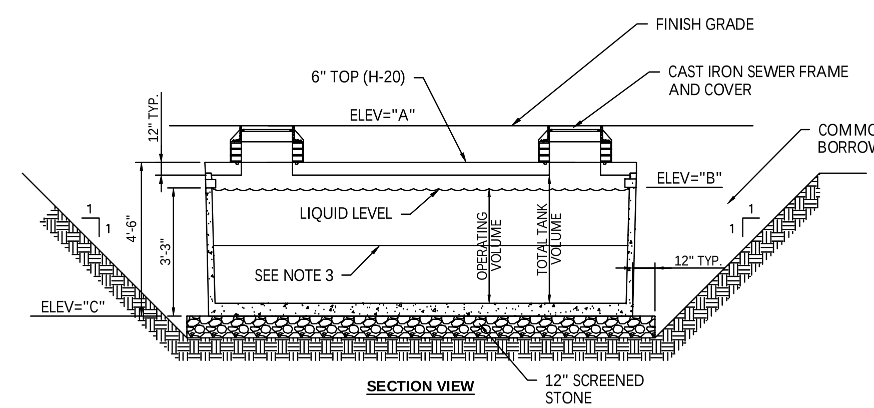
NOTES:
1. INTERMEDIATE POST SPACING SHALL BE 6.25' UNLESS OTHERWISE SHOWN.
2. WOOD RAILS SHALL BE 6x12 OR MATCH EXISTING.
3. WOOD POSTS FOR GUARDRAIL SHALL MATCH EXISTING.
4. WOOD POSTS PUNCHED WITH HOLES IN ADDITION TO THOSE SPECIFIED TO ACCOMMODATE OTHER TYPES OF GUARDRAIL, WILL BE ACCEPTED SUBJECT TO THE APPROVAL OF THE ENGINEER.

WOOD GUARDRAIL
SCALE: NTS



FINAL TRENCH PAVING
SCALE: NTS



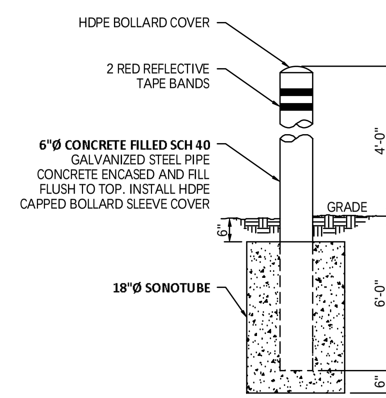


NOTES:
1. CONCRETE: 4,000 PSI MINIMUM AFTER 28 DAYS.
2. ALL REINFORCEMENT PER ASTM C1227.
3. TONGUE AND GROOVE JOINT SEALED WITH BUTYL RESIN.

ELEVATION TABLE

ELEV.	MAIN ST.	CENTRAL ST.
"A"	97.00'	79.50'
"B"	"B"	"B"
"C"	"C"	"C"

1,000 GAL. TIGHT TANK DETAIL
SCALE: NTS



BOLLARD
SCALE: NTS

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TOWN OF NORTH READING, MASSACHUSETTS
CHEMICAL FEED STATIONS

DETAILS II

DRAWING
C-7

NOT TO SCALE

EROSION AND SEDIMENTATION CONTROL NOTES

THIS PLAN HAS BEEN DEVELOPED AS A STRATEGY TO CONTROL SOIL EROSION AND SEDIMENTATION DURING AND AFTER CONSTRUCTION. THIS PLAN IS BASED ON THE STANDARDS AND SPECIFICATIONS FOR EROSION PREVENTION IN URBAN AND SUBURBAN AREAS AS CONTAINED IN THE "MASSACHUSETTS EROSION AND SEDIMENT CONTROL GUIDELINES FOR URBAN AND SUBURBAN AREAS", FRANKLIN, HAMPDEN, HAMPSHIRE CONSERVATION DISTRICTS, DATED MARCH, 1997.

THE PROPOSED LOCATIONS OF SILTATION AND EROSION CONTROL STRUCTURES REQUIRED FOR THE PUMP STATION AND WATER METERING STATION ARE SHOWN ON THE GRADING/EROSION CONTROL PLANS. PROVIDE SILT FENCE, STONE CHECK DAMS AND OTHER EROSION CONTROL MEASURES AS REQUIRED TO ADEQUATELY PREVENT SEDIMENT TRANSPORT AS NOTED IN THE BMP.

1. ALL SEDIMENT AND EROSION CONTROL MEASURES SHALL BE DONE IN ACCORDANCE WITH THE "MASSACHUSETTS EROSION AND SEDIMENT CONTROL GUIDELINES FOR URBAN AND SUBURBAN AREAS", FRANKLIN, HAMPDEN, HAMPSHIRE CONSERVATION DISTRICTS, DATED MARCH, 1997.
2. THOSE AREAS UNDERGOING ACTUAL CONSTRUCTION WILL BE MAINTAINED IN AN UNTREATED OR UNVEGETATED CONDITION FOR THE MINIMUM TIME REQUIRED. IN GENERAL, AREAS TO BE VEGETATED SHALL BE PERMANENTLY STABILIZED WITHIN 15 DAYS OF FINAL GRADING AND TEMPORARILY STABILIZED WITHIN 30 DAYS OF INITIAL DISTURBANCE OF THE SOIL.
3. SEDIMENT BARRIERS (SILT FENCE, STONE CHECK DAMS, ETC.) SHOULD BE INSTALLED PRIOR TO ANY SOIL DISTURBANCE OF UPGRADIENT DRAINAGE AREAS.
4. INSTALL SILT FENCE AT TOE OF SLOPES TO FILTER SILT FROM RUNOFF. SEE SILT FENCE DETAIL FOR PROPER INSTALLATION. SILT FENCE WILL REMAIN IN PLACE PER NOTE #5.
5. ALL EROSION CONTROL STRUCTURES WILL BE INSPECTED, REPLACED AND/OR REPAIRED EVERY 7 DAYS AND IMMEDIATELY FOLLOWING ANY SIGNIFICANT RAINFALL OR SNOW MELT OR WHEN NO LONGER SERVICEABLE DUE TO SEDIMENT ACCUMULATION OR DECOMPOSURE. SEDIMENT DEPOSITS MUST BE REMOVED WHEN DEPOSITS REACH APPROXIMATELY ONE HALF THE HEIGHT OF THE BARRIER. SEDIMENT CONTROL DEVICES SHALL REMAIN IN PLACE AND BE MAINTAINED BY THE CONTRACTOR UNTIL AREAS UPSLOPE ARE PERMANENTLY STABILIZED.
6. NO SLOPES, EITHER PERMANENT OR TEMPORARY, SHALL BE STEEPER THAN TWO HORIZONTAL TO ONE VERTICAL (2 TO 1) UNLESS STABILIZED WITH PERMANENT EROSION CONTROL MEASURES.
7. IF FINAL SEEDING OF THE DISTURBED AREAS IS NOT TO BE COMPLETED 30 DAYS PRIOR TO THE ANTICIPATED DATE OF THE FIRST KILLING FROST, USE TEMPORARY MULCHING (DORMANT SEEDING MAY BE ATTEMPTED AS WELL) TO PROTECT THE SITE AND DELAY PERMANENT SEEDING, UNTIL UPGRADIENT AREAS ARE STABILIZED.
8. WHEN FEASIBLE, TEMPORARY SEEDING OF DISTURBED AREAS THAT HAVE NOT BEEN FINISH GRADED SHALL BE COMPLETED 30 DAYS PRIOR TO THE FIRST KILLING FROST.
9. DURING THE CONSTRUCTION PHASE, INTERCEPTED SEDIMENT WILL BE RETURNED TO THE SITE AND REGRADED ONTO OPEN AREAS. POST SEEDING SEDIMENT, IF ANY, WILL BE DISPOSED OF IN AN ACCEPTABLE MANNER.
10. REVEGETATION MEASURES WILL COMMENCE UPON COMPLETION OF CONSTRUCTION EXCEPT AS NOTED ABOVE. ALL DISTURBED AREAS NOT OTHERWISE STABILIZED WILL BE GRADED, SMOOTHED, AND REVEGETATED AS FOLLOWS:
    A. A MINIMUM OF FOUR (4) INCHES OF LOAM WILL BE SPREAD OVER DISTURBED AREAS AND SMOOTHED TO A UNIFORM SURFACE.
    B. APPLY LIMESTONE AND FERTILIZER ACCORDING TO SOIL TEST. IF SOIL TESTING IS NOT DEEMED FEASIBLE ON SMALL OR VARIABLE SITES, OR WHERE TIMING IS CRITICAL, FERTILIZER MAY BE APPLIED AT THE RATE OF 800 POUNDS PER ACRE OR 18.4 POUNDS PER 1,000 SQUARE FEET USING 10-20-20 (N-P205-K20) OR EQUIVALENT. APPLY GROUND LIMESTONE (EQUIVALENT TO 50% CALCIUM PLUS MAGNESIUM OXIDE) AT A RATE OF 3 TONS PER ACRE (138 LB PER 1,000 SQ. FT.).
    C. FOLLOWING SEED BED PREPARATION, DITCHES AND BACK SLOPES WILL BE SEEDED WITH A MIXTURE OF 47% CREEPING RED FESCUE, 5% REDTOP, AND 48% TALL FESCUE. THE LAWN AREAS WILL BE SEEDED WITH A PREMIUM TURF MIXTURE OF 44% KENTUCKY BLUEGRASS, 44% CREEPING RED FESCUE, AND 12% PERENNIAL RYE GRASS: SEEDING RATE IS 3.0 LBS PER 1000 SQ. FT. LAWN QUALITY SOD MAY BE SUBSTITUTED FOR SEED.
    D. HAY MULCH AT THE RATE OF 100 LBS PER 1000 SQUARE FEET OR A HYDRO- APPLICATION OF CELLULOSE FIBER SHALL BE APPLIED FOLLOWING SEEDING. A SUITABLE BINDER WILL BE USED ON HAY MULCH FOR WIND CONTROL.
11. ALL TEMPORARY EROSION CONTROL MEASURES SHALL BE REMOVED ONCE THE WORK AREA IS STABILIZED.
12. WETLANDS (EXCEPTING THOSE WHICH ARE TO BE FILLED IN ACCORDANCE WITH STATE AND FEDERAL REGULATIONS) WILL BE PROTECTED WITH SILT FENCE INSTALLED AT THE EDGE OF THE WETLAND OR THE BOUNDARY OF WETLAND DISTURBANCE.
13. IN GENERAL, AREAS WITHIN 100 FEET OF DELINEATED WETLANDS OR STREAMS SHALL HAVE A MAXIMUM PERIOD OF EXPOSURE OF NOT MORE THAN 15 DAYS.
14. FOLLOW APPROPRIATE EROSION CONTROL MEASURES PRIOR TO EACH STORM IN ALL AREAS WITHIN 100 FEET OF DELINEATED WETLANDS OR STREAMS.

EROSION CONTROL DURING WINTER CONSTRUCTION

1. WINTER CONSTRUCTION PERIOD DEFINED: NOVEMBER 1 THROUGH APRIL 15.
2. WINTER EXCAVATION AND EARTHWORK SHALL BE DONE SUCH THAT NO MORE THAN 1 ACRE OF THE SITE IS WITHOUT STABILIZATION AT ANY ONE TIME.
3. EXPOSED AREA SHOULD BE LIMITED TO THAT THAT CAN BE MULCHED IN ONE DAY PRIOR TO ANY PRECIPITATION EVENT.
4. AN AREA SHALL BE CONSIDERED TO HAVE BEEN STABILIZED WHEN EXPOSED SURFACES HAVE BEEN EITHER MULCHED WITH STRAW OR HAY AT A RATE OF 100 LB. PER 1,000 SQUARE FEET (WITH OR WITHOUT SEEDING) OR DORMANT SEEDED, MULCHED AND ADEQUATELY ANCHORED BY AN APPROVED ANCHORING TECHNIQUE. IN ALL CASES, MULCH SHALL BE APPLIED SUCH THAT SOIL SURFACE IS NOT VISIBLE THROUGH THE MULCH.
5. BETWEEN THE DATES OF OCTOBER 15 AND APRIL 1ST, LOAM OR SEED WILL NOT BE REQUIRED. DURING PERIODS OF ABOVE-FREEZING TEMPERATURES, THE SLOPES SHALL BE FINE GRADED AND EITHER PROTECTED WITH MULCH OR TEMPORARILY SEEDED AND MULCHED UNTIL SUCH TIME AS THE FINAL TREATMENT CAN BE APPLIED. IF THE DATE IS AFTER NOVEMBER 1ST AND IF THE EXPOSED AREA HAS BEEN LOAMED, FINAL GRADED AND IS SMOOTH, THEN THE AREA MAY BE DORMANT SEEDED AT A RATE 200 - 300% HIGHER THAN SPECIFIED FOR PERMANENT SEED AND THEN MULCHED. IF CONSTRUCTION CONTINUES DURING FREEZING WEATHER, ALL EXPOSED AREAS SHALL BE GRADED BEFORE FREEZING AND THE SURFACE TEMPORARILY PROTECTED FROM EROSION BY THE APPLICATION OF MULCH. SLOPES SHALL NOT BE LEFT EXPOSED OVER THE WINTER OR ANY OTHER EXTENDED TIME OF WORK SUSPENSION UNLESS TREATED IN THE ABOVE MANNER. UNTIL SUCH TIME AS WEATHER CONDITIONS ALLOW DITCHES TO BE FINISHED WITH THE PERMANENT SURFACE TREATMENT, EROSION SHALL BE CONTROLLED BY THE INSTALLATION OF BALES OF HAY OR STONE CHECK DAMS IN ACCORDANCE WITH THE STANDARD DETAILS.
6. BETWEEN THE DATES OF NOVEMBER 1ST AND APRIL 15TH ALL MULCH SHALL BE EITHER WOOD CELLULOSE FIBER OR BE ANCHORED WITH MULCH NETTING OR CHEMICAL TACK.
7. MULCH NETTING SHALL BE USED TO ANCHOR MULCH IN ALL DRAINAGE WAYS WITH A SLOPE GREATER THAN 3%, FOR SLOPES EXPOSED TO DIRECT WINDS AND FOR ALL OTHER SLOPES GREATER THAN 8%.
8. MULCH NETTING SHALL BE USED TO ANCHOR MULCH IN ALL AREAS WITH SLOPES GREATER THAN 15%. AFTER OCTOBER 1ST, THE SAME APPLIES FOR ALL SLOPES GREATER THAN 8%.
9. AFTER NOVEMBER 1ST THE CONTRACTOR SHALL APPLY DORMANT SEEDING OR MULCH AND ANCHORING ON ALL BARE EARTH AT THE END OF EACH WORKING DAY.
10. DURING WINTER CONSTRUCTION PERIODS ALL SNOW SHALL BE REMOVED FROM AREAS OF SEEDING AND MULCHING PRIOR TO PLACEMENT.

MULCH ANCHORING

ANCHOR MULCH WITH: MULCH NETTING (AS PER MANUFACTURER); ASPHALT EMULSION (0.05 GALLONS PER SQ. YD.); CHEMICAL TACK (AS PER MANUFACTURER'S SPECIFICATIONS); OR BE WOOD CELLULOSE FIBER (2000 LBS/ACRE). WETTING FOR SMALL AREAS AND ROAD DITCHES MAY BE PERMITTED.

ADDITIONAL TEMPORARY SEED MIXTURE (OR PERIODS LESS THAN 12 MONTHS)

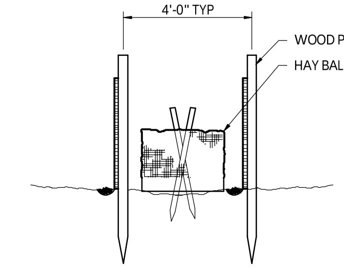
SEED	RATE
OATS	80 LBS/ACRE
ANNUAL RYE GRASS	40 LBS/ACRE
WINTER RYE	120 LBS/ACRE
MULCH W/ DORMANT SEED	80 LBS/ACRE*
FOXTAIL MILLET	30 LBS/ACRE

MULCH AND MULCH ANCHORING

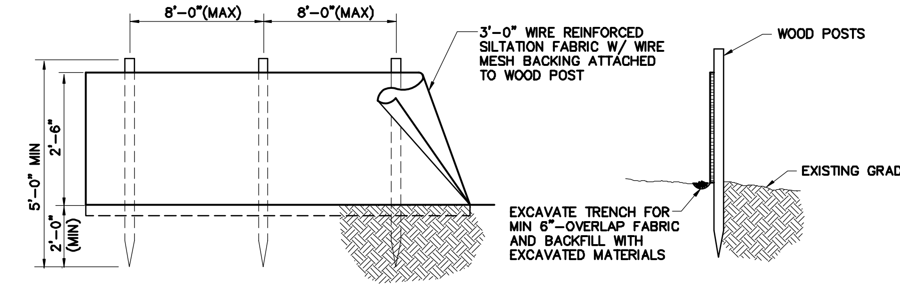
MULCH

LOCATION	MULCH	RATE (1000 S.F.)
PROTECTED AREA	STRAW OR HAY *	100 POUNDS
WINDY AREAS	STRAW OR HAY (ANCHORED) *	100 POUNDS
MODERATE TO HIGH VELOCITY AREAS OR STEEP SLOPES (GREATER THAN 3:1)	JUTE MESH,	AS REQUIRED
	EXCELSIOR MAT OR EQUIV.	AS REQUIRED

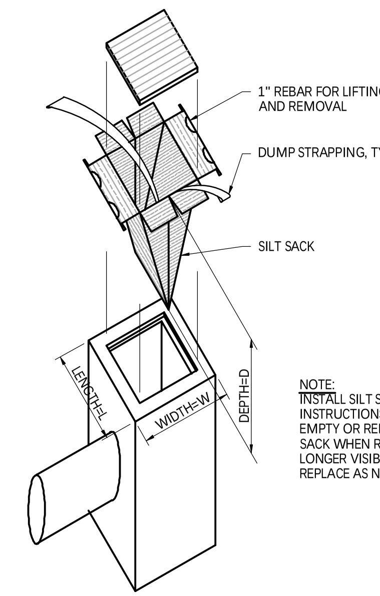
* A HYDRO-APPLICATION OF CELLULOSE FIBER MAY BE APPLIED FOLLOWING SEEDING. A SUITABLE BINDER SHALL BE USED ON HAY MULCH FOR WIND CONTROL.



COMBINATION SILT FENCE AND HAY BALE BARRIER
SCALE: NTS

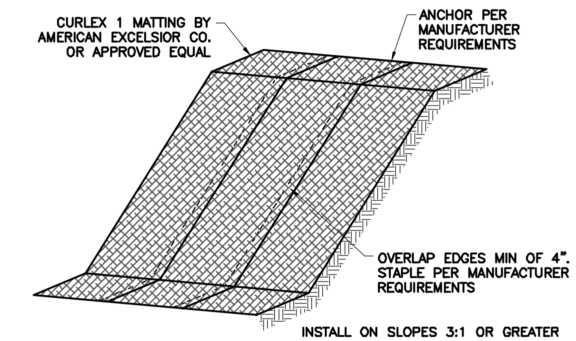


SILT FENCE INSTALLATION DETAIL
SCALE: "NTS"



NOTE:
INSTALL SILT SACK PER MANUFACTURER'S INSTRUCTIONS AND RECOMMENDATIONS. EMPTY OR REMOVE SEDIMENT FROM SILT SACK WHEN RESTRAINT CORD IS NO LONGER VISIBLE. CLEAN, RINSE, AND REPLACE AS NEEDED.

SILT SACK CATCH BASIN INLET
SCALE: NTS



EROSION CONTROL MATTING - SLOPES
SCALE: NTS

NO	SUBMISSIONS/REVISIONS	APP'D	DATE
	60% DESIGN SUBMITTAL	R.WIL	02-20

DESIGNED BY: P.QUE/B.JON
CAD COORD: B.JON
CAD: B.JON
CHECKED BY:
DATE:
APPROVED BY:
DATE:
PROJECT NO: 14296

FEIR PERMIT SUBMITTAL

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TOWN OF NORTH READING, MASSACHUSETTS
CHEMICAL FEED STATIONS

EROSION CONTROL NOTES AND DETAILS

DRAWING
C-8

NOT TO SCALE

E

WRIGHT-PIERCE
Engineering a Better Environment

APPENDIX E
Water Conservation

CDM Smith

Memorandum

To: *James McSurdy, Water Treatment Superintendent*

From: *Colleen Heath, P.E.*

Date: *March 15, 2016*

Subject: *Unaccounted-For Water Investigation – Final Report*

This memorandum details the results of the CDM Smith Inc. (CDM Smith) review of water production, consumption, and accounting records for the Town of Andover as it pertains to their unaccounted-for water (UAW). UAW is a performance standard set by the Massachusetts Department of Environmental Protection (MassDEP) to encourage water suppliers to reduce water losses in their system, with the goal of making water systems more efficient and reduce the overall volume of water withdrawn from sources of supply. UAW is calculated by subtracting the metered water use and the confidently estimated municipal use (CEMU) from the volume of water supplied to the distribution system. This remaining volume is considered to be UAW. MassDEP's UAW standard for permitted water suppliers is to meet or demonstrate steady progress toward meeting a percentage of 10 percent UAW or less. The calculated value is reported to MassDEP annually within the Annual Statistical Report (ASR).

The Town of Andover is required to renew their Water Management Act (WMA) water withdrawal permit in November 2018. As of the November 2014 update of the WMA regulations, the State can enforce the requirement that permitted municipalities meet their water conservation performance standards, such as being under 10 percent UAW. In the event that the Town does not meet the UAW standard within two years (by 2020) of their permit renewal, MassDEP will require the Town to follow an Individual UAW Compliance Plan, which can be written by the Town and can include criteria from the MassDEP Functional Equivalency Plan (FEP) for UAW. If the Town has not met the performance standard by 5 years after permit renewal (by 2023), they will be required to follow the FEP. **An example of some of the action items for the FEP include, within one year of FEP implementation, requiring the Town to replace all large meters (2-inches or greater) and to implement water pricing sufficient to pay for all water system operation and capital costs, and within three years, requiring the Town to implement bi-monthly or quarterly billing.**

In 2014, the Town of Andover's UAW was 25-percent, reflecting an increasing trend from 2009 to 2014, as shown in Table 1 and Figure 1. In 2014, the water production cost was determined to be $415 per million gallons. **Based on these costs it cost the Town approximately $230,000 to produce water that was unaccounted-for in 2014.** If this "lost" water was reduced to the 10 percent standard, and the recovered water was instead sold to customers at the residential rate of $3.10 per 100 cubic feet, the Town could see an increase of revenue of up to $1,400,000 and alleviate concerns about increasing their permitted volume from MassDEP. It should be noted that it is unlikely that all of the unaccounted-for water is due to unmeasured water that is delivered to customers, and thus the increase in revenue is likely less than projected.

Table 1 Historical Unaccounted-For Water

	2004	2005	2006	2007	2008	2009	2010	2011	2012	2013	2014
UAW (Million Gallons)	140	157	6	238	72	118	324	526	504	566	562
UAW (%)	7.1	8.5	0.3	12.0	3.9	6.5	16.0	25.7	23.0	24.9	25.0

Note: These values are as reported in the Annual Statistical Reports.

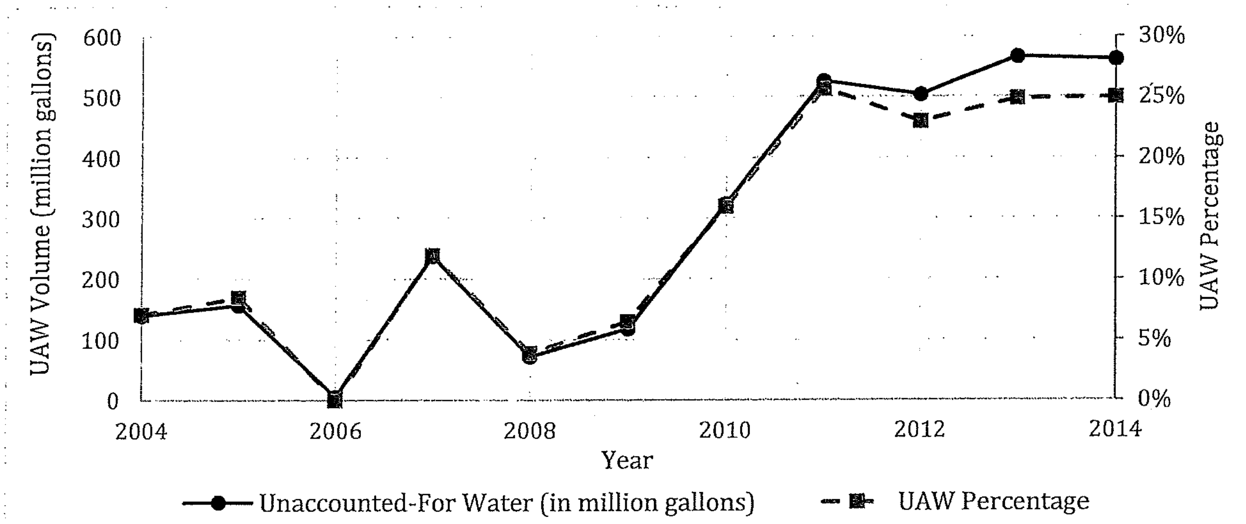

Figure 1
Unaccounted-For Water Is Increasing Over Time: UAW from 2004 to 2014 in Million Gallons and as a Percentage of Finished Water.

In evaluating UAW, it is often helpful to breakdown the total water use by water user types/components such as: Agricultural, Commercial, Industrial, Irrigation, Municipal, Residential, and Unaccounted-for Water. Figure 2 shows how Andover's water usage by component has changed from 2004 to 2014, and Figure 3 shows how the different usage types comprise the total finished water in 2014.

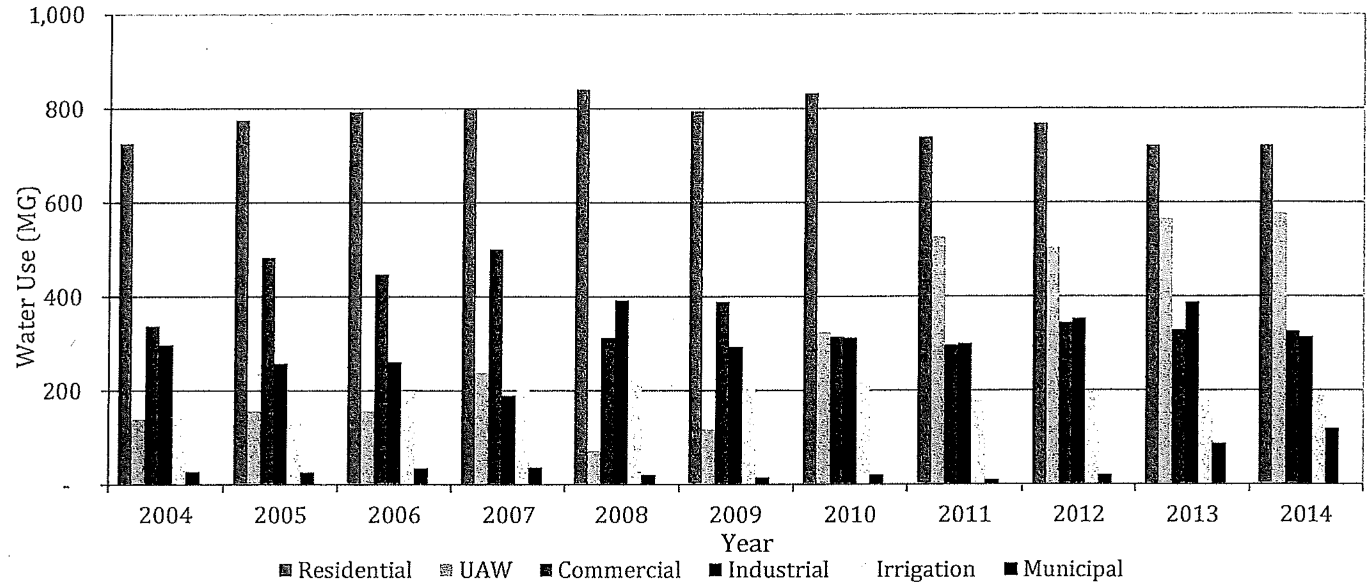

Figure 2
How Different Water Users add to the Total Water Demand: Water Usage in Million Gallons by Category from 2004 to 2014
Note: Agricultural usage represented less than 1 percent of total finished water in 2014.

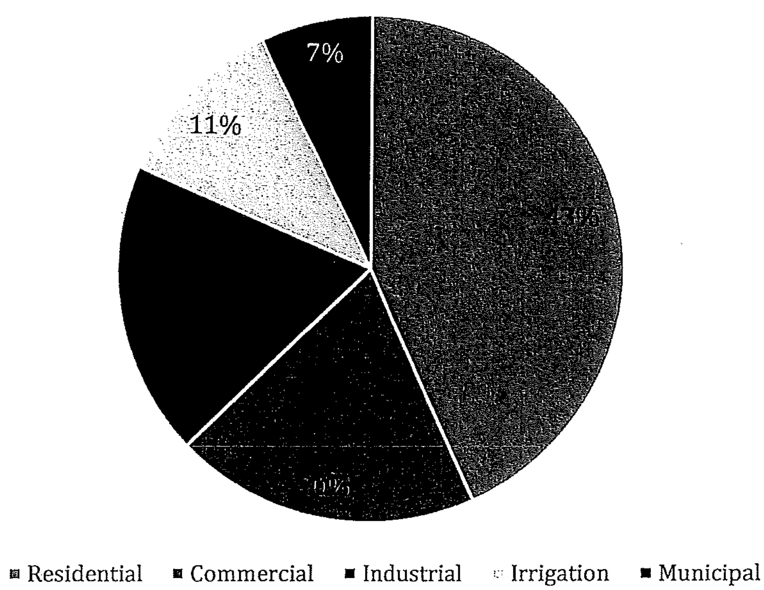

Figure 3
How Different Water Users add to the Total Water Demand: 2014 Water Use as a Percentage of Total Accounted-for Water
Note: Agricultural usage was considered to be negligible in 2014.

Review of Water Production Meters and Records

The Town has large water production meters located at Fish Brook and the water treatment plant. CDM Smith reviewed the meter calibration reports of the water production meters and records of any adjustments in the ASRs to determine whether a meter error could be contributing to the UAW percentage. These meters were calibrated on a quarterly basis from 2009 to 2014 and were found to be within the manufacturer's standards. Because of this, no adjustments were made to the amount of the water withdrawal volumes and no correlation between water production meter error and UAW could be made.

Review of Water Main Break and Leak Detection and Repair Records

The goal of the MassDEP UAW standard is to reduce the volume of water "lost" in the system through accounting issues as well as real, physical losses. Both water main breaks and water main and service leakage represent real, physical losses in the system. MassDEP allows a certain amount of water to be discounted from the UAW value for water main breaks, but does not allow any accounting for water main and water service leakage. In spite of this, the Town keeps water main and service leak records and estimates the volume of water lost in order to demonstrate how leakage impacts their UAW value. Table 2 and Figure 4 show the number of leaks found and repaired, as well as the estimated volume of water lost. **In 2014, 115 leaks were found in the system and the estimated volume of water lost was 90 million gallons, representing 4 percent of the total water volume produced for that year.**

Table 2 Historical Leak Detection and Repair Activities

	2012	2013	2014
Number of Leaks Found	50	69	115
Number of Leaks Repaired	21	23	72
Estimated Volume of Water Lost (MG)	54.7	136.4	90.2

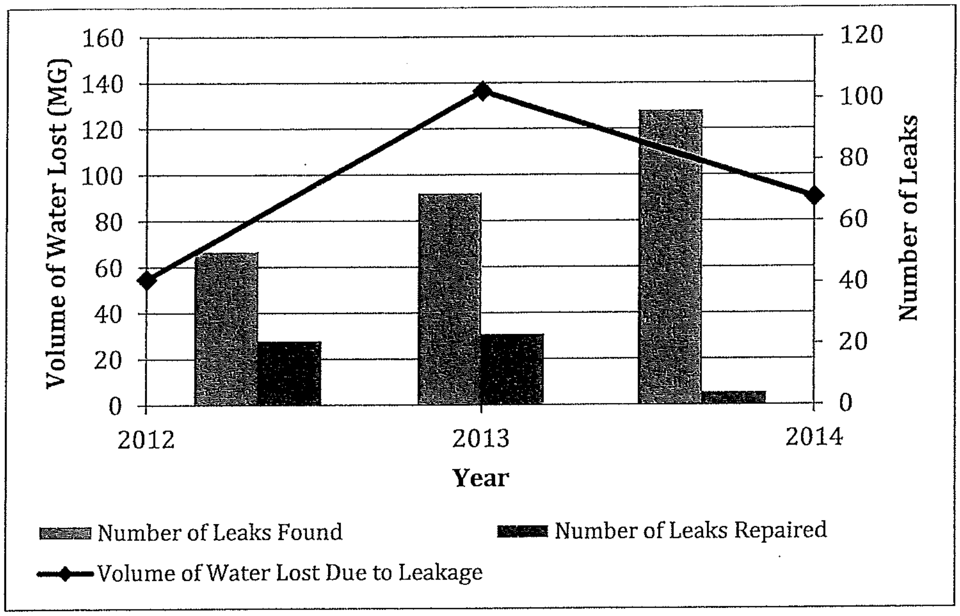

Figure 4
Leakage Quantity and Volume Increasing Over Time: Number of Leaks Found and Repaired, and the Estimated Volume of Water Lost from 2012 to 2014

Since 2012, the Town of Andover employed leak detection services to identify and to estimate the number of leaks within the system and deployed field crews to repair the leaks. The Town assumes that leaks found in the surveys began on January 1, and the duration lasts until the known repair date or through December 31. However, the real duration of a leak is unknown, and thus the volume of leakage estimated by this method cannot be substantiated. In some instances, a leak left unrepaired may be found again on the next year's leak detection survey, although this has not been the case consistently. Some of the unrepaired leaks are because the leaks are located on services located on private property, limiting the Town's ability to repair the leaks. The Town is drafting a policy that will require service leaks on private property to be repaired within 30 days of being discovered, which will likely increase the percentage of leaks repaired moving forward. Table 3 and Figure 5 show a breakdown of the types of leaks identified and their follow up activities for 2014.

Table 3 Leaks Identified and Follow-Up Activities by Type in 2014

	Water Service (Town Side)	Water Service (Homeowner Side)	Hydrant Leak	Water Main Leak (Town Owned)	Water Main (Private)
Number of Leaks Found	48	53	9	4	1
Number of Leaks Repaired	22	40	7	3	0

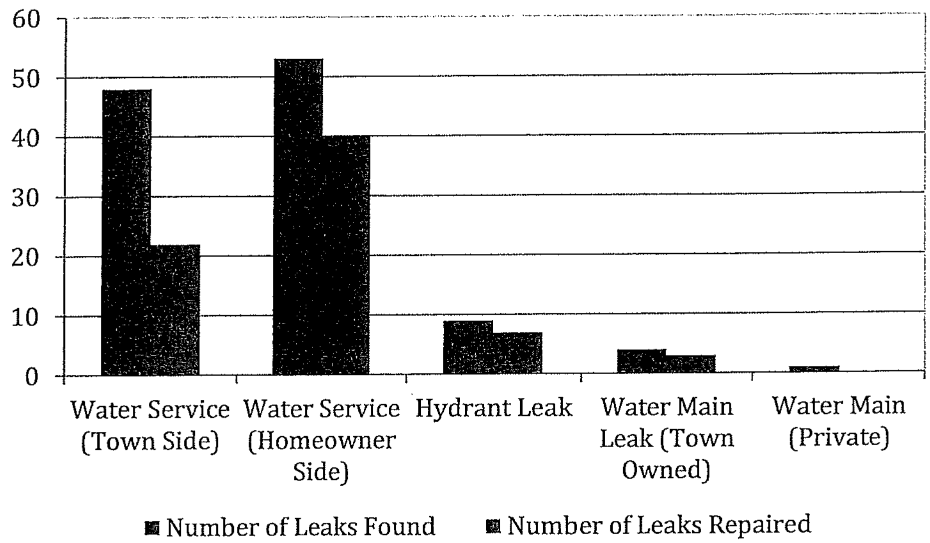

Figure 5
Water Service Leaks are More Prevalent than Other Types and Less Likely to be Repaired: Number of Leaks Found and Repaired in 2014

One of the typical causes of water main breaks is having a pipe leak for an extended period, deteriorating the condition of the pipe or its bedding. By employing more aggressive leak detection measures and performing the follow up activities, the Town of Andover has reduced the number of water main breaks and volume of water lost during breaks and increased the number of leaks found and repaired. The number of water main breaks and the estimated volumes of water lost are shown in Table 4 and Figure 6.

Table 4 Historical Water Main Breaks

	2012	2013	2014
Number of Water Main Breaks	32	25	22
Estimated Volume of Water Lost (MG)	8.1	3.7	1.3

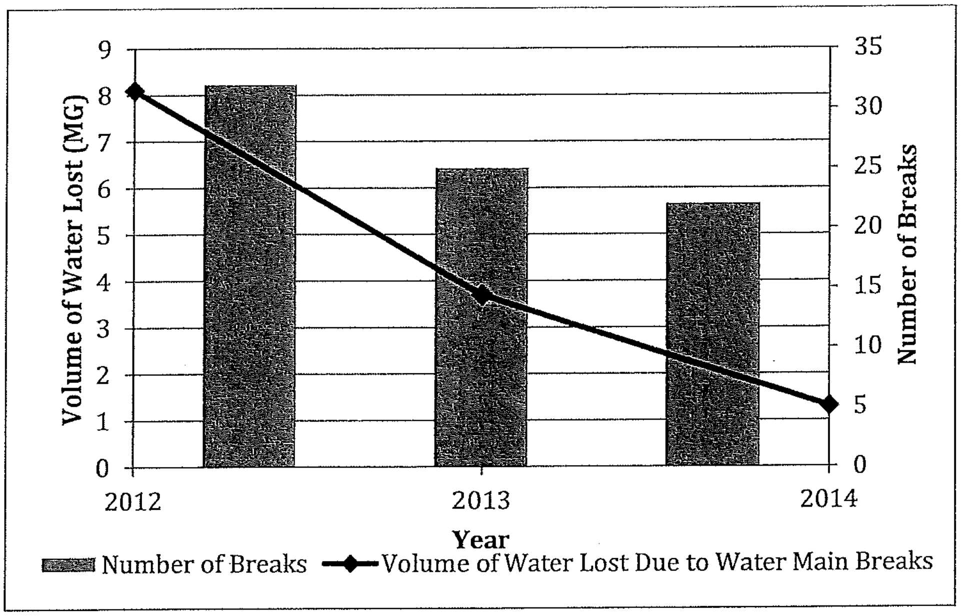

Figure 6
Number of Water Main Breaks Decreasing Over Time: Number of Water Main Breaks and the Estimated Volume of Water Lost from 2012 to 2014

The Town of Andover keeps records of major water main breaks and employs an estimating methodology of reviewing SCADA data before and after a break to determine the volume of water lost during the large main breaks, and using a visual inspection for smaller breaks.

Although a reduction in breaks reduces the quantity of water that can be discounted from the UAW calculation, the volume in recent years is so minimal that it makes little difference on the UAW percentage. For example, from 2012 to 2013, the Town reduced the water lost during breaks from 8.1 MG to 3.7 MG, which accounts for 0.8 percent of the total unaccounted-for water volume in 2013. However, the trend in breaks can be unpredictable because variable factors such as depth of frost, pipe deterioration, adjacent construction activities and water hammer can cause breaks. In addition, the volume of water released in a break depends on the type of break and the time it takes to locate and isolate the break, so the UAW benefit of reducing breaks can vary from year to year. Also, the infrastructure benefits of aggressive leak detection and follow up activities means fewer breaks that disturb the water system, roadways, and the customers being served.

Review of Confidently Estimated Municipal Uses

In addition to providing metered water data in the ASR, the Town of Andover follows MassDEP methods for estimating certain unmetered water uses. This category of water consumption is called confidently estimated municipal use (CEMU) and includes fire protection and training, water main flushing and main construction, fire flow testing, sewer and stormwater system flushing, street cleaning, and major water main breaks. Table 5 summarizes the breakdown of the CEMU from 2009 to 2014. Since 2011, the Town has been working on improving the accuracy of their estimates.

Table 5 Confidently Estimated Municipal Use (in million gallons)

	2009	2010	2011	2012	2013	2014
Fire Protection and Training	1.80	2	2.45	11.97	10.91	3.70
Hydrant/water main flushing and construction	16.20	20	9.4	2.56	8.93	2.73
Flow Testing	4.08	5	0.72	0.29	0.90	0.19
Bleeders/Blow Offs	0.25	0.5	8.64	0	0	0
Tank Overflow and Drainage	0	0	0	5	0	0
Sewer & Stormwater System Flushing	0.13	0.5	0	0.18	0.23	0.23
Street Cleaning	0.11	0.25	2.48	0.25	0.25	0.25
Source Meter Calibration Adjustments	0	0	0	0	0	0
Major Water Main Breaks	11.40	19.25	1.6	38.81	3.73	1.30
Total (Million Gallons)	**33.97**	**47.5**	**25.26**	**59.06**	**24.94**	**8.39**

After reviewing the backup documentation to the ASRs, the following observations were made:

- In 2011, **fire protection and training volume** was estimated based on number of sessions as provided by the fire chief, the average duration of the training session (4 hours), and an average flow rate of 500 gpm. In 2012, fire protection volume was determined by the number of fires by estimated flow rate (1000-1500 gpm) and an estimated time of 90 minutes per fire. In 2013 and 2014, the level of detail improved even further.
- In 2011, low flow rate **hydrant flushing volume** was determined by number of hydrants flushed per year, average duration of flush (8 hours), and an approximated flow rate (50 gpm). The latter low flow rate is usually used to clear up localized water quality problems. The same flow rate was used for construction projects, but actual durations are recorded. There is a hydrant flushing log that estimates volume based on above methodology and that keeps track of number of "flushes". The 50 gpm flow rate was determined by the water shop staff by placing a meter on a hydrant and running it at their typical rate for clearing discolored water for five hours, then calculating the flow volume to be used in the estimates based on the volume measured by the meter. The Town used the same methodology, i.e., rate times time, as well as more detailed data, from CDM Smith to estimate water volumes for unidirectional flushing in 2014.
- **Bleeders** Volumes are determined by number of bleeders per year, average duration of bleeder (24 hours), and flow rate (20 gpm). Typically, a bleeder is a temporary connection to a hydrant or blow-off that provides a continuous flow to help reduce discolored water. Since 2012, any construction project bleeder volumes are included in the "flushing" category.

- **Flow testing volume** from 2010 to 2012 was determined by number of tests, average duration (5 minutes) with a 7,500 gpm flow rate, plus an average volume of water needed to flush after the test the test (12,000 gallons). In 2013 and 2014 the actual flows measured were used.

- **Street sweeping volume** is determined by tank size (330 gallons) multiplied by 5 fills per day per truck, 5 days a week for 30 weeks per year.

- **Sewer flushing volume** (starting in 2012) was estimated by size of truck (1,500 gal) multiplied by 2 fills per day per truck, 3 days per week for 20 weeks per year.

The Town of Andover does a thorough job of estimating municipal uses and should continue following these methodologies in the future. As estimation methods are refined, the Town can get a better picture of how much water they are actually using for different unmetered municipal uses.

Review of North Reading Meter and Interconnections

The Town of Andover sells water to the adjacent Town of North Reading on an as-needed basis. An 8-in meter on Gould Road measures flow entering the North Reading distribution system. There is an additional metered interconnection with North Reading on South Main Street. These meters are calibrated by North Reading. Table 6 summarizes the total volume of water sold to North Reading from 2009 to 2014.

Table 6 Water Sold to North Reading from 2009 to 2014 (million gallons)

2009	2010	2011	2012	2013	2014
315.81	322.97	342.33	309.79	319.42	347.58

In addition to the two interconnections at North Reading, the Town has nine other interconnections with surrounding towns, although none of the other interconnections have been operated recently. The following is a list of the specific interconnections:

- Along Haverhill Street connecting to the North Andover System (Booster station interconnection, flow totalizer)
- Along Route 125 to the North Andover system (Isolation valve, meter vault)
- Along Elm Street to the North Andover System
- Along Bellevue Road to the Tewksbury system (Isolation valve, metered)
- Along Dascomb Road to the Tewksbury system (Isolation valve, metered)
- Along Lowell Street to the Tewksbury system
- Along River Road to the Lawrence system (Isolation valve, unmetered)

- Along Union Street to the Lawrence system (Isolation valve, unmetered)
- Along North Street at Mt. Vernon Street to the Lawrence system (Isolation valve, unmetered, abandoned)

Additionally, the Town has a connection to Merrimack College along Rock Ridge Road. Maps of the interconnection locations are included in Appendix A. The Town is preparing a cost estimate for replacing all of the interconnection valves. In order to prevent tampering, the Town is considering installing isolation valves on the Andover side only, or install locked valve boxes.

Residential Water Metering and Billing

Another source of unaccounted-for water may be the flat quantity policy of billing 10,000 cubic feet per bill to any water customer who has refused entry to their home for a radio read meter install or for a manual read. The flat fee equivalent of 100 HCF can be less, sometimes significantly less, than the amount of water actually used by the 171 flat fee accounts. This would lead to both additional unaccounted-for water and unrecognized Andover water revenues.

Reviewing the residential water meter data from 2013, it was determined that the top 1,200 residential water users use between 200 HCF and 1,700 HCF. There may be consumers who don't have their meter read, but are likely to have high consumption similar to these accounts. In this instance, the potential UAW would be up to 1,500 HCF per account, and a revenue loss of up to $4,485. Increasing the flat fee for unmetered accounts could help to reduce unaccounted-for water and unrecognized revenue, as well as to incentivize residents to upgrade to a radio-read meter.

Andover's UAW water issues are compounded by the infrequency of meter reads - only two billing cycles per year. With only 6 month frequency data, it is difficult to compare meter read data to production and pumping records to diagnose UAW. Also, if a home is experiencing a leaky toilet it can easily run unknown for 6 months before a customer will notice an unusually high water bill. In this case, the town loses greater revenue because any adjustment or credits are for a ½ year time period and not simply a month or a quarter of water use.

Every year, more communities are moving toward more frequent billing practices. **This is in accordance with the MassDEP Water Conservation Standard to implement quarterly or more frequent billing as soon as possible.** Additionally, more communities are following DEP's recommendation of ascending rate structures whereby the largest users pay a higher unit rate. For Andover's reference and consideration, below is a list of similar or neighboring communities and their Residential water billing frequency.

Table 7 Billing Frequency of Similar and Neighboring Communities

Monthly or Bimonthly	Quarterly or Triannually	Biannually (6 mo. Period)
Concord	Acton	Andover
Wellesley	Belmont	Bedford
	Lincoln	Lexington
	Newton	
	Natick	
	N. Andover	
	N. Reading	
	Reading	
	Lawrence	
	Lowell	
	Tewksbury	
	Westford	

UAW Losses in Data Transmission and Billing Unit Conversion

On January 8, 2016, staff from the Andover Water Department and CDM Smith attended a meeting with Tom Garrity and Peter Elwell from TI-Sales to investigate potential meter and software issues with the new Neptune residential meters and the CUSI software. The following sections discuss the results from that meeting.

Meter Transmission Losses

One of the major topics discussed at the January 8th meeting was the difference between 2- and 3-board meters. Andover's system includes many 2-board meter transmitters that truncate tens- and ones-place data, sending readings in even values of hundred cubic feet (HCF). For example, a residential meter register that reads 567,899 CF in a 2-board transmitter would only have 5,678 transmitted. Then (if the software is set up correctly) the CUSI software would read that value as 5,678 HCF. However, by truncating the last two digits information, the water data shows 567,800 and 99 cubic feet of water is unaccounted-for. This is not terribly impactful to the revenues as the billing unit is HCF; however lost water can add up to a significant volume once you multiply by all the 2-board accounts.

Because the meter itself is still recording the water use down to the ones place, the water is not lost forever. One might say the data will "catch –up" on the next read, which is only partially true because even while the previous truncation may be included in the next reading, the new reading will also be truncated so there will always be an under reading margin of error. Continuing the first example, if the readings were 567,899 CF in May, 568,077 CF in November and 568,147 CF the following May, each recorded reading would be less than true reading (by 99 cf, 77 cf and 47 cf, respectively). The actual use would be 178 cf in the summer/fall and 70 cf in the winter/spring for a total of 248 cf for the year. Based on a 2-board transmitter, the recorded use would be 2 HCF in the summer/fall and 0 HCF in the winter/spring for a total of 2 HCF for the year. Thus 48 CF of water is lost for this one example accumulates over the year and a half period. As time goes on, the recorded volume would continue to be off from the actual use at varying amounts, up to 99 cf each cycle per account. Therefore the water billing data will always be behind or less than the actual use. The overall impact is a "paper loss" of water used and an overestimation in UAW.

Conversion Losses

For every CUSI account, there are 5 important manually entered data fields that either tell the program how to convert the transmitted meter data into the water usage for billing, or are key in quality control as this information is necessary to check that the first group of data fields are entered correctly. This is because different manufacturers may use a different number of dials, have "painted" zeros or different multiplier/conversion factors for varying sized meters. These parameters are listed below:

- Number of dials– tells how many digits of data was transmitted
- Multiplier – dictates the conversion factor to use on transmitted data
- Size of Meter - also dictates the conversion factor to use on transmitted data
- Meter make
- Meter model

Using the example 2-board account in the Transmission Losses section above, the correct CUSI account data for this account should be: Dials = 4 and Multiplier = 100, such that the transmitted 5,678 is correctly converted to 5,678 HCF. If the account information was incorrectly set to Dials= 6, and Multiplier = 1 (which would be correct for a 3 –board transmitter) the transmitted value of 5,678 would be incorrectly interpreted as 5,678 CF which would be recorded as 56 HCF. In this case the water reading would be off by a factor of 100.

Size of meter is also used to determine the correct mathematical conversion from transmitted reading to recorded meter reading for billing purposes. In the case of larger meters the factor of error is larger.

Implications of High UAW on Sewer Revenues

Approximately 60 percent of properties in the Town of Andover are sewered. These properties receive sewer bills based off of their metered water usage. As such, any under reading metering error associated with the metered accounts would be compounded for sewered properties because the water volumes missing impact revenues twice; once for water billings and once for sewer billings. In 2015, the sewer rate was $3.64 per HCF. If the Town reduced their UAW from 25 percent to 10 percent, and the recovered water was instead sold to customers, the Town could see an increase in sewer revenues of up to $1,000,000.

Recommendations

Although there appears to be no single major cause of the increase in unaccounted-for water, based on the above findings there are a number of identified factors that could cumulatively contribute to the high UAW. CDM Smith has developed recommendations to help to reduce Andover's unaccounted-for water.

Master Meter Recommendations

Although the review of the master meters indicated no issues encountered during the quarterly calibrations, it is still possible that the master meters are over or under reading in relation to each other. **The Town should continue to use an independent party to calibrate their meters on a quarterly basis.** If the finished water meter is over reading, an adjustment to the values in the ASR could help to lower the UAW percentage.

Leak Detection and Meter Reading Recommendations

The Town of Andover has improved their leak detection efforts from 2009 to 2014 and should continue working to improve their efforts to follow up with the repairs. In 2014, 96 leaks were detected and 4 leaks were repaired. Assuming each leak contributed equally to the estimated 90.2 MG volume estimated, these leaks will add a 0.24 MGD demand to the water system in 2015 as unaccounted-for water. At a volume of 90.2 MG, these leaks represented 4 percent of the Town's total water demand in 2014. Repairing the leaks will not only reduce the total water demand on the system, but also reduce the likelihood of either more leaks or a water main break. Additionally, **it is recommended that the Town document the leaks found and date when they were repaired.** Using this information, they could cross check whether the same leaks are found in the following year's leak detection survey and if not, carry over the estimated volume as an additional source of UAW. Additionally, **the Town should continue to use pipe condition and leak detection specialists for leak detection on large diameter (16-in and larger) transmission mains and at stream, railroad and highway crossings; Conventional leak detection is typically not sensitive enough to be effective in the latter cases.**

Currently the Town reads seven billing sections in six months. With today's radio transmitted readings, the meter reading can be done via car in a fraction of the time. **Based on Andover's layout and current technology, simplifying from 7 meter routes to 3 that match the 3 pressure zones is recommended.** All of the readings in each of the 3 meter areas would be taken at similar times and thus could be balance against the pumped water use in each of the 3 pressure zones. This setup could act as a district metering area (DMA), which would enhance leak detection efforts. DMAs are an effective leak detection strategy because flow entering the DMA is monitored continuously, which will help to establish "base" night flow, and trigger an alarm when the DMA sees larger flows indicative of a leak.

Once the meter routes are reclassified based on pressure zone, **it is recommended that the Water Department conduct a test scenario for using the pressure zones as the DMAs.** The Water Department should have access to the CUSI data independent of the accounting department operations so the unadjusted meter readings can be compared to pumping records. The data from the test scenario could be compared to the billing data provided by the Accounting Department to determine how and why adjustments to the records are made.

Customer Meter Recommendations

It is recommended that quality reviews of all accounts be conducted to make sure that at a minimum 10,000 CF is entered as the estimated water use for each non-metered account in each billing period, both for billing and ASR reporting purposes. Since the top ten percent of residential water users use more than 200 HCF of water, **it is recommended that the flat quantity be increased in order to incentivize installing a new water meter.** An alternative to increasing the flat quantity could be to consider eliminating the need for a flat quantity policy. This could be done by utilizing existing building plumbing codes (or developing new Andover policies) to allow for building entry and installation of up-to-date radio transmitting meters.

Another potential contributor to the high UAW is how the meter readings are processed using the CUSI software. **It is recommended that the number of dials on the customer meter, the multiplier, and meter size be verified in CUSI for all accounts.** Using the Meter Exception Reports generated by the software, the field of potentially incorrect accounts can be narrowed down somewhat; however the safest approach would be a full review of all accounts. Error is compounded as the meter size increases, and often those accounts with the biggest meters are also the commercial and industrial accounts using the most water. Therefore quality control checking of the largest meters would be a top priority. Meters could be checked based on knowledge of make and model of the meter. In instances where this data is unknown, the meter reader could take pictures of the meter and coordinate with TI-Sales to try and determine what the key information for the meter is.

The Town has several high water users with larger meters. Having an improperly sized meter could yield inaccurate readings, contributing to the Town's UAW. **The Town should do a review of the water consumption data for their top 25 high water users with regard to their meter size.** If the water volumes observed do not match up with the flow specifications on a meter, the Town should make an effort to "right size" the meter. The Town is currently drafting a revision to the Annual Large Meter Testing Policy in order to "right size" large meters.

In accordance with the MassDEP Water Conservation Standards, **it is recommended that the Town implement quarterly or more frequent billing as soon as possible.** Additionally, the Town should consider following DEP's recommendation of ascending rate structures whereby the largest users pay a higher unit rate.

CEMU Estimating Recommendations

The Town has greatly improved their estimation for confidently estimated municipal use from 2009 to 2014. A potential further improvement is related to the flushing conducted specifically for water quality complaints. **Flow rates used to estimate flushing for water quality issues should be verified by installing a meter on a hydrant to measure the typical flow rate for flushing due**

to water quality complaints. If a higher flow rate is measured, even by 1 gpm, this could result in a higher number for CEMU in the future. Additionally, it is recommended that any operations associated with hydrant usage (ie, construction and fire fighting training) should use a meter to measure actual volumes used.

In the 2014 ASR, it was noted that temporary mains used during construction and unmetered municipal use were listed as sources of unaccounted-for water. When temporary mains are in place, the water typically bypasses the customer meter. **The water used for temporary mains should be added to the other construction water use estimates included in the CEMU table**, provided there is a methodology included showing how it was estimated. The Town should also consider installing meters for the remaining municipal unmetered facilities/buildings as soon as practical.

Interconnections Recommendations

Although the interconnections (aside from the North Reading ones) have not been operated for several years, **it is recommended that the Town check these connections to confirm that valves are fully closed and not leaking.** The meters at the interconnections should be calibrated yearly by the Town (independent of calibration activities performed by the adjacent communities) to confirm that the flows measured entering other water systems are measured accurately, particularly the two meters actively supplying North Reading.

Summary

As shown in Figure 1, from 2009 to 2010, UAW increased from 6.5 percent to 16 percent, and then increased to 25.7 percent in 2011; it has remained in the mid-20s since 2011. During the same timeframe the sum of all customer metered categories has remained about the same or declined a little despite implementation of a new meter installation program; new meter programs usually result in higher customer billing. The recommended review of the CUSI software having the correct information to process the meter reads could reduce errors and apparent loss of water. These losses are considered to be an apparent loss of water because actual "real water" is not physically lost from the system. However, since production at the WTP from 2009 to 2011 increased by 11 percent and has continued to increase by 9 percent from 2011 to 2014, while UAW was also on the rise, real physical non-revenue water losses must also be contributing significantly to the UAW increase. Though, as a first step, master meter readings should be confirmed, as recommended below, to ensure that production numbers are correct.

Although there are some metering issues to be corrected and improved bookkeeping practices that may lower UAW, the Town should primarily focus reducing sources of non-revenue water (ie, un-metered water, water main leaks and breaks) as they are likely the biggest cause of the Town's unaccounted-for water. The Town should begin to implement the proposed recommendations, summarized in Table 8, with an emphasis on pursuing more aggressive leak detection and subsequent repair activities to reduce UAW with the goal of eventually meeting the State's standard of 10 percent.

Table 8 Recommendations Summary

	Recommendation	
Master Meters	1	Continue to do an independent quarterly calibration of the master meters. Adjust the raw and finished water values in the ASR based on the results.
Leak Detection and Repair	2	Document the leaks found and date that they were repaired.
	3	Based on Andover's meter reading layout and current technology, simplify from 7 meter routes to 3 that match the 3 pressure zones.
	4	Consider using DMAs for enhanced leak detection.
	5	Consider special high sensitivity leak detection on transmission mains and at stream, railroad and highway crossings.
	6	Conduct a test scenario for using pressure zones as DMAs.
Customer Meters	7	Conduct quality reviews of all accounts to make sure that at a minimum 100 HCF is entered as the estimated water use for each billing period.
	8	Increase flat billing quantity from 200 HCF to a higher value in order to incentivize getting a water meter installed.
	9	Consider increasing billing frequency to monthly, to increase the opportunities to recognize and address poor data.
	10	Verify in CUSI that the number of dials on the customer meter, the multiplier, and meter size are correct for all accounts.
	11	"Right size" large size meters.
Confidently Estimated Municipal Use	12	Include water used while on bypass for construction in CEMU estimate. Include backup to support the estimate in the ASR.
	13	Verify flushing flow rates used to address complaints
Interconnections	14	Confirm that all of the interconnections with adjacent towns are closed and not leaking
	15	Independently calibrate meters at interconnections yearly, particularly the meters at the North Reading interconnections.

It should be noted that over the long term, system renewal improvements such as water main cleaning and cement lining and replacement also have the side benefit of reduced system leakage. This benefit supports Andover's continued capital improvements project implementation.

cc: Morris Gray, Town of Andover
Karen Martin, Town of Andover
John Doherty, P.E., BCEE, CDM Smith
James Pescatore, P.E., BCEE, CDM Smith
Lisa Gove, P.E., BCEE, CDM Smith

Appendix A: Interconnection Maps

COMMITMENT & INTEGRITY
DRIVE RESULTS

40 Shattuck Road | Suite 110
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www.woodardcurran.com

T 866.702.6371
T 978.557.8150
F 978.557.7948

MEMORANDUM

TO: Christopher Cronin, Director of Public Works, Town of Andover, MA

CC: James McSurdy, Water Treatment Superintendent, Town of Andover, MA

FROM: Woodard & Curran

DATE: May 17, 2016

RE: Peer Review – CDM Smith Unaccounted-For Water (UAW) Investigation

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In March 2016, CDM Smith provided the Town of Andover, Massachusetts (the Town) with a memorandum outlining their review of water production, consumption and accounting records as they pertain to the Town's unaccounted-for water. Woodard & Curran performed a peer review of this memorandum dated March 15, 2016. CDM Smith's investigation looked at historical unaccounted for water, water production meters and records, water main break and leak detection reports, confidently estimated municipal use, municipal interconnections, residential water metering, and billing and data transmission. Woodard & Curran met with the Town on April 25, 2016 to go over the findings from the peer review. This memorandum presents a summary of Woodard & Curran's observations and recommendations to the Town for future action.

Findings

1. **Historical Unaccounted-for Water (UAW) –** The historical UAW prior to 2010 appears to be unusually low. The lowest reported value was 0.3% in 2006. During 2004 through 2009 there may have been issues with the method used to calculate the UAW.
2. **Water Production Meters –** Water production meters at Fish Brook and the water treatment plant have been calibrated quarterly since 2009 and were found within the manufacturer's standards.
3. **Water Main Break and Leak Detection/Repair Records** – The number of leaks found is increasing significantly year-to-year. In 2014, approximately 63% of leaks found were repaired. In 2013, approximately 33% of leaks found were repaired. It appears that the amount of water lost due to water main breaks has significantly decreased over time. The Town is taking a very proactive approach to find and repair leaks in the system.
4. **Confidently Estimate Municipal Use** – The Town is increasing the level of detail for confidently estimating municipal use. All municipal use and irrigation use is metered. All hydrant flushing and temporary construction uses are also metered.
5. **Municipal Interconnections –** The Town sells water to North Reading on an as-needed basis through a metered interconnection. The Town of North Reading maintains and tests the water meter. In addition to the interconnection with North Reading, the Town has nine other interconnections with adjacent Towns. All emergency interconnections are closed but not metered. Interconnections that are open are metered.
6. **Residential Water Meters** – Residential Meters were recently replaced and are read using a drive-by radio read system. The Town owns and maintains the residential water meters.
7. **Commercial/Industrial Water Meters** – Some commercial meters have been replaced. Large commercial and industrial meters are read manually. They are owned, maintained and tested by the customer. The Town requires annual testing with a certificate submitted showing

accuracy. The large meters are older but as long as they test within specification, the customer does not need to replace them. The Town does not have a large meter replacement schedule.

8. **Water Billing** – The Town bills biannually. There are 171 “flat fee” accounts that are charged for 10,000 cubic feet. Flat fee accounts were established for any water customer that has refused entry into their home for a radio read meter installation or for a manual read. The Town recently replaced residential meters and currently utilizes the CUSI software. The Town replaced the billing system with the CUSI software in 2010. There appears to be a correlation with UAW increasing during that timeframe. The CDM Smith review identified some potential issues regarding fixed zeros and multipliers for large water meters. The Town is in the process of reviewing every account to correct multiplier issues in the billing system.

Recommendations

1. **Water Production Meters**
    - The Town should continue to regularly calibrate water production meters and take action if the meters appear to be outside of the manufacturer’s standard.
2. **Water Main Break and Leak Detection/Repair Records**
    - The Town should continue leak detection efforts and document all information regarding leaks found.
    - It is understood from the investigation that many leaks are on private property. The Town should expedite drafting and implementing a policy that will require service leaks on private property to be repaired within 30-days of discovery.
3. **Confidently Estimate Municipal Use**
    - The Town should continue increasing the level of detail for confidently estimated municipal use.
    - The Town should continue to meter all hydrant flushing and temporary water supply for construction.
    - The Town should work on more detailed documentation to estimate losses from water main breaks and usage during fires.
4. **Municipal Interconnections and Large Water Meters**
    - The Town should consider replacing and taking ownership of all large meters, including interconnections, and perform testing and maintenance to ensure accuracy. Other communities who recently did this reduced UAW and substantially increased water and sewer revenue.
    - All valves at interconnections should be checked periodically to confirm they are closed and not leaking.
    - Meters should be installed for all interconnections that are unmetered, regardless of how often the connection is used.
    - The Town should add anti-tampering measures such as isolation valves on the Andover side or locked valve boxes.

5. **Small Diameter Water Meters**

   - The Town should consider quarterly billing.
   - The seven meter reading routes should be downsized to match the three pressure zones. One pressure zone route could be completed each month, allowing for consistent income.
   - Flat fee accounts should be revisited. It is in the Town's best interest to eliminate all flat fee accounts. The Town should consider additional fees for the flat fee accounts.

6. **Data Transmission and Billing Unit Conversion**

   - Continue performing an in depth review of all accounts in the CUSI software:
     - Verify the number of dials, multiplier, size of meter, meter make, and meter model for all accounts.
     - Verify that all closed accounts have been properly closed.

Chapter 191. Water

Article II. Water Supply Conservation

[Adopted 10-21-1974 ATM by Art. 38, approved 12-13-1974; amended 10-17-1977 ATM by Art. 22, approved 2-28-1978; 10-9-1997 ATM; by Art. 9, approved 1-29-1998]

§ 191-2. Purpose.

The purpose of this bylaw is to protect, preserve and maintain the public health, safety and welfare whenever there is in force a state of water supply conservation or state of water supply emergency by providing for enforcement of any duly imposed restrictions, requirements, provisions or conditions imposed by the Town or by the Department of Environmental Protection.

§ 191-3. Authority.

This bylaw is adopted by the Town under its police power to protect public health and welfare and its power under MGL c. 40, § 21 et seq. and implements the Town authority to regulate water use pursuant to MGL c. 41, § 69B. This bylaw also implements the Town's authority under MGL c. 40, § 41A, conditioned upon a declaration of water supply emergency issued by the Department of Environmental Protection.

§ 191-4. Definitions.

PERSON — Shall mean any individual, corporation, trust, partnership or association, or other entity.

STATE OF WATER SUPPLY EMERGENCY
Shall mean a state of water supply emergency declared by the Department of Environmental Protection under MGL c. 21G, §§ 15 to 17.

STATE OF WATER SUPPLY CONSERVATION
Shall mean a state of water supply conservation declared by the Town pursuant to § **191-5** of this bylaw.

WATER USERS or WATER CONSUMERS
Shall mean all public and private users of the Town's public water system, irrespective of any person's responsibility for billing purposes for water used at any particular facility.

§ 191-5. Declaration of state of water supply conservation.

The Town, through its Board of Selectmen, may declare a State of Water Supply Conservation upon determination by a majority vote of the Board that a shortage of water exists and conservation measures are appropriate to ensure an adequate supply of water to all consumers. Public notice of a state of water supply conservation shall be given under § **191-7** of this bylaw before it may be enforced.

§ 191-6. Restrictions on water use.

[Amended 10-12-2000 ATM by Art. 29; 10-4-2010 OTM by Art. 22, approved 2-7-2011]
The Board of Selectmen may adopt and periodically amend, rules and regulations relating to the procedures and administration of Chapter **191**, Article **II** after public notice and a public hearing.

§ 191-7. Notification of public and Department of Environmental Protection.

Notification of any provision, restriction, requirement or condition imposed by the Town as part of a state of water supply conservation shall be published in a newspaper of general circulation within the Town, or by such other means reasonably calculated to reach and inform all users of water of the state of water supply conservation. All restrictions imposed under § **191-6** shall not be effective until such notification is provided. Notification of the state of water supply conservation shall also be simultaneously provided to the Massachusetts Department of Environmental Protection.

§ 191-8. Termination of state of water supply conservation; notice.

A state of water supply conservation may be terminated by a majority vote of the Board of Selectmen, upon a determination that the water supply shortage no longer exists. Public notification of the termination of a state of water supply conservation shall be given in the same manner as required in § **191-7**.

§ 191-9. State of water supply emergency.

Upon notification to the public that a declaration of a state of water supply emergency has been issued by the Department of Environmental Protection, no person shall violate any provision, restriction, requirement or condition of any order approved or issued by the Department intended to bring about an end to the state of water supply emergency.

§ 191-10. Violations and penalties.

A. Any person violating this bylaw shall be liable to the Town in the amount of $50.00 for the first violation and $100.00 for each subsequent violation which shall inure to the Town.

B. The enforcing persons of the by laws and rules and regulations under Chapter **191**, Water shall be any police officer of the Town and the Director of the Department of Public Works or his designee(s) under the provisions of Chapter **1**, General Provisions, Section **1-5B**, Non criminal disposition, of the General Bylaws of the Town of North Reading.
[Amended 10-6-2014 OTM by Art. 17, approved 1-20-2015]

C. Fines shall be recovered by increment, or upon complaint before the District Court, or by non-criminal disposition in accordance with Section 21D of Chapter 40 of the General Laws. Each day of violation shall constitute a separate offense.

D. The Town reserves the right to shut off any water supply or service for disregard of water use restrictions in cases of a state of water supply conservation or state of water supply emergency.
[Added 10-4-2010 OTM by Art. 22, approved 2-7-2011]

§ 191-11. Severability.

The invalidity of any portion or provision of this bylaw shall not invalidate any other portion or provision thereof.

F

APPENDIX F
Leak Detection

Town of N. Reading Massachusetts

Water Department

Water System Leak Detection Survey Report 2016-17

Prepared By

<u>Arthur Pyburn & Sons Inc.</u>

Technical Services

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March 15, 2016

Town of North Reading Water Department
235 North St
North Reading, MA 01864

The following is a summary of leak detection performed on 86 miles of North Reading Water Department's distribution system.

The pages that follow are the individual reports for each leak.

During the course of this survey leaks were found at the following locations.

Services found to be leaking:

14 Pine Glen Rd, Service leaking, 2-4gpm
9 Caroline Rd, Service leaking, 2-4gpm
126 Chestnut St. Service Leaking, 2-4gpm
26 Cedar St, Service leaking, 1-3gpm
257 Park St, Service Leaking, 2-4gpm
185 Chestnut St, Service Leaking, 2-4gpm
6 Sumner St, Service Leaking, 3-5gpm
9 Liberty Lane, Service Leaking, 2-4gpm
6 Old Andover Rd, Service Leaking,2-4gpm
9 Spruce Rd, Service Leaking, 2-4gpm
47 Spruce Rd, Service Leaking, 2-4gpm
22 Ridgeway Rd, Service Leaking, 1-3gpm
51 Niblick Way, Service Leaking 2-4gpm
12 Macintyre Dr, Service Leaking 2-4gpm
3 Erwin Rd, Service Leaking, 2-4gpm
4 Snowcrest Rd, Service Leaking, 1-3gpm

16 Shasta Drive, Service Leaking, 2-4gpm
8 Pickard Ln, Service Leaking,1-3gpm
12 Fieldstone Way, Service Leaking, 3-5gpm
176 Haverhill St, Service Leaking,1-3gpm
166 Haverhill St, Service Leaking, 1-3gpm
82 Haverhill St, Service Leaking, 1-3gpm
48 Haverhill St, Service Leaking, 2-4gpm
24 Haverhill St, Service Leaking, 3-5gpm
12 Swan Pond Rd, Service leaking, 2-4gpm
72 Elm St, Service Leaking, 3-5gpm
6 Gillis Rd, Service Leaking, 3-5gpm
3 Greenmeadow Dr, Service Leaking, 3-5gpm
6 Crestwood Rd, Service Leaking, 3-5gpm
34 Hickory Lane, Service Leak, 1-3gpm
9 Marshall St, Service Leak, 2-4gpm
4 Rust Way, Service Leaking, 3-5gpm
4 Fox Run, Service Leaking, 1-3gpm
10 Woodland Rd, Service Leaking, 1-3gpm

The total leakage due to service and hydrant leaks is estimated to be between 69 and 138 gallons per/min.

Main Line leaks:

Heritage to Crestwood cross country main, Leaking 50-75gpm
Southwick Road by #26, Main Leaking 500gpm

The leakage due to main leaks is estimated to be between 550 and 575 gallons per/min.

Thirty six leaks were located during the course of this survey. The total of estimated leakage from the leaks found during this survey is approximately 619 to 713 gallons per/min.

The leakage amounts noted in this report are only estimates and require confirmation during the repair of the leaks.

Respectfully Submitted by Gregory Pyburn

Arthur Pyburn & Sons Inc.

Technical Services

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Phone (617) 529-3646 ▯Fax (978) 948-5066

gpyburn@apsitech.com

Leak worksheet

Date: 3/15/17

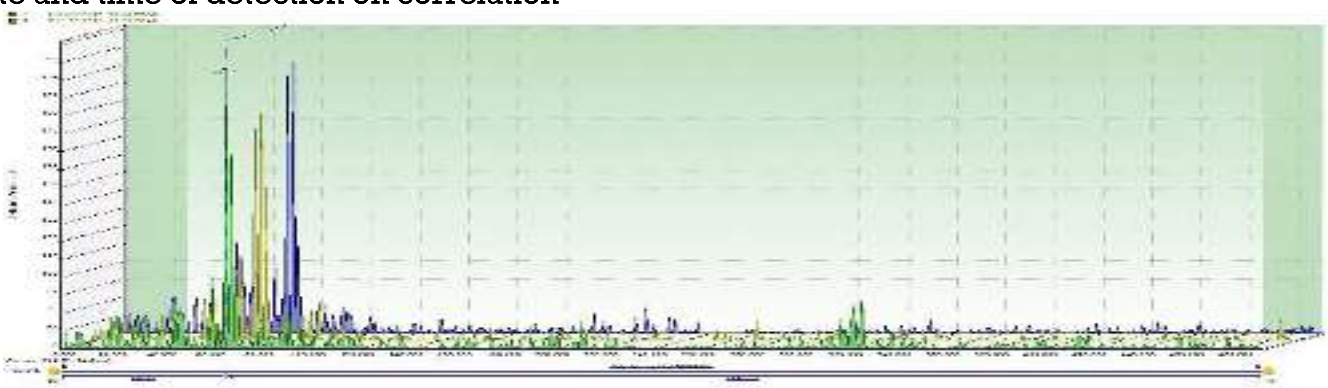
System Name: Town of North Reading Water Department

Location: 14 Pine Glen, Service Leaking

Approx. Size: 2-4 gpm

Pipe Material 8" CI

Date and time of detection on correlation



Pipe ID	Length	Diameter	Material	Sound Velocity
P12	490' 0"	12"	Cast Iron	3770 feet/sec

Leak ID	Leak Position	Correlation Between	Confidence	Recording Time
L49	668' 1" from 11	11 -> 13	88.9%	Dec 29 2016, 05:38:56AM
L50	668' 2" from 11	11 -> 13	88.7%	Dec 29 2016, 05:39:56AM
L51	668' 6" from 11	11 -> 13	85.0%	Dec 29 2016, 05:40:56AM
L52	68' 1" from 12	12 -> 13	86.0%	Dec 29 2016, 05:38:56AM
L53	68' 0" from 12	12 -> 13	87.7%	Dec 29 2016, 05:39:56AM
L54	68' 0" from 12	12 -> 13	87.0%	Dec 29 2016, 05:40:56AM
L70	68' 0" from 12	12 -> 13	86.5%	Dec 29 2016, 05:39:56AM
L71	68' 5" from 12	12 -> 13	86.7%	Dec 29 2016, 05:40:56AM

Arthur Pyburn & Sons Inc.
Technical Services

Leak worksheet

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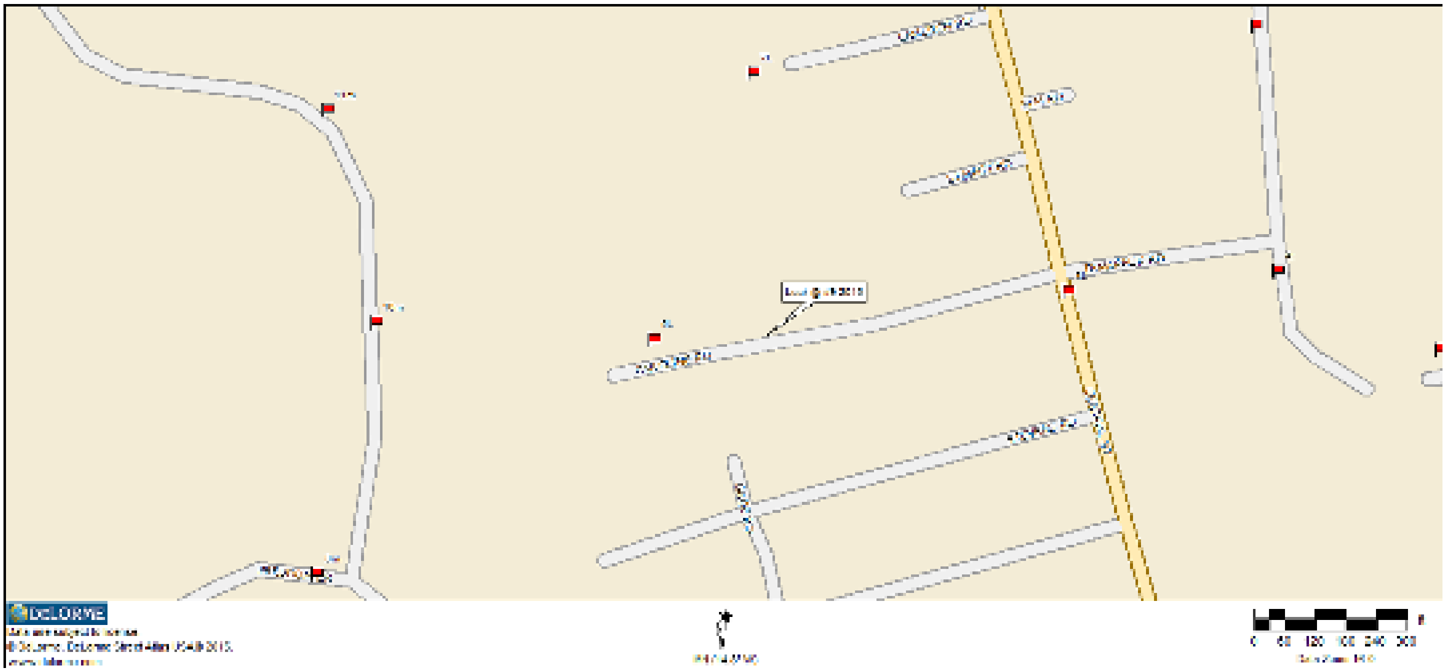
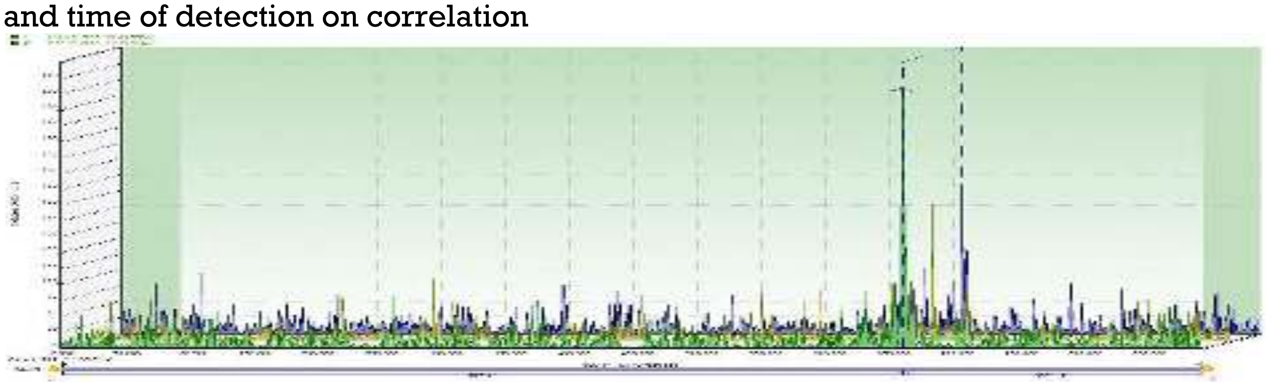


Date: 3/15/17
System Name: Town of North Reading Water Department
Location: 9 Caroline Rd, Service Leaking
Approx. Size: 2-4 gpm
Pipe Material CI
Date and time of detection on correlation



Pipe ID	Length	Diameter	Material	Sound Velocity
P4	550' 0"	12"	Cast iron	[illegible]

Leak ID	Leak Position	Correlation Between	Confidence	Recording Time
L14	1509' 11" from 4	4 -> 5	64.5%	Dec 29 2016, 05:39:56AM
L15	1151' 11" from 4	4 -> 5	75.5%	Dec 29 2016, 05:40:56AM
L16	657' 1" from 3	3 -> 5	82.5%	Dec 29 2016, 05:38:56AM
L17	664' 1" from 4	4 -> 6	75.6%	Dec 29 2016, 05:45:56AM
L18	665' 10" from 4	4 -> 6	73.8%	Dec 29 2016, 06:40:56AM
L72	657' 1" from 3	3 -> 5	75.8%	Dec 29 2016, 05:39:56AM
L73	657' 1" from 3	3 -> 5	77.0%	Dec 29 2016, 05:40:56AM

Printed Dec 29 2016, 07:37:30PM, Recorded Dec 29 2016, 05:38:56AM

RADCOM TECHNOLOGIES LTD SoundSens

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Leak worksheet

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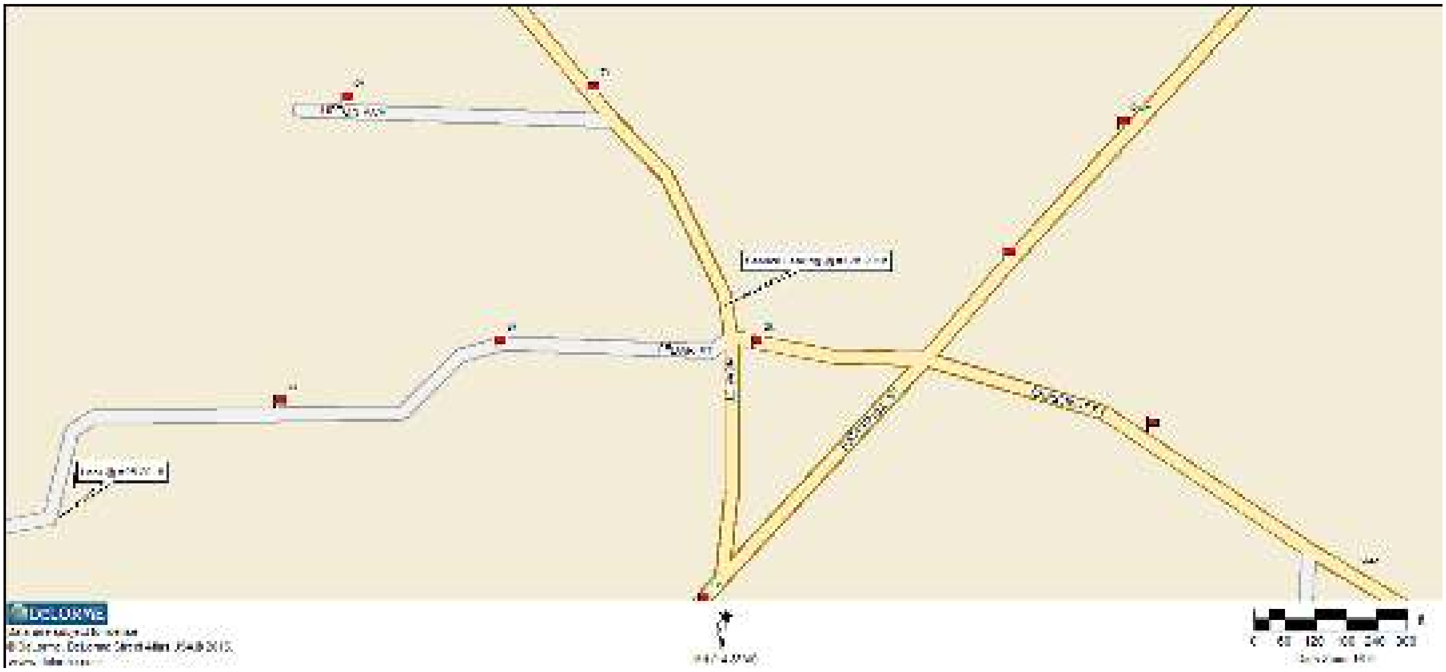
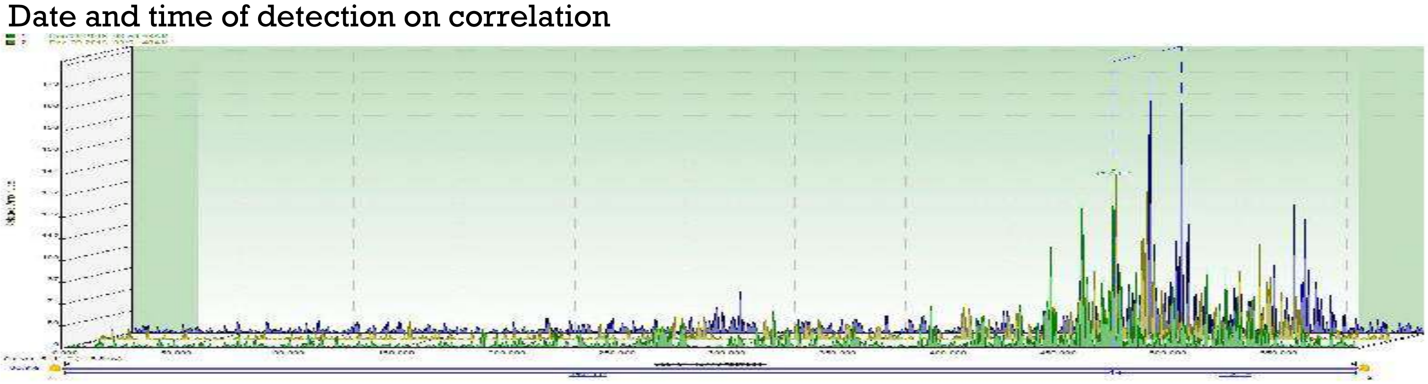


Date: 3/15/17
System Name: Town of North Reading Water Department
Location: 126 Chestnut St, Service Leaking
Approx. Size: ___2-4 gpm___
Pipe Material CI
Date and time of detection on correlation



Pipe ID	Length	Diameter	Material	Sound Velocity
P7	585' 0"	12"	Cast Iron	3770 feet/sec

Leak ID	Leak Position	Correlation Between	Confidence	Recording Time
L31	474' 11" from 7	7 -> 2	80.9%	Dec 29 2016, 03:50:48AM
L32	460' 9" from 7	7 -> 2	81.0%	Dec 29 2016, 03:51:48AM
L33	460' 9" from 7	7 -> 2	83.7%	Dec 29 2016, 03:52:48AM
L70	460' 9" from 7	7 -> 2	81.0%	Dec 29 2016, 03:51:48AM
L71	460' 9" from 7	7 -> 2	83.7%	Dec 29 2016, 03:52:48AM

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Technical Services

Leak worksheet

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Date: 3/15/17

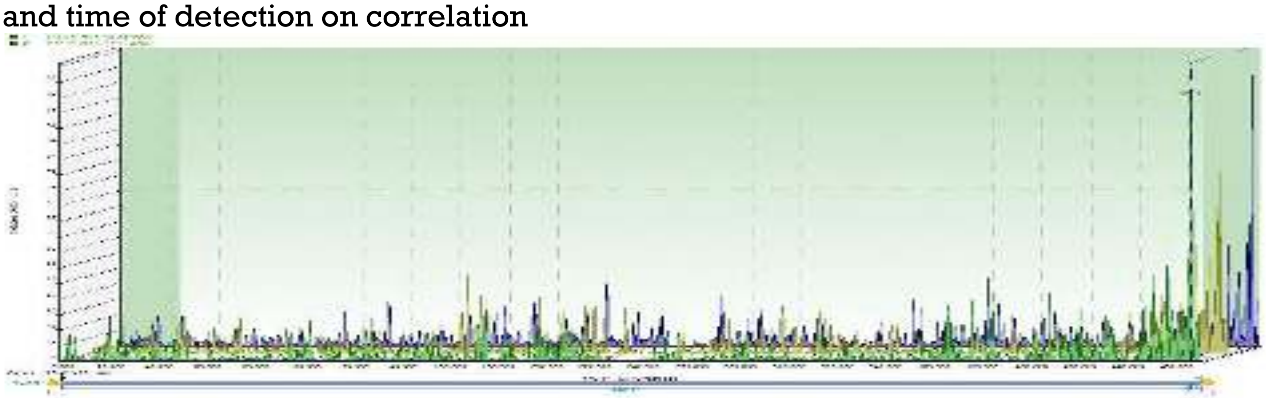
System Name: Town of North Reading Water Department

Location: 26 Cedar St, Service Leaking

Approx. Size: ___1-3 gpm__

Pipe Material CI

Date and time of detection on correlation



Pipe ID	Length	Diameter	Material	Sound Velocity
P4	[illegible]	12"	Cast Iron	[illegible]

Leak ID	Leak Position	Correlation Between	Confidence	Recording Time
L16	486' 1" from 4	4 -> 5	90.6%	Dec 29 2016, 03:50:48AM
L17	480' 1" from 4	4 -> 5	93.4%	Dec 29 2016, 03:51:48AM
L18	486' 6" from 4	4 -> 5	90.7%	Dec 29 2016, 03:52:48AM
L72	486' 1" from 4	4 -> 5	76.6%	Dec 29 2016, [illegible]
L73	486' 6" from 4	4 -> 5	90.7%	Dec 29 2016, 03:52:48AM

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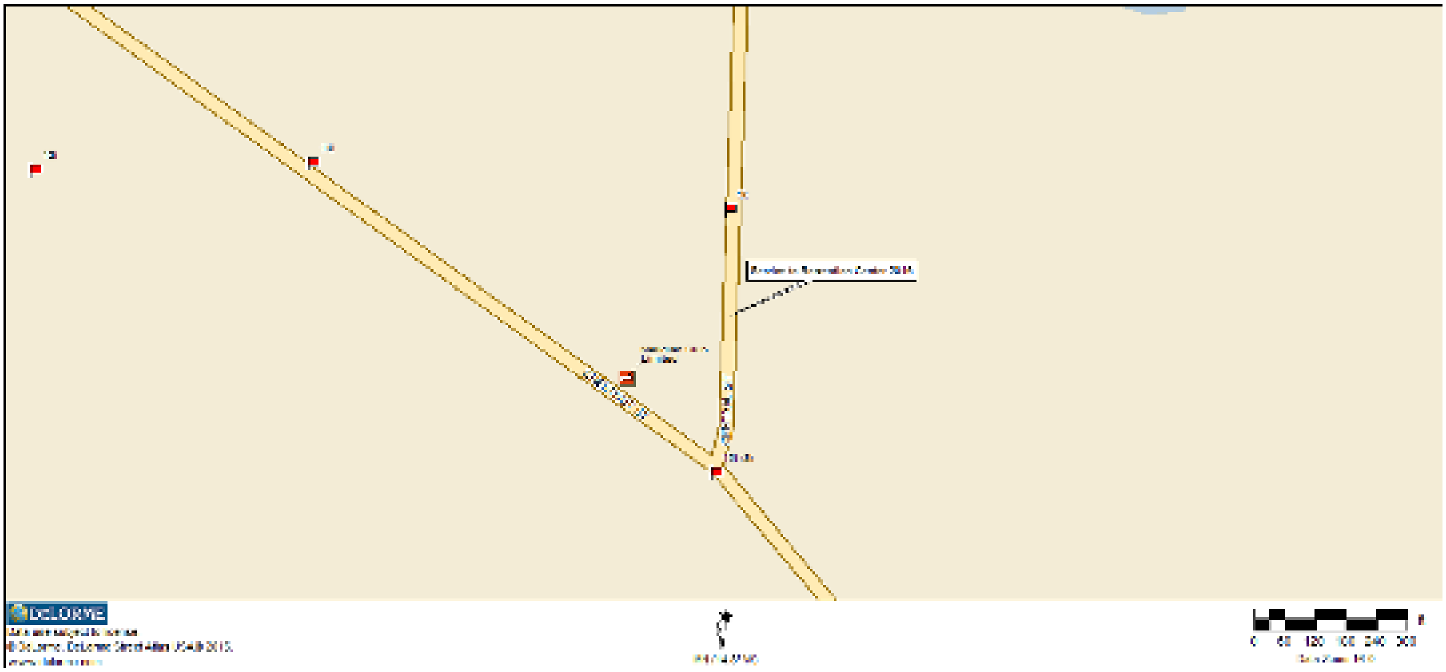
Leak worksheet



Date: 3/15/17

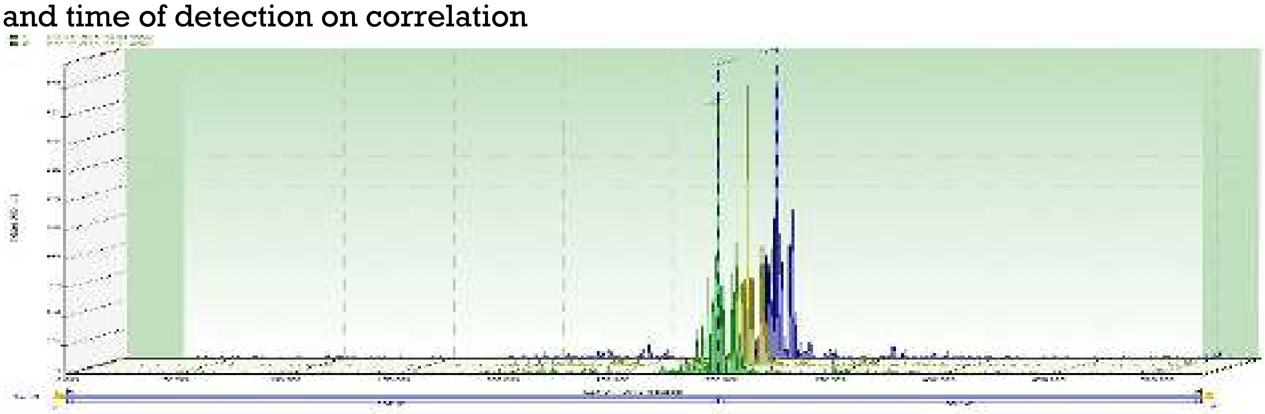
System Name: Town of North Reading Water Department

Location: Central St (Recreation Center), Service Leaking

Approx. Size: ___3-5 gpm___

Pipe Material CI

Date and time of detection on correlation



Pipe ID	Length	Diameter	Material	Sound Velocity
P8	1080' 0"	10"	Cast iron	3770 feet/sec

Leak ID	Leak Position	Correlation Between	Confidence	Recording Time
L37	725' 4" from 7	7 → 9	80.5%	Dec 29 2016, 03:50:48AM
L38	727' 4" from 7	7 → 9	87.6%	Dec 29 2016, 03:51:48AM
L39	727' 8" from 7	7 → 9	58.9%	Dec 29 2016, 03:52:48AM
L40	290' 6" from 8	8 → 9	43.1%	Dec 29 2016, 03:50:48AM
L41	295' 1" from 8	8 → 9	35.2%	Dec 29 2016, 03:51:48AM
L42	295' 1" from 8	8 → 9	35.4%	Dec 29 2016, 03:52:48AM
L74	290' 1" from 8	8 → 9	23.1%	Dec 29 2016, 03:51:48AM
L75	295' 1" from 8	8 → 9	53.0%	Dec 29 2016, 03:52:48AM

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1065 Summer Street ⍰ Lynnfield, MA, 01940
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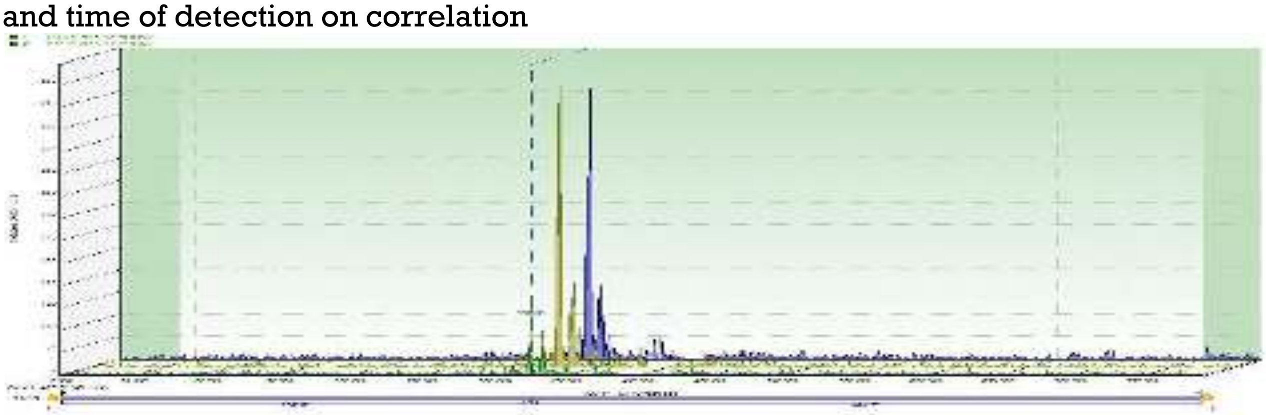
gpyburn@apsitech.com

Date: 3/15/17
System Name: Town of North Reading Water Department
Location: 257 Park St, Service Leaking
Approx. Size: 2-4 gpm
Pipe Material: CI
Date and time of detection on correlation



Pipe ID	Length	Diameter	Material	Sound Velocity
P1	750' 0"	12"	Cast Iron	3773 feet/sec

Leak ID	Leak Position	Correlation Between	Confidence	Recording Time
L1	325' 6" from 1	1 <-> 2	84.7%	Dec 29 2016, 02:24:00AM
L2	325' 0" from 1	1 <-> 2	91.5%	Dec 29 2016, 02:27:00AM
L3	324' 6" from 1	1 <-> 2	90.4%	Dec 29 2016, 02:30:00AM
L5	325' 0" from 1	1 <-> 2	91.5%	Dec 29 2016, 02:27:00AM
L10	324' 6" from 1	1 <-> 2	90.3%	Dec 29 2016, 02:25:00AM
L11	547' 11" from 1	1 <-> 2	71.1%	Dec 29 2016, 02:33:00AM

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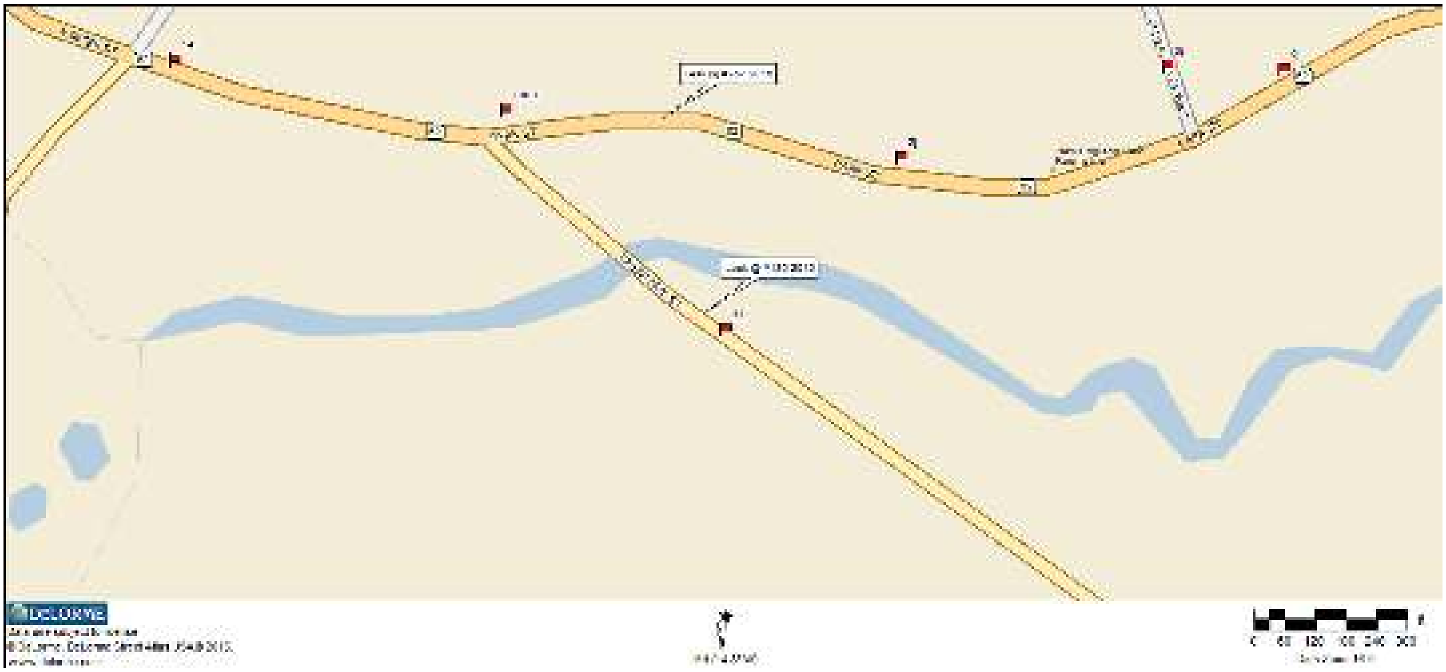
Leak worksheet



Date: 3/15/17

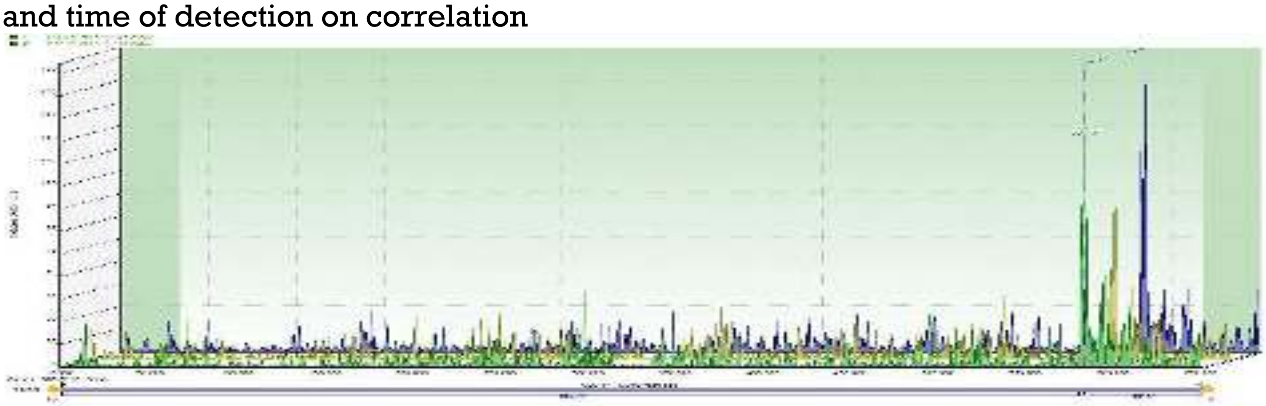
System Name: Town of North Reading Water Department

Location: 185 Chestnut St, Service Leaking

Approx. Size: 2-4 gpm

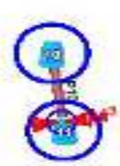
Pipe Material: CI

Date and time of detection on correlation



Pipe ID	Length	Diameter	Material	Sound Velocity
P11	660' 0"	8"	Cast Iron	[illegible]

Leak ID	Leak Position	Correlation Between	Confidence	Recording Time
L43	584' 3" from 10	10 -> 11	81.5%	Dec 29 2016, 01:32:24AM
L44	584' 3" from 10	10 -> 11	79.8%	Dec 29 2016, 01:33:24AM
L46	584' 3" from 10	10 -> 11	82.4%	Dec 29 2016, 01:34:24AM
L58	584' 3" from 10	10 -> 11	75.2%	Dec 29 2016, 01:35:24AM
L59	584' 3" from 10	10 -> 11	83.4%	Dec 29 2016, 01:34:24AM



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Leak worksheet

Date: 3/15/17

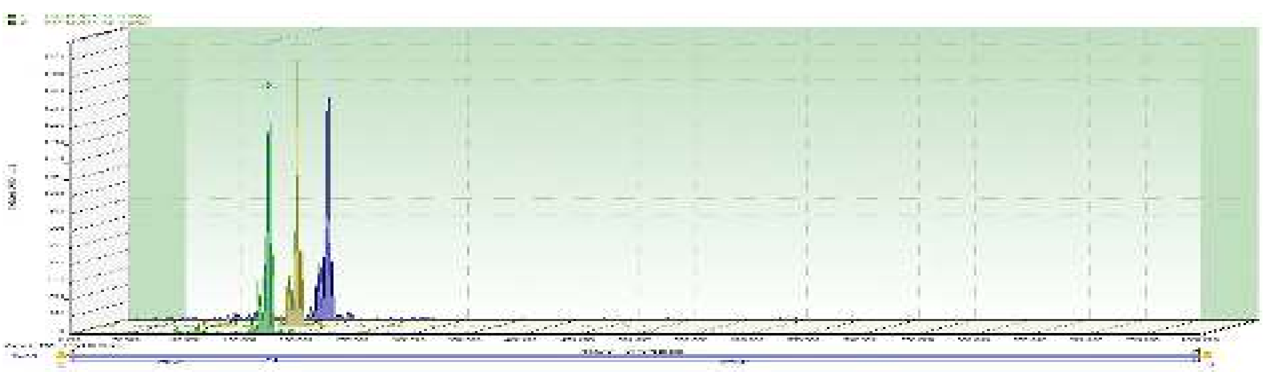
System Name: Town of North Reading Water Department

Location: 6 Sumner St, Service Leaking

Approx. Size: 3-5 gpm

Pipe Material: CI

Date and time of detection on correlation



Pipe ID	Length	Diameter	Material	Sound Velocity
P15	1000' 0"	12"	Cast Iron	3770 ft/sec

Leak ID	Leak Position	Correlation Between	Confidence	Recording Time
L58	175' 4" from 12	12 ↔ 13	95.0%	Dec 14 2016, 04:14:49AM
L59	175' 12" from 12	12 ↔ 13	96.0%	Dec 14 2016, 04:15:49AM
L60	175' 4" from 12	12 ↔ 13	95.0%	Dec 14 2016, 04:15:49AM
L61	343' 6" from 12	12 ↔ 14	84.1%	Dec 14 2016, 04:14:49AM
L62	345' 6" from 12	12 ↔ 14	87.2%	Dec 14 2016, 04:15:49AM
L63	344' 1" from 12	12 ↔ 14	80.8%	Dec 14 2016, 04:15:49AM
L68	175' 12" from 13	12 ↔ 13	95.0%	Dec 14 2016, 04:15:49AM
L70	176' 4" from 12	12 ↔ 13	96.0%	Dec 14 2016, 04:15:49AM

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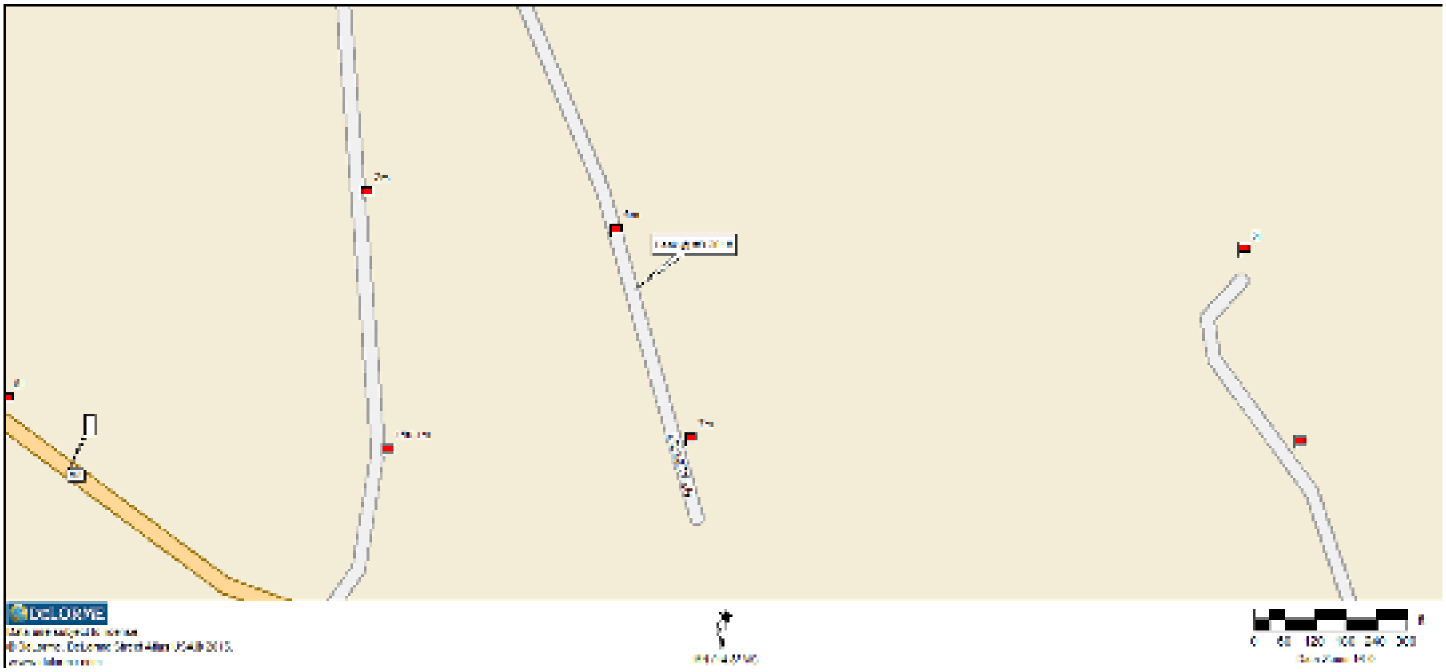
Leak worksheet



Date: 3/15/17

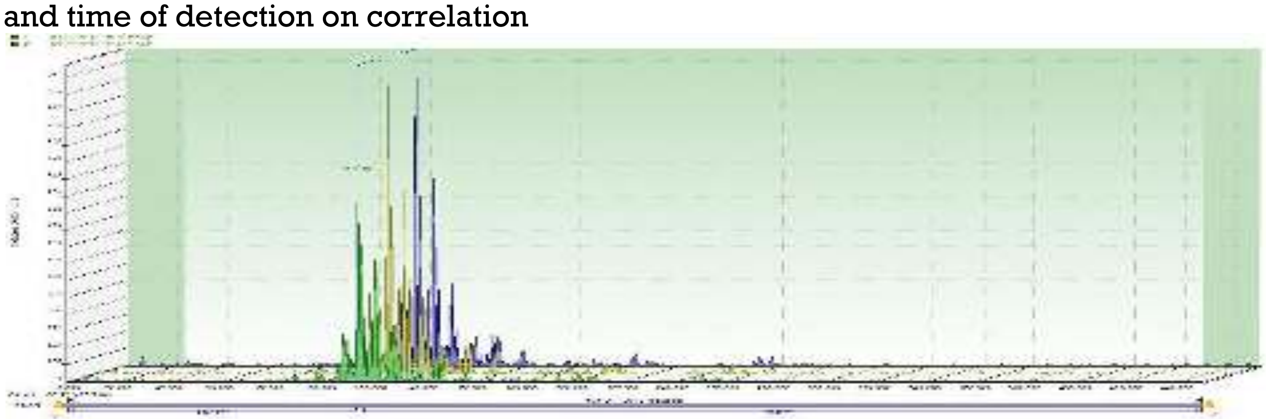
System Name: Town of North Reading Water Department

Location: 9 Liberty Lane, Service Leaking

Approx. Size: 2-4 gpm

Pipe Material: CI

Date and time of detection on correlation



Pipe ID	Length	Diameter	Material	Sound Velocity
P6	[illegible]	[illegible]	Cast Iron	[illegible] feet/sec.

Leak ID	Leak Position	Correlation Between	Confidence	Recording Time
L22	594' 1" from 5	5 -> 7	93.6%	Jan 02 2017, 08:43:53AM
L23	[illegible]	[illegible]	92.7%	[illegible]
L24	594' 1" from 5	5 -> 7	88.4%	Jan 02 2017, 08:44:53AM
L25	114' 10" from 6	6 -> 7	91.3%	[illegible]
L26	114' 10" from 6	6 -> 7	91.7%	Jan 02 2017, 08:43:52AM
L27	114' 6" from 6	6 -> 7	92.0%	Jan 02 2017, 08:44:52AM
L04	114' 10" from 6	6 -> 7	91.7%	Jan 02 2017, 08:43:53AM
L06	114' 6" from 6	6 -> 7	92.0%	[illegible]

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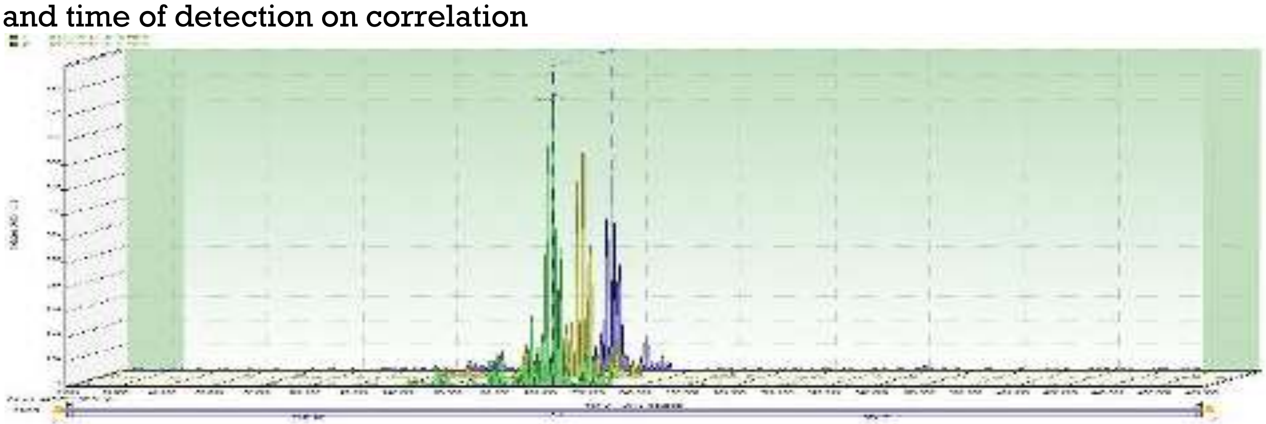
Technical Services

Leak worksheet

Date: 3/15/17
System Name: Town of North Reading Water Department
Location: 6 Old Andover Rd, Service Leaking
Approx. Size: ___2-4 gpm___
Pipe Material: CI
Date and time of detection on correlation



Pipe ID	Length	Diameter	Material	Sound Velocity
P6	[illegible]	[illegible]	Cast Iron	[illegible]

Leak ID	Leak Position	Correlation Between	Confidence	Recording Time
L19	227' 10" from 5	5 -> 7	91.0%	Jan 02 2017, 01:00:50PM
L20	[illegible]	[illegible]	[illegible]	[illegible]
L21	225' 10" from 5	5 -> 7	91.2%	Jan 02 2017, 01:02:56PM
L22	[illegible]	5 -> 6	[illegible]	[illegible]
L23	220' 2" from 8	8 -> 6	94.2%	Jan 02 2017, 01:01:56PM
L24	220' 6" from 8	8 -> 6	94.3%	Jan 02 2017, 01:02:56PM
L58	227' 10" from 5	5 -> 7	91.3%	Jan 02 2017, 01:01:50PM
L59	[illegible]	[illegible]	[illegible]	[illegible]

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Leak worksheet

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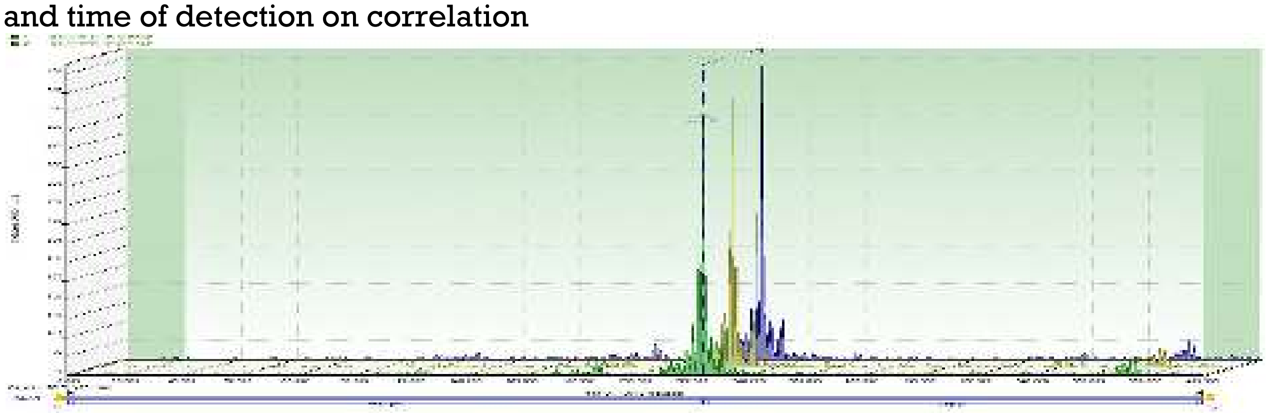
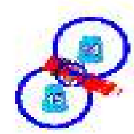
Date: 3/15/17
System Name: Town of North Reading Water Department
Location: 9 Spruce Rd, Service Leaking
Approx. Size: 2-4 gpm
Pipe Material: CI
Date and time of detection on correlation



Pipe ID	Length	Diameter	Material	Sound Velocity
P1[illegible]	400' 0"	10"	Cast iron	3770 feet/sec

Leak ID	Leak Position	Correlation Between	Confidence	Recording Time
L58	690' 5" from 13	13 ↔ 15	90.7%	Jan 03 2017, 08:42:52AM
L59	694' 10" from 13	13 ↔ 15	90.1%	Jan 03 2017, 08:43:52AM
L60	696' 5" from 13	13 ↔ 15	90.6%	Jan 03 2017, 08:44:52AM
L61	223' 10" from 14	14 ↔ 15	90.3%	Jan 03 2017, 08:42:52AM
L62	224' 4" from 14	14 ↔ 15	92.3%	Jan 03 2017, 08:43:52AM
L63	225' 12" from 14	14 ↔ 15	92.4%	Jan 03 2017, 08:44:52AM
L64	223' 6" from 14	14 ↔ 15	92.3%	Jan 03 2017, 08:42:52AM
L66	226' 12" from 14	14 ↔ 15	92.4%	Jan 03 2017, 08:44:52AM



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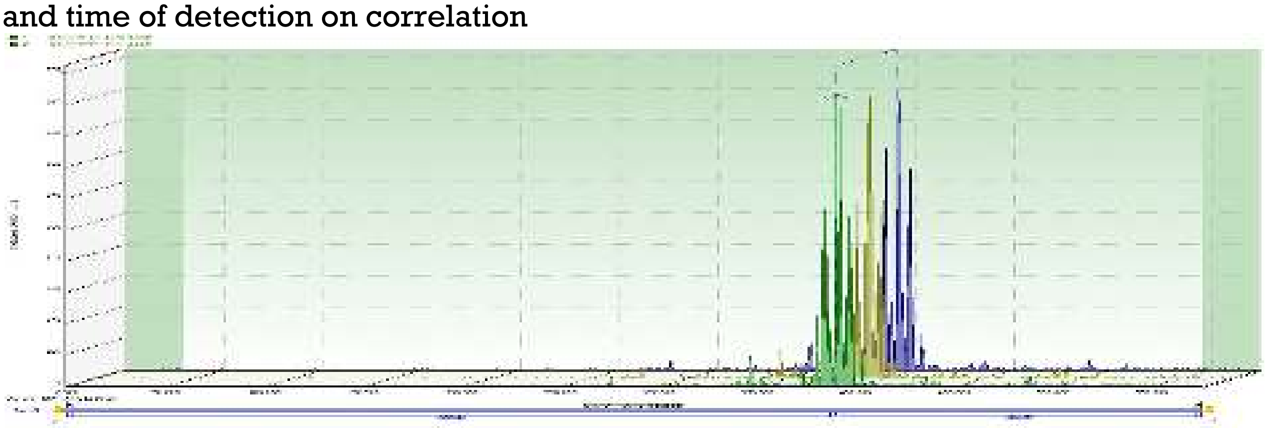
Leak worksheet

Date: 3/15/17
System Name: Town of North Reading Water Department
Location: 47 Spruce Rd, Service Leaking
Approx. Size: 2-4 gpm
Pipe Material: CI
Date and time of detection on correlation



Pipe ID	Length	Diameter	Material	Sound Velocity
P3	575' 0"	12"	Cast Iron	3770 feet/sec

Leak ID	Leak Position	Correlation Between	Confidence	Recording Time
L10	392' 5" from 3	3 -- 4	33.1%	Jan 02 2017, 09:30:44AM
L11	392' 4" from 3	3 -- 4	93.1%	Jan 03 2017, 09:31:44AM
L12	392' 4" from 3	3 -- 4	33.1%	Jan 02 2017, 09:32:44AM
L13	407' 4" from 3	3 -- 5	91.5%	Jan 02 2017, 09:30:44AM
L14	407' 5" from 3	3 -- 5	41.7%	Jan 03 2017, 09:31:44AM
L16	407' 4" from 3	3 -- 5	32.6%	Jan 02 2017, 09:32:44AM
L73	392' 4" from 3	3 -- 4	33.1%	Jan 02 2017, 09:31:44AM
L74	392' 4" from 3	3 -- 4	93.1%	Jan 03 2017, 09:32:44AM
L76	392' 4" from 3	3 -- 4	33.1%	Jan 02 2017, 09:31:44AM
L79	392' 4" from 3	3 -- 4	93.1%	Jan 02 2017, 09:32:44AM

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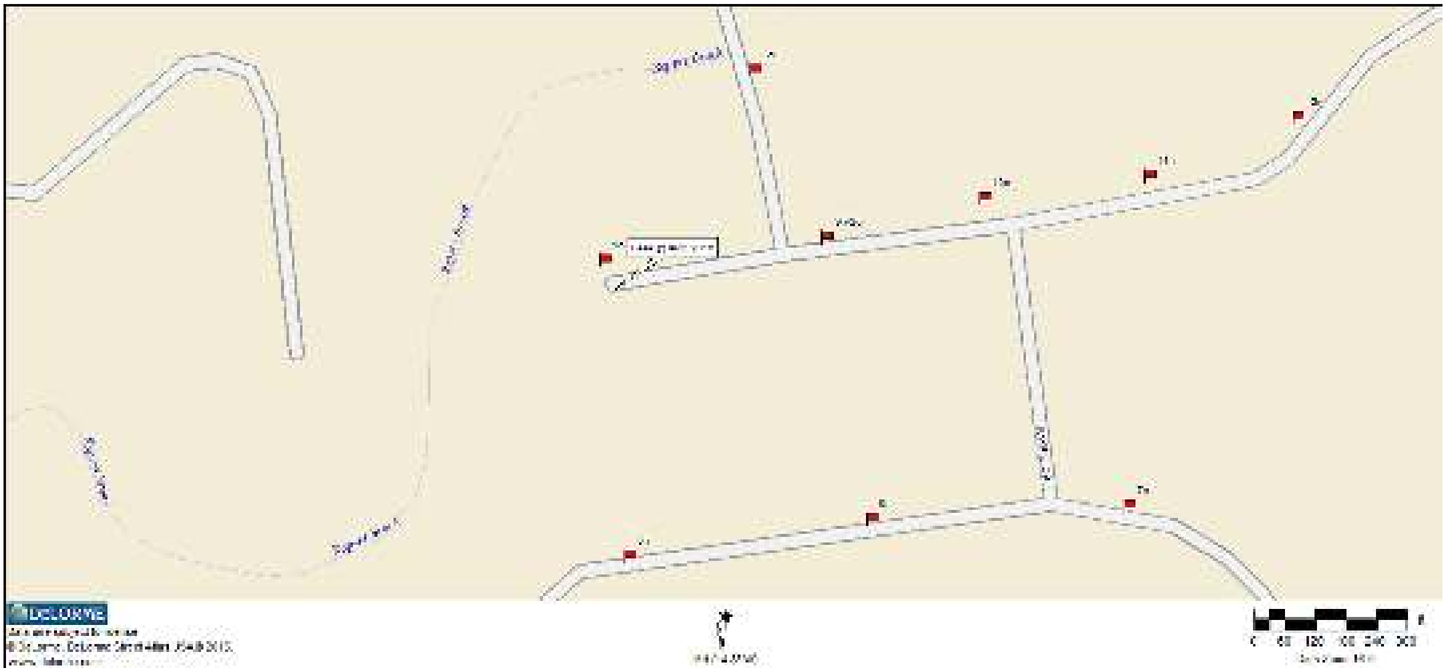


Date: 3/15/17

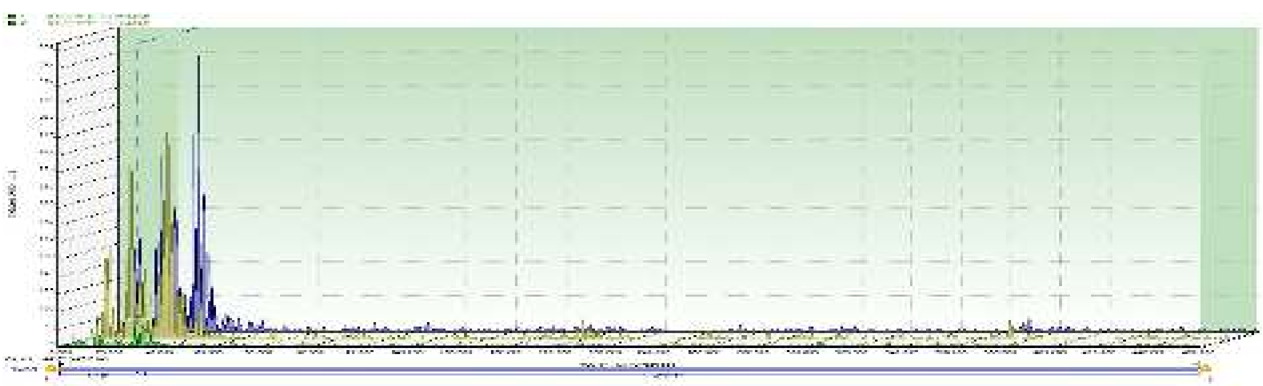
System Name: Town of North Reading Water Department

Location: 22 Ridgeway, Service Leaking

Approx. Size: 1-3 gpm

Pipe Material: CI

Date and time of detection on correlation



Pipe ID	Length	Diameter	Material	Sound Velocity
P1	440' 0"	10"	Cast Iron	3770 feet/sec

Leak ID	Leak Position	Correlation Between	Confidence	Recording Time
L1	31' 5" from 1	1 → 2	90.0%	Jan 03 2017, 10:10:49AM
L2	31' 8" from 1	1 → 2	88.8%	Jan 02 2017, 10:17:49AM
L3	31' 10" from 1	1 → 2	89.3%	Jan 02 2017, 10:18:49AM
L4	66' 3" from 1	1 → 3	70.4%	Jan 03 2017, 10:16:49AM
L5	62' 11" from 1	1 → 3	81.6%	Jan 02 2017, 10:17:49AM
L6	60' 6" from 1	1 → 3	84.9%	Jan 02 2017, 10:18:49AM
L07	31' 5" from 1	1 → 2	90.5%	Jan 03 2017, 10:17:49AM
L08	31' 10" from 1	1 → 2	91.9%	Jan 02 2017, 10:18:49AM

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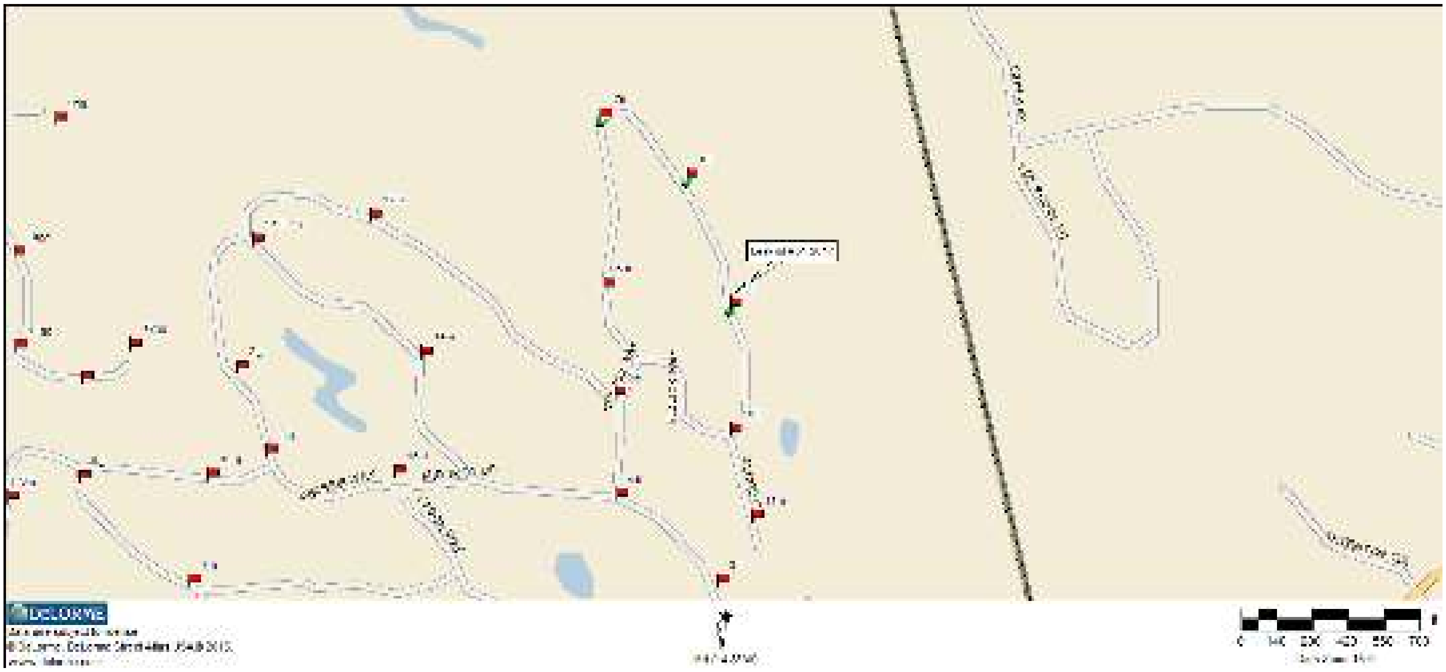
Leak worksheet



Date: 3/15/17

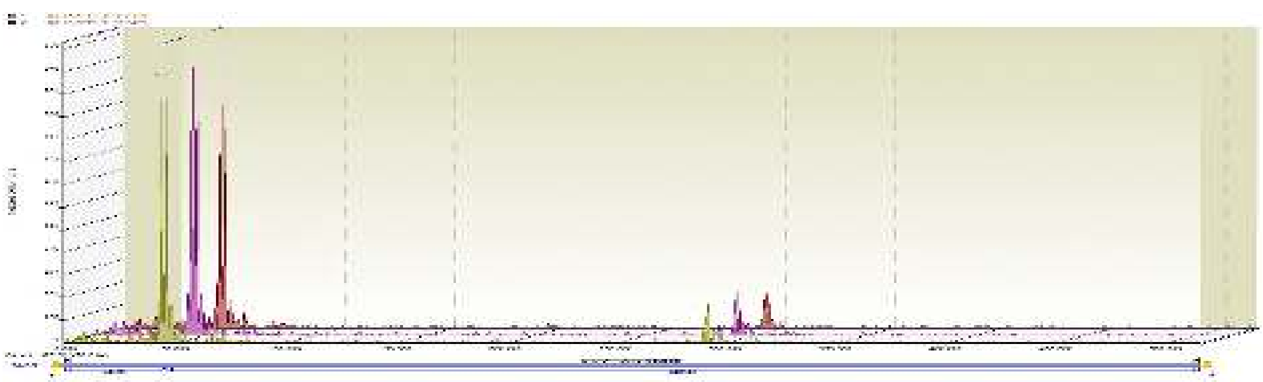
System Name: Town of North Reading Water Department

Location: 51 Niblick Way, Service Leaking

Approx. Size: 2-4 gpm

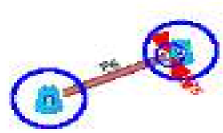
Pipe Material: CI

Date and time of detection on correlation



Pipe ID	Length	Diameter	Material	Sound Velocity
P6	[illegible]	[illegible]	Cast Iron	[illegible]

Leak ID	Leak Position	Correlation Between	Confidence	Recording Time
L25	45' 7" from 9	9 ↔ 8	32.5%	Jan 16 2017, 01:02:24PM
L26	45' 12" from 9	9 ↔ 8	33.0%	Jan 16 2017, 01:03:24PM
L27	44' 0" from 9	9 ↔ 8	34.5%	Jan 16 2017, [illegible]
L77	44' 12" from 9	9 ↔ 8	34.0%	Jan 16 2017, [illegible]
L78	44' 0" from 9	9 ↔ 8	33.5%	Jan 16 2017, 01:04:24PM



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Leak worksheet

Date: 3/15/17

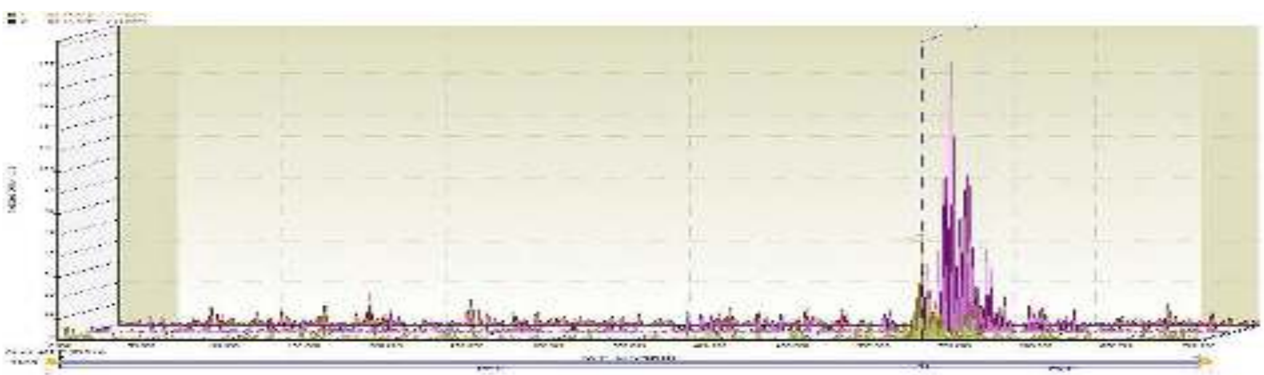
System Name: Town of North Reading Water Department

Location:12 Macintyre, Service Leaking

Approx. Size: 2-4 gpm

Pipe Material: CI

Date and time of detection on correlation



Pipe ID	Length	Diameter	Material	Sound Velocity
P6	700' 0"	12"	Cast Iron	3773 feet/sec

Leak ID	Leak Position	Correlation Between	Confidence	Recording Time
L26	527' 6" from 5	5 -> 7	91.5%	Jan 16 2017, 12:21:08PM
L26	529' 1" from 5	5 -> 7	85.0%	Jan 16 2017, 12:22:08PM
L26	530' 7" from 5	5 -> 9	76.3%	Jan 16 2017, 12:21:08PM
L25	540' 7" from 5	5 -> 9	77.8%	Jan 16 2017, 12:22:08PM
L30	585' 5" from 5	5 -> 9	80.0%	Jan 16 2017, 12:23:08PM
L26	529' 1" from 5	5 -> 7	84.0%	Jan 16 2017, 12:22:08PM

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Leak worksheet

Date: 3/15/17

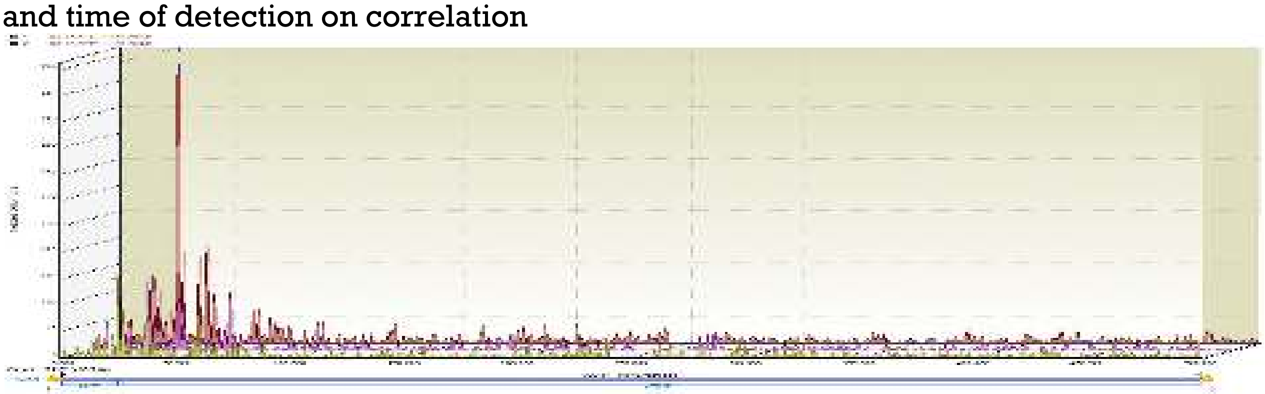
System Name: Town of North Reading Water Department

Location:3 Erwin, Service Leaking

Approx. Size: ___2-4 gpm__

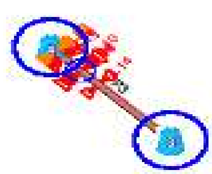
Pipe Material: CI

Date and time of detection on correlation



Pipe ID	Length	Diameter	Material	Sound Velocity
P3	[illegible]	6"	Cast Iron	4373 feet/sec

Leak ID	Leak Position	Correlation Between	Confidence	Recording Time
L10	215' 10" from 4	4 <-> 3	82.8%	Jan 16 2017, 10:57:[illegible]AM
L11	263' 5" from 4	4 <-> 3	81.8%	Jan 16 2017, 11:00:[illegible]AM
L12	215' 10" from 4	4 <-> 3	88.5%	Jan 16 2017, 11:01:36AM
L13	753' 3" from 3	3 <-> 2	66.0%	Jan 16 2017, 10:59:36AM
L14	614' 2" from 3	3 <-> 2	78.0%	Jan 16 2017, 11:00:36AM
L03	219' 3" from 4	4 <-> 3	86.0%	Jan 16 2017, 11:00:36AM
L04	215' 10" from 4	4 <-> 3	85.6%	Jan 16 2017, 11:07:[illegible]AM
L08	48' 5" from 4	4 <-> 3	75.0%	Jan 16 2017, 10:57:[illegible]AM
L09	49' 2" from 4	4 <-> 3	78.4%	Jan 16 2017, 11:00:36AM
L90	48' 9" from 4	4 <-> 3	86.9%	Jan 16 2017, 11:07:36AM
L01	24' 7" from 4	4 <-> 3	78.5%	Jan 16 2017, 10:58:36AM
L02	23' 1" from 4	4 <-> 3	76.2%	Jan 16 2017, 11:00:36AM
L03	24' 7" from 4	4 <-> 3	86.5%	Jan 16 2017, 11:07:[illegible]AM



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Leak worksheet

Date: 3/15/17

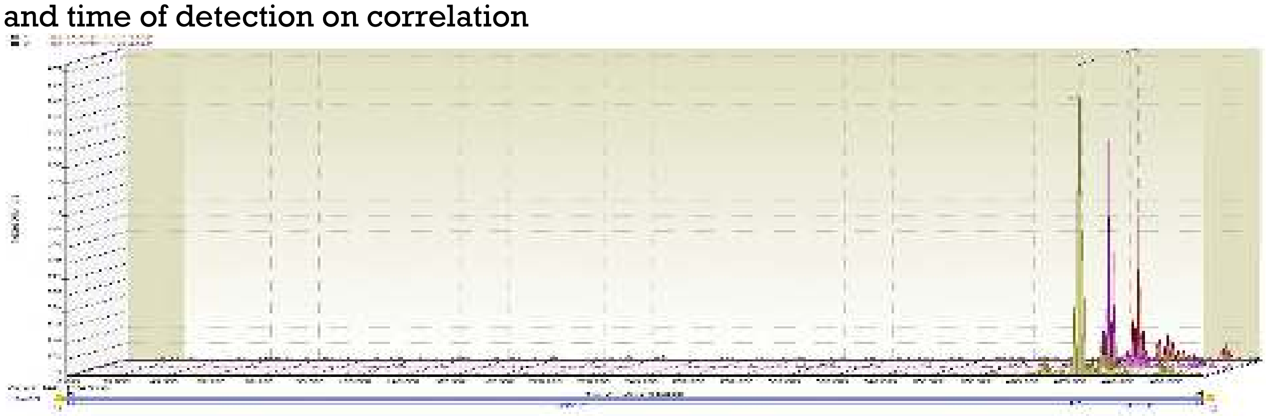
System Name: Town of North Reading Water Department

Location:4 Snowcrest, Service Leaking

Approx. Size: ___1-3 gpm__

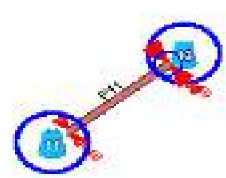
Pipe Material: CI

Date and time of detection on correlation



Pipe ID	Length	Diameter	Material	Sound Velocity
P11	475' 0"	12"	Cast Iron	3770 feet/sec

Leak ID	Leak Position	Correlation Between	Confidence	Recording Time
L48	695' 2" from 10	10 → 12	71.3%	Jan 16 2017, 10:22:48AM
L49	425' 1" from 11	11 → 12	93.2%	Jan 16 2017, 10:21:48AM
L50	423' 6" from 11	11 → 12	90.8%	Jan 16 2017, 10:22:28AM
L51	425' 1" from 11	11 → 12	91.3%	Jan 16 2017, 10:23:48AM
L57	425' 6" from 11	11 → 12	92.8%	Jan 16 2017, 10:22:48AM
L58	423' 1" from 11	11 → 12	91.2%	Jan 16 2017, 10:23:48AM



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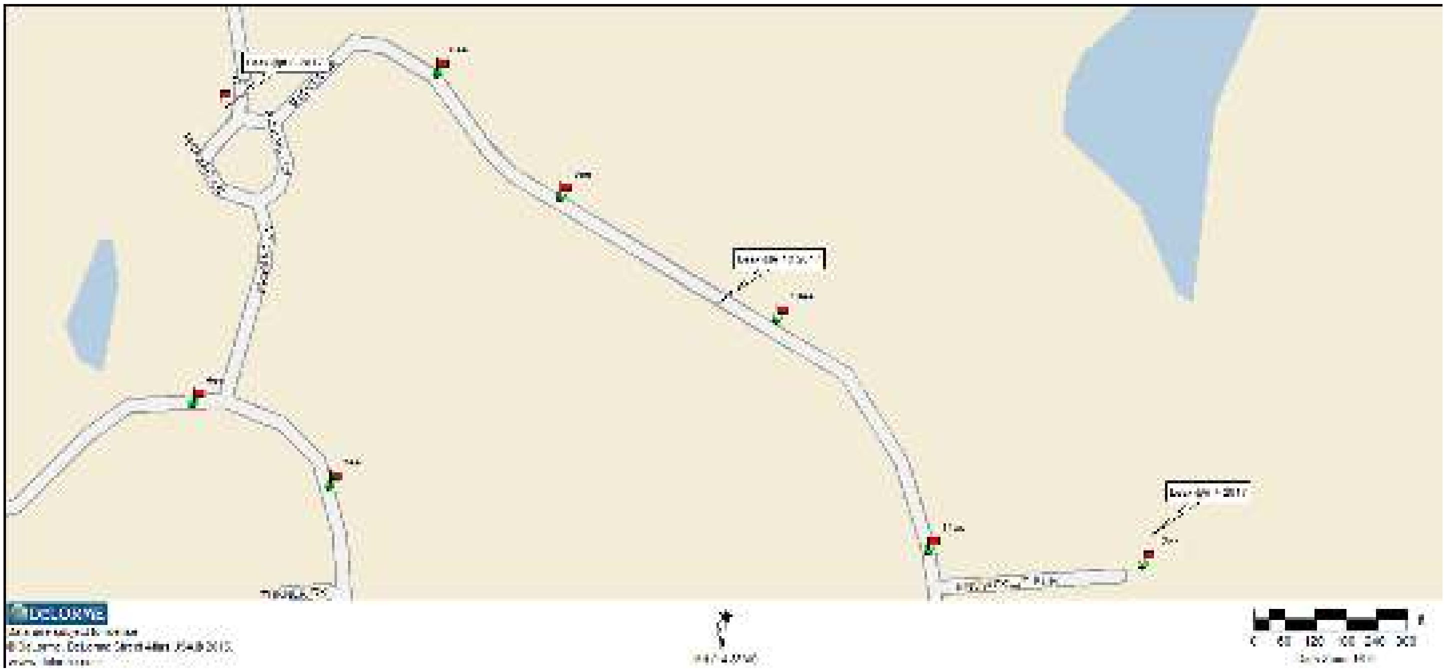
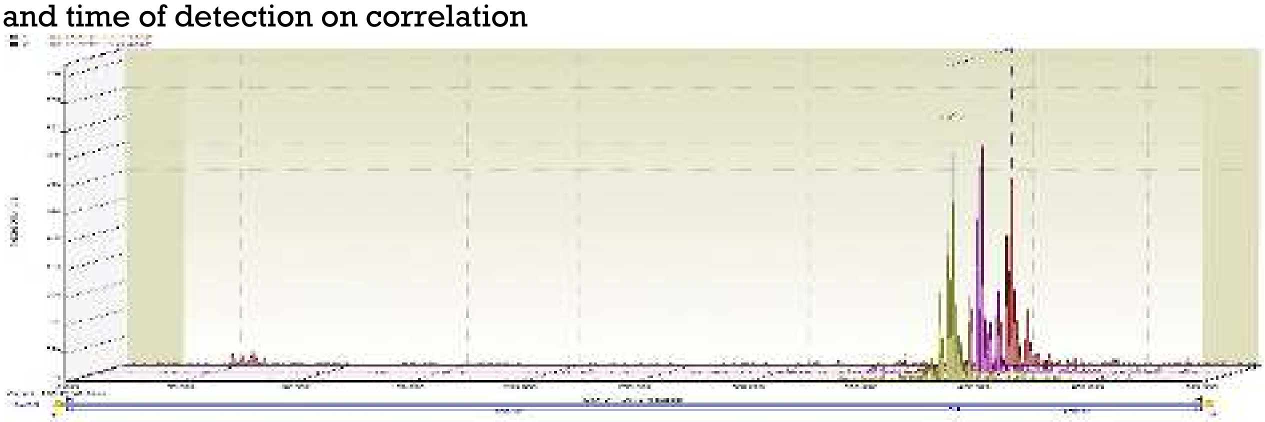
Technical Services

Leak worksheet

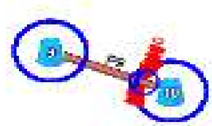


Date: 3/15/17
System Name: Town of North Reading Water Department
Location:16 Shasta Dr, Service Leaking
Approx. Size: ___2-4 gpm__
Pipe Material: CI
Date and time of detection on correlation



Pipe ID	Length	Diameter	Material	Sound Velocity
P9	[illegible]	10"	Cast Iron	[illegible]

Leak ID	Leak Position	Correlation Between	Confidence	Recording Time
L37	737' 9" from 8	8 <-> 10	98.2%	Jan 16 2017, 10:21:48AM
L38	736' 2" from 8	8 <-> 10	98.7%	Jan 16 2017, 10:22:48AM
L39	734' 7" from 8	8 <-> 10	98.2%	Jan 16 2017, 10:23:48AM
L40	387' 4" from 9	9 <-> 10	93.0%	Jan 16 2017, 10:21:48AM
L41	387' 11" from 9	9 <-> 10	93.7%	Jan 16 2017, 10:22:48AM
L42	380' 4" from 9	9 <-> 10	91.3%	Jan 16 2017, 10:23:48AM
[illegible]	389' 11" from 9	9 <-> 10	93.7%	Jan 16 2017, 10:22:48AM
[illegible]	387' 4" from 9	9 <-> 10	91.3%	Jan 16 2017, 10:22:48AM



Printed Jan 30 2017, 03:37:09PM, Recorded Jan 16 2017, 10:21:48AM

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Leak worksheet

Date: 3/15/17

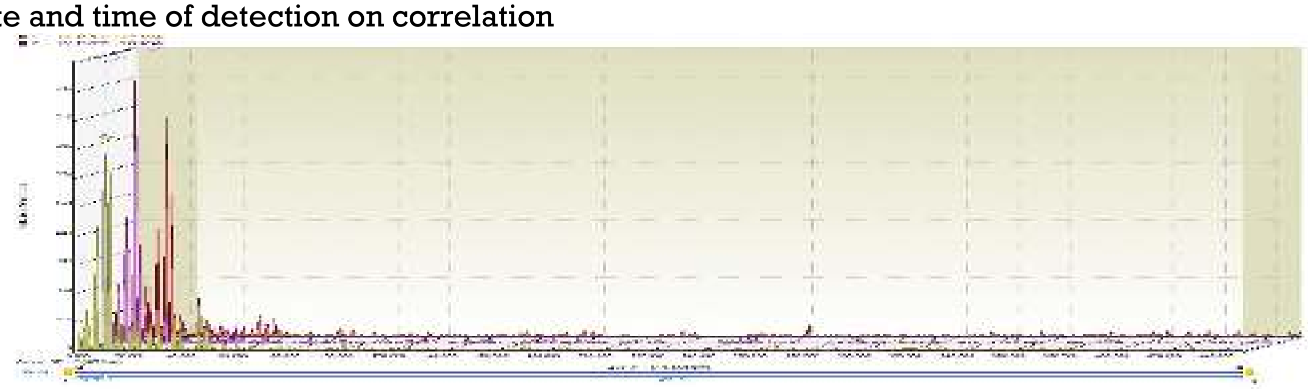
System Name: Town of North Reading Water Department

Location: 8 Pickard Ln, Service Leaking

Approx. Size: ___1-3 gpm__

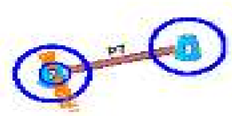
Pipe Material: CI

Date and time of detection on correlation



Pipe ID	Length	Diameter	Material	Sound Velocity
P7	450' 0"	12"	Cast Iron	3770 feet/sec

Leak ID	Leak Position	Correlation Between	Confidence	Recording Time
L31	10' 3" from 7	7 -> 8	89.6%	Jan 16 2017, 10:21:48AM
L32	10' 3" from 7	7 -> 8	90.9%	Jan 16 2017, 10:22:48AM
L33	10' 7" from 7	7 -> 8	89.6%	Jan 16 2017, 10:23:48AM
L71	10' 3" from 7	7 -> 8	90.9%	Jan 16 2017, 10:22:48AM
L72	10' 7" from 7	7 -> 8	89.6%	Jan 16 2017, 10:23:48AM



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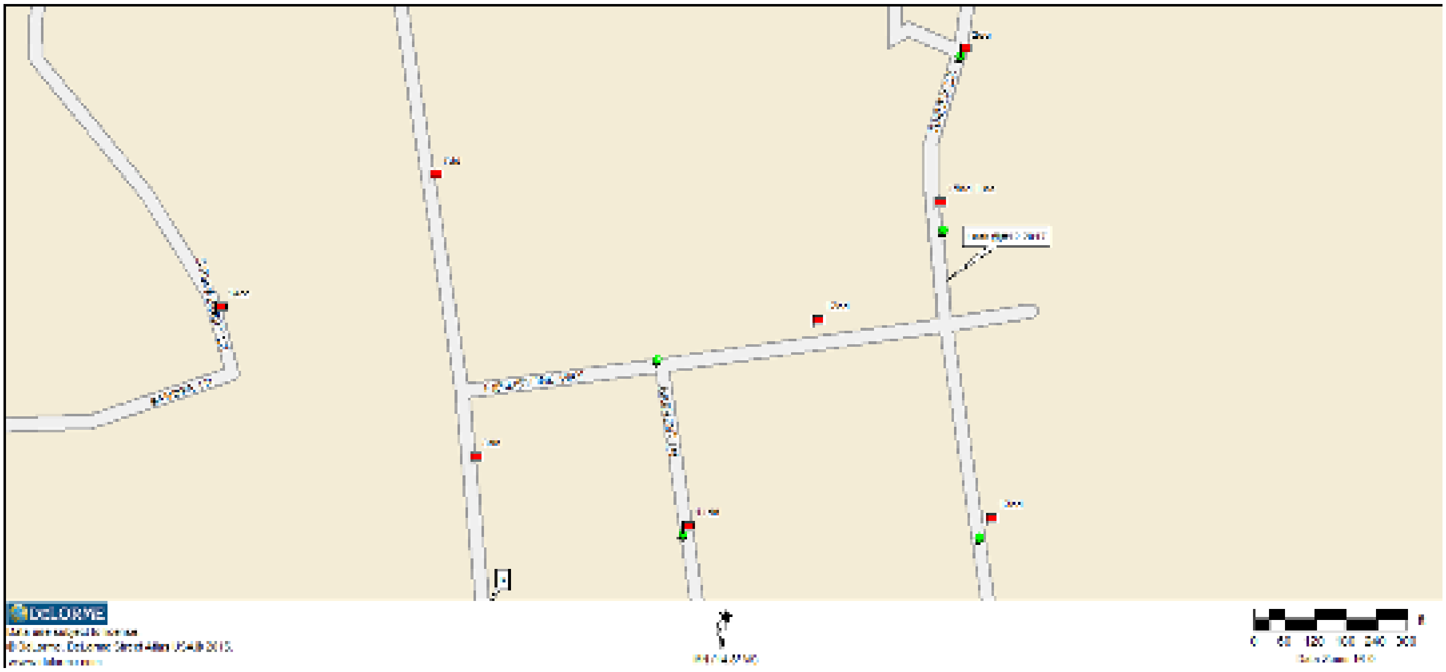
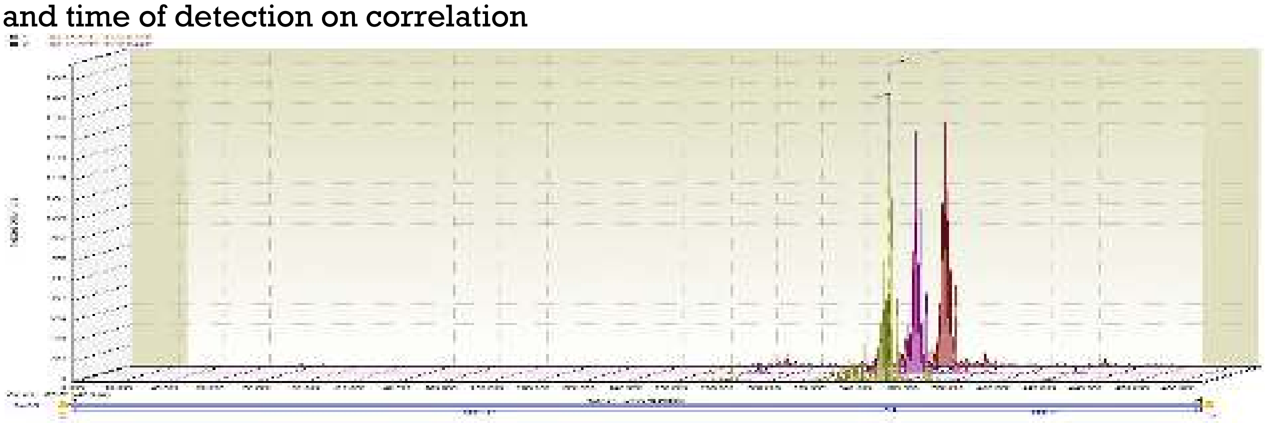
gpyburn@apsitech.com

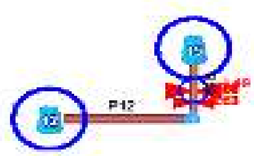


Date: 3/15/17
System Name: Town of North Reading Water Department
Location: 12 Fieldstone Way, Service Leaking
Approx. Size: ___3-5 gpm___
Pipe Material: CI
Date and time of detection on correlation



Pipe ID	Length	Diameter	Material	Sound Velocity
P12	360' 0"	12"	Cast Iron	3778 feet/sec
P13	230' 0"	12"	Cast Iron	3778 feet/sec

Leak ID	Leak Position	Correlation Between	Confidence	Recording Time
L48	365' 11" from 12	12 → 15	95.0%	Jan 16 2017, 09:37:04AM
L50	363' 2" from 12	12 → 15	95.2%	Jan 16 2017, 09:30:04AM
L51	364' 2" from 12	12 → 15	95.4%	Jan 16 2017, 09:37:04AM
L55	141' 2" from 15	15 → 13	95.4%	Jan 16 2017, 09:37:04AM
L56	141' 6" from 15	15 → 13	95.6%	Jan 16 2017, 09:30:04AM
L57	141' 8" from 15	15 → 13	95.4%	Jan 16 2017, 09:30:04AM
L61	960' 4" from 14	14 → 15	93.0%	Jan 16 2017, 09:37:04AM
L62	960' 12" from 14	14 → 15	92.0%	Jan 16 2017, 09:30:04AM
L63	960' 12" from 14	14 → 15	92.9%	Jan 16 2017, 09:37:04AM
L70	363' 8" from 12	12 → 15	94.7%	Jan 16 2017, 09:38:04AM
L71	363' 2" from 12	12 → 15	90.0%	Jan 16 2017, 09:24:04AM



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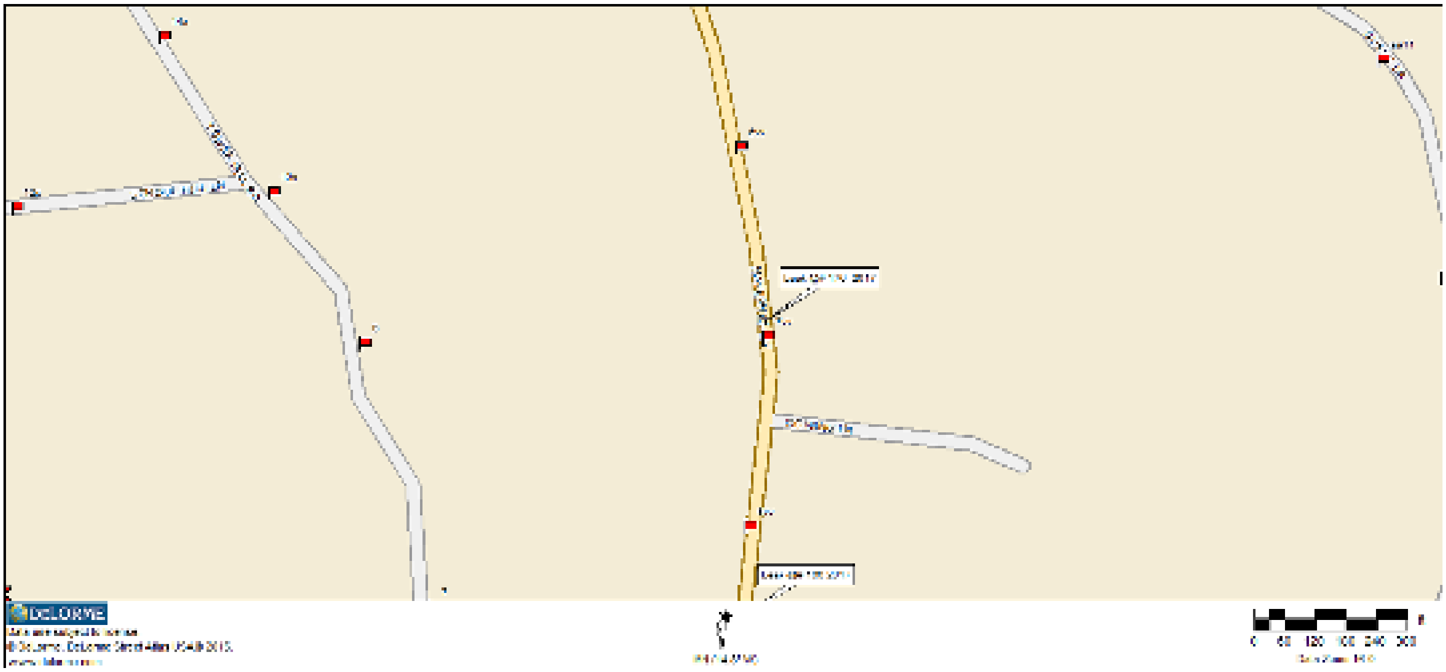


Date: 3/15/17

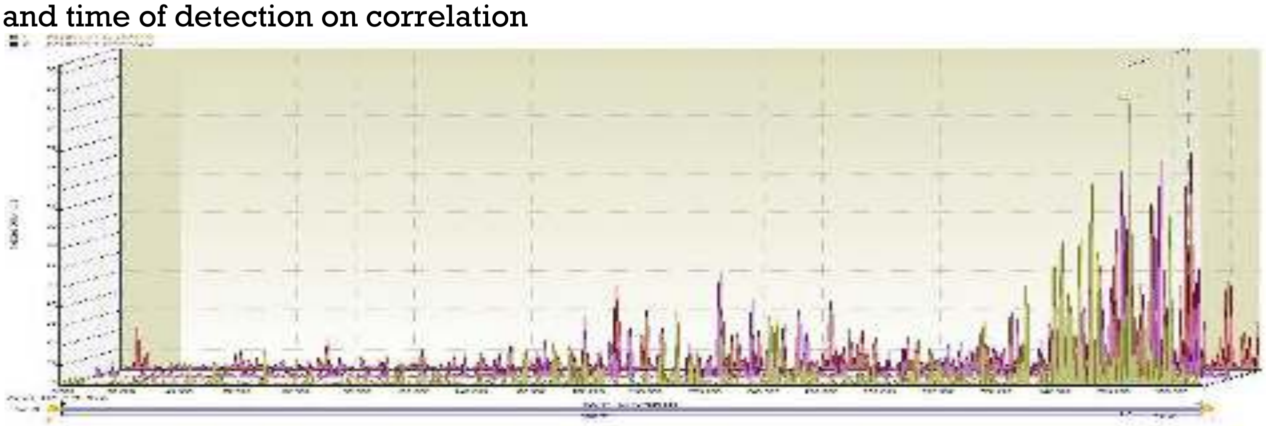
System Name: Town of North Reading Water Department

Location: 176 Haverhill St, Service Leaking

Approx. Size: 1-3 gpm

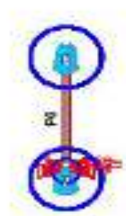
Pipe Material: CI

Date and time of detection on correlation



Pipe ID	Length	Diameter	Material	Sound Velocity
P6	[illegible]	12"	Cast Iron	[illegible]

Leak ID	Leak Position	Correlation Between	Confidence	Recording Time
L25	385' 7" from 6	6 → 7	78.1%	Feb 03 2017, 02:25:58AM
L26	342' 5" from 6	6 → 7	77.7%	Feb 03 2017, 02:57:50AM
L27	382' 9" from 6	6 → 7	76.7%	Feb 03 2017, 02:29:06AM
[illegible]	385' 0" from 6	6 → 7	76.4%	Feb 03 2017, 02:27:56AM
L71	385' 0" from 6	6 → 7	75.5%	Feb 03 2017, 02:25:56AM



Printed Feb 03 2017, 07:46:45AM, Recorded Feb 03 2017, 02:20:55AM

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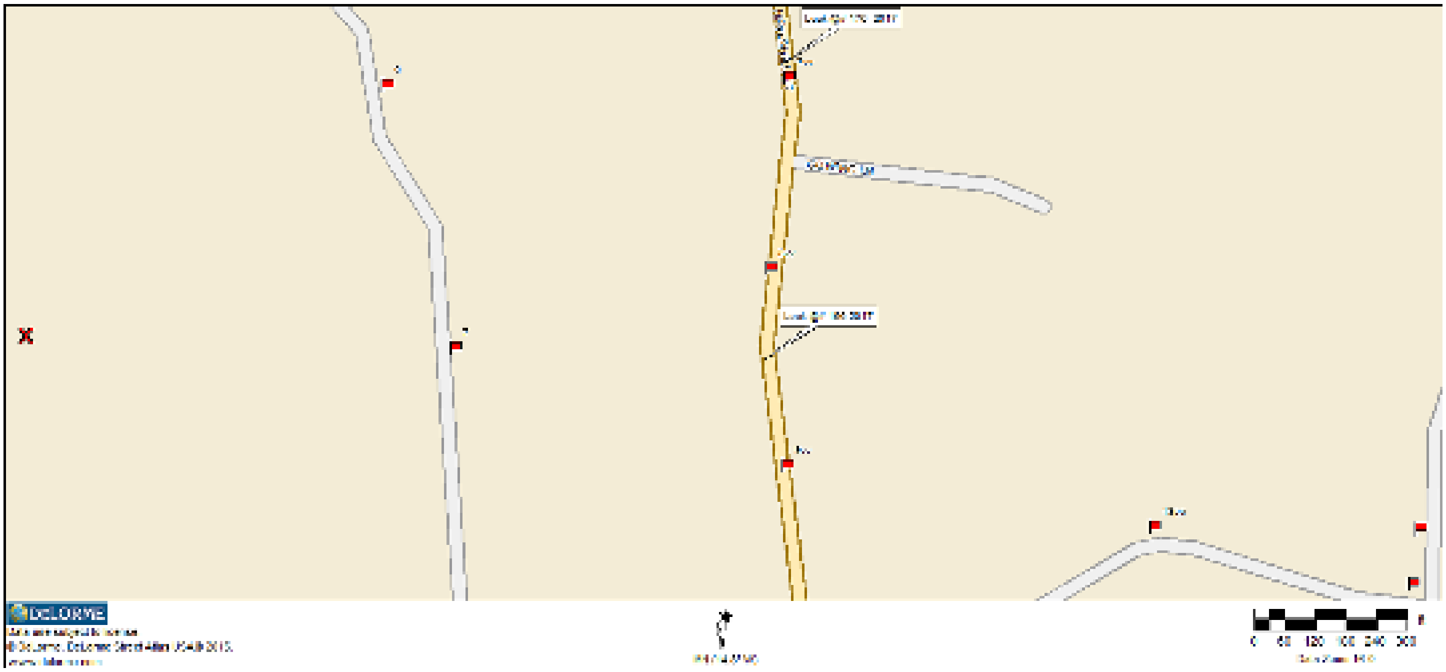


Date: 3/15/17

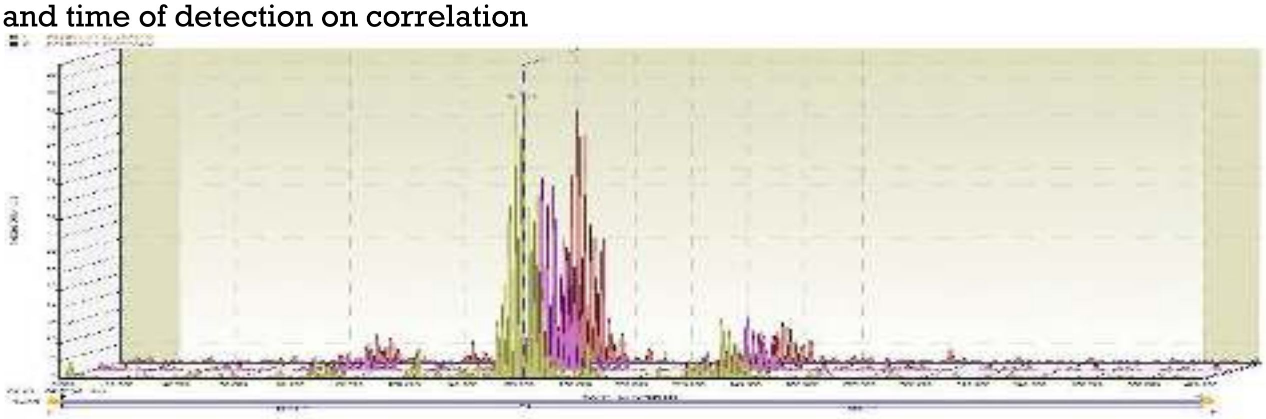
System Name: Town of North Reading Water Department

Location: 166 Haverhill St, Service Leaking

Approx. Size: ____1-3 gpm___

Pipe Material: CI

Date and time of detection on correlation



Pipe ID	Length	Diameter	Material	Sound Velocity
P8	400' 0"	12"	[illegible]	[illegible]

Leak ID	Leak Position	Correlation Between	Confidence	Recording Time
[illegible]	431' 5" from 7	7 <-> 9	[illegible]	Feb 03 2017, 02:26:56AM
L58	411' 5" from 7	7 <-> 9	65.4%	Feb 03 2017, 02:26:56AM
[illegible]	151' 11" from 8	8 <-> 9	65.2%	Feb 03 2017, 02:26:56AM
[illegible]	162' 2" from 8	8 <-> 9	82.9%	Feb 03 2017, 02:27:56AM
[illegible]	167' 4" from 8	8 <-> 9	[illegible]	Feb 03 2017, 02:26:56AM
L72	157' 11" from 8	8 <-> 9	82.5%	Feb 03 2017, 02:27:56AM
L73	160' 4" from 8	8 <-> 9	[illegible]	Feb 03 2017, 02:26:56AM

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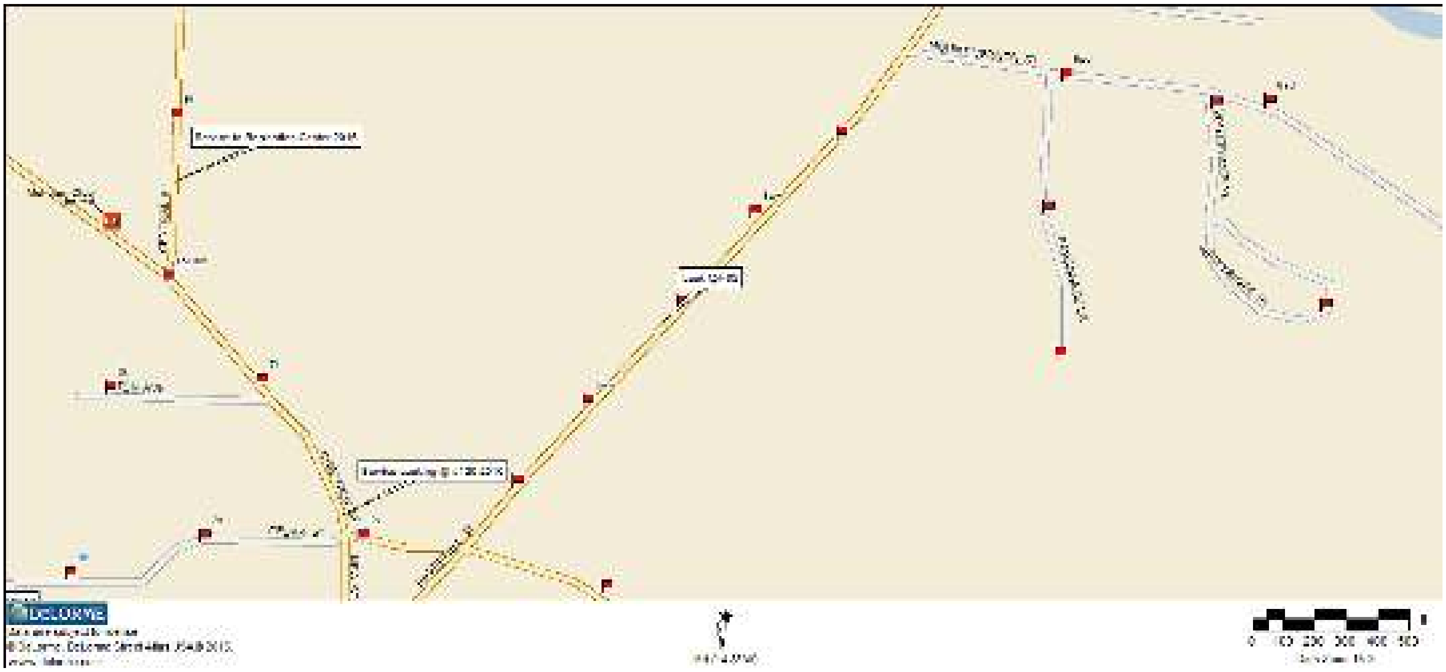


Date: 3/15/17

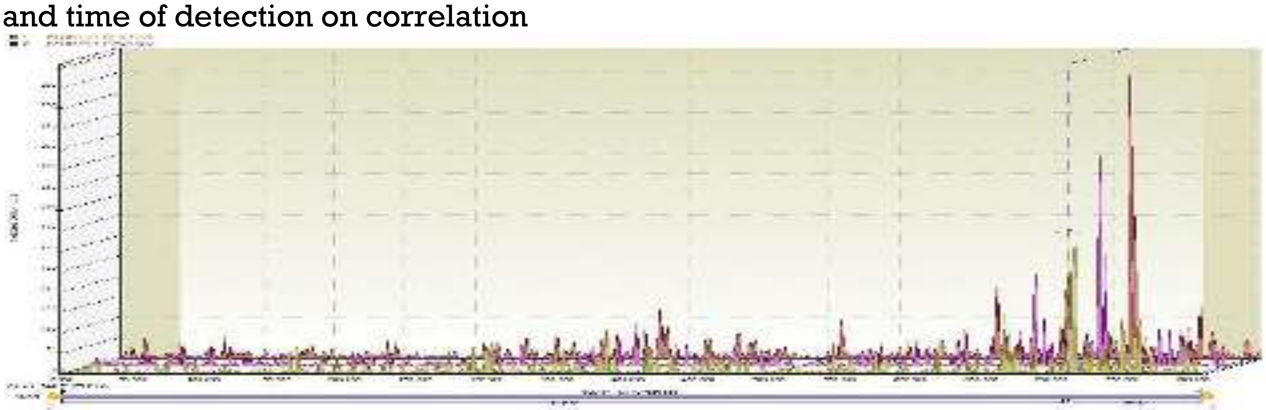
System Name: Town of North Reading Water Department

Location: 82 Haverhill St, Service Leaking

Approx. Size: 1-3 gpm

Pipe Material: CI

Date and time of detection on correlation



Pipe ID	Length	Diameter	Material	Sound Velocity
P3	380' 0"	12"	Cast Iron	3770 feet/sec
P4	[illegible]	10"	Cast Iron	[illegible]

Leak ID	Leak Position	Correlation Between	Confidence	Recording Time
L11	281' 0" from 3	3 -> 4	73.7%	Feb 03 2017, 03:14:12AM
L13	712' 3" from 3	3 -> 5	79.0%	Feb 03 2017, 03:13:12AM
L14	715' 0" from 3	3 -> 5	53.2%	Feb 03 2017, 03:14:12AM
L15	712' 0" from 3	3 -> 5	85.6%	Feb 03 2017, 03:12:12AM
L16	385' 3" from 4	4 -> 5	51.0%	Feb 03 2017, 03:15:12AM
L17	385' 7" from 4	4 -> 5	78.8%	Feb 03 2017, 03:14:12AM
L18	380' 7" from 4	4 -> 5	52.4%	Feb 03 2017, 03:12:12AM
L87	715' 0" from 3	3 -> 5	83.2%	Feb 03 2017, 03:14:12AM
L88	715' 0" from 3	3 -> 5	85.6%	Feb 03 2017, 03:15:12AM

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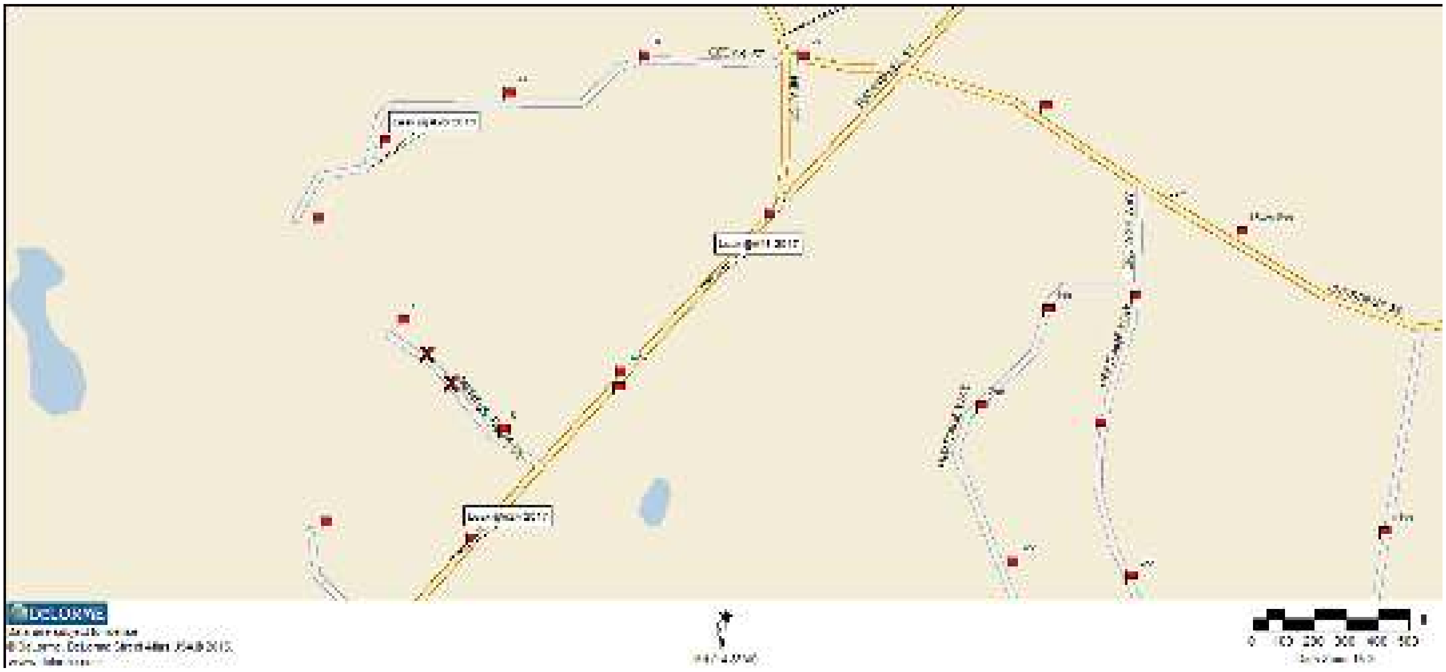
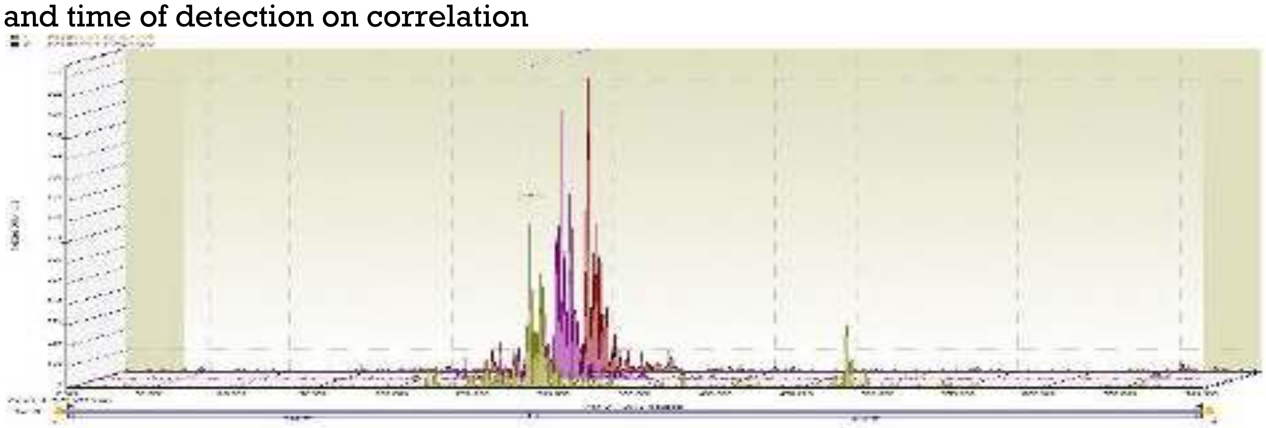
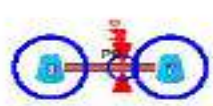


Date: 3/15/17
System Name: Town of North Reading Water Department
Location: 48 Haverhill St, Service Leaking
Approx. Size: 2-4 gpm
Pipe Material: CI
Date and time of detection on correlation



Pipe ID	Length	Diameter	Material	Sound Velocity
P9	[illegible]	12"	Cast Iron	[illegible]

Leak ID	Leak Position	Correlation Between	Confidence	Recording Time
L40	285' 7" from 7	7 ↔ 8	90.7%	Feb 03 2017, 03:13:12AM
L61	285' 7" from 7	7 ↔ 8	91.7%	Feb 03 2017, 03:14:12AM
L42	284' 10" from 7	7 ↔ 8	91.5%	Feb 03 2017, 03:16:12AM
L65	286' 7" from 7	7 ↔ 8	91.7%	Feb 03 2017, 03:14:12AM
L70	284' 10" from 7	7 ↔ 8	91.2%	Feb 03 2017, 03:15:12AM



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Leak worksheet

Date: 3/15/17

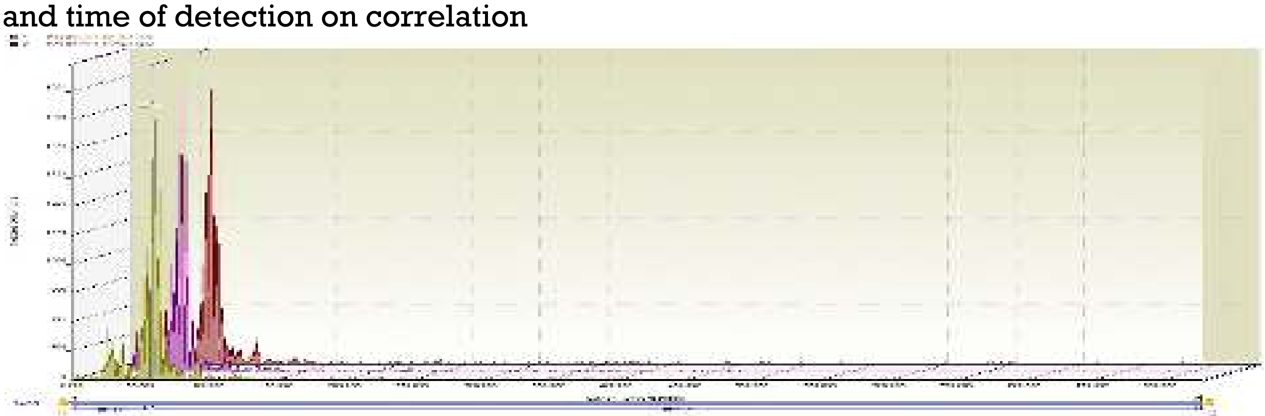
System Name: Town of North Reading Water Department

Location: 24 Haverhill St, Service Leaking

Approx. Size: ___3-5 gpm__

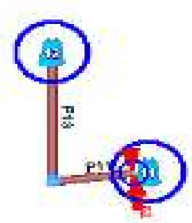
Pipe Material: CI

Date and time of detection on correlation



Pipe ID	Length	Diameter	Material	Sound Velocity
P11	370' 0"	12"	Cast Iron	3770 feet/sec
P13	460' 0"	12"	Cast Iron	3770 feet/sec

Leak ID	Leak Position	Correlation Between	Confidence	Recording Time
L49	62' 3" from 11	11 -- 13	93.0%	Feb 03 2017, 03:13:12AM
L50	62' 11" from 11	11 -- 13	92.3%	Feb 03 2017, 03:14:12AM
L51	62' 11" from 11	11 -- 13	92.2%	Feb 03 2017, 03:15:12AM
L52	68' 11" from 11	11 -- 12	93.9%	Feb 03 2017, 03:13:12AM
L53	68' 2" from 11	11 -- 12	94.0%	Feb 03 2017, 03:14:12AM
L54	68' 2" from 11	11 -- 12	93.8%	Feb 03 2017, 03:15:12AM
L71	68' 2" from 11	11 -- 12	94.0%	Feb 03 2017, 03:14:12AM
L72	68' 2" from 11	11 -- 12	93.9%	Feb 03 2017, 03:15:12AM



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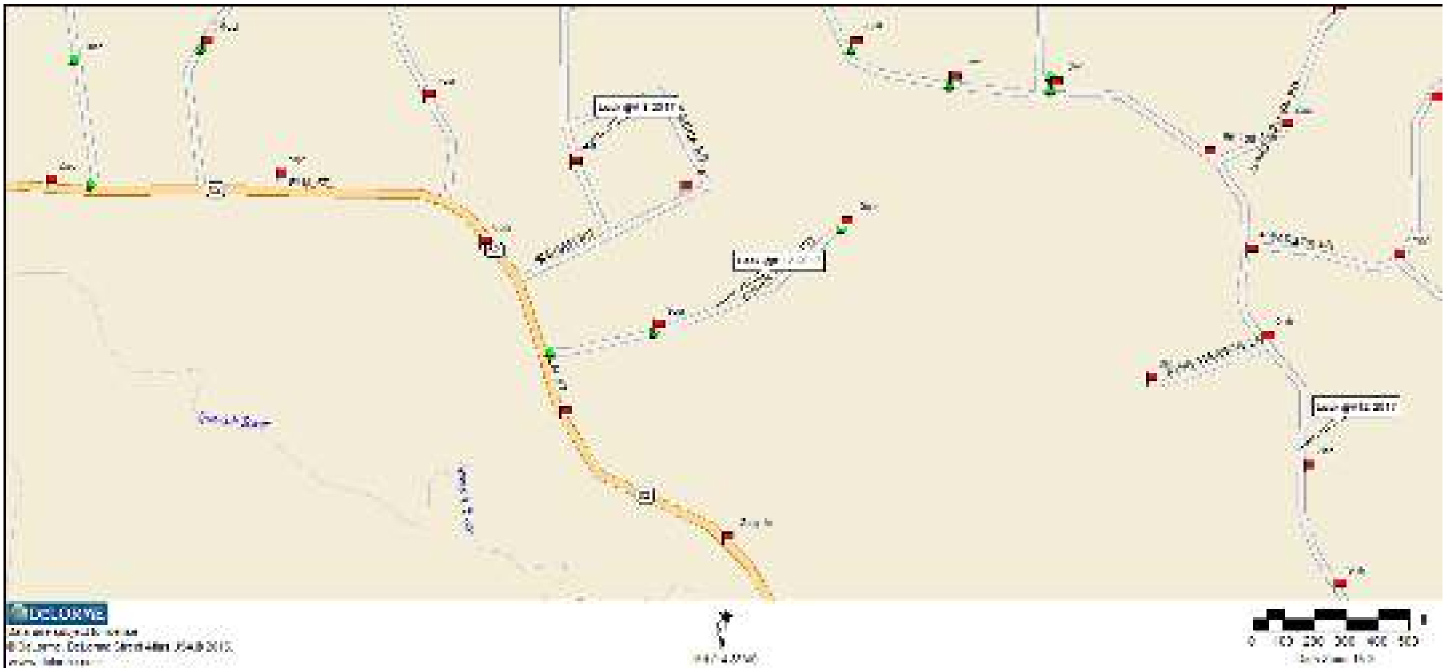


Date: 3/15/17

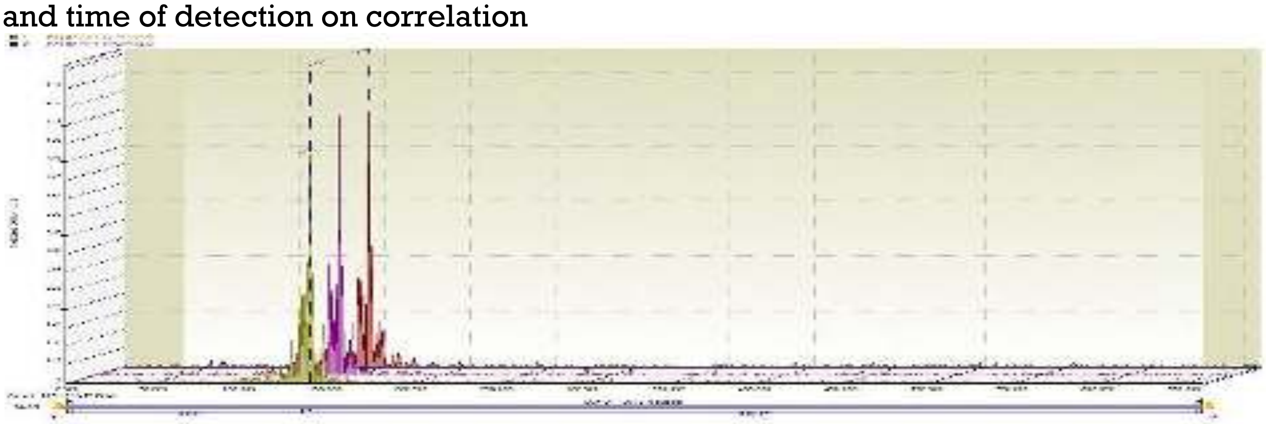
System Name: Town of North Reading Water Department

Location: 12 Swan Pond Rd, Service Leaking

Approx. Size: 2-4 gpm

Pipe Material: CI

Date and time of detection on correlation



Pipe ID	Length	Diameter	Material	Sound Velocity
P5	680' 0"	12"	Cast Iron	3779 feet/sec

Leak ID	Leak Position	Correlation Between	Confidence	Recording Time
L37	141' 0" from 9	9 -> 10	92.8%	Feb 02 2017, 02:41:00AM
L38	141' 0" from 9	9 -> 10	93.2%	Feb 02 2017, 02:42:00AM
L39	140' 8" from 9	9 -> 10	93.0%	Feb 03 2017, 02:43:00AM
L46	680' 7" from 10	10 -> 9	72.2%	Feb 02 2017, 02:41:00AM
L52	141' 0" from 9	9 -> 10	93.2%	Feb 02 2017, 02:42:00AM
L53	140' 8" from 9	9 -> 10	93.2%	Feb 03 2017, 02:43:00AM

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Leak worksheet

Date: 3/15/17

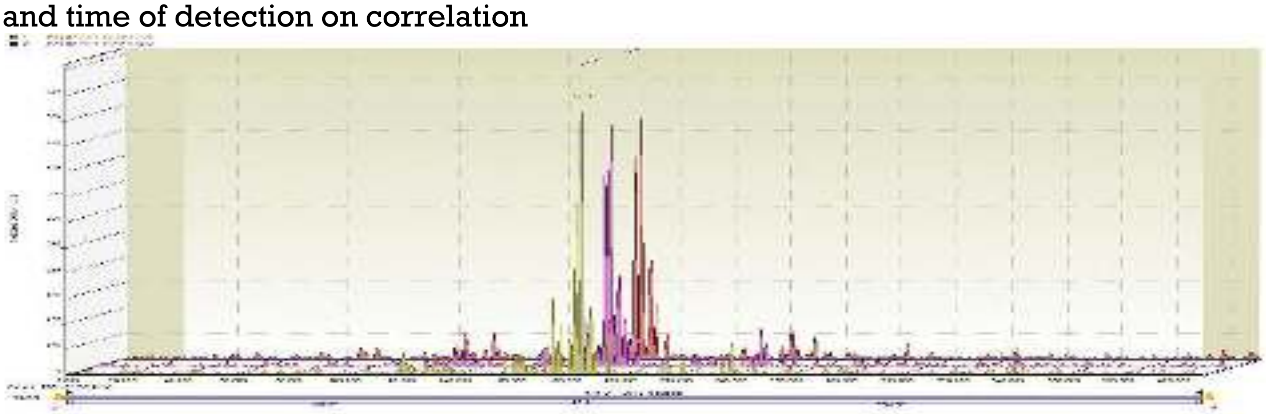
System Name: Town of North Reading Water Department

Location: 72 Elm St, Service Leaking

Approx. Size: 3-5 gpm

Pipe Material: CI

Date and time of detection on correlation



Pipe ID	Length	Diameter	Material	Sound Velocity
P8	410' 0"	12"	Cast Iron	3770 feet/sec

Leak ID	Leak Position	Correlation Between	Confidence	Recording Time
[illegible]	602' 11" from 7	7 -> 9	[illegible]	[illegible]
L34	195' 9" from 8	8 -> 9	88.5%	Feb 02 2017, 03:30:12AM
L35	192' 9" from 8	8 -> 9	[illegible]	Feb 02 2017, 03:31:12AM
L36	196' 2" from 8	8 -> 9	88.2%	Feb 02 2017, 03:32:12AM
L64	195' 5" from 8	8 -> 9	88.5%	Feb 02 2017, 03:31:12AM
L65	190' 2" from 8	8 -> 9	88.2%	Feb 02 2017, 03:32:12AM

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Date: 3/15/17

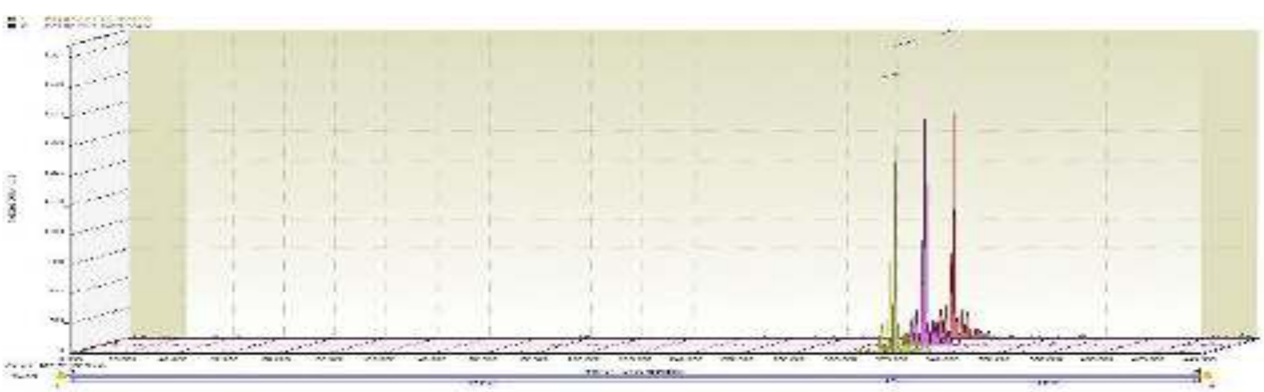
System Name: Town of North Reading Water Department

Location: 6 Gillis, Service Leaking

Approx. Size: ___3-5 gpm__

Pipe Material: CI

Date and time of detection on correlation



Pipe ID	Length	Diameter	Material	Sound Velocity
P6	[illegible]	[illegible]	Cast Iron	[illegible] feet/sec.

Leak ID	Leak Position	Correlation Between	Confidence	Recording Time
L25	331' 4" from 7	7 -> 6	96.3%	Feb 02 2017, 04:19:36AM
L26	321' 5" from 7	7 -> 6	96.2%	Feb 02 2017, 04:20:36AM
L27	331' 8" from 7	7 -> 6	96.2%	Feb 02 2017, 04:21:36AM
L28	332' 5" from 7	7 -> 8	95.3%	Feb 02 2017, 04:19:36AM
L29	335' 1" from 7	7 -> 8	95.3%	Feb 02 2017, 04:20:36AM
L30	335' 1" from 7	7 -> 8	95.1%	Feb 02 2017, 04:21:36AM
L49	331' 8" from 7	7 -> 6	96.3%	Feb 02 2017, 04:22:36AM
L50	321' 4" from 7	7 -> 6	96.0%	Feb 02 2017, 04:21:36AM

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Leak worksheet

Date: 3/15/17

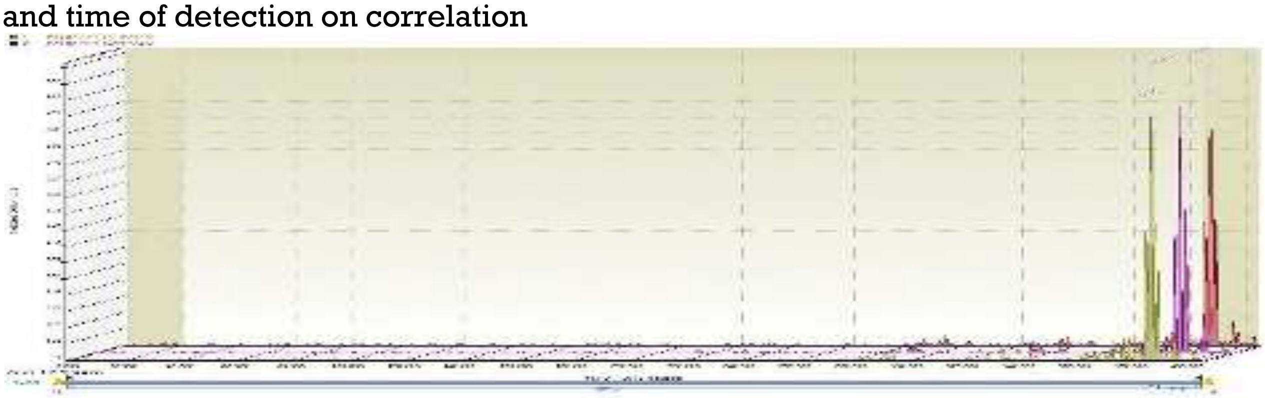
System Name: Town of North Reading Water Department

Location: 3 Greenmeadow, Service Leaking

Approx. Size: 3-5 gpm

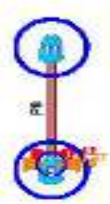
Pipe Material: CI

Date and time of detection on correlation



Pipe ID	Length	Diameter	Material	Sound Velocity
[illegible]	[illegible]	12"	[illegible]	[illegible]

Leak ID	Leak Position	Correlation Between	Confidence	Recording Time
L37	387' 4" from 11	11 → 9	93.6%	Feb 02 2017, 04:19:36AM
L38	387' 4" from 11	11 → 9	95.4%	Feb 02 2017, 04:20:36AM
L39	387' 4" from 11	11 → 9	93.1%	Feb 02 2017, 04:21:36AM
L41	387' 12" from 11	11 → 10	82.8%	Feb 02 2017, [illegible]
L42	382' 4" from 11	11 → 10	83.3%	Feb 02 2017, 04:27:36AM
L51	387' 4" from 11	11 → 9	93.4%	Feb 02 2017, 04:20:36AM
L52	387' 4" from 11	11 → 9	93.1%	Feb 02 2017, [illegible]



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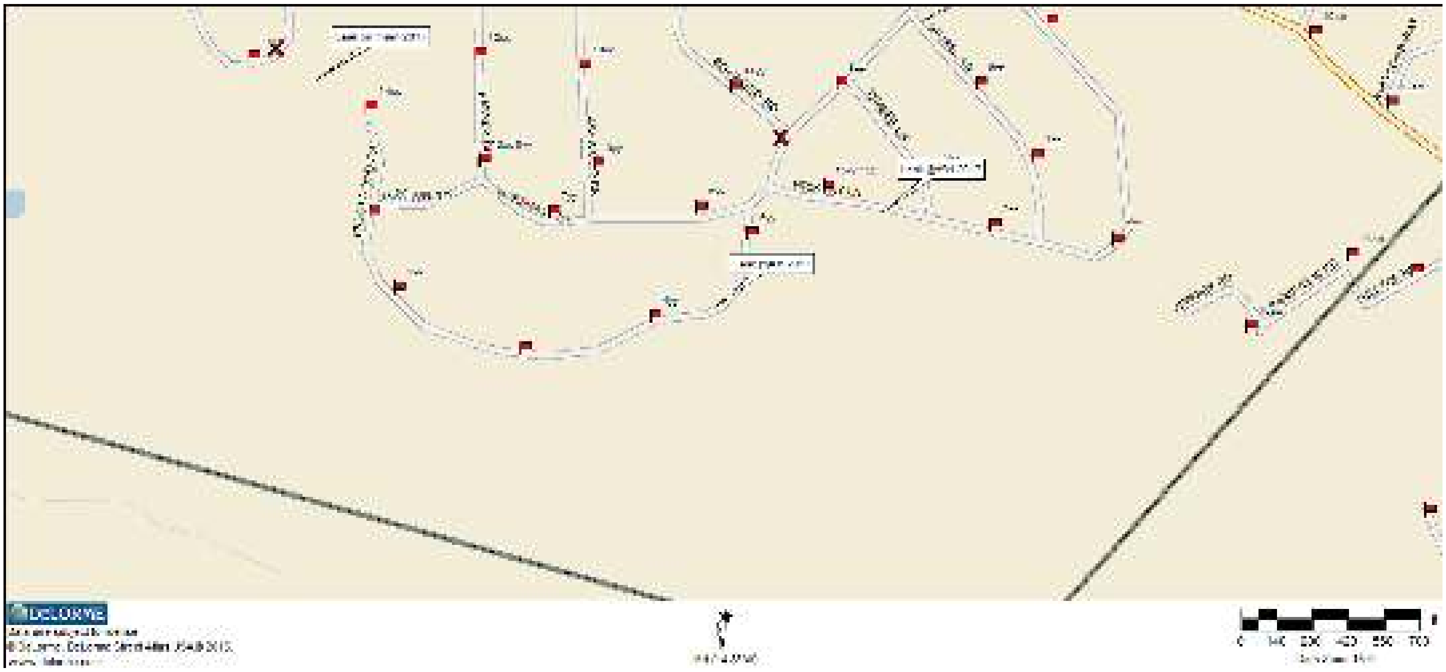


Date: 3/15/17

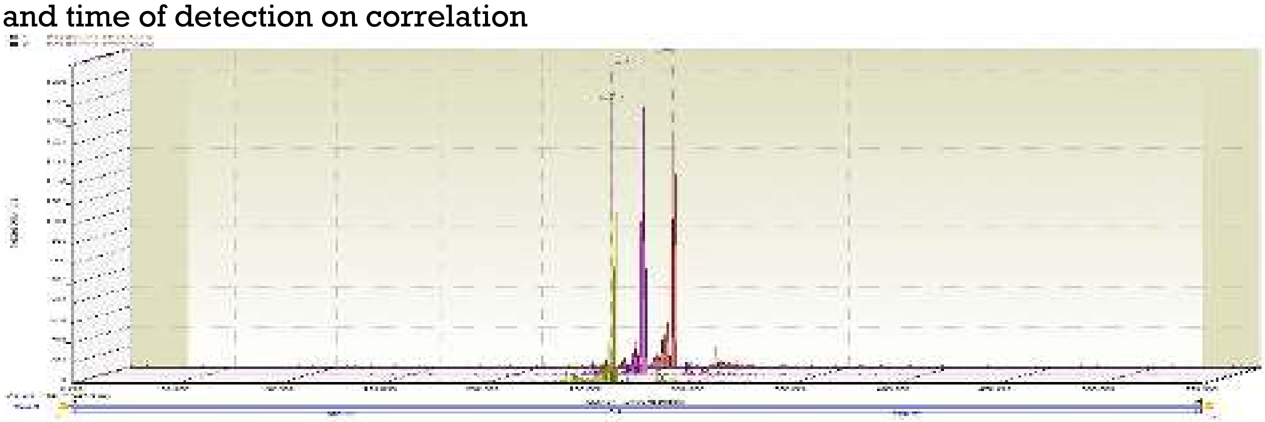
System Name: Town of North Reading Water Department

Location: 6 Crestwood, Service Leaking

Approx. Size: 3-5 gpm

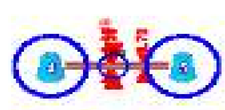
Pipe Material: CI

Date and time of detection on correlation



Pipe ID	Length	Diameter	Material	Sound Velocity
P4	959' 0"	12"	Cast Iron	3779 feet/sec

Leak ID	Leak Position	Correlation between	Confidence	Recording Time
L13	755' 2" from 3	3 <-> 5	92.8%	Feb 03 2017, 09:26:52AM
L14	755' 6" from 3	3 <-> 5	95.4%	Feb 03 2017, 09:27:52AM
L15	755' 10" from 3	3 <-> 5	95.3%	Feb 03 2017, 09:28:52AM
L16	263' 3" from 4	4 <-> 5	96.2%	Feb 03 2017, 09:26:52AM
L17	263' 3" from 4	4 <-> 5	96.2%	Feb 03 2017, 09:27:52AM
L18	263' 7" from 4	4 <-> 5	96.0%	Feb 03 2017, 09:28:52AM
L70	866' 2" from 15	15 <-> 4	79.2%	Feb 03 2017, 09:26:52AM
L71	866' 7" from 15	15 <-> 4	80.2%	Feb 03 2017, 09:27:52AM
L72	863' 5" from 15	15 <-> 4	80.8%	Feb 03 2017, 09:28:52AM
L73	263' 3" from 4	4 <-> 5	96.1%	Feb 03 2017, 09:27:52AM
L74	263' 7" from 4	4 <-> 5	95.9%	Feb 03 2017, 09:28:52AM



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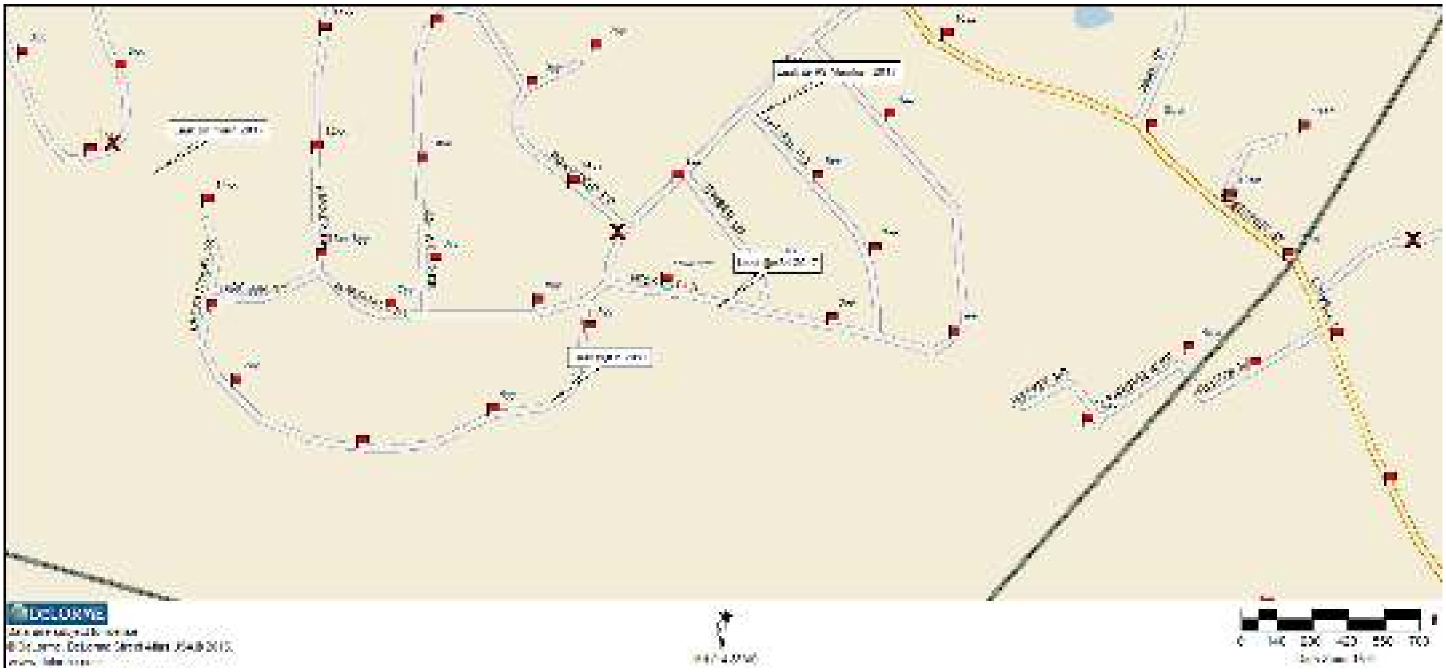
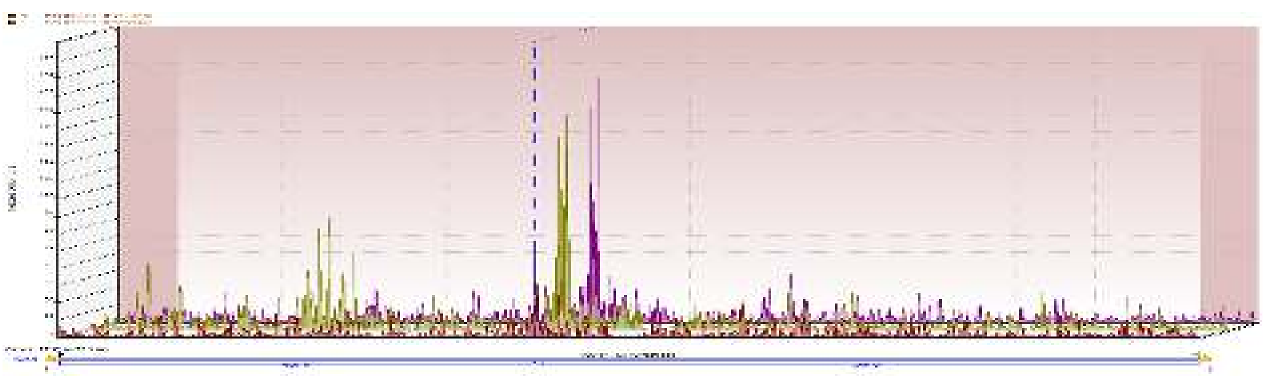


Date: 3/15/17
System Name: Town of North Reading Water Department
Location: 34 Hickory Ln, Service Leaking
Approx. Size: ___3-5 gpm__
Pipe Material: CI
Date and time of detection on correlation



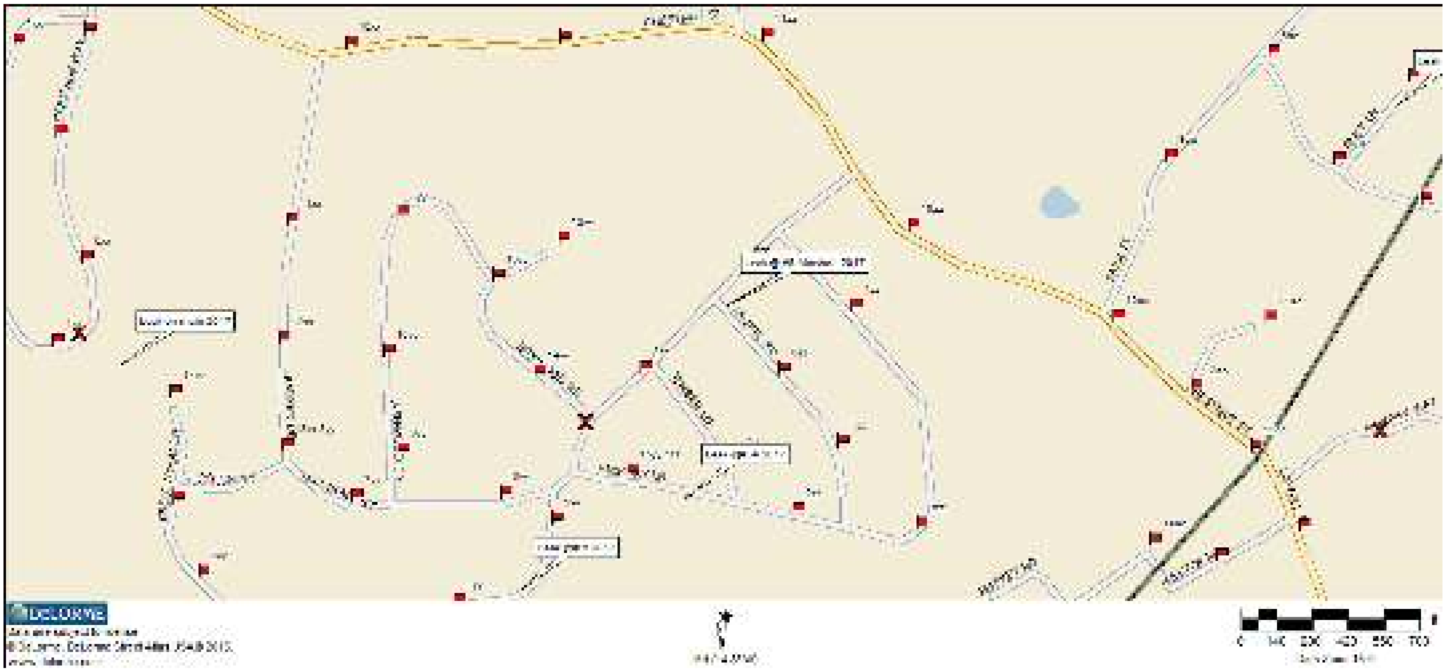
Pipe ID	Length	Diameter	Material	Sound Velocity
P1	700' 0"	12"	Cast Iron	3775 feet/sec

Leak ID	Leak Position	Correlation Between	Confidence	Recording Time
L1	285' 1" from 1	1 -> 2	61.8%	Feb 03 2017, 10:19:20AM
L2	289' 1" from 1	1 -> 2	94.5%	Feb 03 2017, 10:20:20AM
L3	292' 3" from 1	1 -> 2	76.0%	Feb 03 2017, 10:51:20AM
L4	226' 6" from 1	1 -> 3	71.6%	Feb 03 2017, 10:10:20AM
L04	289' 1" from 1	1 -> 2	94.5%	Feb 03 2017, 10:20:20AM
L05	292' 3" from 1	1 -> 2	76.0%	Feb 03 2017, 10:51:20AM

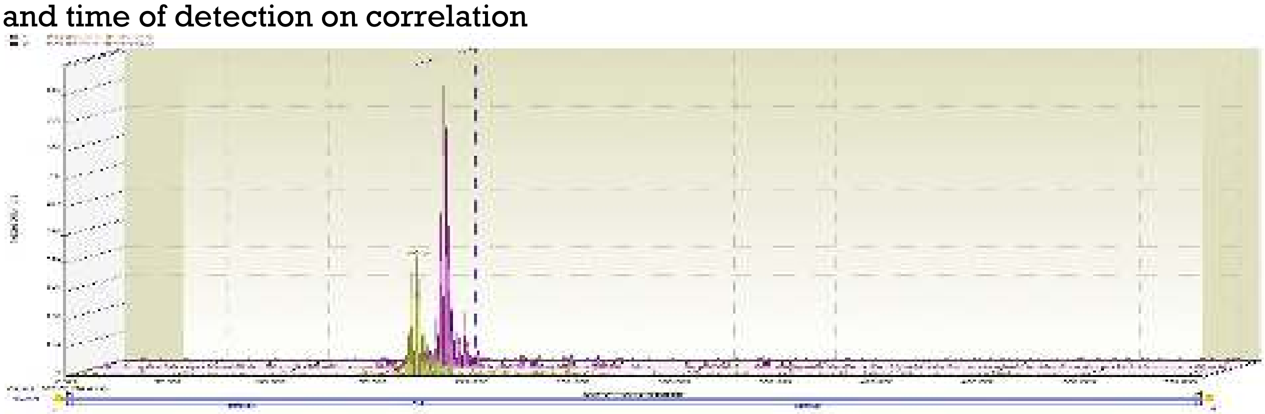
Arthur Pyburn & Sons Inc.
Technical Services

Leak worksheet

1065 Summer Street Lynnfield, MA, 01940
Phone (617) 529-3646 Fax (978) 948-5066
gpyburn@apsitech.com



Date: 3/15/17
System Name: Town of North Reading Water Department
Location: 9 Marshall St, Service Leaking
Approx. Size: 2-4 gpm
Pipe Material: CI
Date and time of detection on correlation



Pipe ID	Length	Diameter	Material	Sound Velocity
P8	560' 0"	12"	Cast Iron	3770 feet/sec

Leak ID	Leak Position	Correlation Between	Confidence	Recording Time
L25	172' 3" from 5	5 -> 6	88.0%	Feb 03 2017, 10:19:30AM
L26	171' 10" from 6	6 -> 5	51.4%	Feb 03 2017, 10:20:20AM
L16	171' 10" from 6	6 -> 5	51.4%	Feb 03 2017, 10:20:20AM

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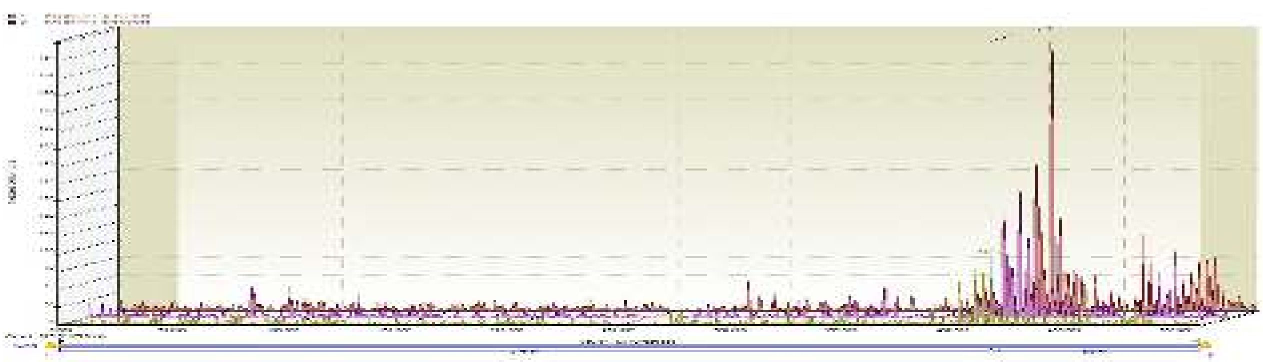
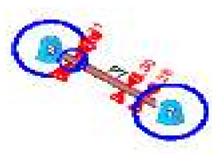
Date: 3/15/17
System Name: Town of North Reading Water Department
Location: 4 Rust Way, Service Leaking
Approx. Size: ___3-5 gpm___
Pipe Material: CI
Date and time of detection on correlation



Pipe ID	Length	Diameter	Material	Sound Velocity
[illegible]	[illegible]	[illegible]	Cast Iron	[illegible]

Leak ID	Leak Position	Correlation Between	Confidence	Recording Time
L28	512' 1" from 6	6 ~ 8	75.2%	Feb 03 2017, 12:07:28PM
L30	592' 5" from 6	6 ~ 8	72.2%	Feb 03 2017, 12:20:28PM
L31	417' 3" from 7	7 ~ 8	76.2%	Feb 03 2017, 13:07:28PM
L32	415' 10" from 7	7 ~ 8	80.2%	Feb 03 2017, 12:08:28PM
[illegible]	415' 1" from 7	7 ~ 8	88.2%	Feb 03 2017, 12:08:28PM
L37	415' 10" from 7	7 ~ 8	80.2%	Feb 03 2017, 12:08:28PM
[illegible]	417' 1" from 7	7 ~ 8	85.2%	Feb 03 2017, 12:09:28PM



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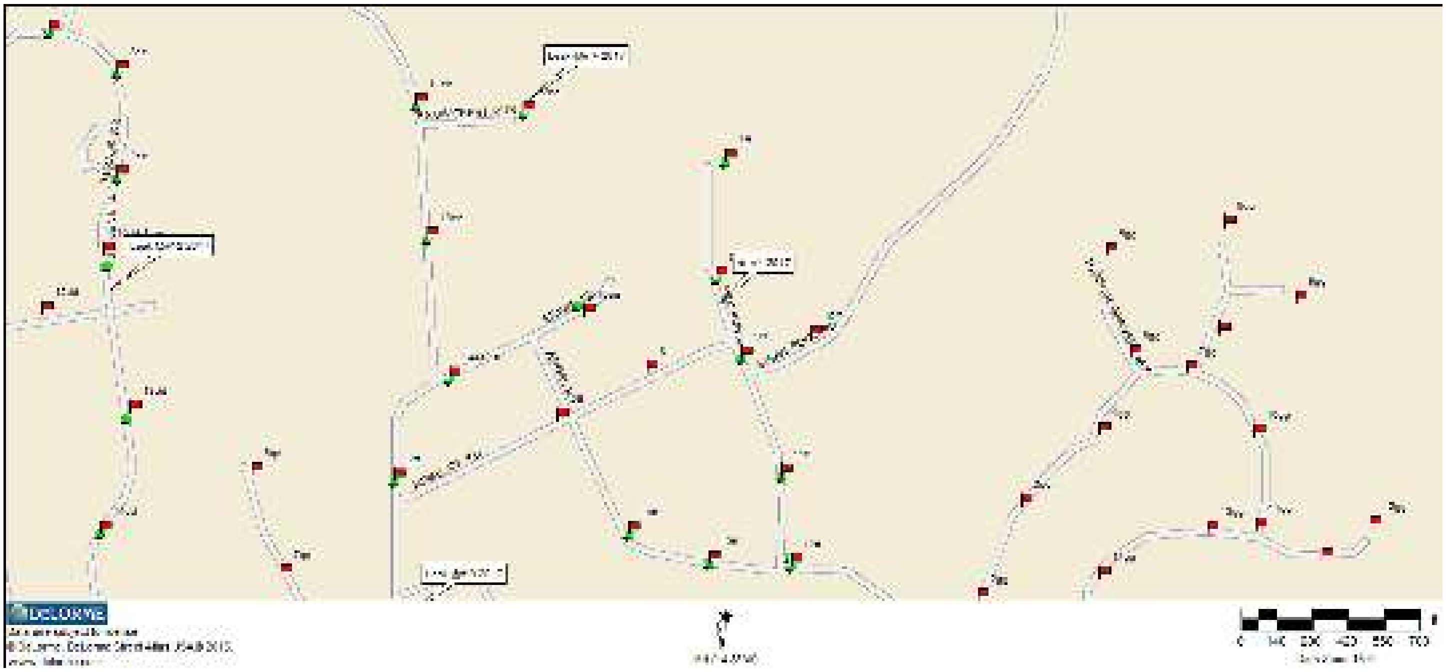
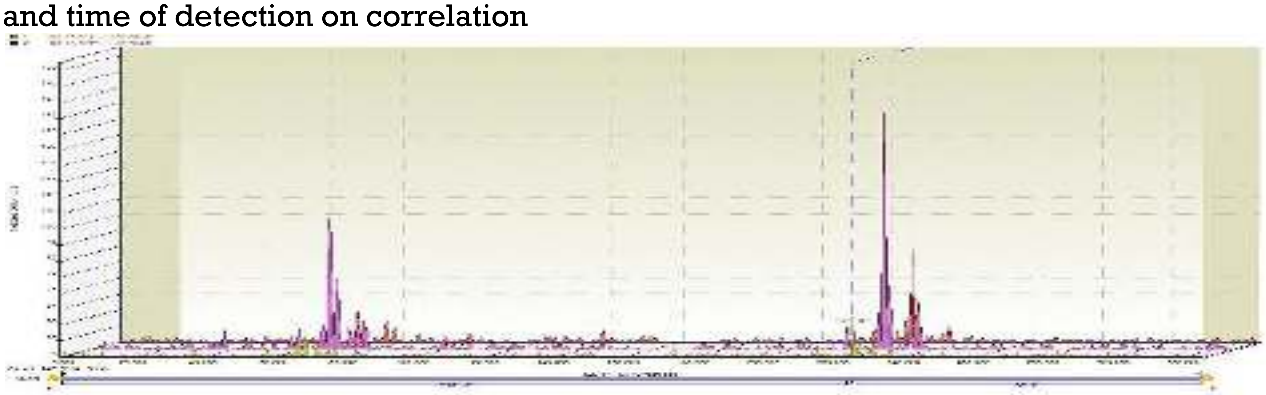
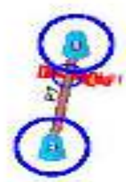


Date: 3/15/17
System Name: Town of North Reading Water Department
Location: 4 Fox Run, Service Leaking
Approx. Size: 1-3gpm
Pipe Material: CI
Date and time of detection on correlation



Pipe ID	Length	Diameter	Material	Sound Velocity
P7	[illegible]	12"	Cast Iron	[illegible]

Leak ID	Leak Position	Correlation Between	Confidence	Recording Time
L31	225' 10" from 9	9 -> 8	73.3%	Jan 16 2017, 10:53:36AM
L32	220' 3" from 9	9 -> 8	86.0%	Jan 16 2017, 11:00:36AM
[illegible]	225' 6" from 9	9 -> 8	[illegible]	Jan 16 2017, [illegible]
[illegible]	225' 2" from 9	9 -> 8	[illegible]	Jan 16 2017, [illegible]
L30	225' 5" from 9	9 -> 8	85.1%	Jan 16 2017, 11:01:36AM



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Leak worksheet

Date: 3/15/17

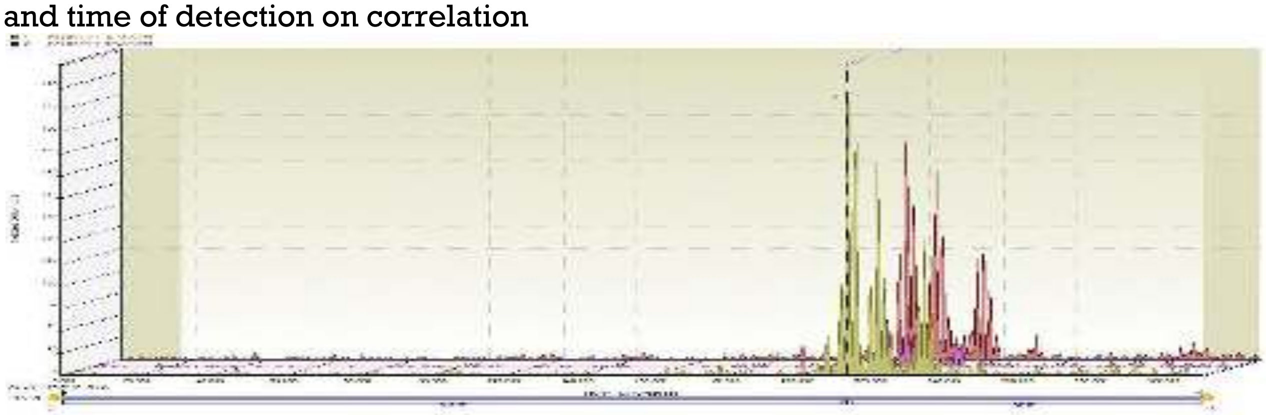
System Name: Town of North Reading Water Department

Location: 10 Woodland, Service Leaking

Approx. Size: 1-3 gpm

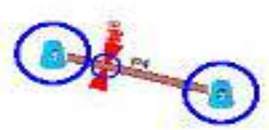
Pipe Material: CI

Date and time of detection on correlation



Pipe ID	Length	Diameter	Material	Sound Velocity
P4	[illegible]	12"	Cast Iron	[illegible]

Leak ID	Leak Position	Correlation Between	Confidence	Recording Time
L16	215' 7" from 5	5 --> 4	57.1%	Feb 03 2017, 12:45:32PM
L17	210' 9" from 5	5 --> 4	52.1%	Feb 03 2017, 12:40:32PM
L18	215' 3" from 5	5 --> 4	56.1%	Feb 03 2017, 12:47:32PM
L56	214' 0" from 5	5 --> 4	51.6%	Feb 03 2017, 12:46:32PM
L58	215' 3" from 5	5 --> 4	56.1%	Feb 03 2017, 12:47:32PM



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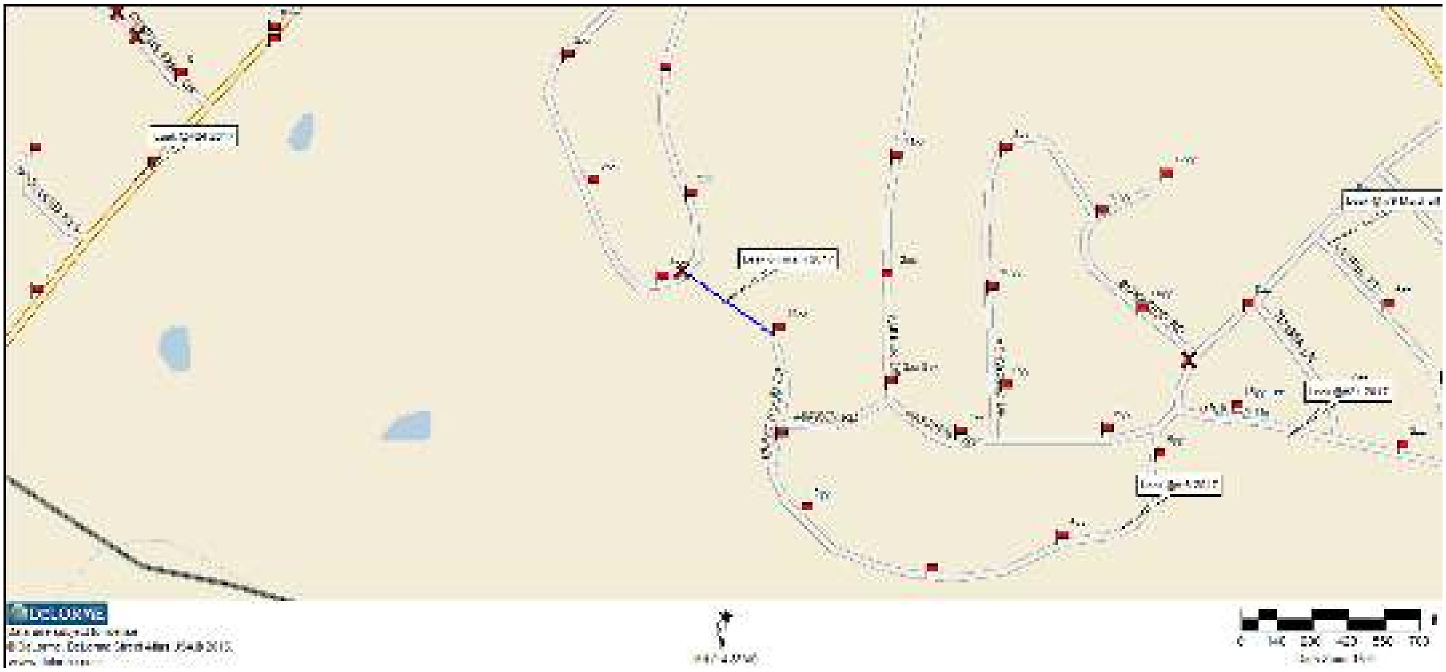
Leak worksheet



Date: 3/15/17

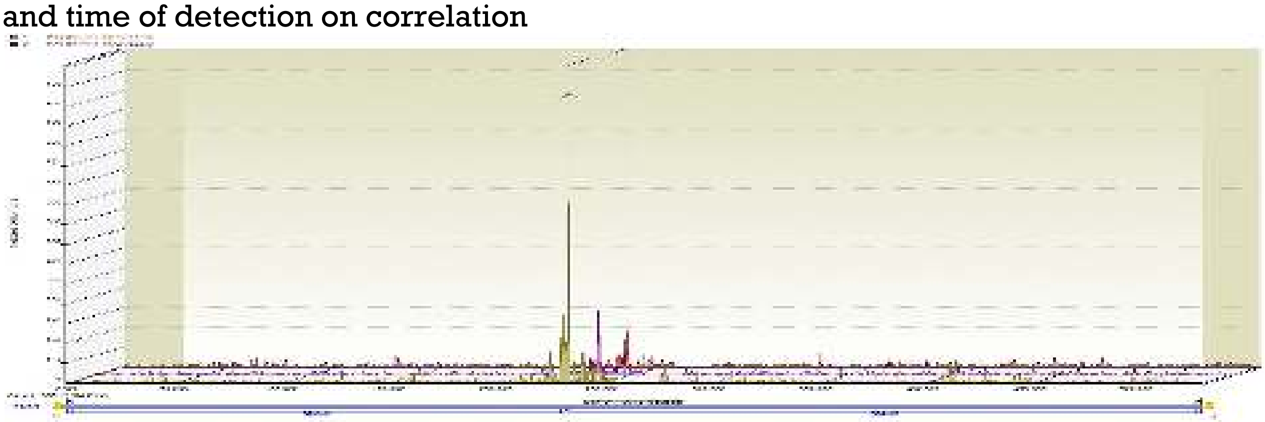
System Name: Town of North Reading Water Department

Location: Heritage to Crestwood cross country main, Main Leaking

Approx. Size: 50-75 gpm

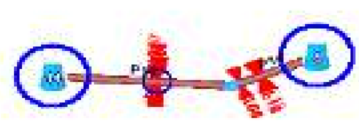
Pipe Material: CI

Date and time of detection on correlation



Pipe ID	Length	Diameter	Material	Sound Velocity
P14	130' 0"	12"	Cast Iron	3770 feet/sec
P15	400' 0"	10"	Cast Iron	3770 feet/sec

Leak ID	Leak Position	Correlation Between	Confidence	Recording Time
L13	687' 2" from 3	3 ↔ 5	85.0%	Feb 03 2017, 08:42:44AM
L14	686' 12" from 3	3 ↔ 5	84.7%	Feb 03 2017, 08:43:44AM
L15	686' 2" from 3	3 ↔ 5	82.8%	Feb 03 2017, 08:44:44AM
L64	119' 7" from 4	4 ↔ 5	90.3%	Feb 03 2017, 08:42:44AM
L65	119' 7" from 4	4 ↔ 5	92.9%	Feb 03 2017, 08:43:44AM
L66	119' 7" from 4	4 ↔ 5	93.6%	Feb 03 2017, 08:44:44AM
L67	234' 4" from 14	14 ↔ 4	90.8%	Feb 03 2017, 08:42:44AM
L68	234' 5" from 14	14 ↔ 4	87.2%	Feb 03 2017, 08:43:44AM
L69	235' 7" from 14	14 ↔ 4	84.0%	Feb 03 2017, 08:44:44AM
L70	233' 10" from 14	14 ↔ 5	90.3%	Feb 03 2017, 08:42:44AM
L71	234' 4" from 14	14 ↔ 5	84.9%	Feb 03 2017, 08:43:44AM
L72	231' 7" from 14	14 ↔ 5	73.6%	Feb 03 2017, 08:44:44AM
L73	234' 5" from 14	14 ↔ 4	87.2%	Feb 03 2017, 08:43:44AM
L74	235' 7" from 14	14 ↔ 4	83.4%	Feb 03 2017, 08:44:44AM



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Leak worksheet

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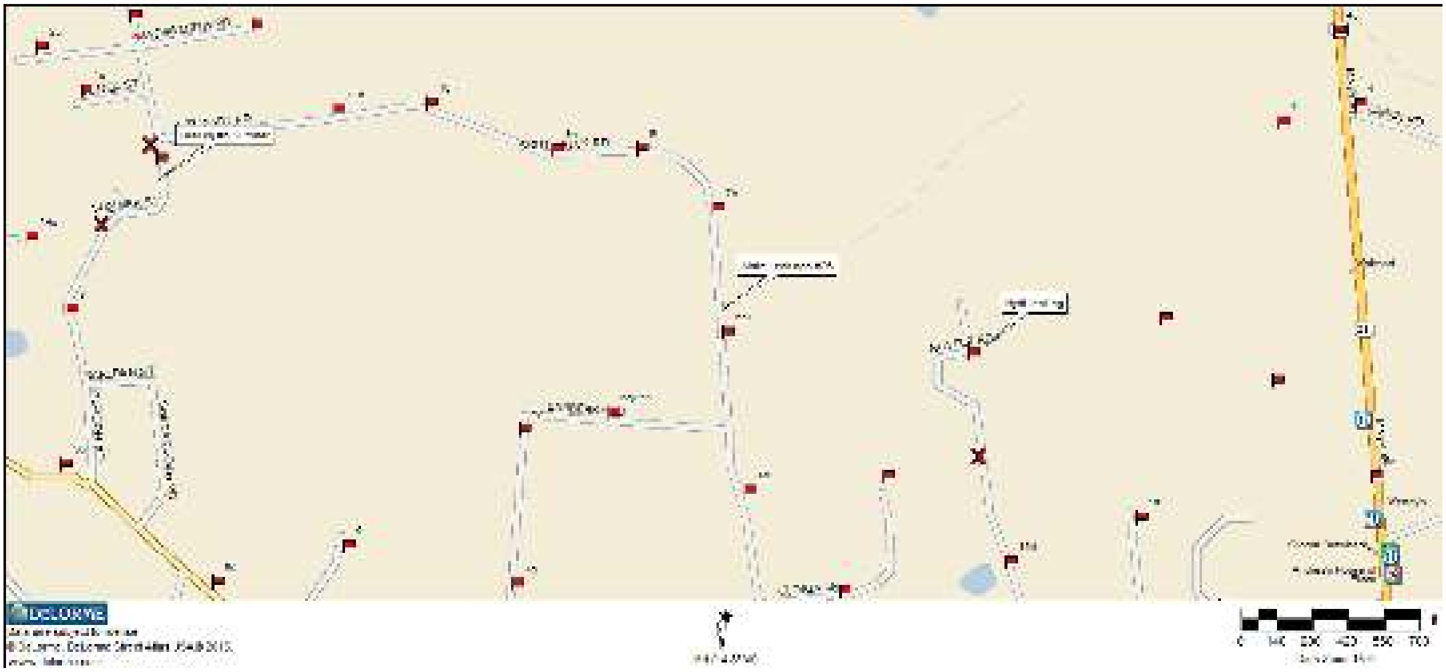
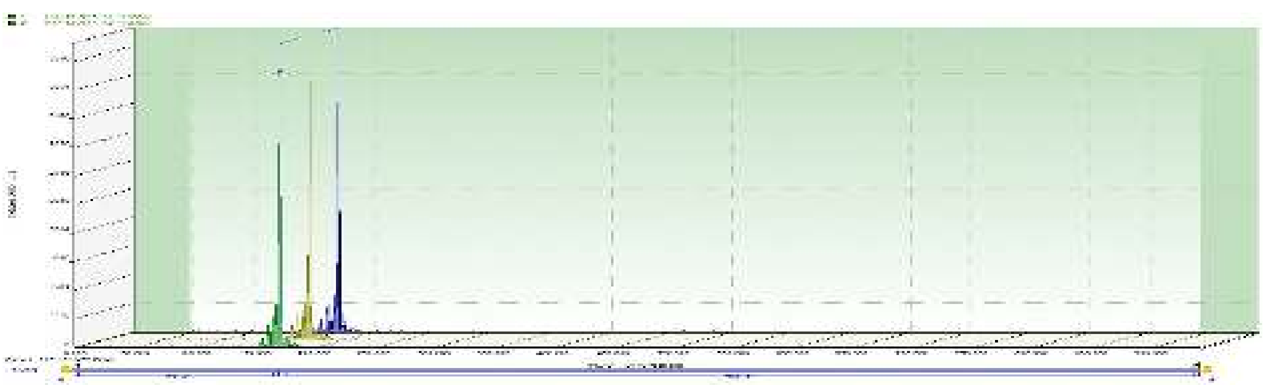


Date: 3/15/17
System Name: Town of North Reading Water Department
Location: Southwick by #26, Main Leaking
Approx. Size: ___500 gpm__
Pipe Material: CI
Date and time of detection on correlation



Pipe ID	Length	Diameter	Material	Sound Velocity
P8	600' 0"	12"	Cast Iron	3770 feet/sec
P9	440' 0"	12"	Cast Iron	3770 feet/sec

Leak ID	Leak Position	Correlation Between	Confidence	Recording Time
L25	149' 4" from 6	6 → 7	35.1%	Dec 14 2016, 04:14:45AM
L26	149' 4" from 6	6 → 7	95.0%	Dec 14 2016, 04:12:45AM
L27	149' 4" from 6	6 → 7	56.2%	Dec 14 2016, 04:16:45AM
L28	171' 4" from 6	6 → 8	27.6%	Dec 14 2016, 04:14:45AM
L29	171' 4" from 6	6 → 8	47.5%	Dec 14 2016, 04:12:45AM
L30	171' 4" from 6	6 → 8	37.5%	Dec 14 2016, 04:16:45AM
L31	15' 9" from 7	7 → 8	34.3%	Dec 14 2016, 04:14:45AM
L32	15' 9" from 7	7 → 8	84.1%	Dec 14 2016, 04:12:45AM
L33	15' 9" from 7	7 → 8	53.7%	Dec 14 2016, 04:16:45AM
L67	171' 4" from 6	6 → 8	27.5%	Dec 14 2016, 04:15:45AM
L68	171' 4" from 6	6 → 8	47.5%	Dec 14 2016, 04:12:45AM

Town of North Reading Massachusetts

Water Department

Water System Leak Detection Survey Report 2019

Prepared By

Arthur Pyburn & Sons Inc.

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October 31, 2019

Town of North Reading
Water Department
235 North Street
N. Reading, MA 01864

The following is a summary of leak detection performed on approximately 80 miles of the N. Reading Water Department's distribution system. The survey took place over the period from November 26, 2019 to January 6, 2020

The pages that follow are the individual reports for each leak.

During the course of this survey leaks were found at the following locations.

Location	Type of Leak	Estimated gpm	Leak Class
4 Rust Ln svc leaking	service	3gpm	3
16 Crestwood Rd Serive Leaking	service	4gpm	3
29 Crestwood Service Leaking	service	3gpm	3
4 Geenmeadow Rd service leaking	service	6gpm	2
51 Niblick Way Service Leaking	service	8gpm	2
4 Fox Run Rd Service Leaking	service	5gpm	2
16 Shasta Dr Service leak	service	3gpm	3
2 Turner Dr Service leak	service	4gpm	3
20 Strawberry Ln Service leaking	service	4gpm	3
6 Arline Dr Service leak	service	5gpm	2
8 Lillian Dr Service leak	service	6gpm	2
17 Tower hill Rd Service leaking	service	4gpm	3
9 Liberty Lane Service leak	service	4gpm	3
14 Pine Glen Dr Service leak	service	6gpm	6
33 Spruce Rd Service leak	service	4gpm	3

15 Ridgeway Service leaking	service	2gpm	3
52 Spruce Rd Service leak	service	4gpm	3
Deerfield Pl Extention	Main	15gpm	1
4 East St. Service leak	service	8gpm	2
25 Fieldcrest Ter. Hydrant leak	service	3gpm	3
24 Haverhill St. Service Leak	service	3gpm	3
8A Chestnut Service Leak	service	8gpm	2
Main St southbound between Jokers Wild & Sweepman Inc Pole 66 Main leak	Main	100gpm	1
3 Gillis Dr. Service leak	service	3gpm	3
7 Hayward Farms	service	3gpm	3
3 Gifford way hydrant leak	Hydrant	1gpm	3

Summary Table Below;

Classification	Number of Leaks	Estimated Leakage GPM	Estimated Leakage GPD	Estimated leakage GPY
1	2	115	165,600	60,444,000
2	8	52	74,880	27,331,200
3	16	52	74,880	27,331,200
Totals	26	217	315,360	115,106,400

Source of Leakage	Number of Leaks	Estimated Leakage GPM	% of Total Number	% of Total Estimated GPM
Mains	2	115	8	53
Services	23	101	88	46.5
Hydrants	1	1	4	0.5
Totals	26	217	100	100

Type of Survey:	**Correlation**	**Grade 1 (C)**	**15 to + GPM**
Miles of Main Inspected:	**80**	**Grade 2 (B)**	**5 to 14 GPM**
Number of Leaks Located:	**26**	**Grade 3 (A)**	**1 to 4 GPM**

Leak Indication Classification

Leak indication classification is not an exact science despite the use of modern instruments as well as training and experience by the consultant. It is impossible to determine the exact condition of the underground piping without exposing it. In view of this limitation, our classification (including estimated volume loss) is intended as an aid in scheduling repairs based upon information available. The consultant's judgement and site conditions at the time of the report is prepared. Once the leak is exposed for repair, the utility may wish to revise the volume loss in order to establish a more accurate estimate of actual water loss.

Respectfully Submitted by Gregory Pyburn

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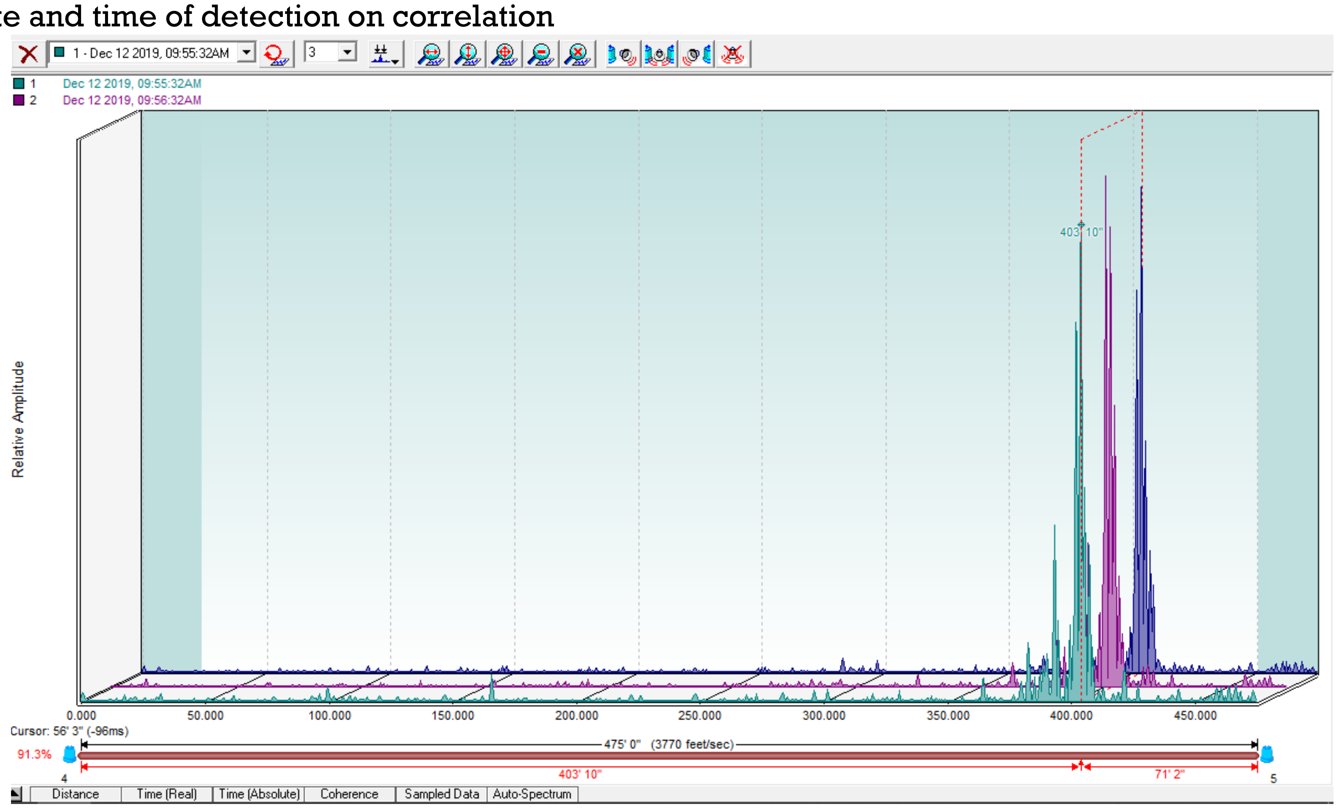
Leak worksheet

Date: 12/30/19
System Name: North Reading
Location: 2 Turner Dr. Service leak
Approx. Size: __4gpm__ Type of Surface Cover: mixed
Leak class: 3
Date and time of detection on correlation



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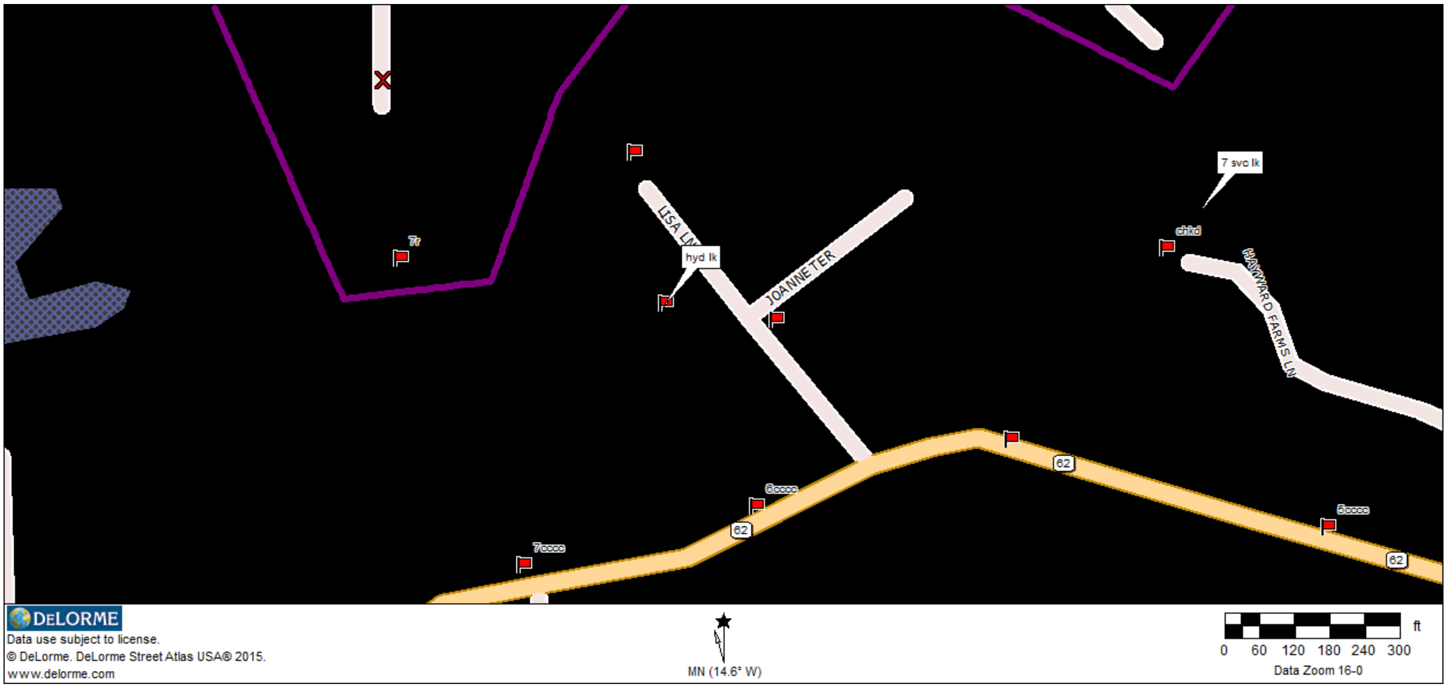
Leak worksheet



Date: 1/10/20
System Name: North Reading
Location: 3 Gifford way. Hydrant leak
Approx. Size: __1gpm__ Type of Surface Cover: mixed
Leak class: 3
Leak detected during audit of logger recordings
Leak detected on 1.7,20 at 1000hrs

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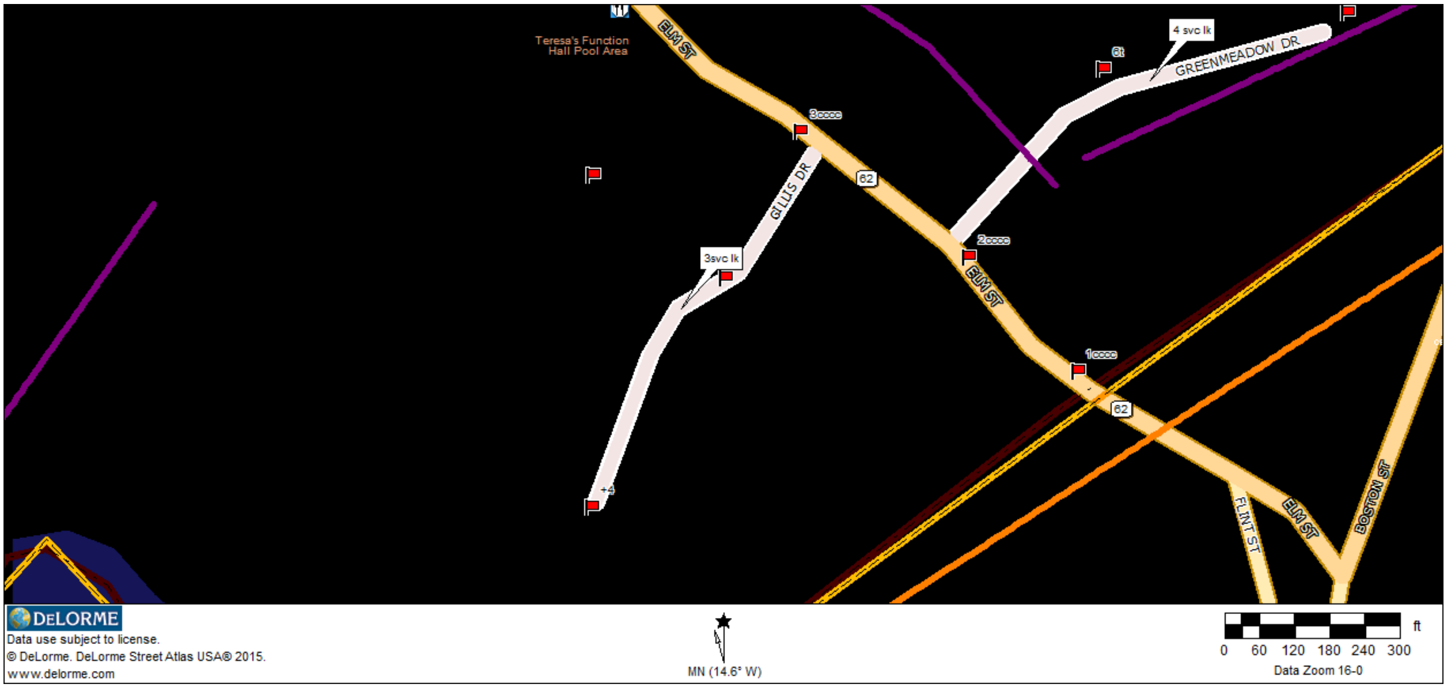
Leak worksheet



Date: 12/30/19
System Name: North Reading
Location: 3 Gillis Dr. Service leak
Approx. Size: __3gpm__ Type of Surface Cover: mixed
Leak class: 3
Leak detected during audit of logger recordings
Leak detected on 1.7,20 at 0930hrs

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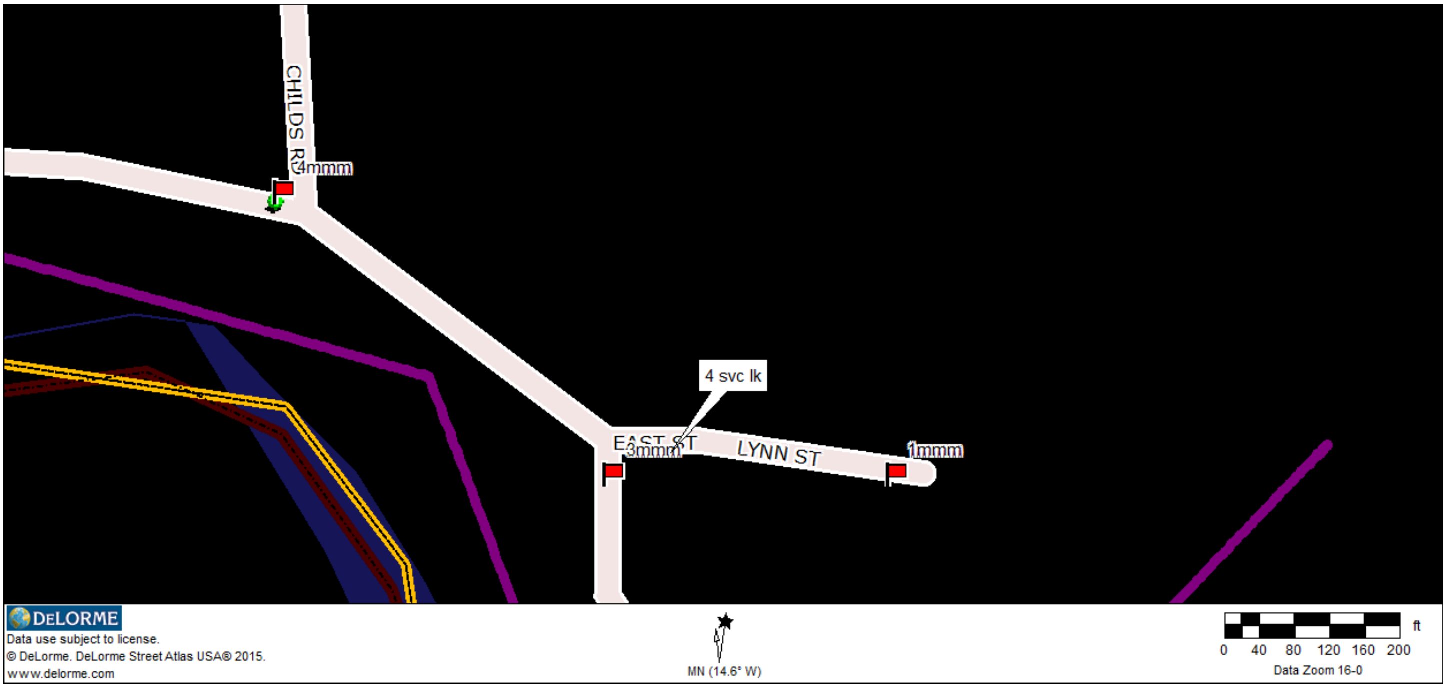
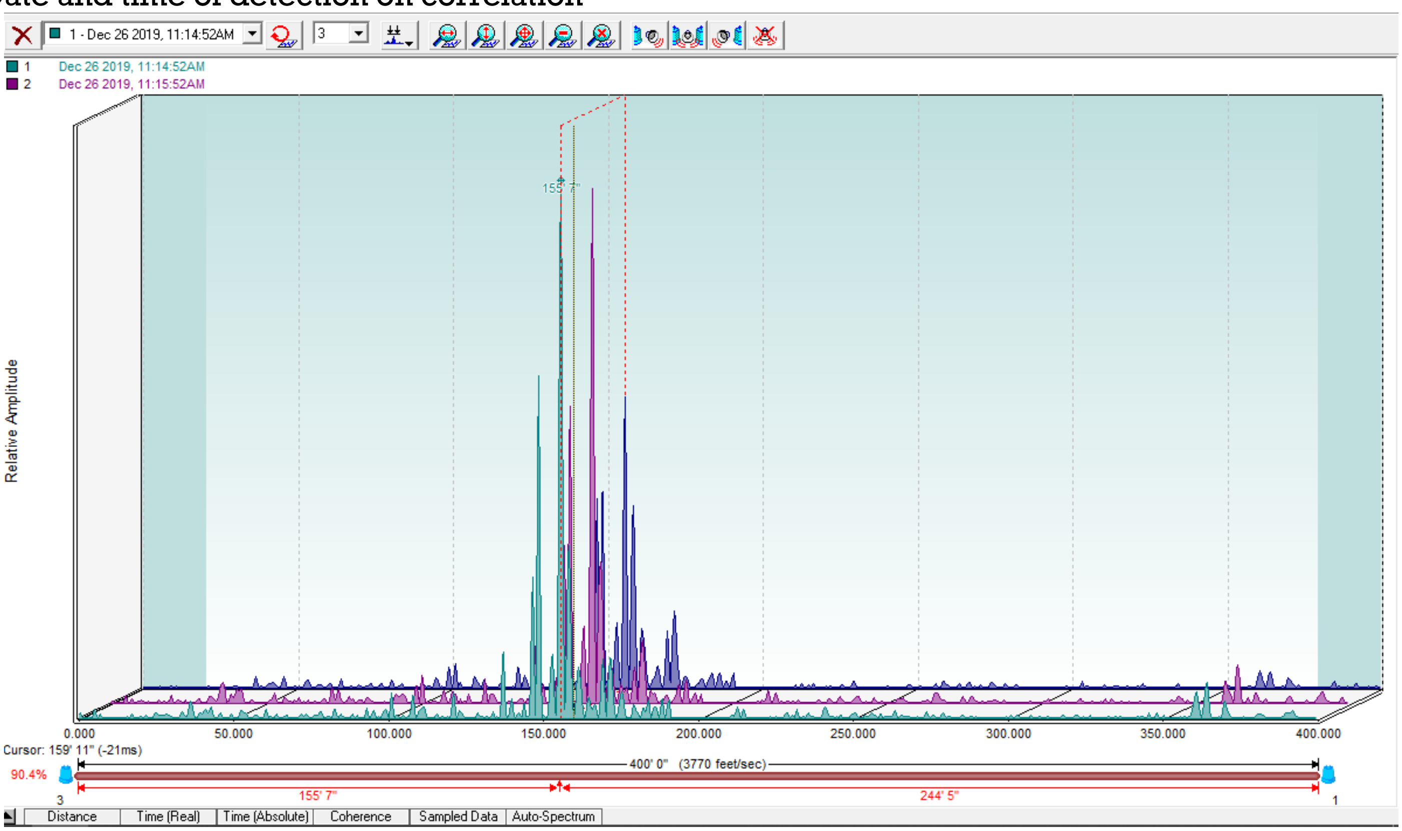
Technical Services

Leak worksheet



Date: 12/30/19
System Name: North Reading
Location:4 East St. Service leak
Approx. Size: __8gpm__ Type of Surface Cover: mixed
Leak class: 2
Date and time of detection on correlation



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Leak worksheet

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Date: 12/30/19

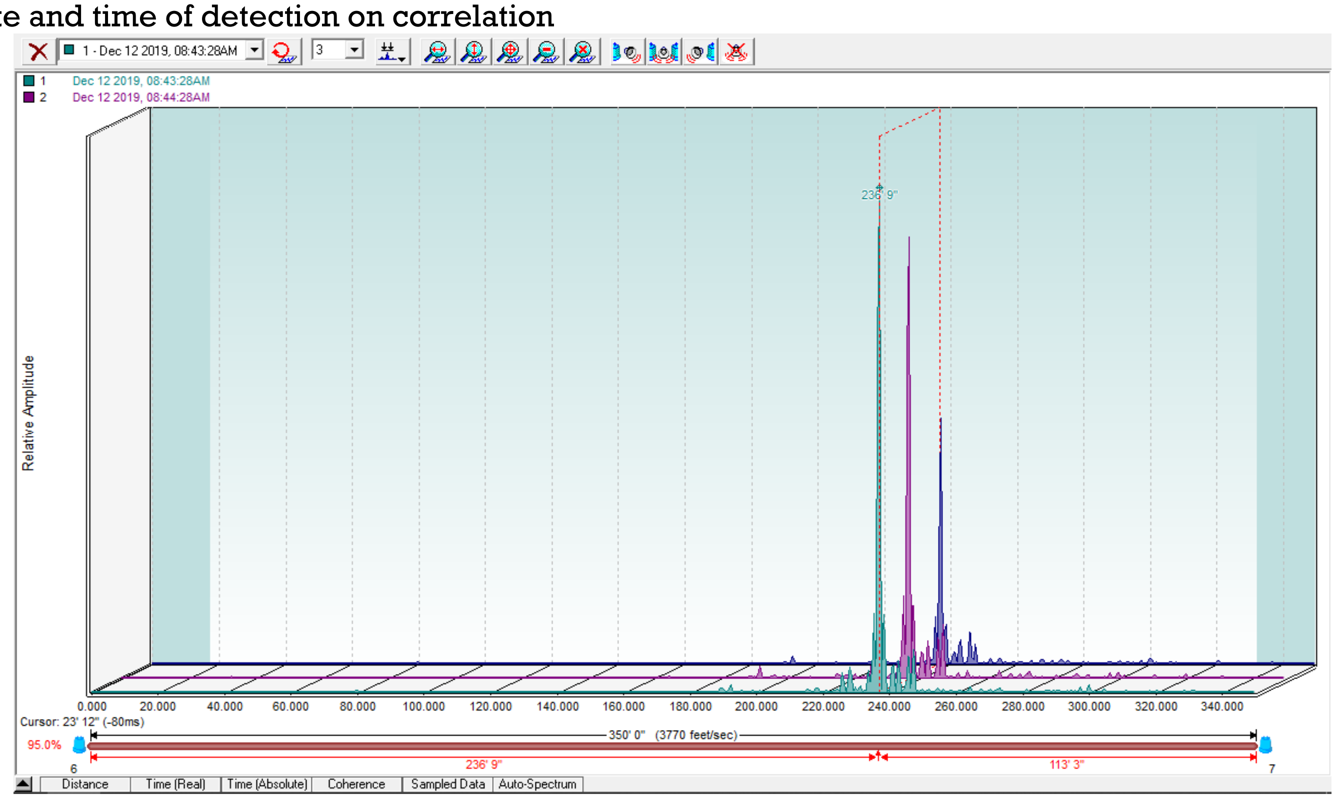
System Name: North Reading

Location: 4 Fox Run Rd. Service leak

Approx. Size: __5gpm__ Type of Surface Cover: mixed

Leak class: 2

Date and time of detection on correlation



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Leak worksheet

Date: 12/30/19

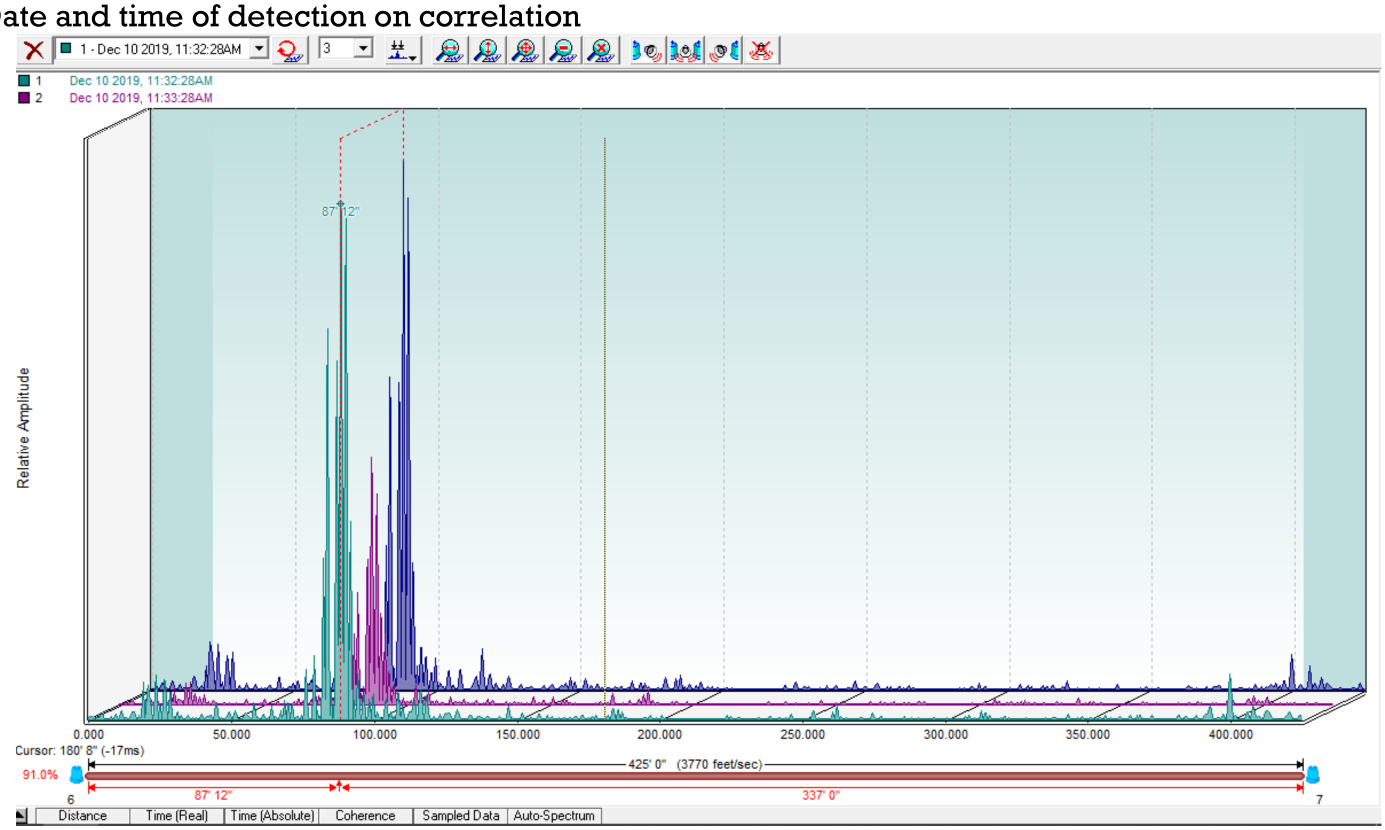
System Name: North Reading

Location: 4 Greenmeadow Rd. Service leak

Approx. Size: __6gpm__ Type of Surface Cover: mixed

Leak class: 2

Date and time of detection on correlation



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Leak worksheet

Date: 12/30/19

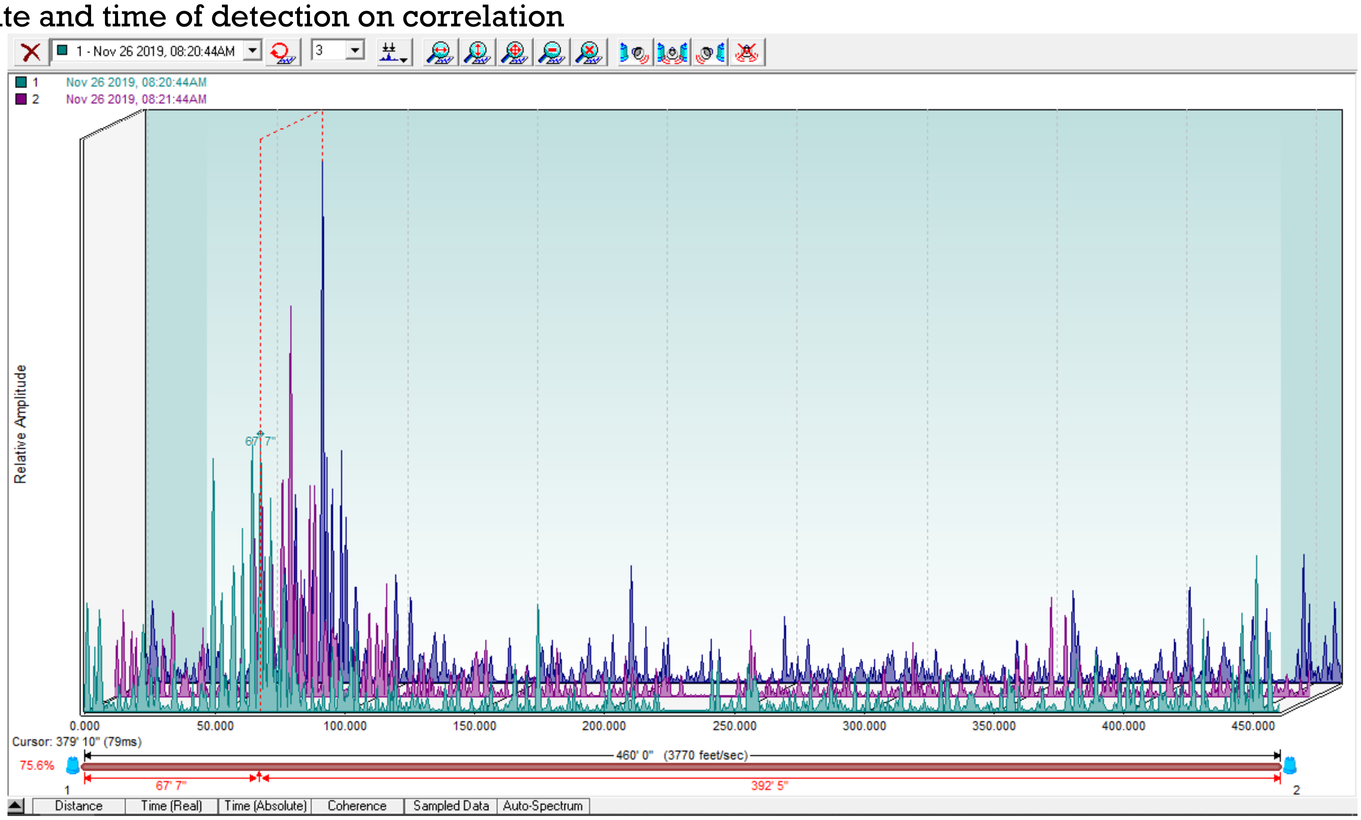
System Name: North Reading

Location: 4 Rust Ln. Service leak

Approx. Size: __3 gpm__ Type of Surface Cover: mixed

Leak class: 3

Date and time of detection on correlation



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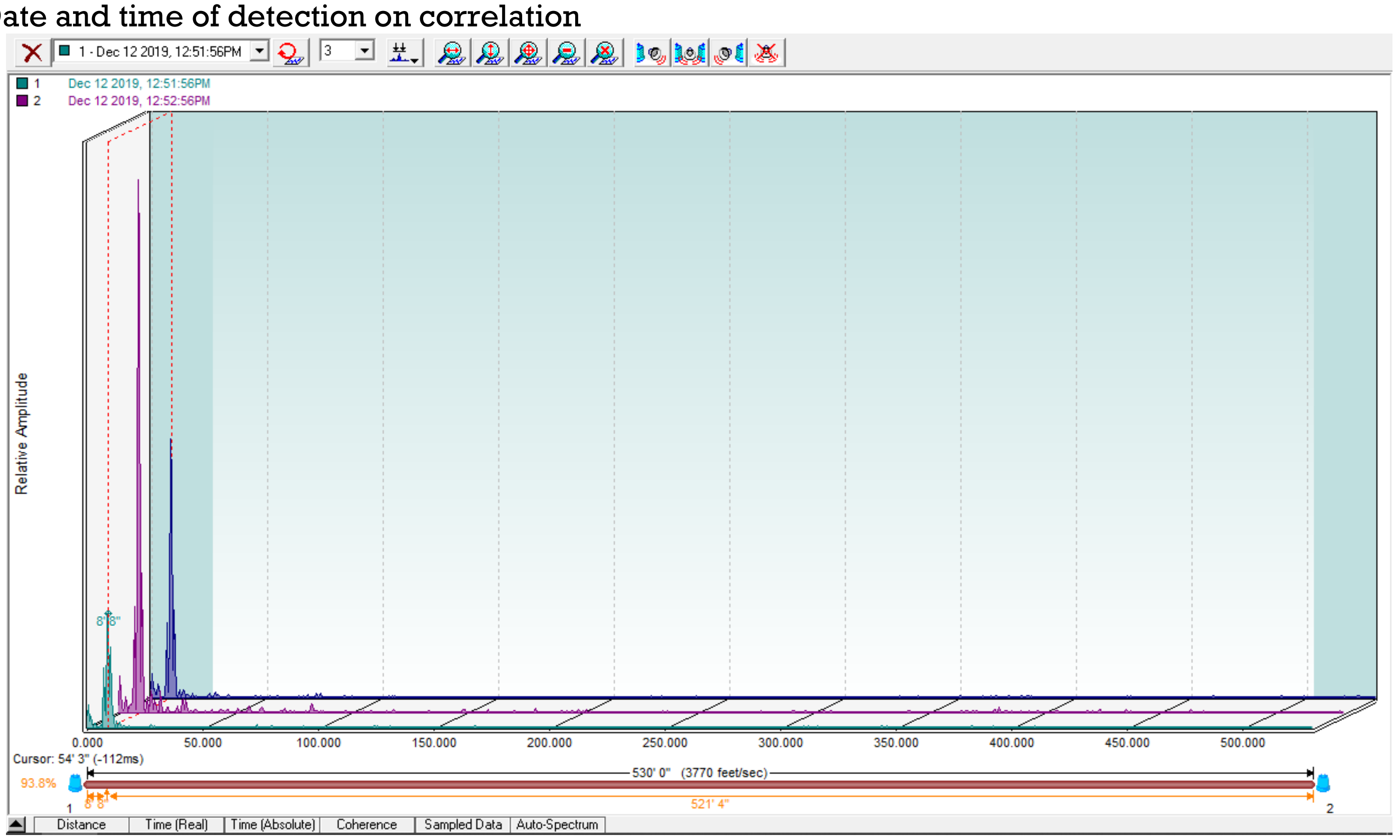
Leak worksheet

Date: 12/30/19
System Name: North Reading
Location: 6 Arline Dr. Service leak
Approx. Size: __5gpm__ Type of Surface Cover: mixed
Leak class: 2
Date and time of detection on correlation



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Leak worksheet

Date: 1/10/20
System Name: North Reading
Location: 7 Hayward Farms Ln. Service leak
Approx. Size: __3gpm__ Type of Surface Cover: mixed
Leak class: 3
Leak detected during audit of logger recordings
Leak detected on 1.7,20 at 1000hrs

Arthur Pyburn & Sons Inc.
Technical Services
Leak worksheet

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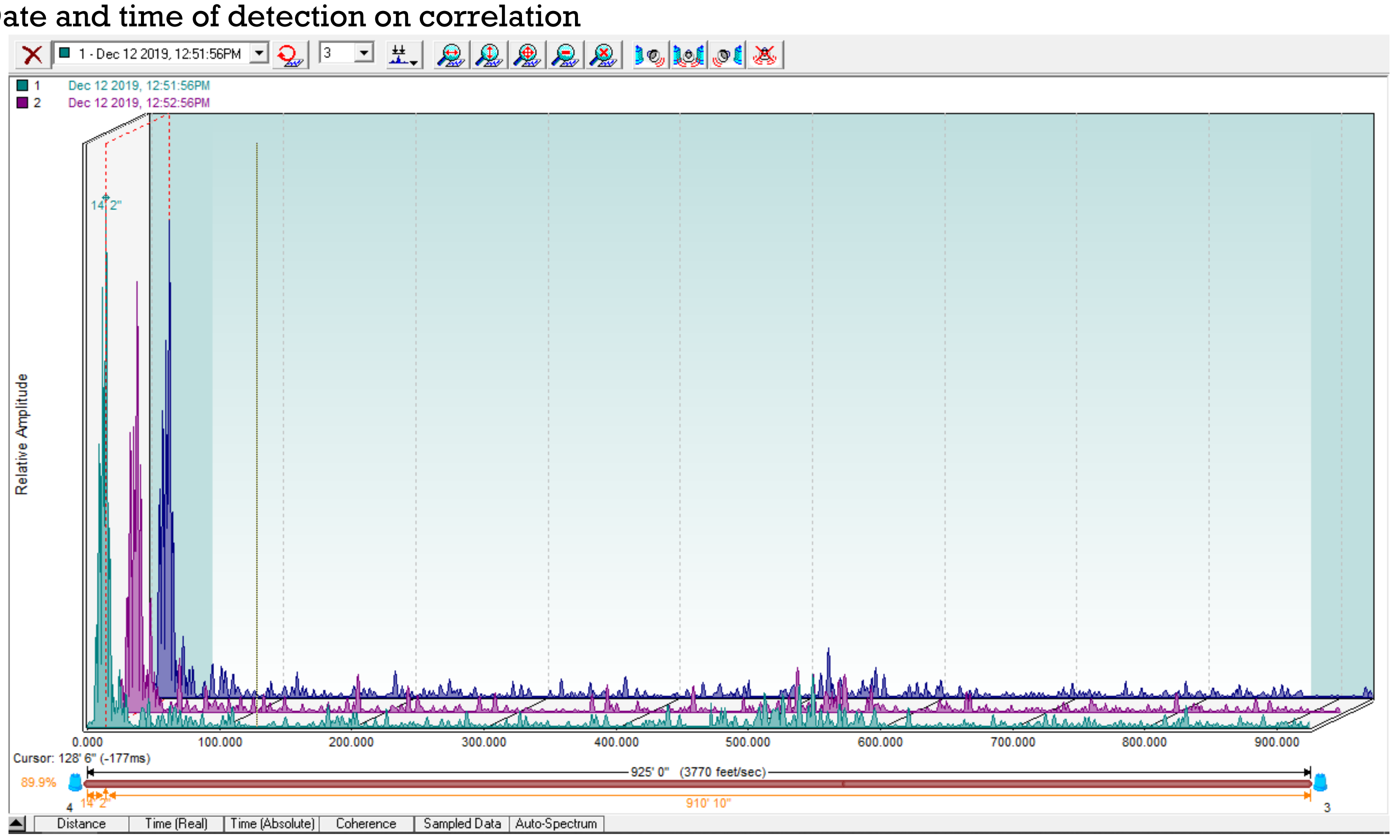
Date: 12/30/19
System Name: North Reading
Location: 8 Lillian Dr. Service leak
Approx. Size: __6gpm__ Type of Surface Cover: mixed
Leak class: 2
Date and time of detection on correlation



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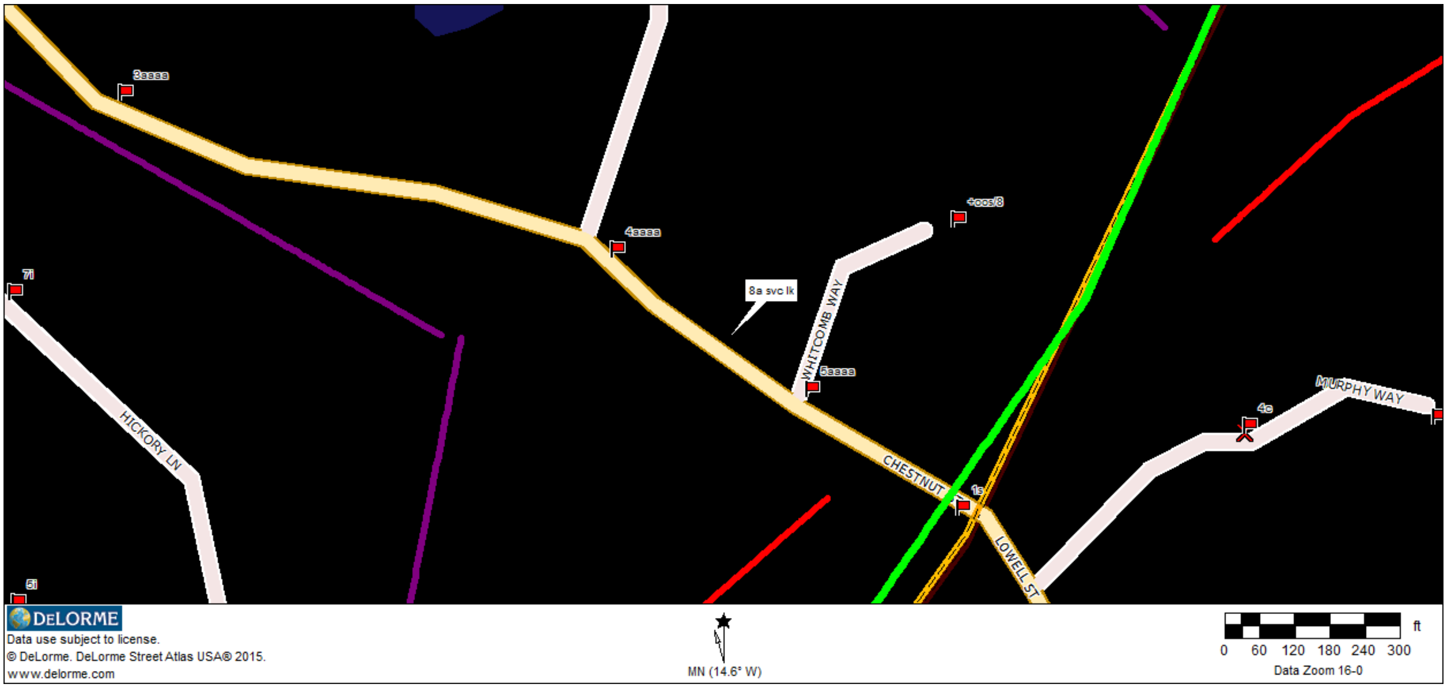
Leak worksheet



Date: 12/30/19

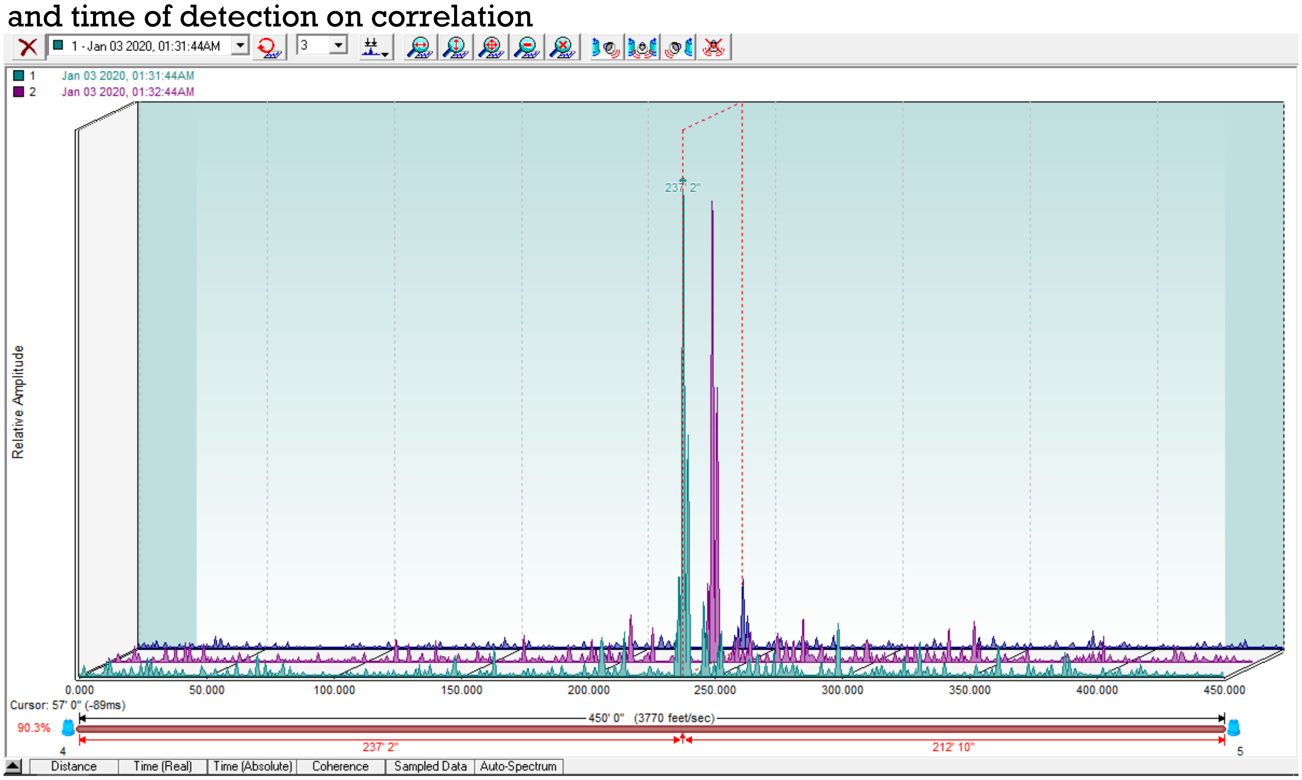
System Name: North Reading

Location: 8A Chestnut St. Service leak

Approx. Size: __8gpm__ Type of Surface Cover: mixed

Leak class: 2

Date and time of detection on correlation



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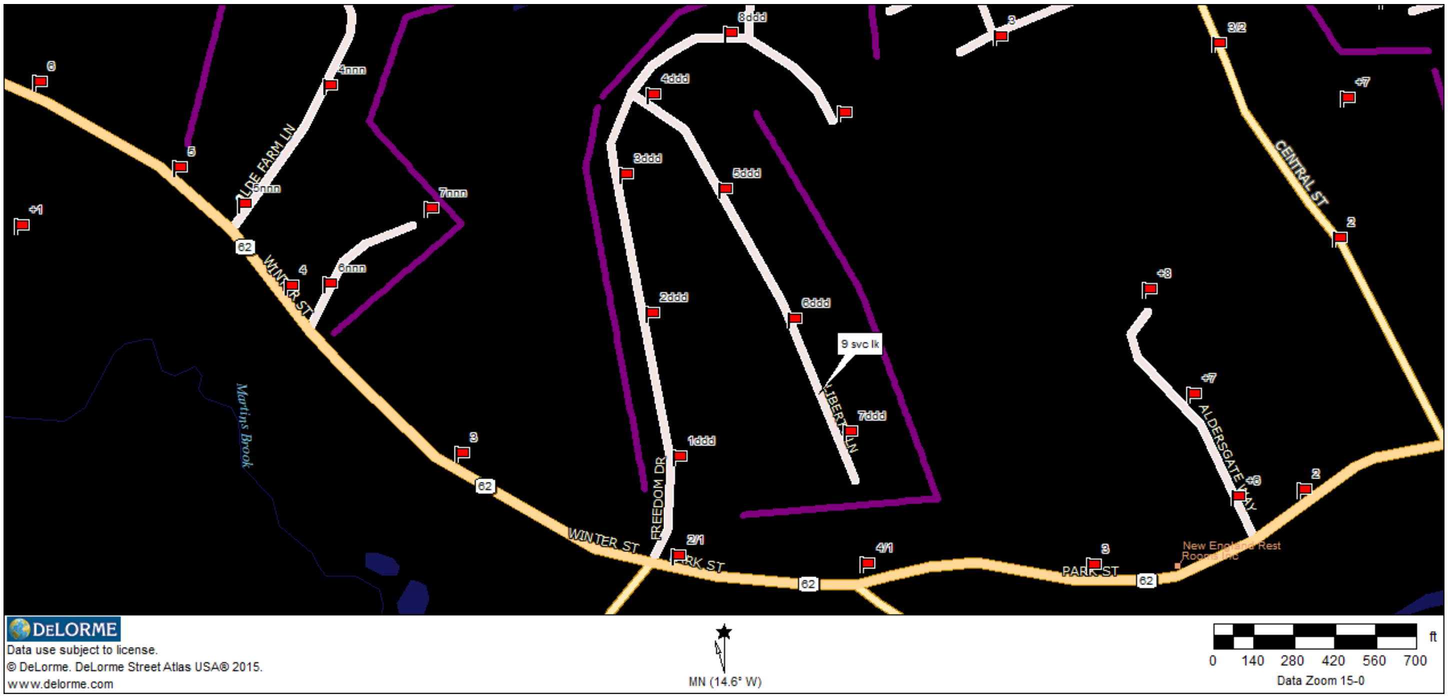
Leak worksheet



Date: 12/30/19

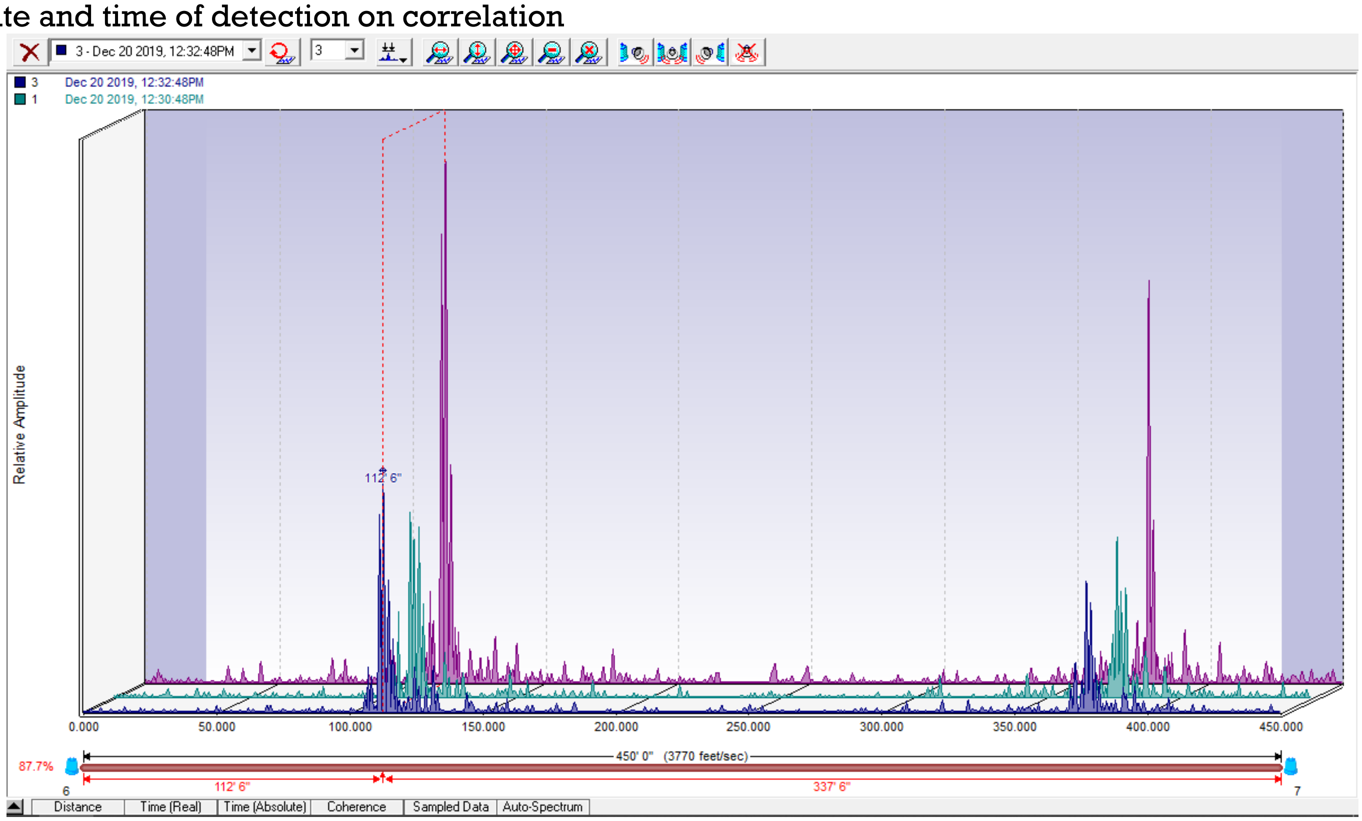
System Name: North Reading

Location: 9 Liberty Ln. Service leak

Approx. Size: __4gpm__ Type of Surface Cover: mixed

Leak class:3

Date and time of detection on correlation



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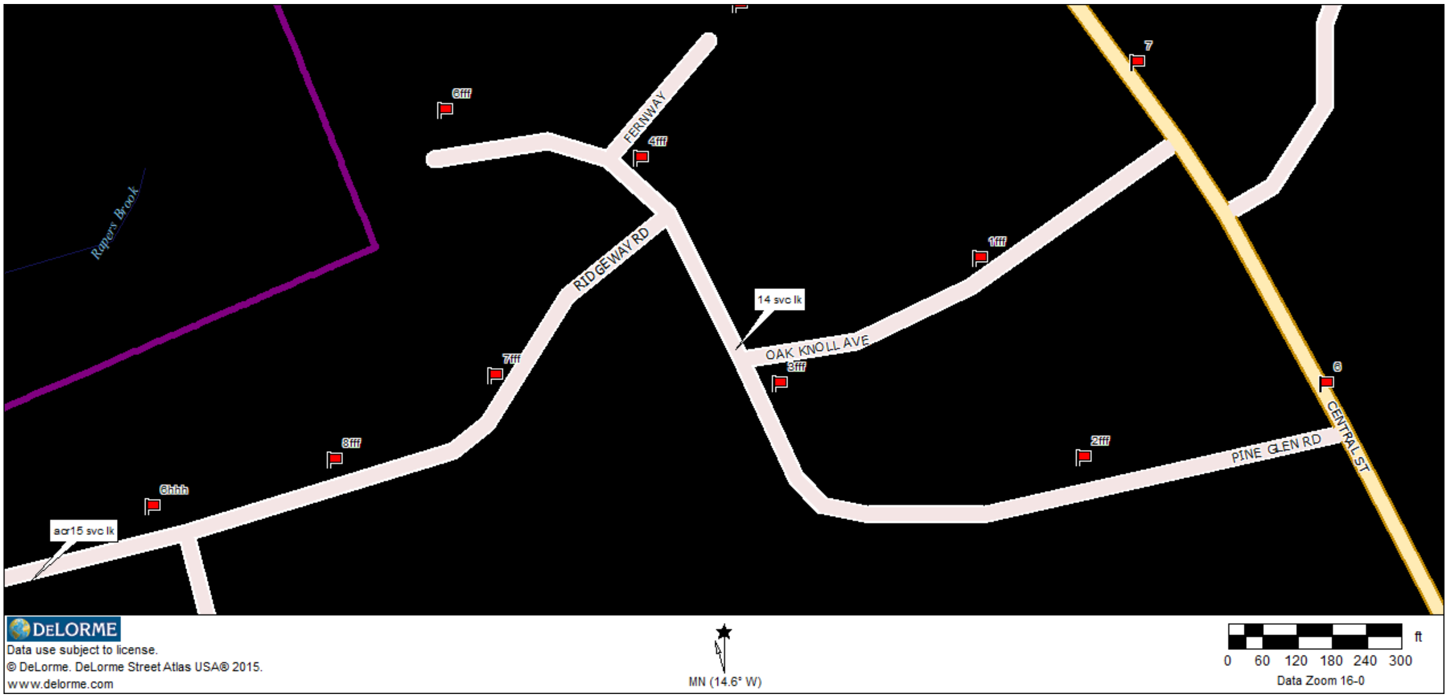
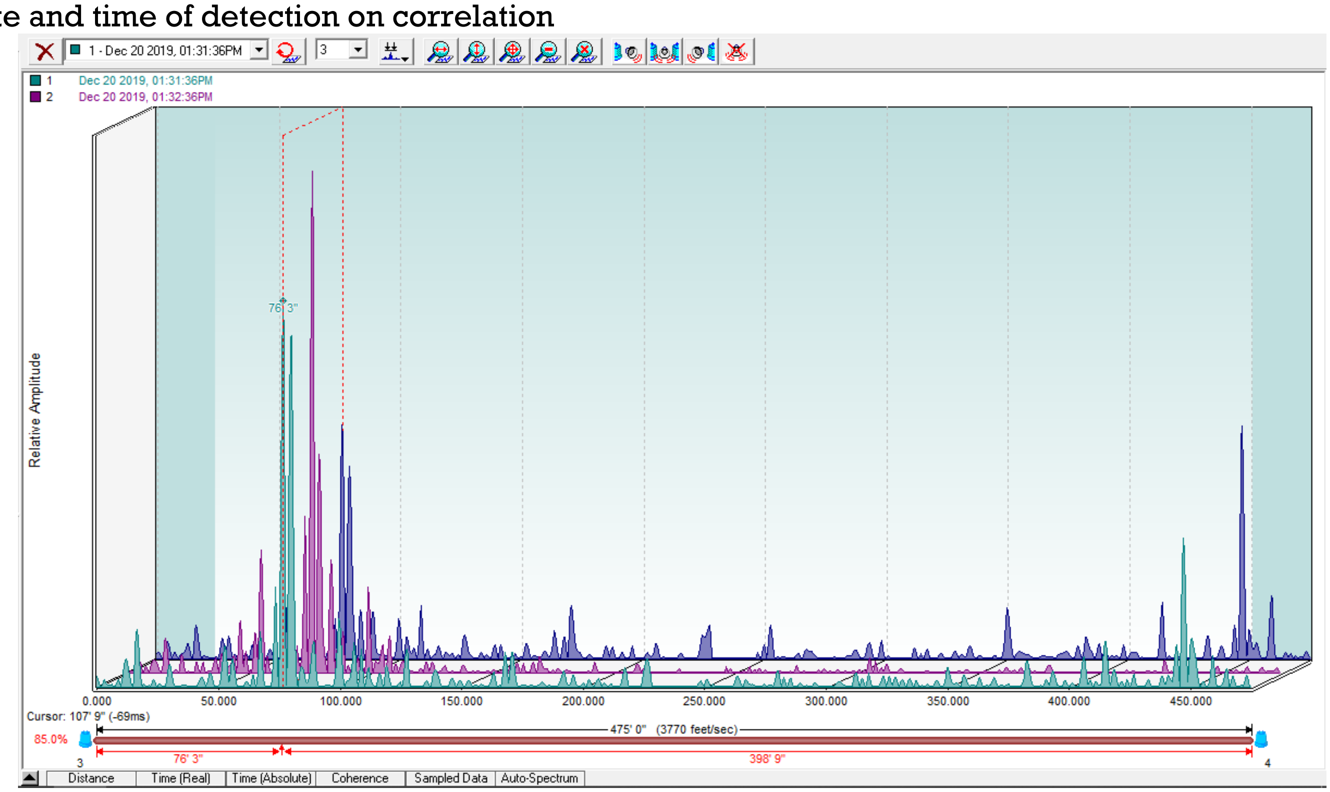
Phone (617) 529-3646 ♦ gpyburn@apsitech.com

Leak worksheet



Date: 12/30/19
System Name: North Reading
Location: 14 Pine Glen Dr. Service leak
Approx. Size: __6gpm__ Type of Surface Cover: mixed
Leak class:2
Date and time of detection on correlation



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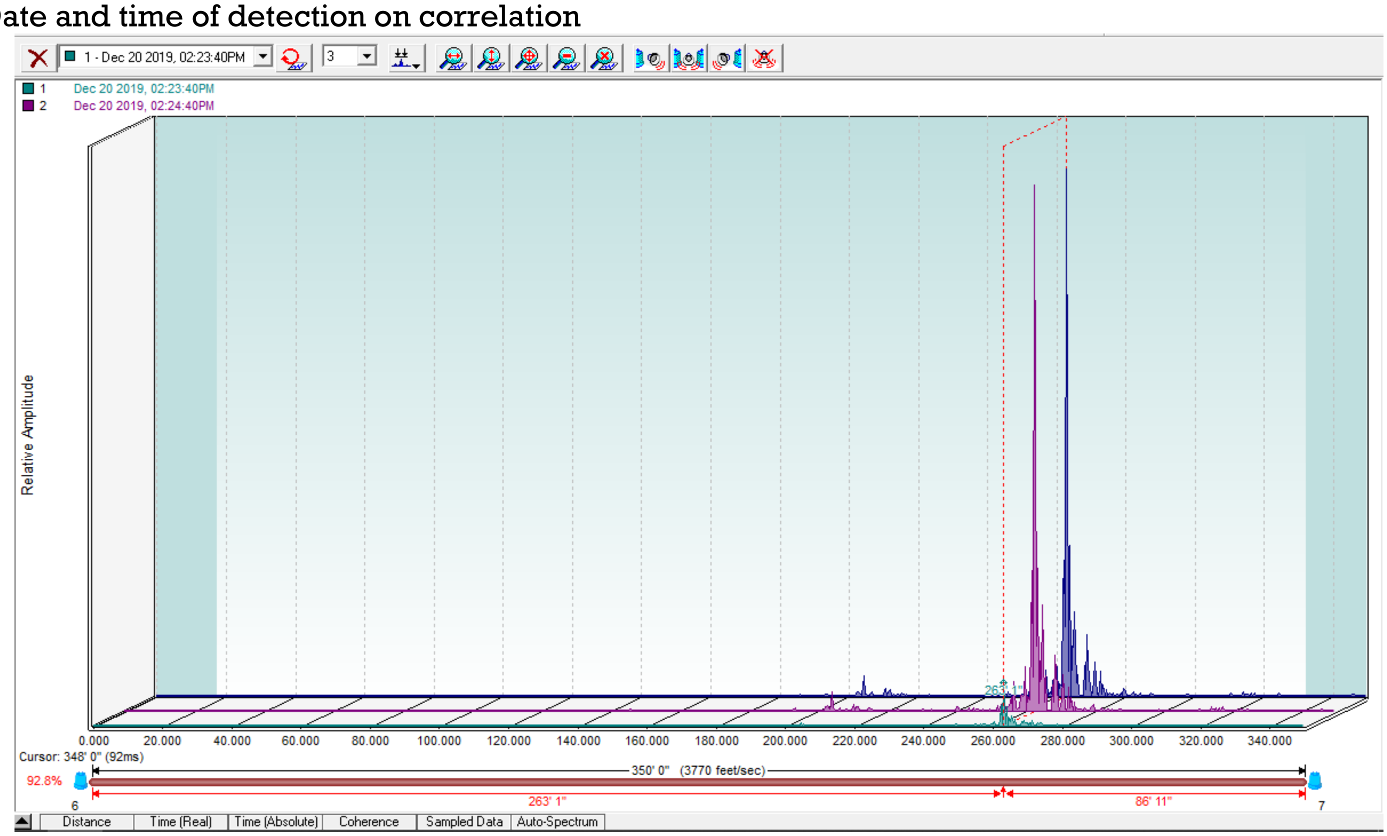
Leak worksheet

Date: 12/30/19
System Name: North Reading
Location: 15 Ridgeway Rd. Service leak
Approx. Size: __2gpm__ Type of Surface Cover: mixed
Leak class:3
Date and time of detection on correlation



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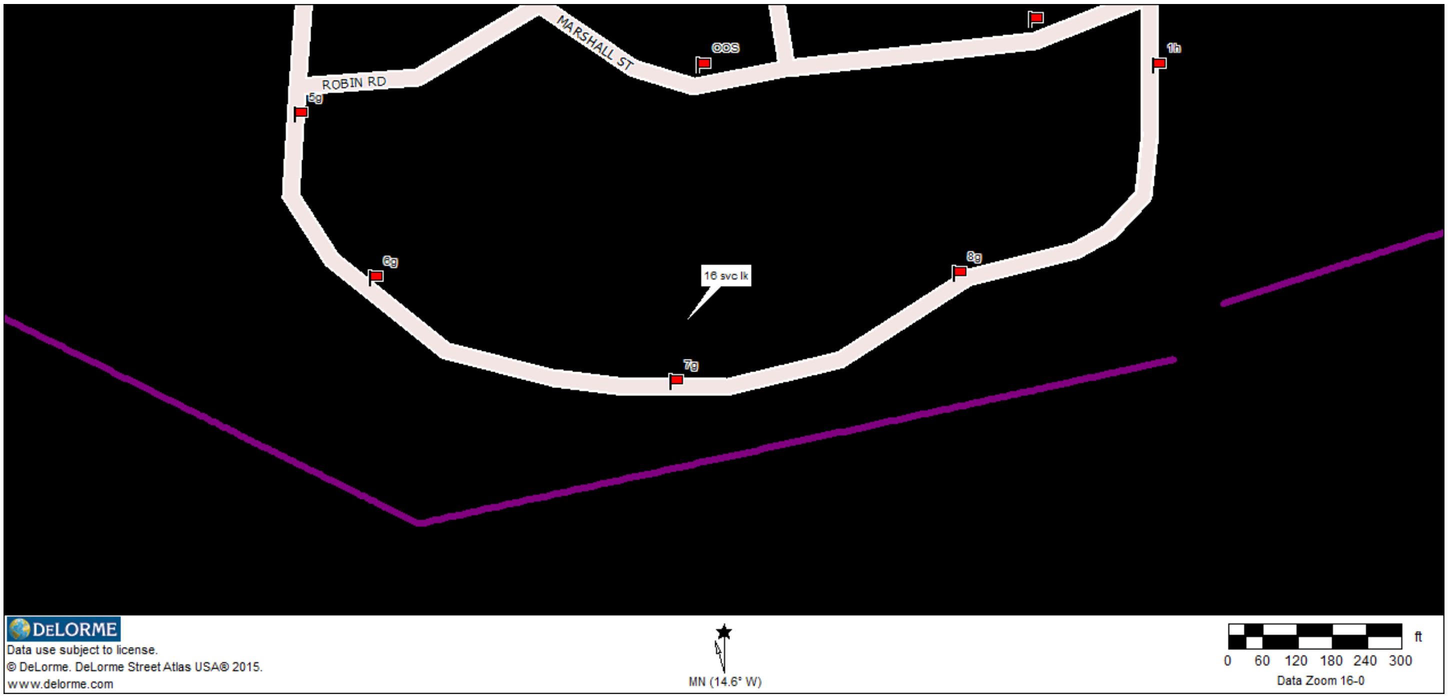
Leak worksheet



Date: 12/30/19

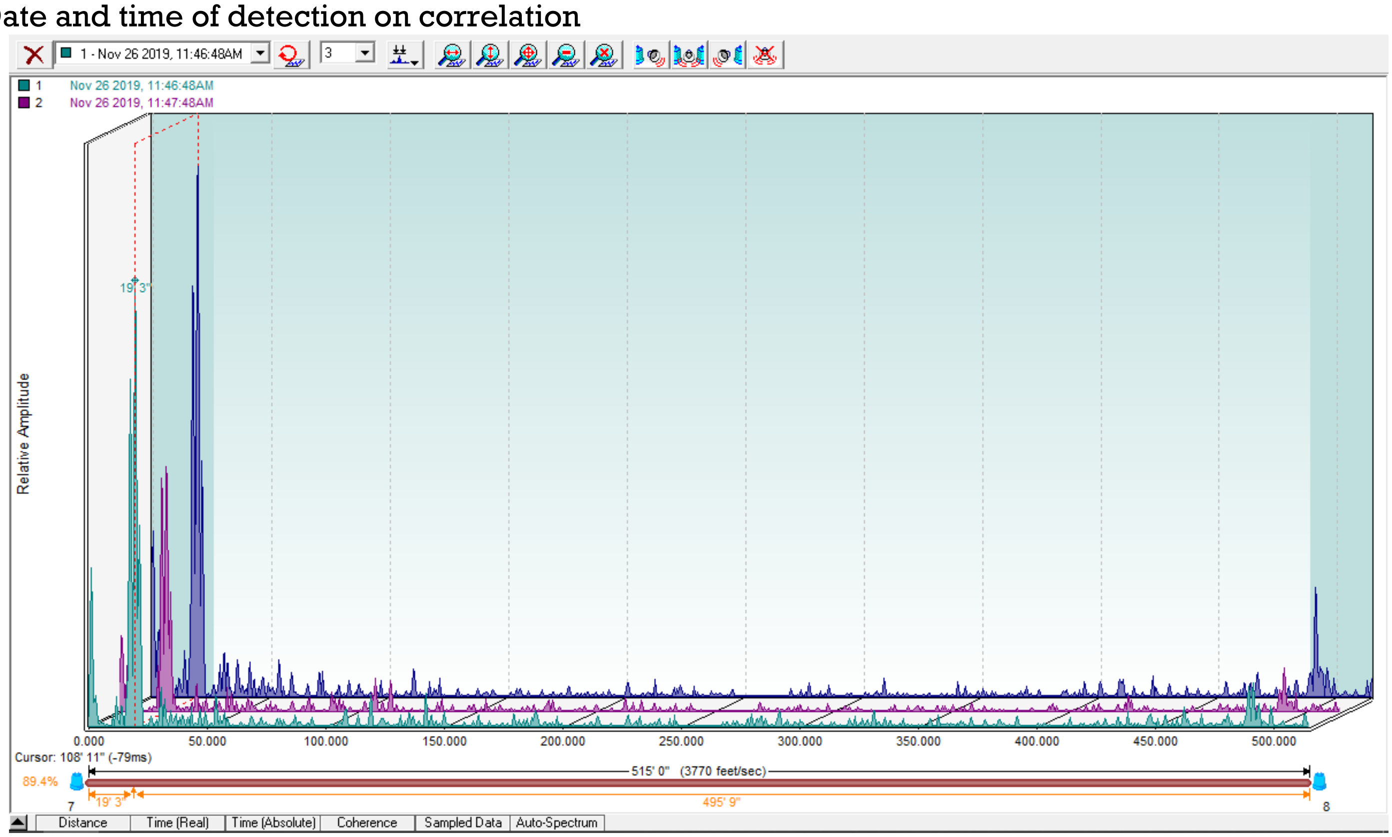
System Name: North Reading

Location: 16 Crestwood Rd. Service leak

Approx. Size: __4 gpm__ Type of Surface Cover: mixed

Leak class: 3

Date and time of detection on correlation



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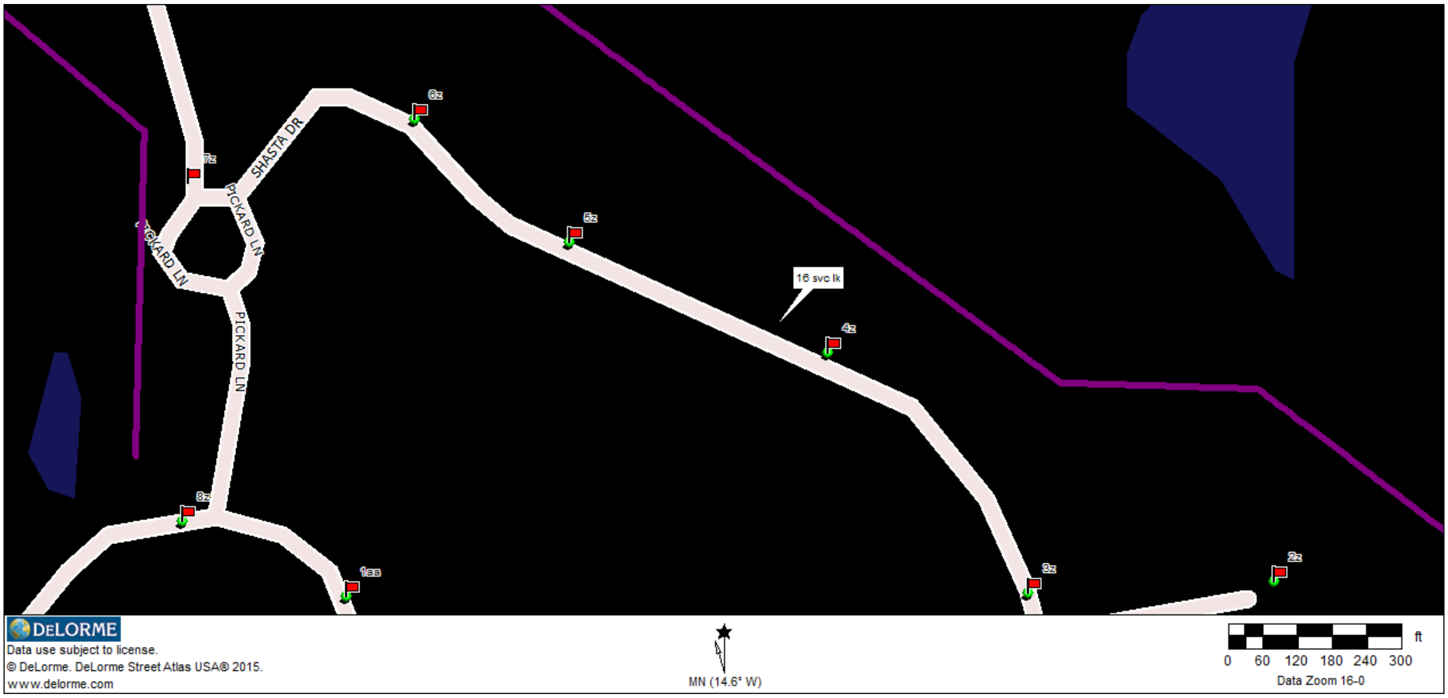
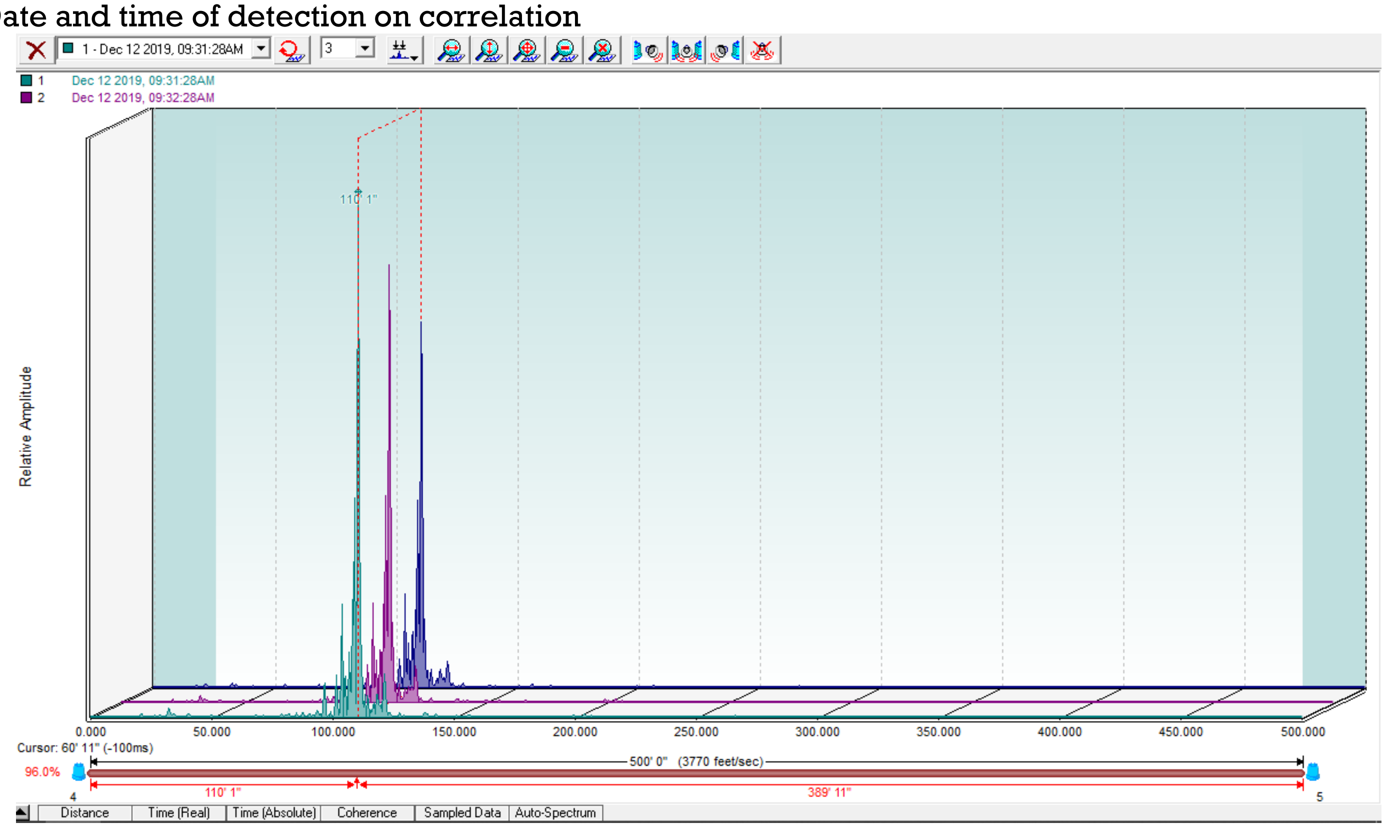
Leak worksheet



Date: 12/30/19
System Name: North Reading
Location:16 Shasta Dr. Service leak
Approx. Size: __3gpm__ Type of Surface Cover: mixed
Leak class: 3
Date and time of detection on correlation



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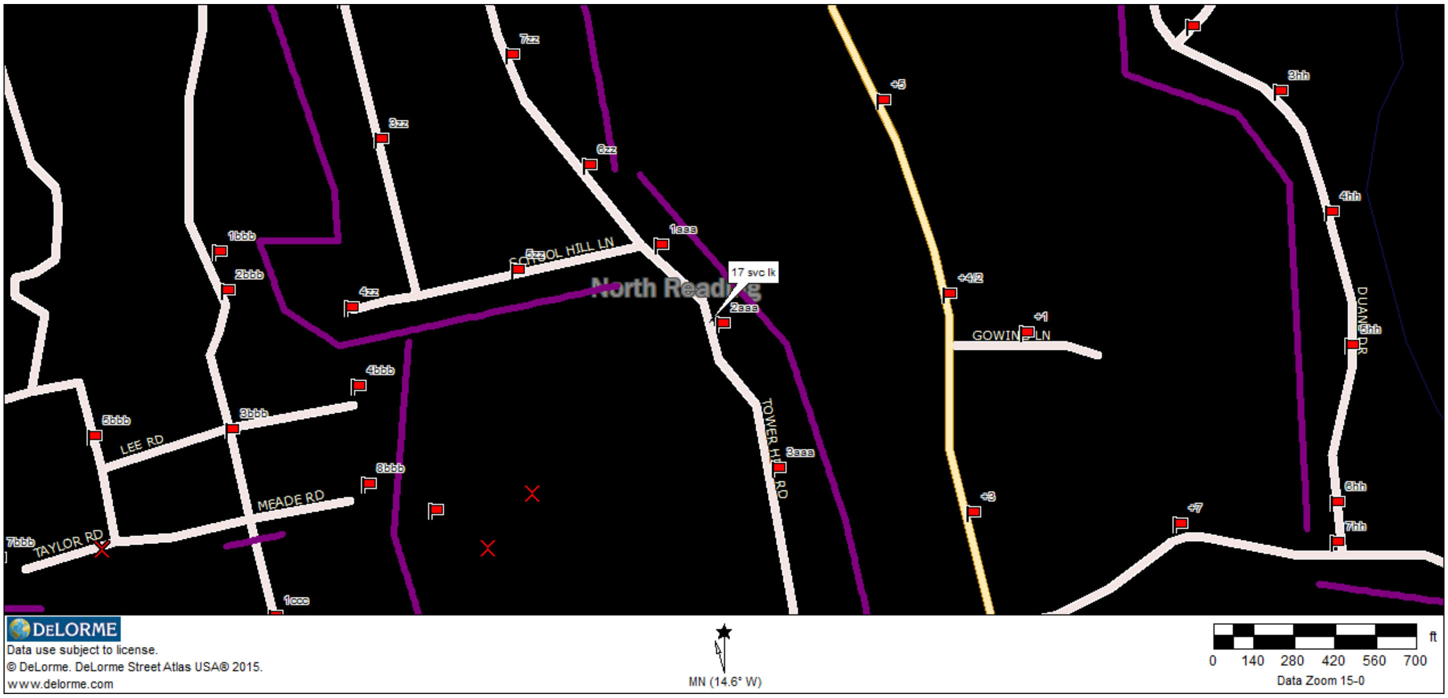
Leak worksheet



Date: 12/30/19

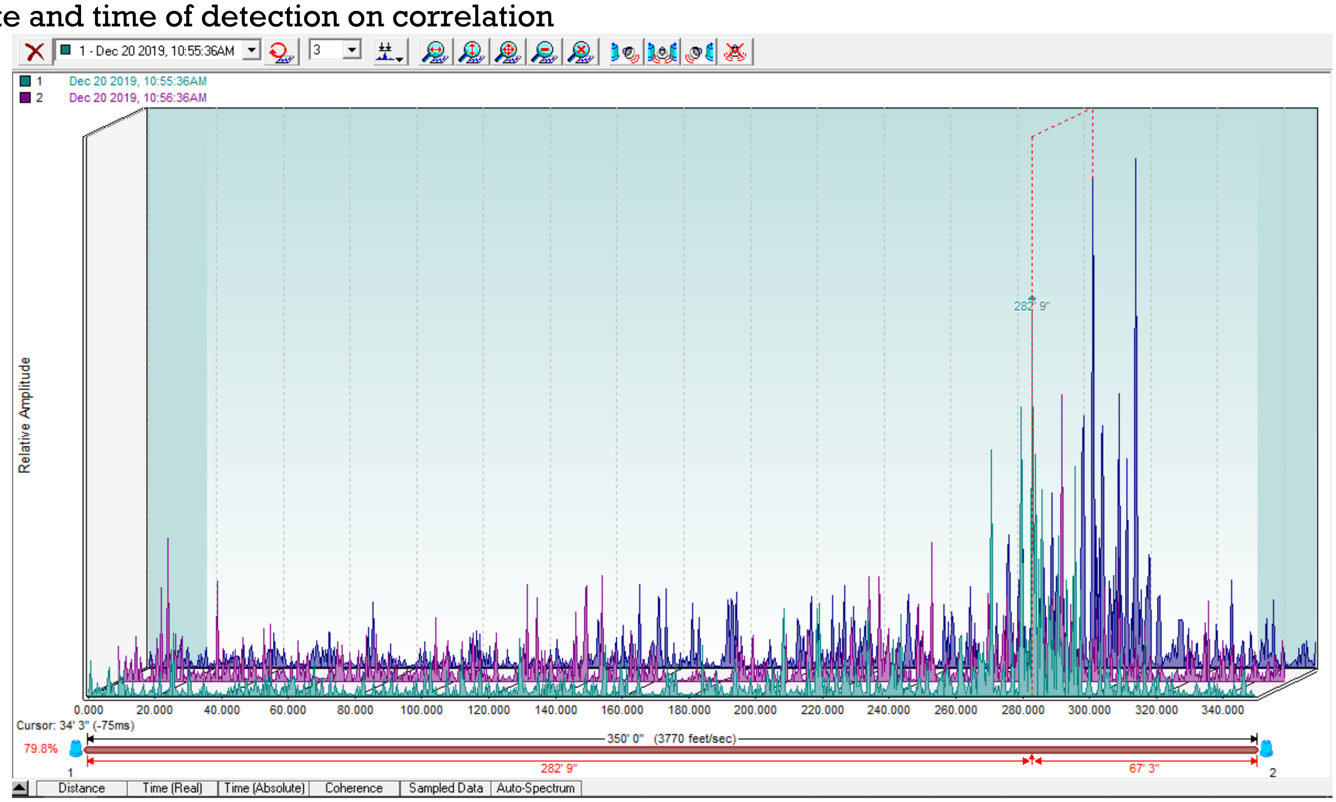
System Name: North Reading

Location: 17 Tower Hill Rd. Service leak

Approx. Size: __4gpm__ Type of Surface Cover: mixed

Leak class:3

Date and time of detection on correlation



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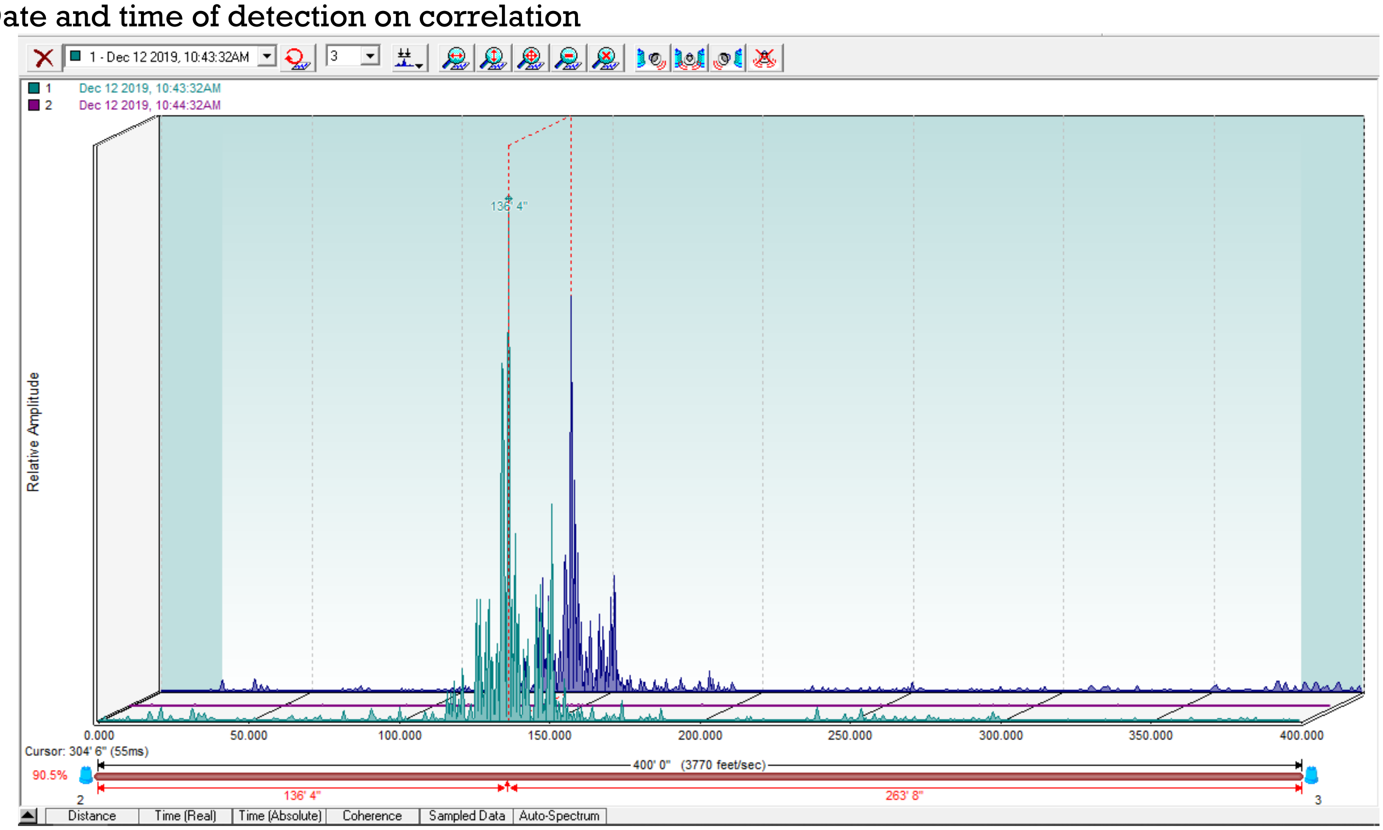
Leak worksheet

Date: 12/30/19
System Name: North Reading
Location: 20 Strawberry Ln. Service leak
Approx. Size: __4gpm__ Type of Surface Cover: mixed
Leak class: 3
Date and time of detection on correlation



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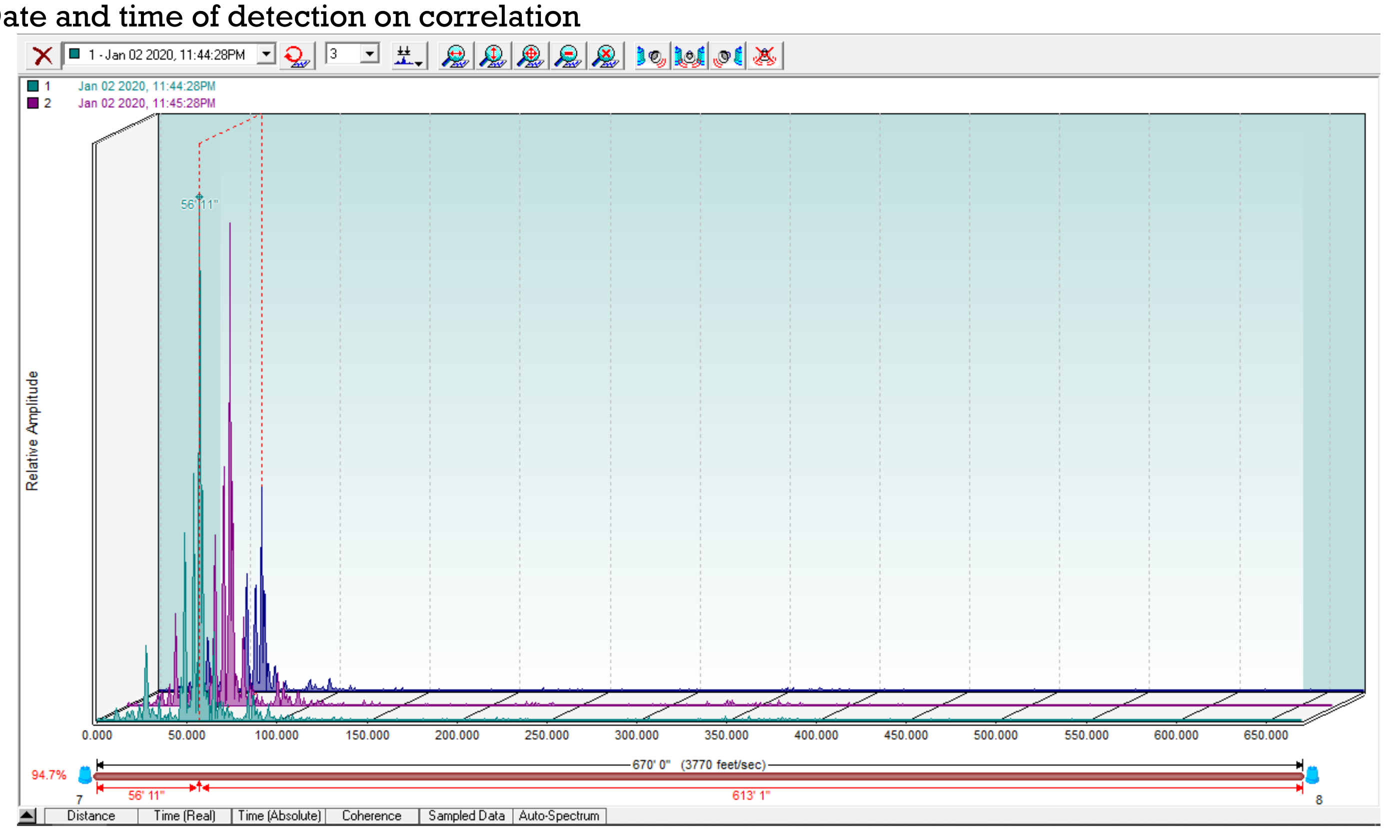
Leak worksheet

Date: 12/30/19
System Name: North Reading
Location: 24 Haverhill St. Service leak
Approx. Size: __3gpm__ Type of Surface Cover: mixed
Leak class: 3
Date and time of detection on correlation



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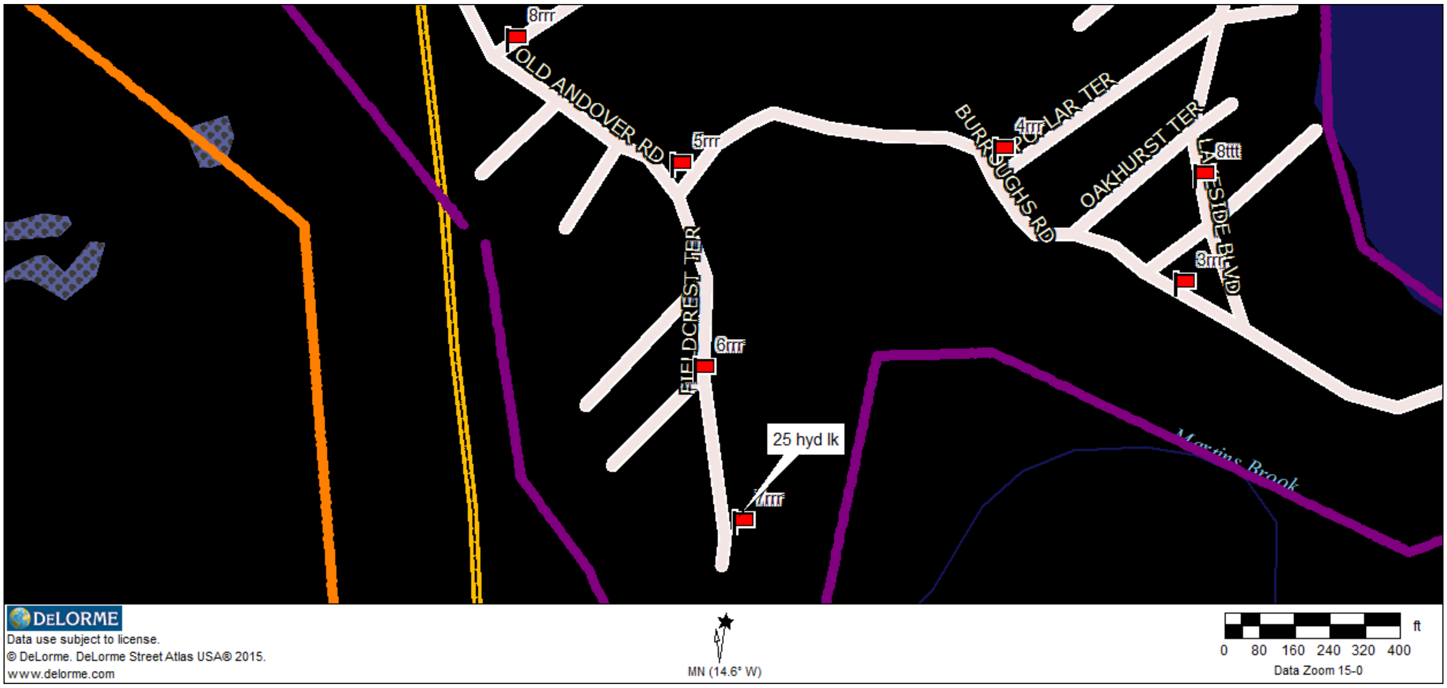
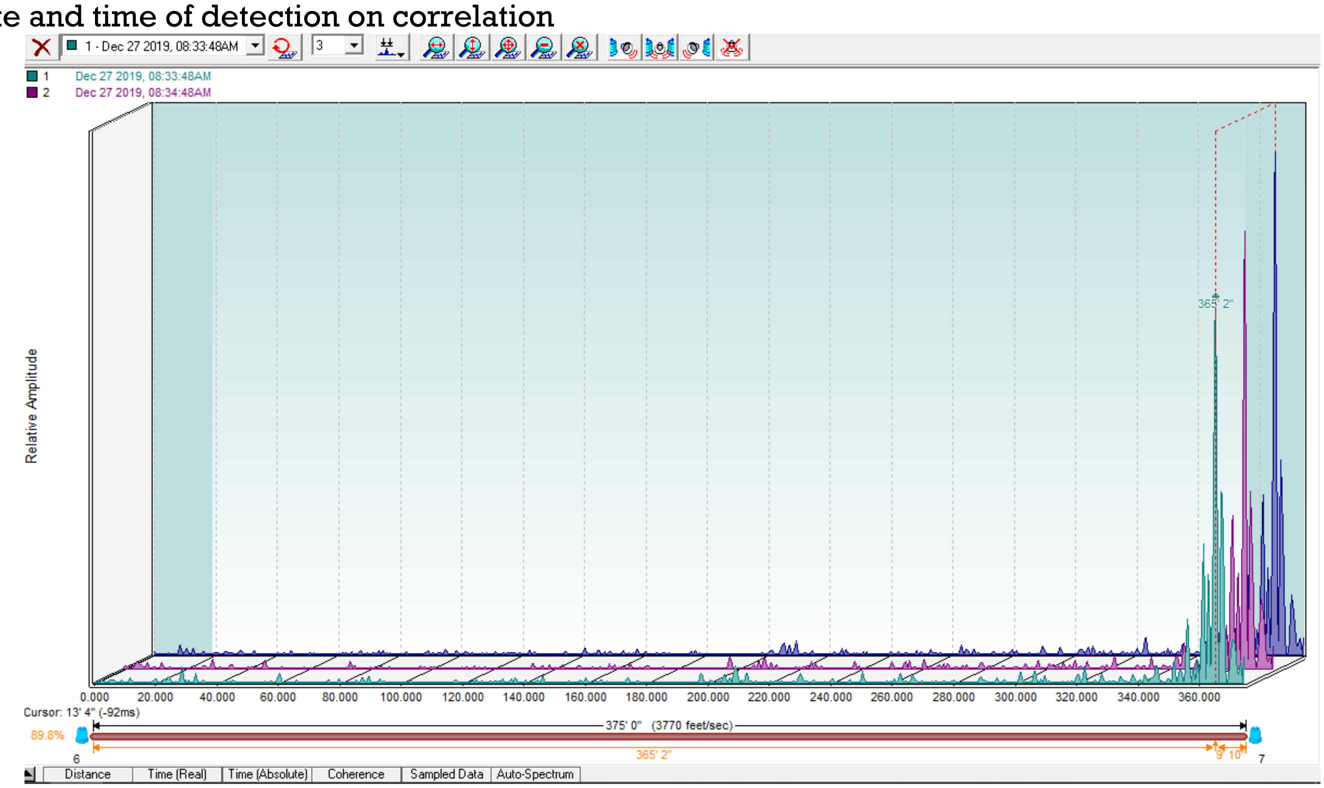
Leak worksheet



Date: 12/30/19
System Name: North Reading
Location: 25 Fieldcrest Ter. Hydrant Leak
Approx. Size: __3gpm__ Type of Surface Cover: mixed
Leak class: 3
Date and time of detection on correlation



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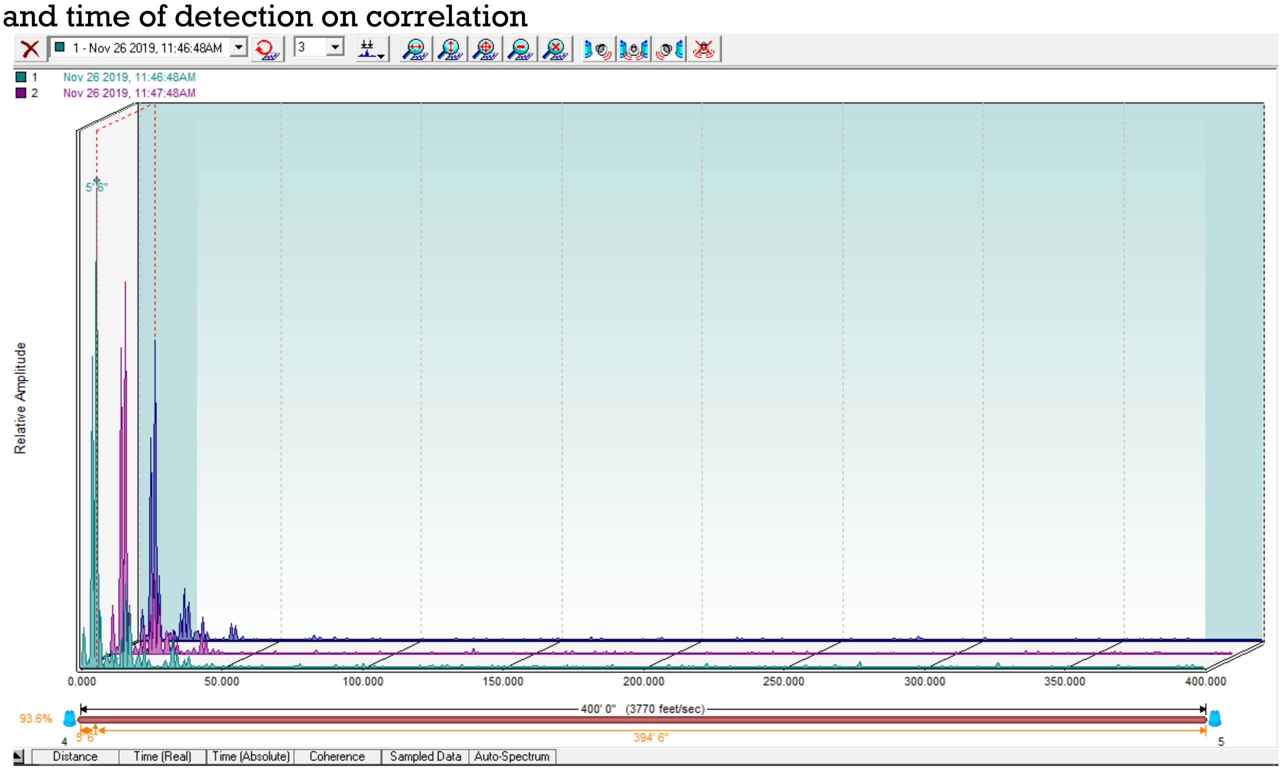
Leak worksheet

Date: 12/30/19
System Name: North Reading
Location: 29 Crestwood Rd. Service leak
Approx. Size: __3gpm__ Type of Surface Cover: mixed
Leak class: 3
Date and time of detection on correlation



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Technical Services

Leak worksheet

Date: 12/30/19

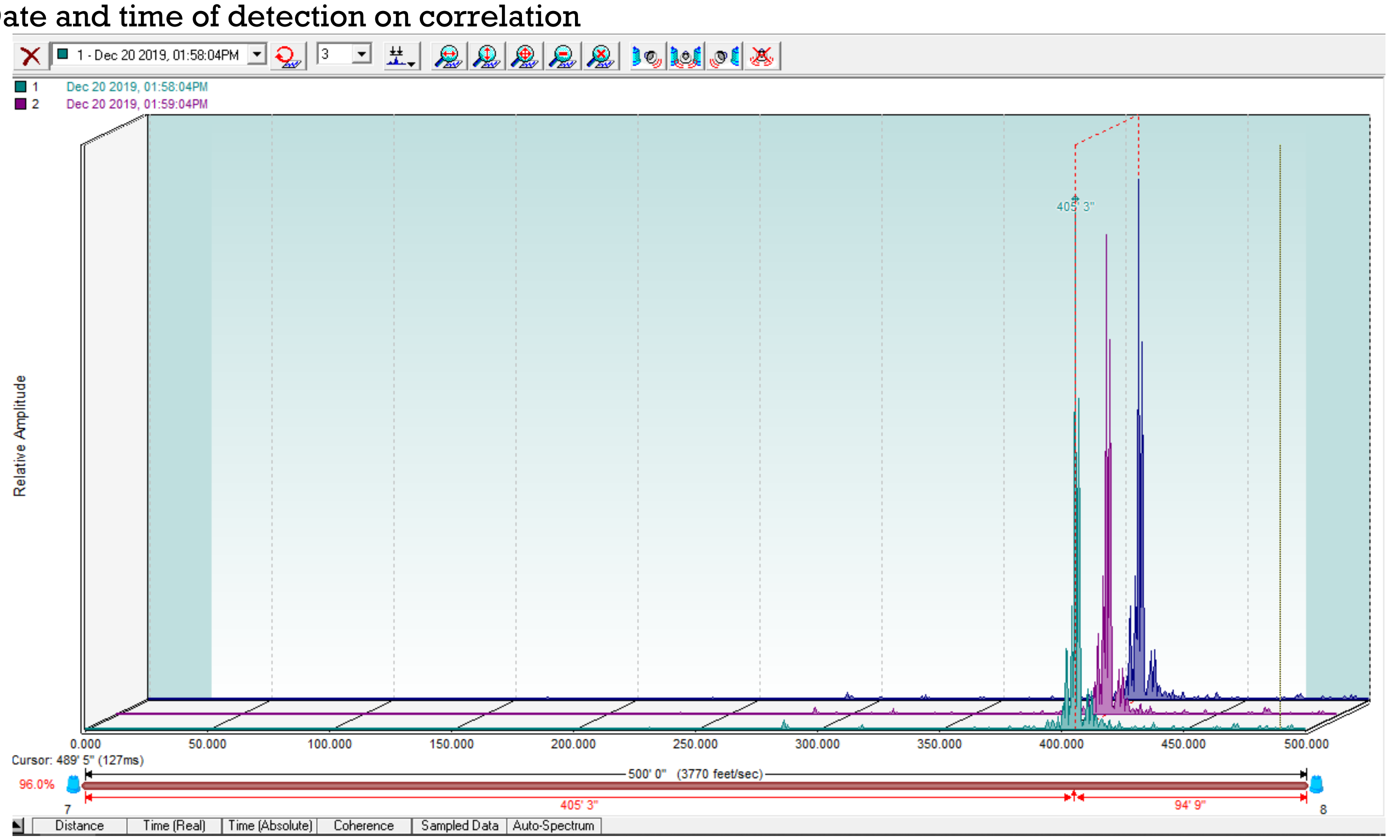
System Name: North Reading

Location: 33 Spruce Rd. Service leak

Approx. Size: __4gpm__ Type of Surface Cover: mixed

Leak class:3

Date and time of detection on correlation



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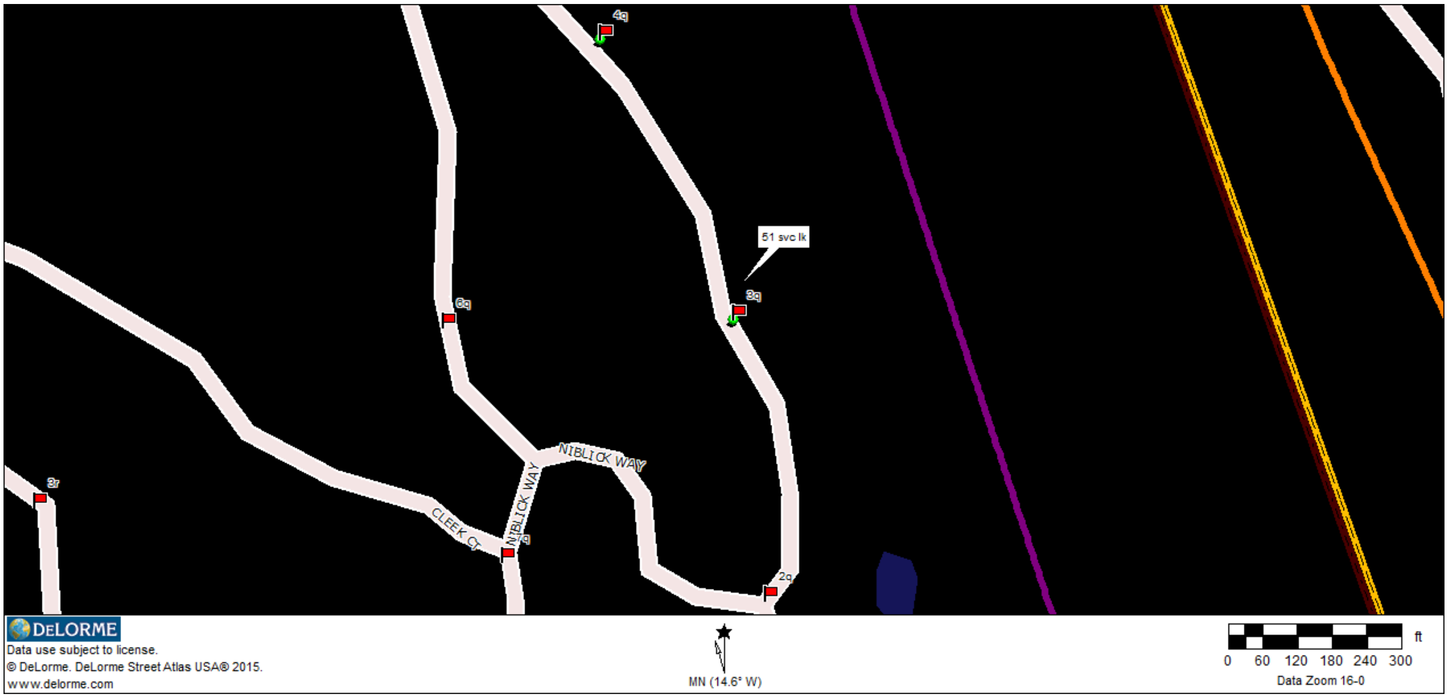
Leak worksheet



Date: 12/30/19

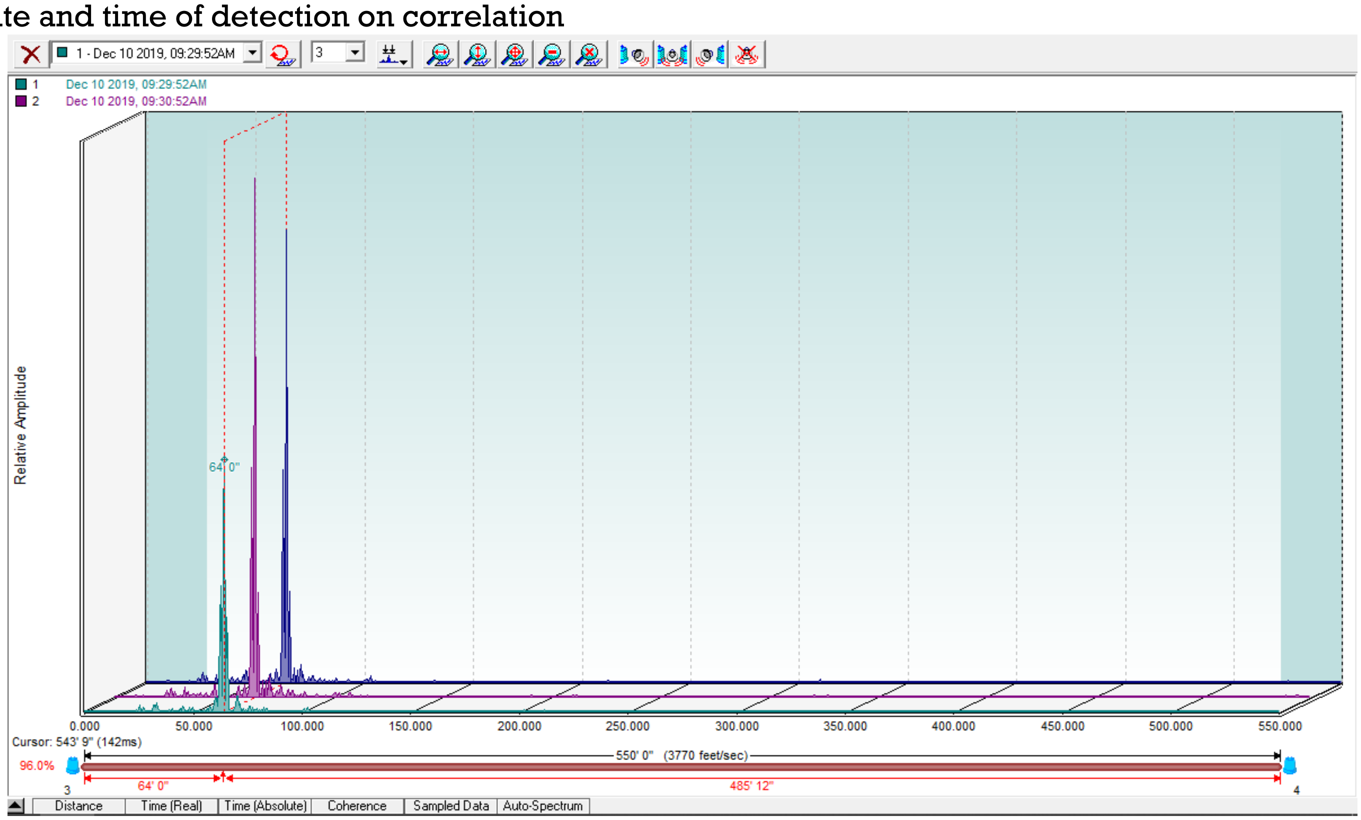
System Name: North Reading

Location: 51 Niblick Way Service leak

Approx. Size: __8gpm__ Type of Surface Cover: mixed

Leak class: 2

Date and time of detection on correlation



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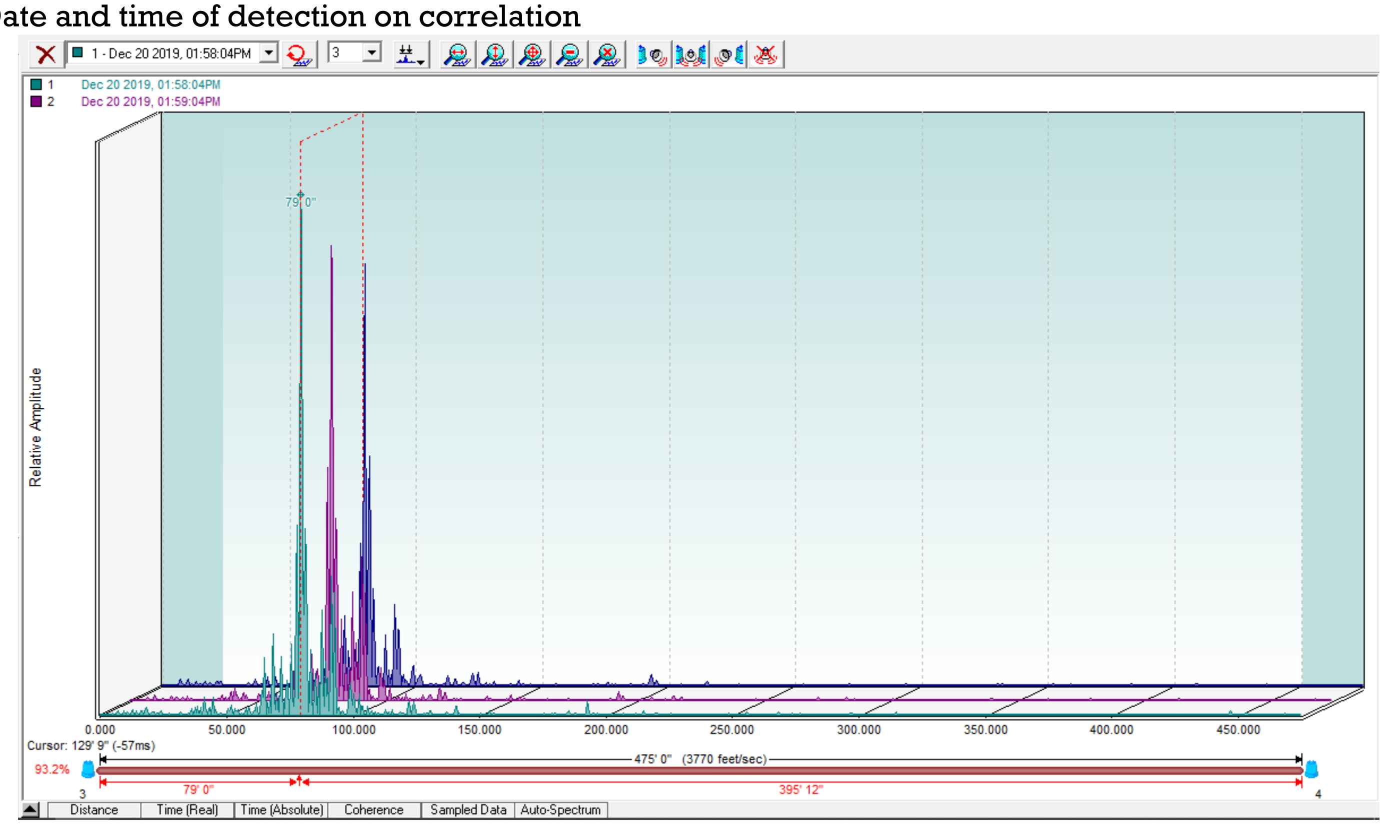
Leak worksheet

Date: 12/30/19
System Name: North Reading
Location: 52 Spruce Rd. Service leak
Approx. Size: __4gpm__ Type of Surface Cover: mixed
Leak class:3
Date and time of detection on correlation



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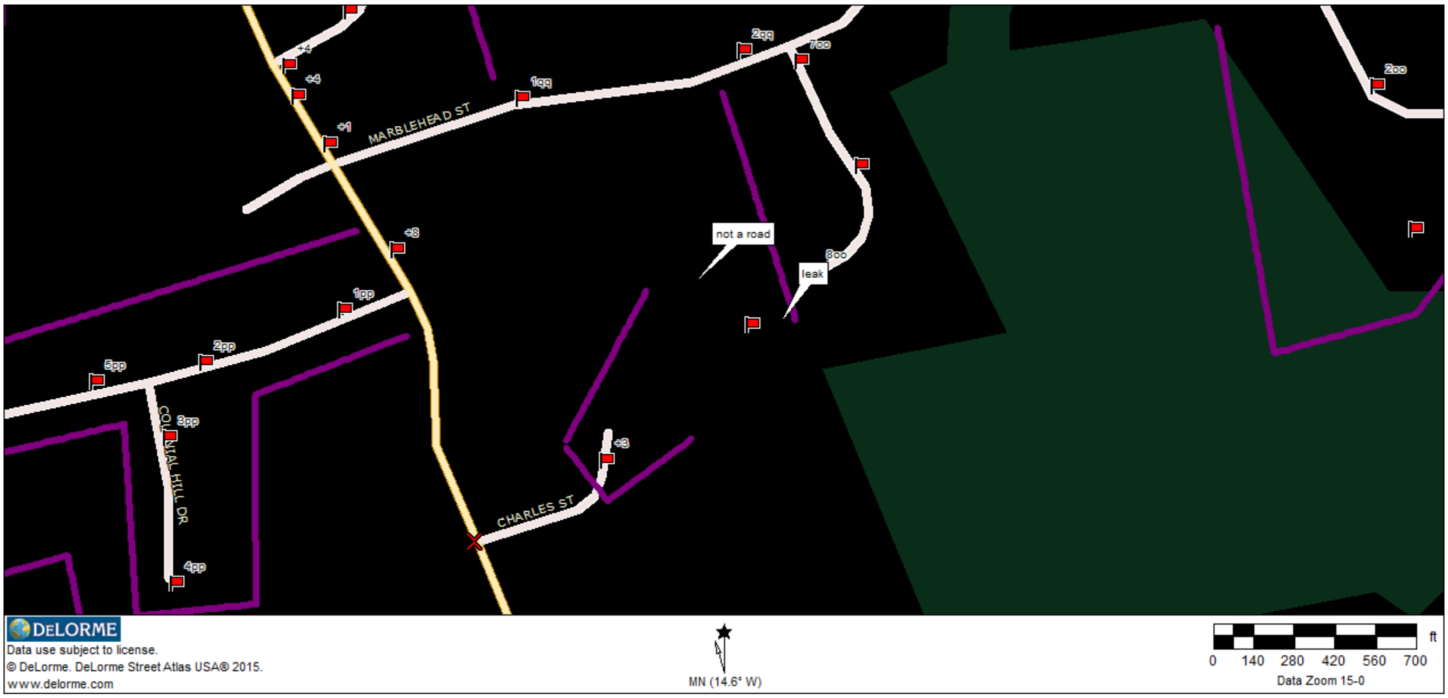
Leak worksheet



Date: 12/30/19

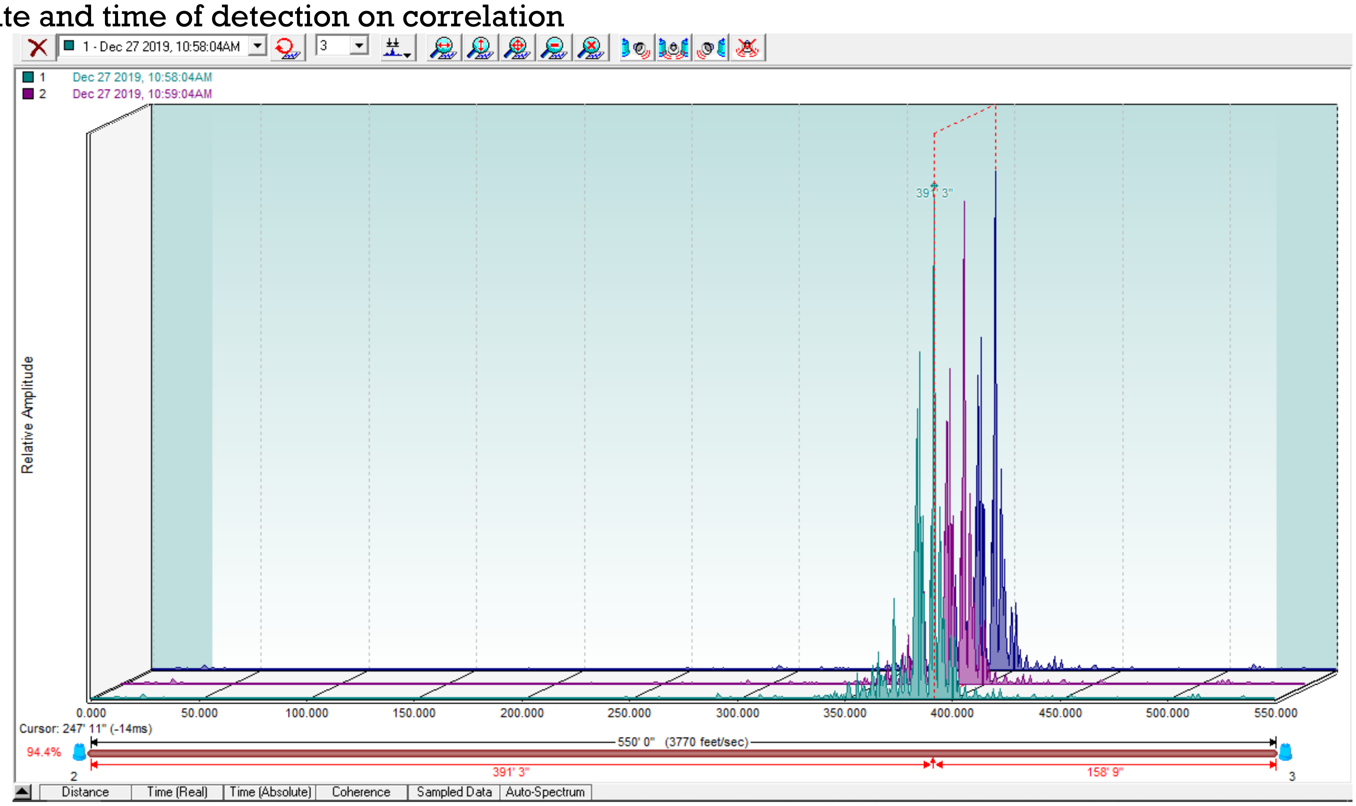
System Name: North Reading

Location: Deerfield Pl Extension Main Leak

Approx. Size: __15gpm__ Type of Surface Cover: mixed

Leak class: 1

Date and time of detection on correlation



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Leak worksheet

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Date: 12/30/19

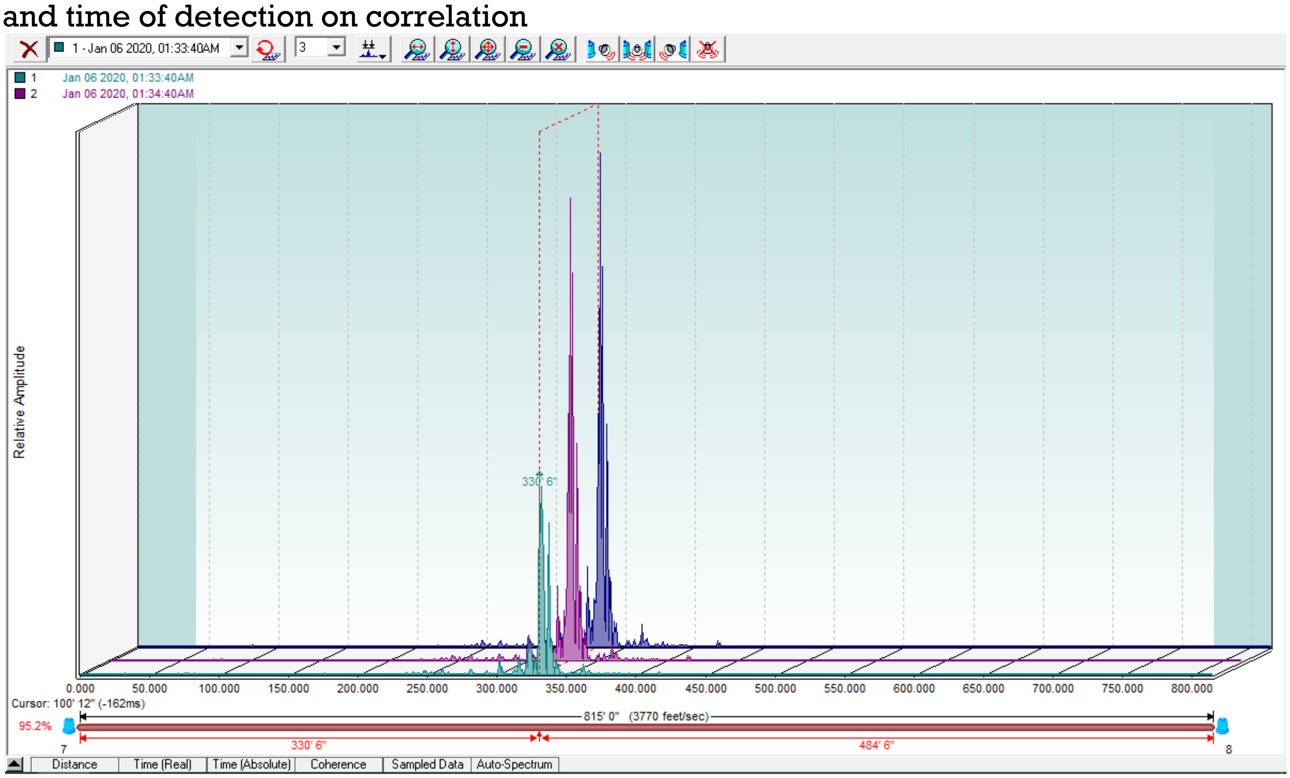
System Name: North Reading

Location: Main St southbound between Jokers Wild & Sweepman Inc Pole 66 Main leak

Approx. Size: __100gpm__ Type of Surface Cover: mixed

Leak class: 1

Date and time of detection on correlation



Town of Andover Massachusetts
Department of Public Works

Water System Leak Detection Survey Report
East High Pressure Zone
2017

Prepared By

<u>Arthur Pyburn & Sons Inc.</u>

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May 25, 2017

Town of Andover
Department of Public Works
397 Lowell Street
Andover, MA 01810

The following is a summary of leak detection performed on 53 miles of the "East High Zone" of the Andover Water Department's distribution system. Cross country lines were also checked

The pages that follow are the individual reports for each leak.

During the course of this survey leaks were found at the following locations.

Services found to be leaking:

165 Elm Street, Service Leaking, Box to Cellar, 2-4gpm
3 Parnussus Place, Service Leaking, Box to Cellar, 1-3gpm
10 Ivanhoe Lane, Service leaking, Box to Cellar, 2-4gpm
304 Salem Street, Service Leaking, Box to Cellar, 1-3gpm
5 Sawyer Lane, Service Leaking, Box to Cellar, 2-4gpm
6 Cameron Road, Service Leaking, Box to Cellar, 2-4gpm
6 Wethersfield Drive, Service Leaking, Box to Cellar, 1-3gpm
20 Embassy Lane, Service Leaking Main to Box, 2-4gpm
9 Forbes Lane, Service Leaking, Box to Cellar, 1-3gpm
28 Orchard Crossing, Service Leaking, Box to Cellar, 2-4 gpm
Glenwood Road, Service Leaking, Repaired,2-4gpm
8 Donna Road, Service Leaking, Box to Cellar, Repaired, 2-4 gpm
5 Boston Rd, Service Leaking, Box to Cellar, 1-3gpm
50 Farrwood Drive, Service Leaking, Main to Box, 2-4gpm, Repaired
242 S. Main Street, Service Leaking, Main to Box, 2-4gpm, Repaired
37 Kathleen Drive, Service Leaking, Box to Cellar, 1-3gpm

10 Morningside Drive, Service leaking, Box to Cellar, 1-3gpm

In conclusion, 18 leaks were located during the course of this survey. The total of estimated leakage from the leaks found during this survey is approximately 29 to 62 gallons per/min.

The leakage amounts noted in this report are only estimates and require confirmation during the repair of the leaks.

Respectfully Submitted by Gregory Pyburn

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Leak worksheet

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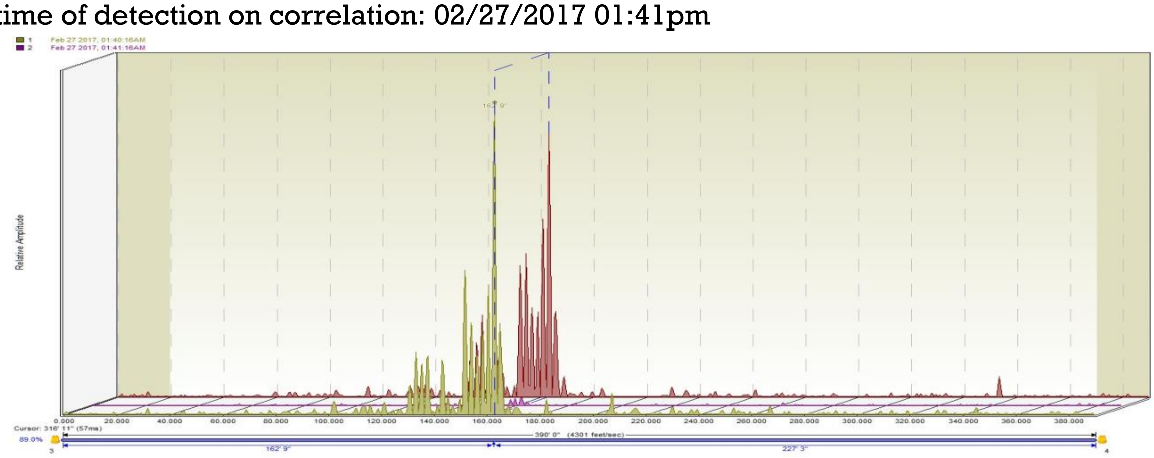
System Name: Andover Water Department's Distribution System, East High Zone

Location: 165 Elm Street, Andover, Service Leaking, Box to Cellar

Approx. Size: 2-4 GPM

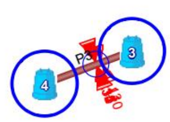
Pipe Material 1" Copper

Date and time of detection on correlation: 02/27/2017 01:41pm



Pipe ID	Length	Diameter	Material	Sound Velocity
P3	390' 0"	3"	Cast Iron	4301 feet/sec

Leak ID	Leak Position	Correlation Between	Confidence	Recording Time
L10	162' 9" from 3	3 -> 4	89.0%	Feb 27 2017, 01:40:16AM
L11	163' 2" from 3	3 -> 4	77.0%	Feb 27 2017, 01:41:16AM
L12	162' 9" from 3	3 -> 4	88.1%	Feb 27 2017, 01:42:16AM
L13	133' 12" from 3	3 -> 5	68.7%	Feb 27 2017, 01:40:16AM
L15	159' 6" from 3	3 -> 5	70.9%	Feb 27 2017, 01:42:16AM
L34	162' 9" from 3	3 -> 4	76.8%	Feb 27 2017, 01:41:16AM
L35	162' 9" from 3	3 -> 4	88.1%	Feb 27 2017, 01:42:16AM



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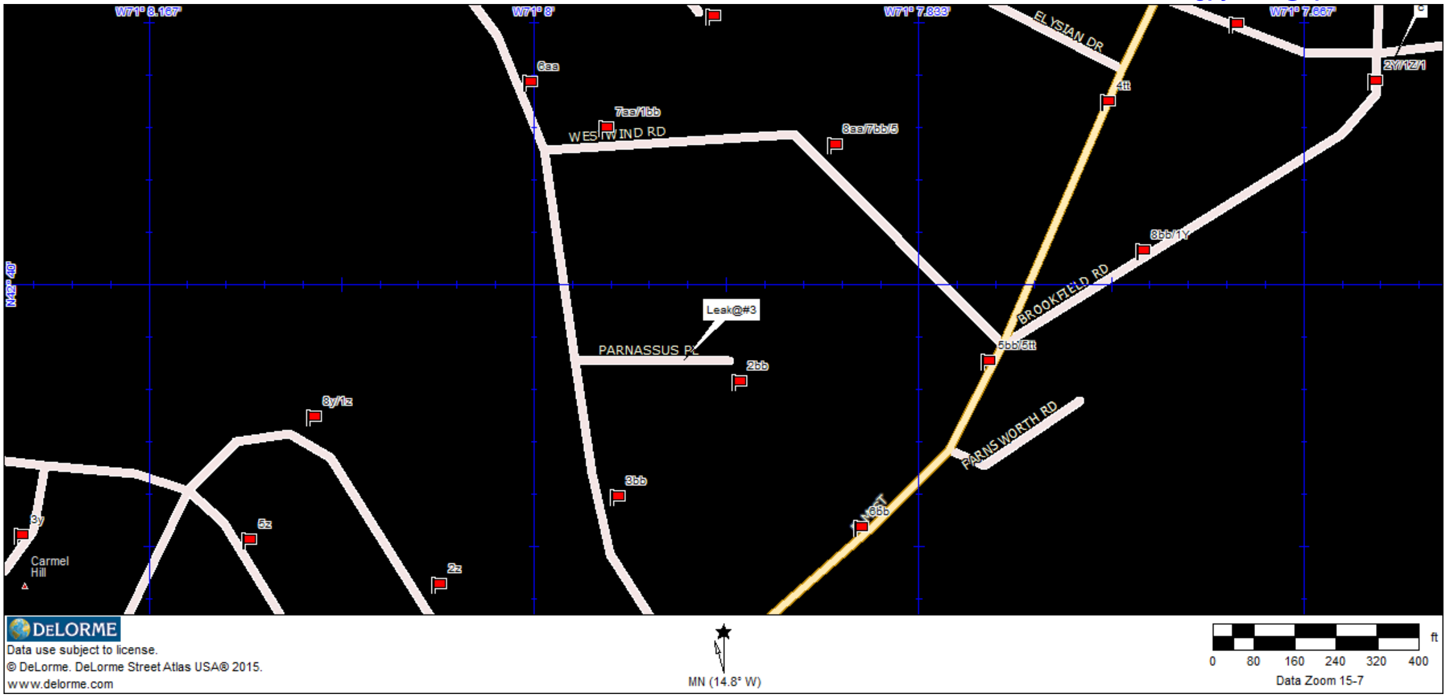
Leak worksheet



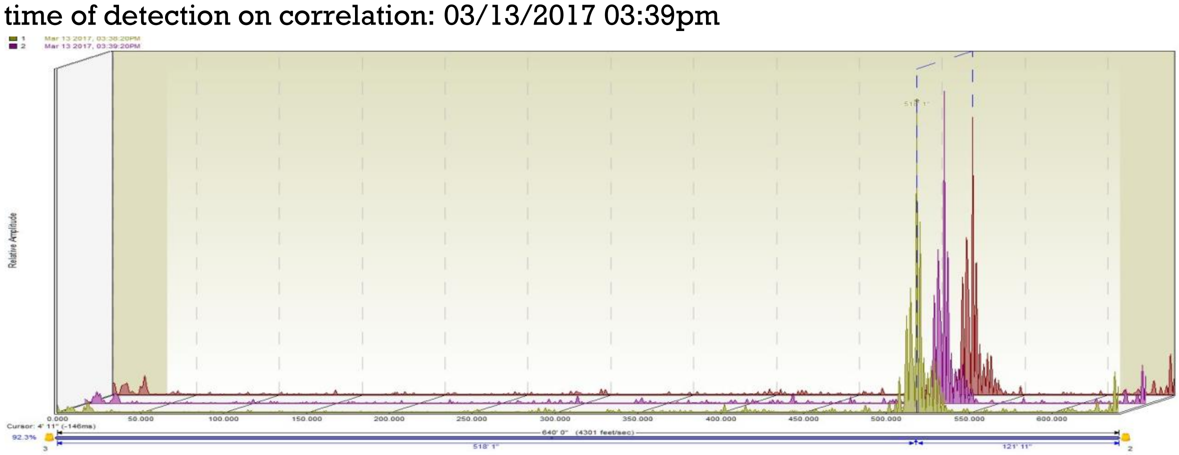
System Name: Andover Water Department's Distribution System, East High Zone

Location: 3 Parnussus Place, Andover, Service Leaking, Box to Cellar

Approx. Size: 2-4 GPM

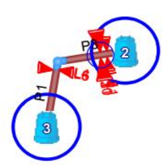
Pipe Material 1" Copper

Date and time of detection on correlation: 03/13/2017 03:39pm



Pipe ID	Length	Diameter	Material	Sound Velocity
P1	300' 0"	3"	Cast Iron	4301 feet/sec
P3	340' 0"	3"	Cast Iron	4301 feet/sec

Leak ID	Leak Position	Correlation Between	Confidence	Recording Time
L1	518' 1" from 3	3 -> 2	92.3%	Mar 13 2017, 03:38:20PM
L2	515' 5" from 3	3 -> 2	92.1%	Mar 13 2017, 03:39:20PM
L3	515' 5" from 3	3 -> 2	92.0%	Mar 13 2017, 03:40:20PM
L4	268' 6" from 3	3 -> 1	85.2%	Mar 13 2017, 03:38:20PM
L5	263' 7" from 3	3 -> 1	84.6%	Mar 13 2017, 03:39:20PM
L6	260' 11" from 3	3 -> 1	84.9%	Mar 13 2017, 03:40:20PM
L7	789' 6" from 1	1 -> 2	88.5%	Mar 13 2017, 03:38:20PM
L8	791' 3" from 1	1 -> 2	87.8%	Mar 13 2017, 03:39:20PM
L9	791' 9" from 1	1 -> 2	89.6%	Mar 13 2017, 03:40:20PM
L10	518' 1" from 3	3 -> 2	92.0%	Mar 13 2017, 03:39:20PM
L11	518' 7" from 3	3 -> 2	91.4%	Mar 13 2017, 03:40:20PM



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Leak worksheet

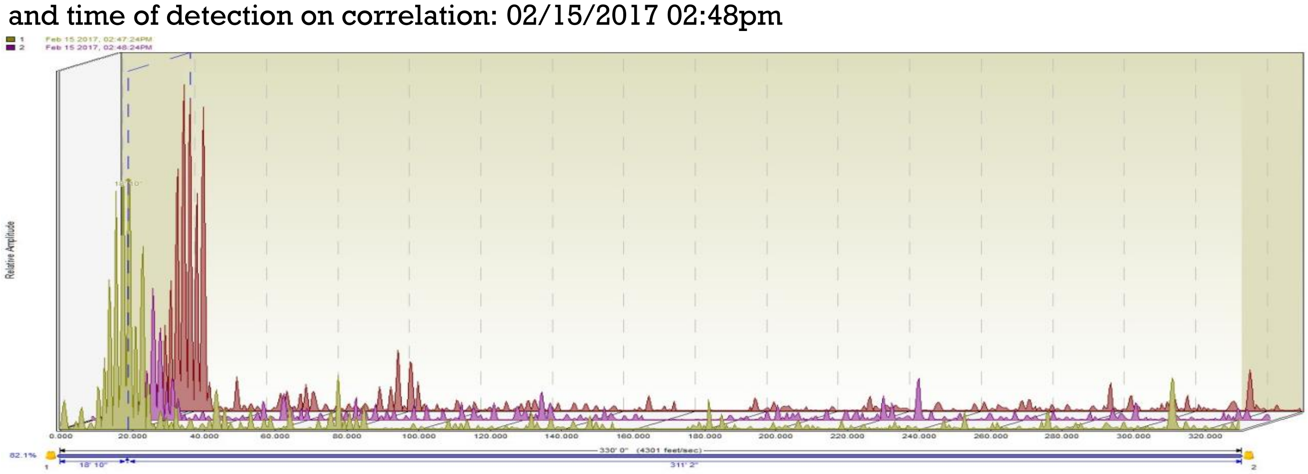
System Name: Andover Water Department's Distribution System, East High Zone

Location: 10 Ivanhoe Lane, Andover, Service Leaking, Box to Cellar

Approx. Size: 1-3 GPM

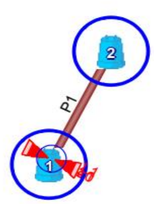
Pipe Material 1" Copper

Date and time of detection on correlation: 02/15/2017 02:48pm



Pipe ID	Length	Diameter	Material	Sound Velocity
P1	330' 0"	3"	Cast Iron	4301 feet/sec

Leak ID	Leak Position	Correlation Between	Confidence	Recording Time
L1	18' 10" from 1	1 -> 2	82.1%	Feb 15 2017, 02:47:24PM
L2	17' 0" from 1	1 -> 2	79.6%	Feb 15 2017, 02:48:24PM
L3	17' 0" from 1	1 -> 2	83.8%	Feb 15 2017, 02:49:24PM
L40	17' 0" from 1	1 -> 2	79.6%	Feb 15 2017, 02:48:24PM
L41	17' 0" from 1	1 -> 2	83.8%	Feb 15 2017, 02:49:24PM



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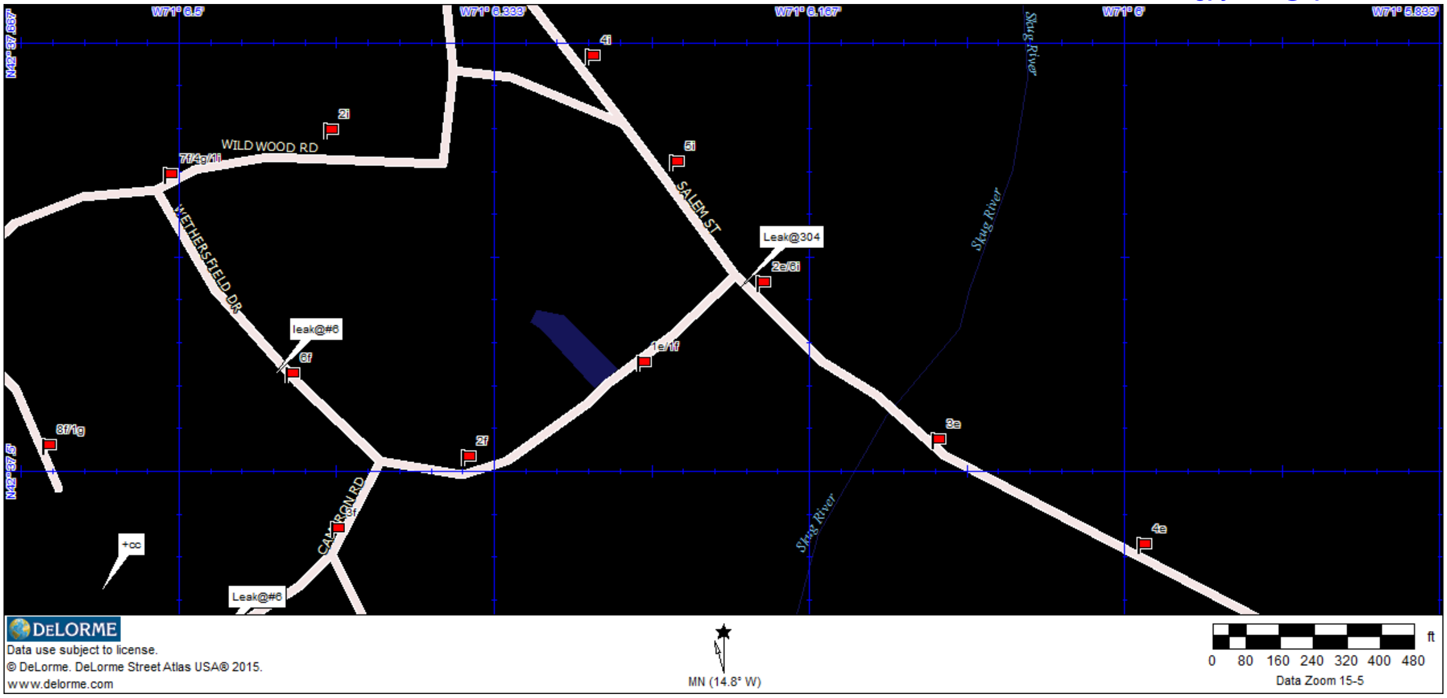
Leak worksheet



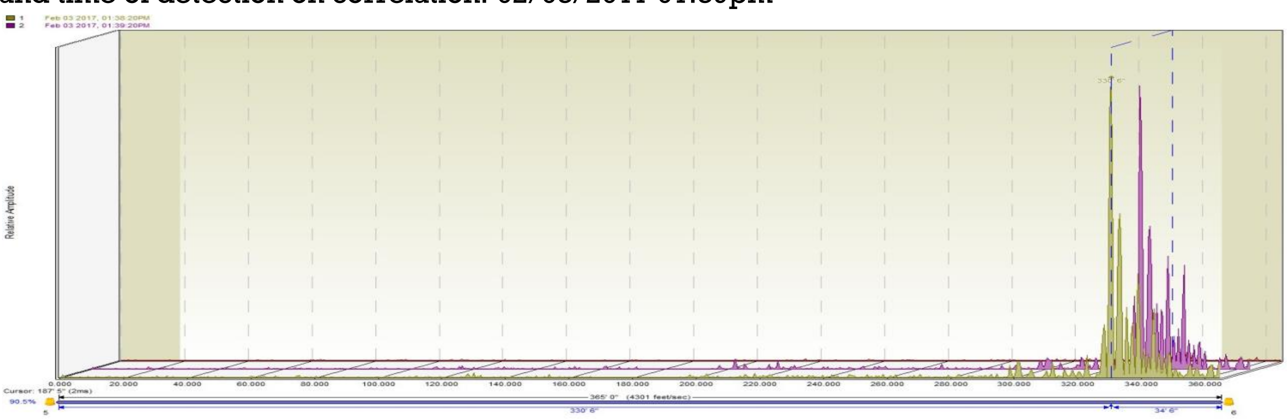
System Name: Andover Water Department's Distribution System, East High Zone

Location: 304 Salem Street, Andover, Service Leaking, Box to Cellar

Approx. Size: 1-3 GPM

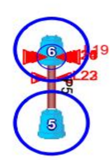
Pipe Material 1" Copper

Date and time of detection on correlation: 02/03/2017 01:39pm



Pipe ID	Length	Diameter	Material	Sound Velocity
P5	365' 0"	3"	Cast Iron	4301 feet/sec

Leak ID	Leak Position	Correlation Between	Confidence	Recording Time
L19	330' 6" from 5	5 -> 6	90.5%	Feb 03 2017, 01:38:20PM
L20	330' 0" from 5	5 -> 6	90.5%	Feb 03 2017, 01:39:20PM
L21	333' 2" from 5	5 -> 6	82.5%	Feb 03 2017, 01:40:20PM
L22	145' 9" from 6	6 -> 4	84.4%	Feb 03 2017, 01:38:20PM
L23	145' 9" from 6	6 -> 4	83.5%	Feb 03 2017, 01:39:20PM
L34	330' 0" from 5	5 -> 6	90.2%	Feb 03 2017, 01:39:20PM
L35	330' 11" from 5	5 -> 6	80.2%	Feb 03 2017, 01:40:20PM



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Leak worksheet

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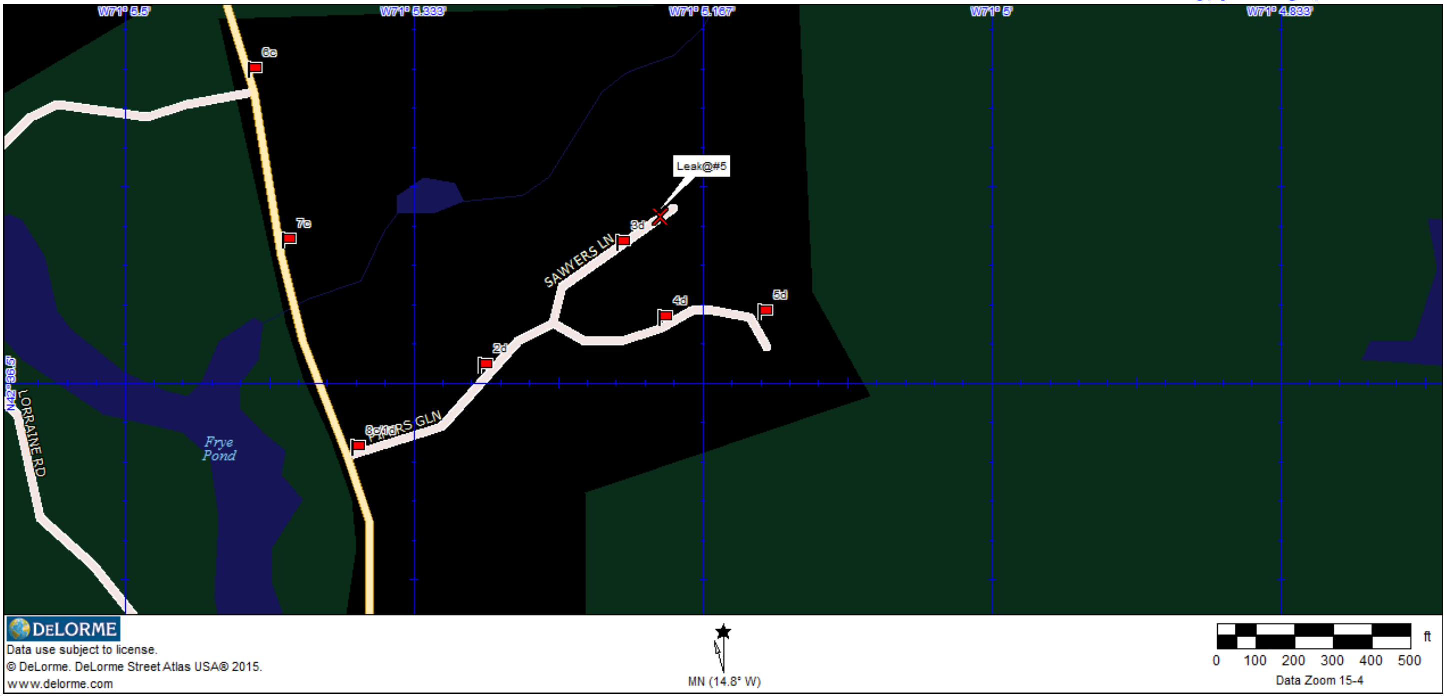
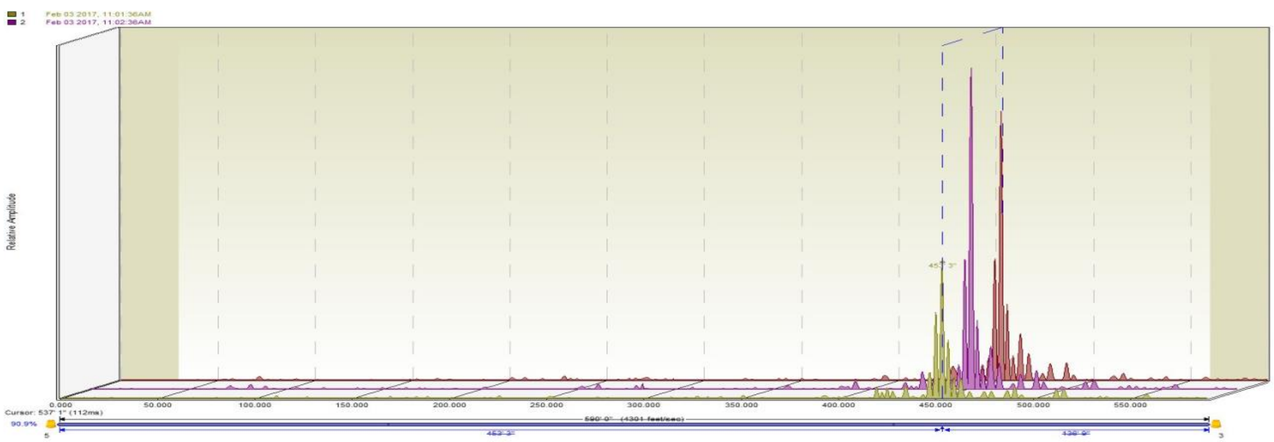
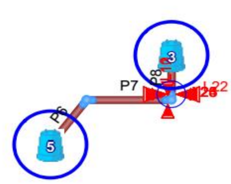


System Name: Andover Water Department's Distribution System, East High Zone
Location: 5 Sawyer Lane, Andover, Service Leaking, Box to Cellar
Approx. Size: 2-4 GPM
Pipe Material 1" Copper
Date and time of detection on correlation: 02/03/2017 11:02am



Pipe ID	Length	Diameter	Material	Sound Velocity
P6	170' 0"	3"	Cast Iron	4301 feet/sec
P7	260' 0"	3"	Cast Iron	4301 feet/sec
P8	160' 0"	3"	Cast Iron	4301 feet/sec

Leak ID	Leak Position	Correlation Between	Confidence	Recording Time
L10	351' 5" from 4	4 -> 3	88.8%	Feb 03 2017, 11:01:36AM
L11	351' 0" from 4	4 -> 3	91.3%	Feb 03 2017, 11:02:36AM
L12	350' 7" from 4	4 -> 3	87.5%	Feb 03 2017, 11:03:36AM
L22	453' 3" from 5	5 -> 3	90.9%	Feb 03 2017, 11:01:36AM
L23	452' 10" from 5	5 -> 3	92.9%	Feb 03 2017, 11:02:36AM
L24	452' 4" from 5	5 -> 3	92.6%	Feb 03 2017, 11:03:36AM
L25	452' 10" from 5	5 -> 3	92.9%	Feb 03 2017, 11:02:36AM
L26	452' 4" from 5	5 -> 3	92.6%	Feb 03 2017, 11:03:36AM



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Technical Services

Leak worksheet

System Name: Andover Water Department's Distribution System, East High Zone

Location: 6 Wethersfield Drive, Andover, Service Leaking, Box to Cellar

Approx. Size: 1-3 GPM

Pipe Material 1" Copper

Leak detected during the audit of noise logger recordings. No correlations available. Located using ground microphone.

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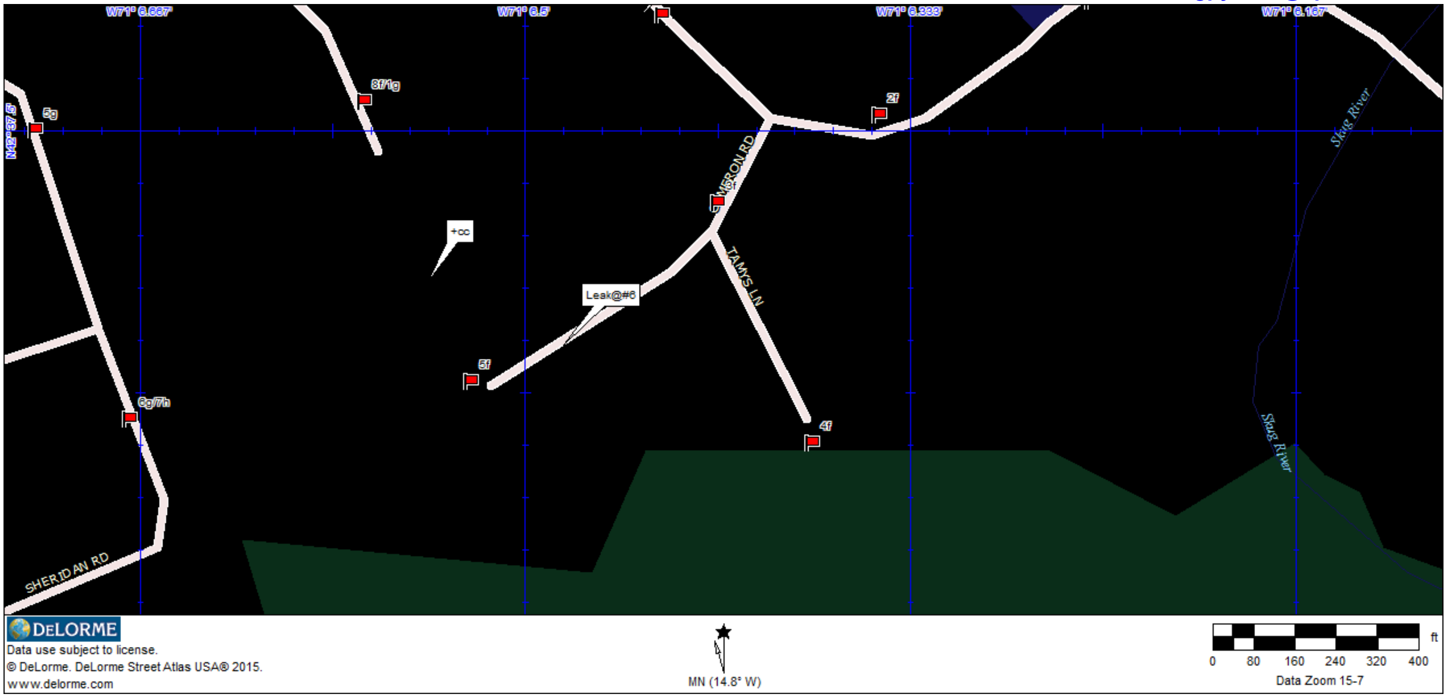


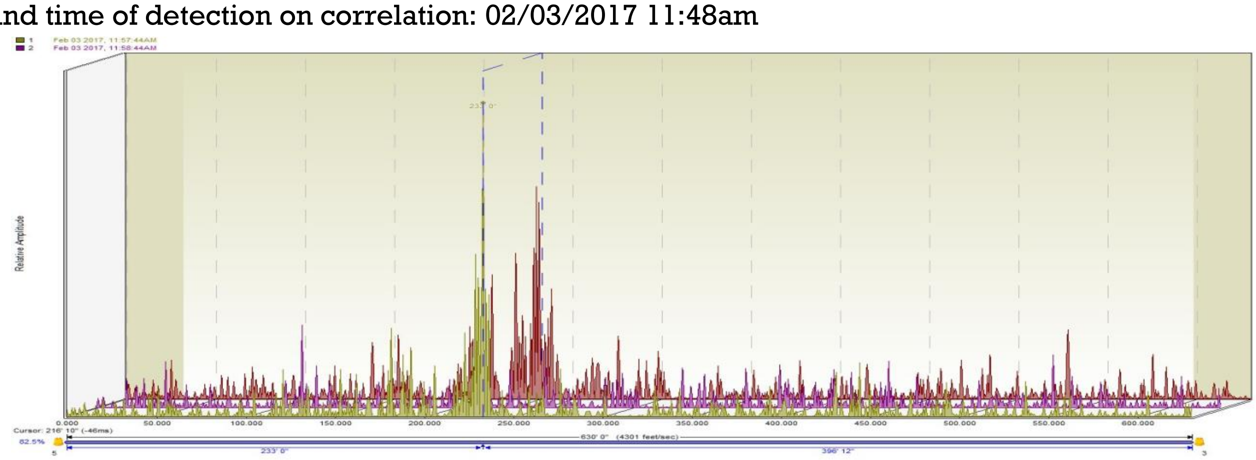
System Name: Andover Water Department's Distribution System, East High Zone

Location: 6 Cameron Road, Andover, Service Leaking, Box to Cellar

Approx. Size: 2-4 GPM

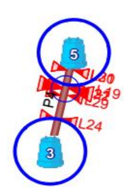
Pipe Material 1" Copper

Date and time of detection on correlation: 02/03/2017 11:48am



Pipe ID	Length	Diameter	Material	Sound Velocity
P4	630' 0"	3"	Cast Iron	4301 feet/sec

Leak ID	Leak Position	Correlation Between	Confidence	Recording Time
L19	233' 0" from 5	5 -> 3	82.5%	Feb 03 2017, 11:57:44AM
L20	115' 2" from 5	5 -> 3	69.4%	Feb 03 2017, 11:58:44AM
L21	229' 5" from 5	5 -> 3	77.4%	Feb 03 2017, 11:59:44AM
L24	424' 6" from 5	5 -> 2	68.8%	Feb 03 2017, 11:59:44AM
L29	876' 4" from 8	8 -> 3	78.2%	Feb 03 2017, 11:58:44AM
L31	115' 2" from 5	5 -> 3	69.4%	Feb 03 2017, 11:58:44AM
L32	229' 5" from 5	5 -> 3	77.4%	Feb 03 2017, 11:59:44AM



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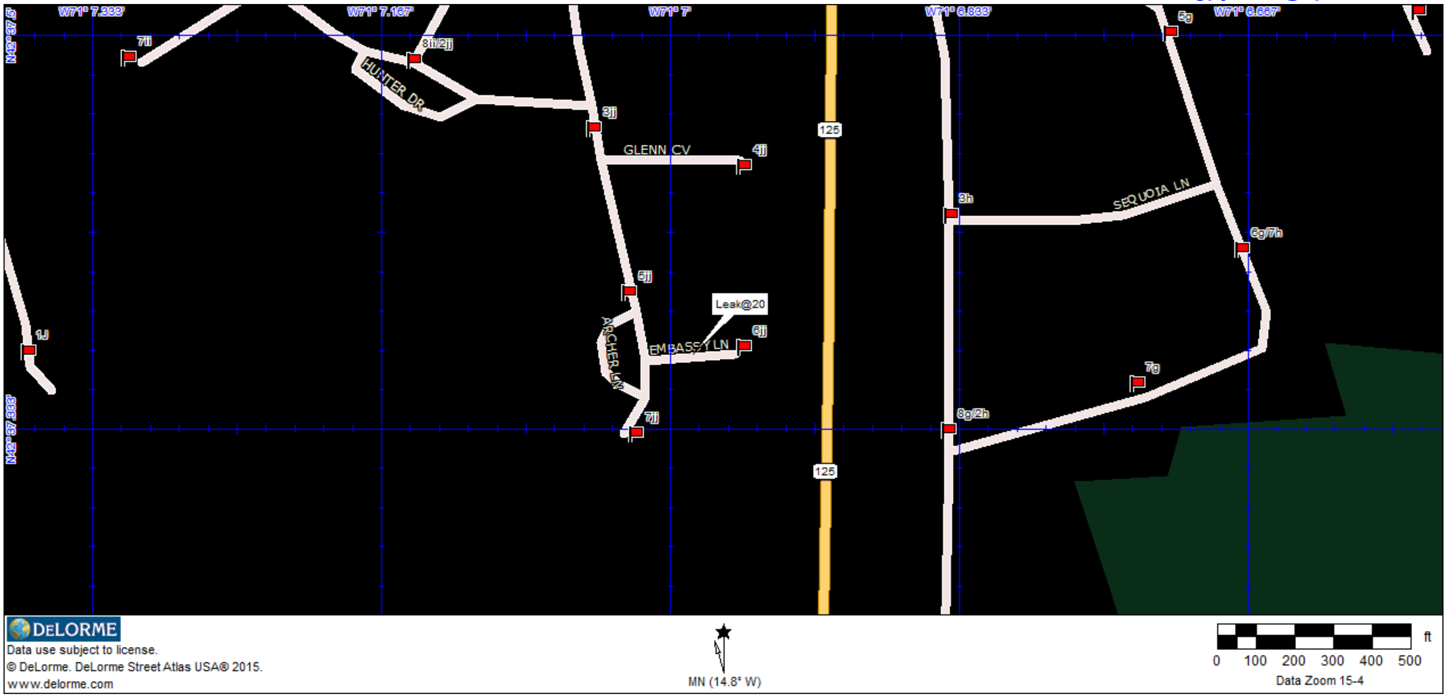


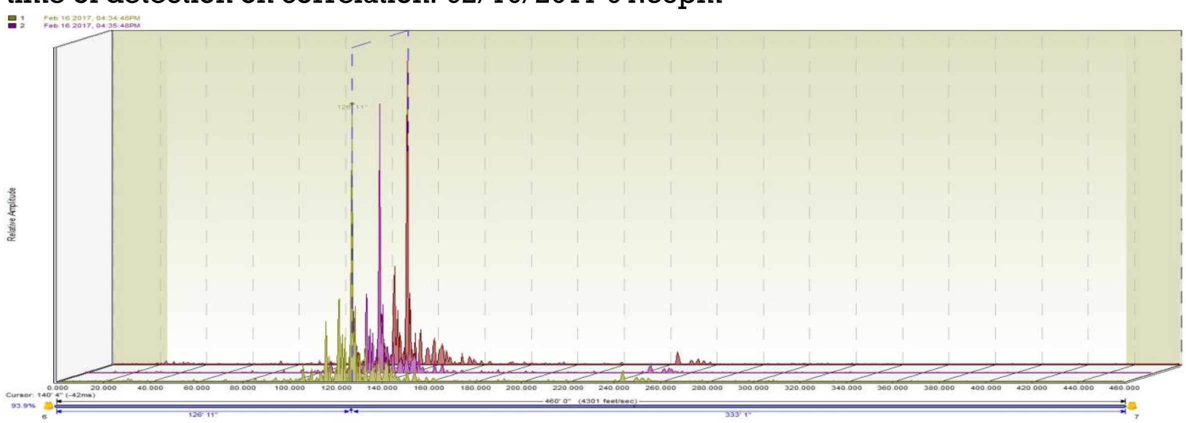
System Name: Andover Water Department's Distribution System, East High Zone

Location: 20 Embassy Lane, Andover, Service Leaking, Main to Box

Approx. Size: 2-4 GPM

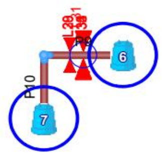
Pipe Material 1" Copper

Date and time of detection on correlation: 02/16/2017 04:35pm



Pipe ID	Length	Diameter	Material	Sound Velocity
P9	250' 0"	3"	Cast Iron	4301 feet/sec
P10	210' 0"	3"	Cast Iron	4301 feet/sec

Leak ID	Leak Position	Correlation Between	Confidence	Recording Time
L28	282' 10" from 5	5 -> 6	91.3%	Feb 16 2017, 04:34:48PM
L29	282' 10" from 5	5 -> 6	90.1%	Feb 16 2017, 04:35:48PM
L30	282' 10" from 5	5 -> 6	91.0%	Feb 16 2017, 04:36:48PM
L31	126' 11" from 6	6 -> 7	93.9%	Feb 16 2017, 04:34:48PM
L32	126' 11" from 6	6 -> 7	94.0%	Feb 16 2017, 04:35:48PM
L33	126' 5" from 6	6 -> 7	94.2%	Feb 16 2017, 04:36:48PM
L34	126' 11" from 6	6 -> 7	94.0%	Feb 16 2017, 04:35:48PM
L35	126' 5" from 6	6 -> 7	94.2%	Feb 16 2017, 04:36:48PM



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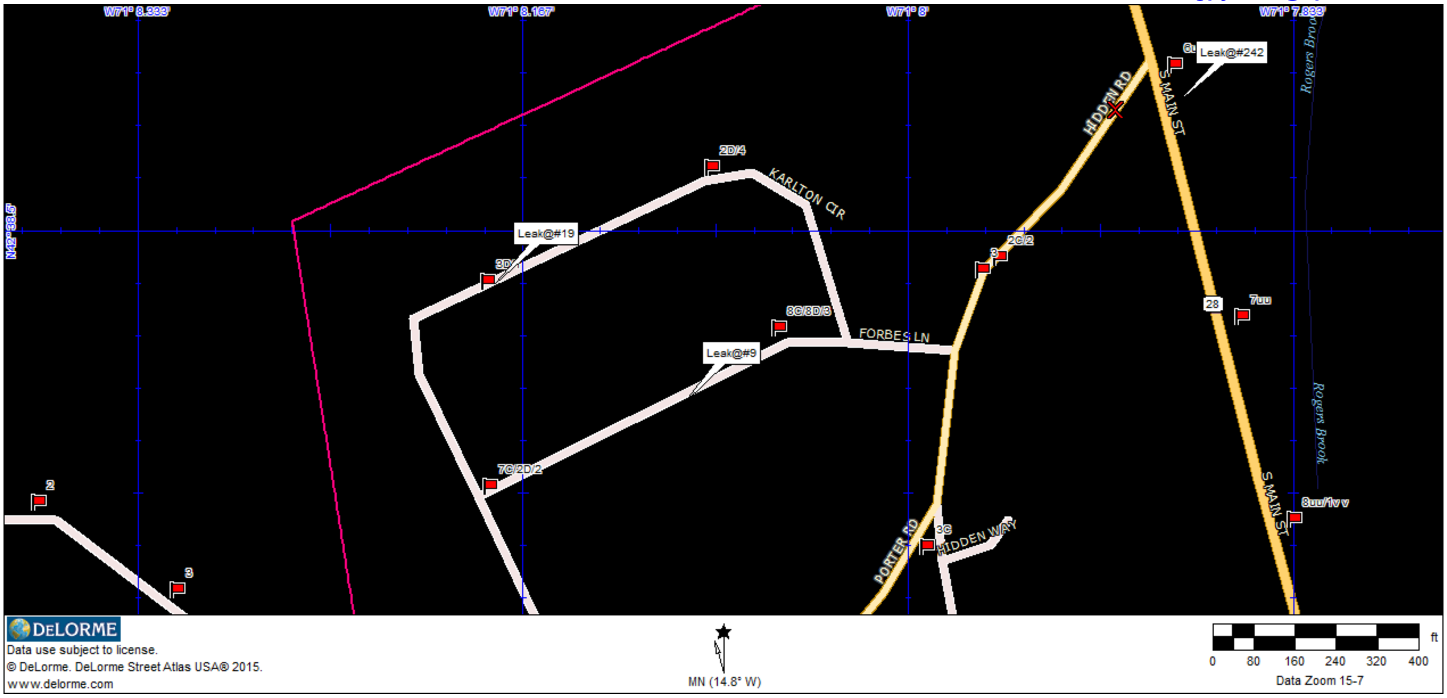
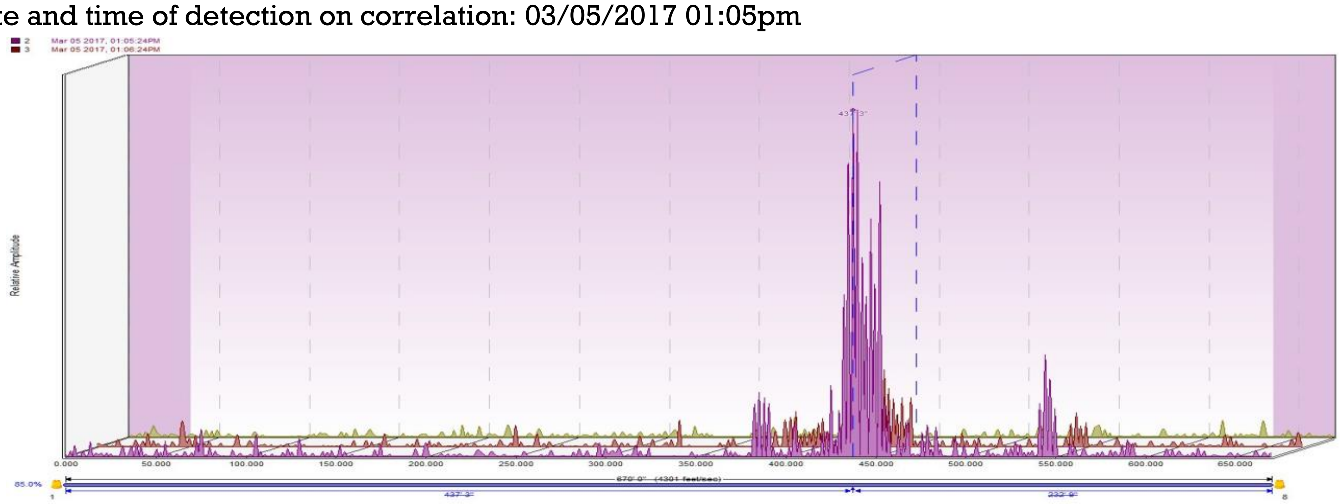
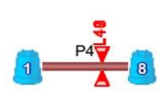


System Name: Andover Water Department's Distribution System, East High Zone
Location: 9 Forbes Lane, Andover, Service Leaking, Box to Cellar
Approx. Size: 1-3 GPM
Pipe Material 1" Copper
Date and time of detection on correlation: 03/05/2017 01:05pm



Pipe ID	Length	Diameter	Material	Sound Velocity
P4	670' 0"	3"	Cast Iron	4301 feet/sec

Leak ID	Leak Position	Correlation Between	Confidence	Recording Time
L17	439' 11" from 1	1 -> 8	86.4%	Mar 05 2017, 01:05:24PM
L18	444' 5" from 1	1 -> 8	80.3%	Mar 05 2017, 01:06:24PM
L40	437' 3" from 1	1 -> 8	85.0%	Mar 05 2017, 01:05:24PM
L41	437' 3" from 1	1 -> 8	76.3%	Mar 05 2017, 01:06:24PM



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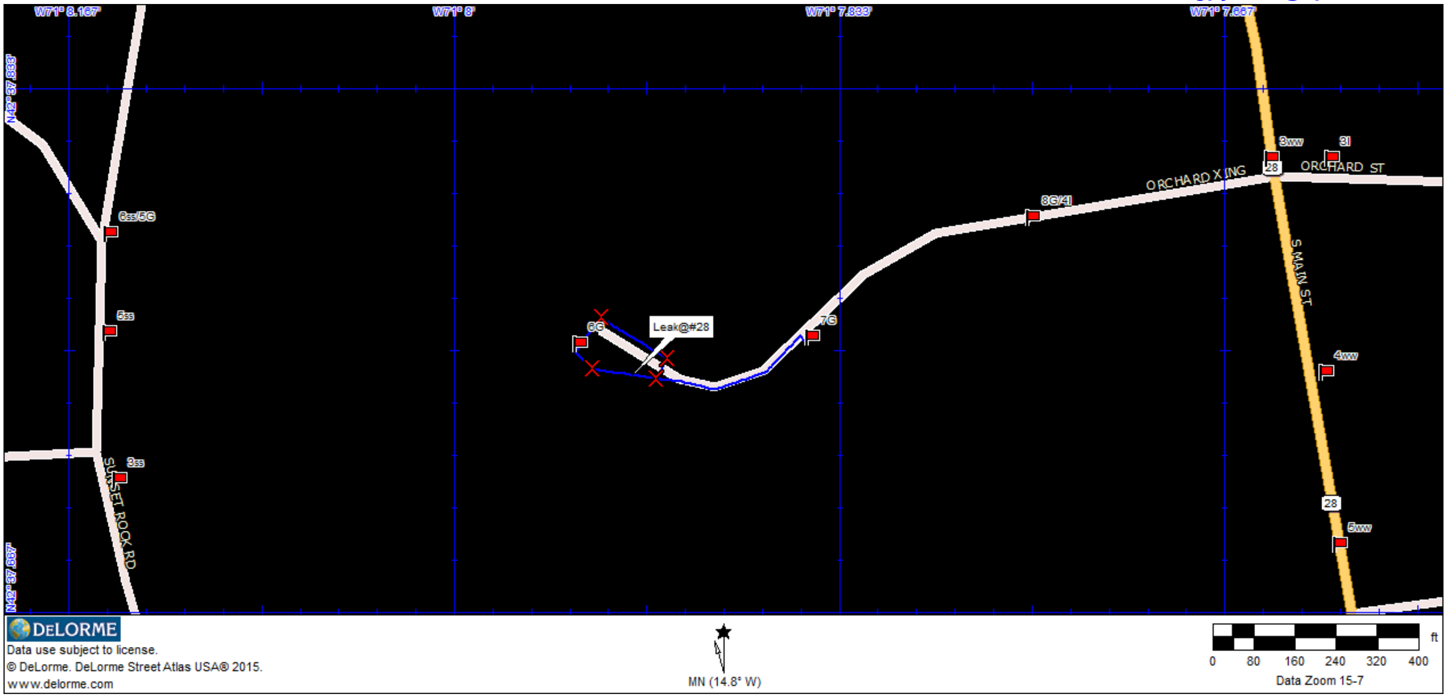


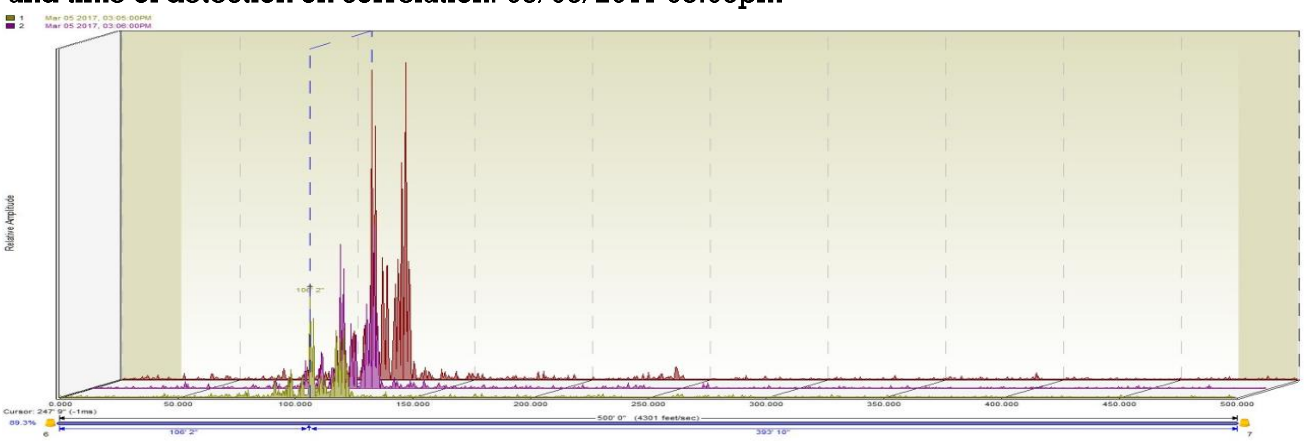
System Name: Andover Water Department's Distribution System, East High Zone

Location: 28 Orchard Crossing, Andover, Service Leaking, Box to Cellar

Approx. Size: 2-4 GPM

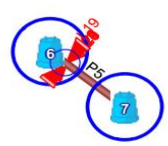
Pipe Material 1" Copper

Date and time of detection on correlation: 03/05/2017 03:05pm



Pipe ID	Length	Diameter	Material	Sound Velocity
P5	500' 0"	3"	Cast Iron	4301 feet/sec

Leak ID	Leak Position	Correlation Between	Confidence	Recording Time
L19	106' 2" from 6	6 -> 7	89.3%	Mar 05 2017, 03:05:00PM
L20	120' 6" from 6	6 -> 7	90.6%	Mar 05 2017, 03:06:00PM
L21	120' 6" from 6	6 -> 7	91.8%	Mar 05 2017, 03:07:00PM
L22	113' 5" from 6	6 -> 8	87.0%	Mar 05 2017, 03:05:00PM
L23	113' 10" from 6	6 -> 8	78.7%	Mar 05 2017, 03:06:00PM
L24	113' 10" from 6	6 -> 8	74.4%	Mar 05 2017, 03:07:00PM
L28	120' 6" from 6	6 -> 7	89.8%	Mar 05 2017, 03:06:00PM
L29	120' 6" from 6	6 -> 7	91.3%	Mar 05 2017, 03:07:00PM



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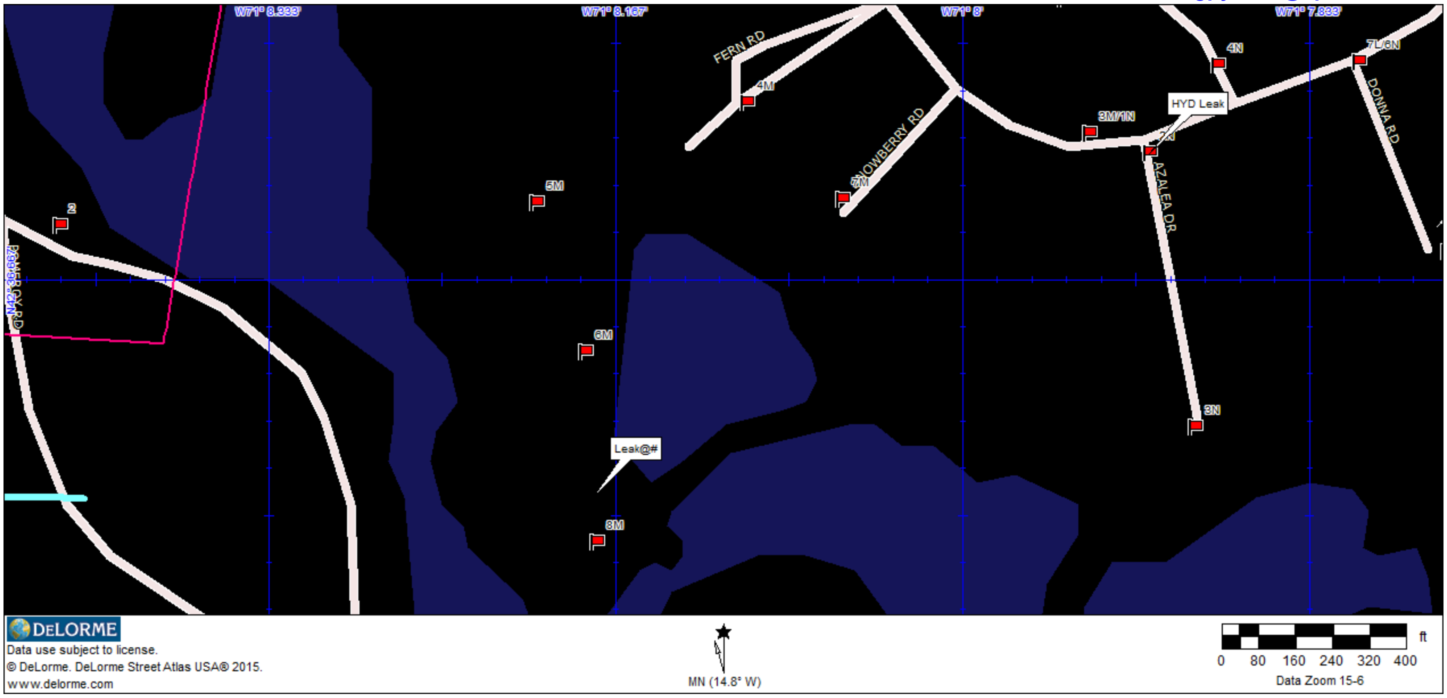


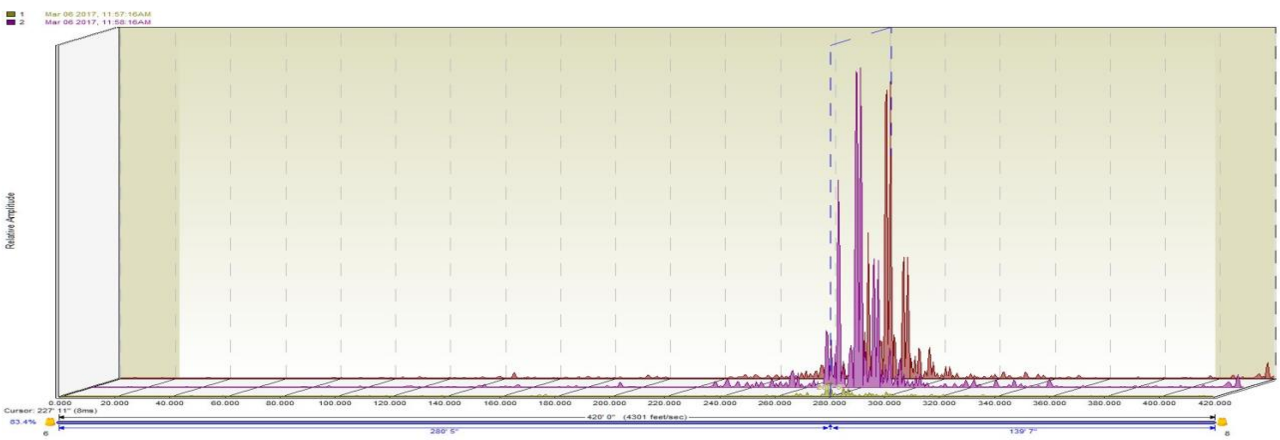
System Name: Andover Water Department's Distribution System, East High Zone

Location: Glenwood Road, Andover, Service Leaking, Box to Cellar

Approx. Size: 2-4 GPM

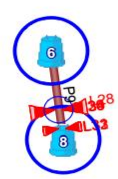
Pipe Material 1" Copper

Date and time of detection on correlation: 03/06/2017 11:58am



Pipe ID	Length	Diameter	Material	Sound Velocity
P9	420' 0"	3"	Cast Iron	4301 feet/sec

Leak ID	Leak Position	Correlation Between	Confidence	Recording Time
L28	280' 5" from 6	6 -> 8	83.4%	Mar 06 2017, 11:57:16AM
L29	280' 5" from 6	6 -> 8	91.4%	Mar 06 2017, 11:58:16AM
L30	280' 0" from 6	6 -> 8	91.7%	Mar 06 2017, 11:59:16AM
L31	55' 2" from 8	8 -> 5	73.5%	Mar 06 2017, 11:57:16AM
L32	55' 2" from 8	8 -> 5	88.2%	Mar 06 2017, 11:58:16AM
L33	55' 2" from 8	8 -> 5	86.4%	Mar 06 2017, 11:59:16AM
L34	280' 5" from 6	6 -> 8	91.4%	Mar 06 2017, 11:58:16AM
L35	280' 0" from 6	6 -> 8	91.7%	Mar 06 2017, 11:59:16AM



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Leak worksheet

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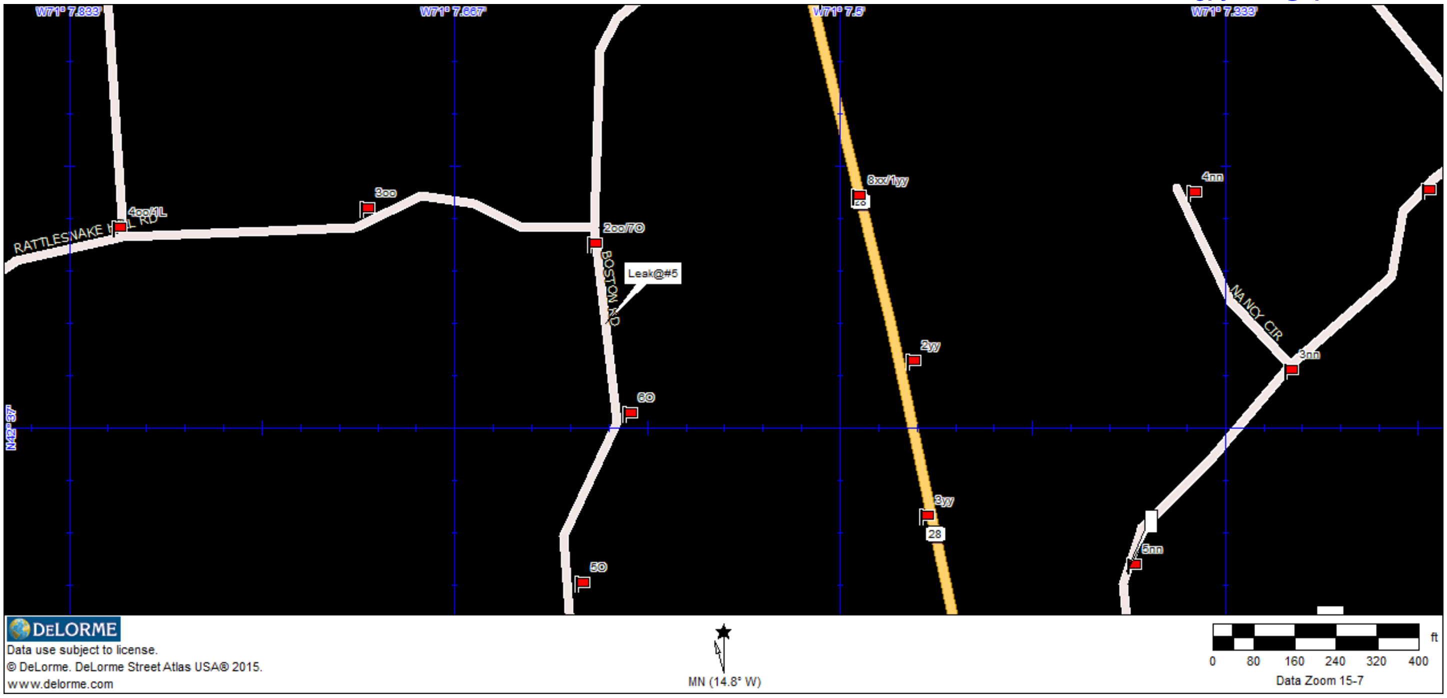


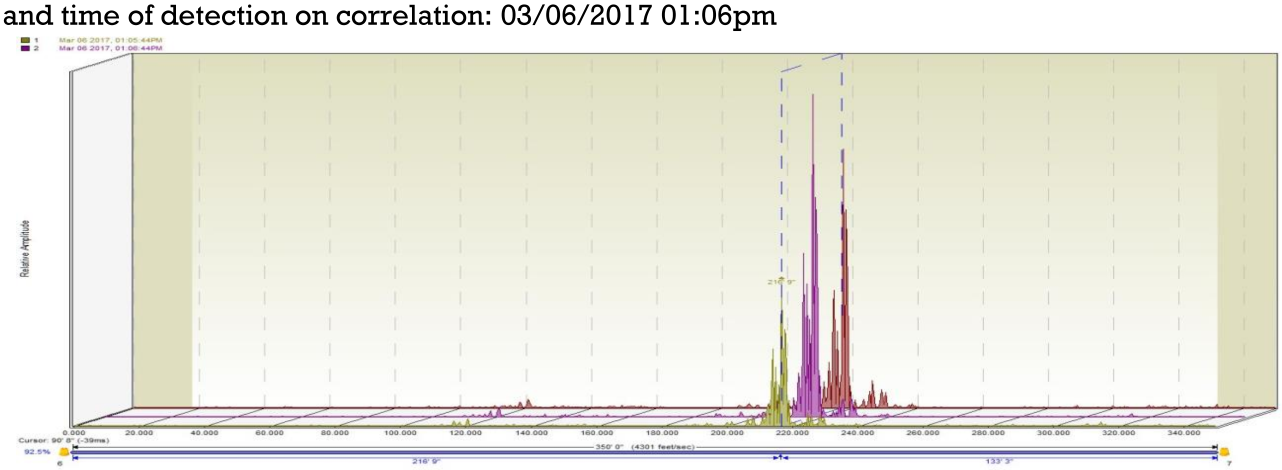
System Name: Andover Water Department's Distribution System, East High Zone

Location:5 Boston Road, Andover, Service Leaking, Box to Cellar

Approx. Size: 2-4 GPM

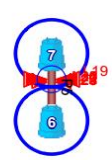
Pipe Material 1" Copper

Date and time of detection on correlation: 03/06/2017 01:06pm



Pipe ID	Length	Diameter	Material	Sound Velocity
P5	350' 0"	3"	Cast Iron	4301 feet/sec

Leak ID	Leak Position	Correlation Between	Confidence	Recording Time
L19	216' 9" from 6	6 -> 7	92.5%	Mar 06 2017, 01:05:44PM
L20	217' 2" from 6	6 -> 7	94.2%	Mar 06 2017, 01:06:44PM
L21	217' 2" from 6	6 -> 7	93.3%	Mar 06 2017, 01:07:44PM
L22	151' 6" from 7	7 -> 5	82.2%	Mar 06 2017, 01:05:44PM
L23	152' 11" from 7	7 -> 5	89.6%	Mar 06 2017, 01:06:44PM
L24	153' 4" from 7	7 -> 5	88.8%	Mar 06 2017, 01:07:44PM
L34	217' 2" from 6	6 -> 7	94.2%	Mar 06 2017, 01:06:44PM
L35	217' 2" from 6	6 -> 7	93.3%	Mar 06 2017, 01:07:44PM



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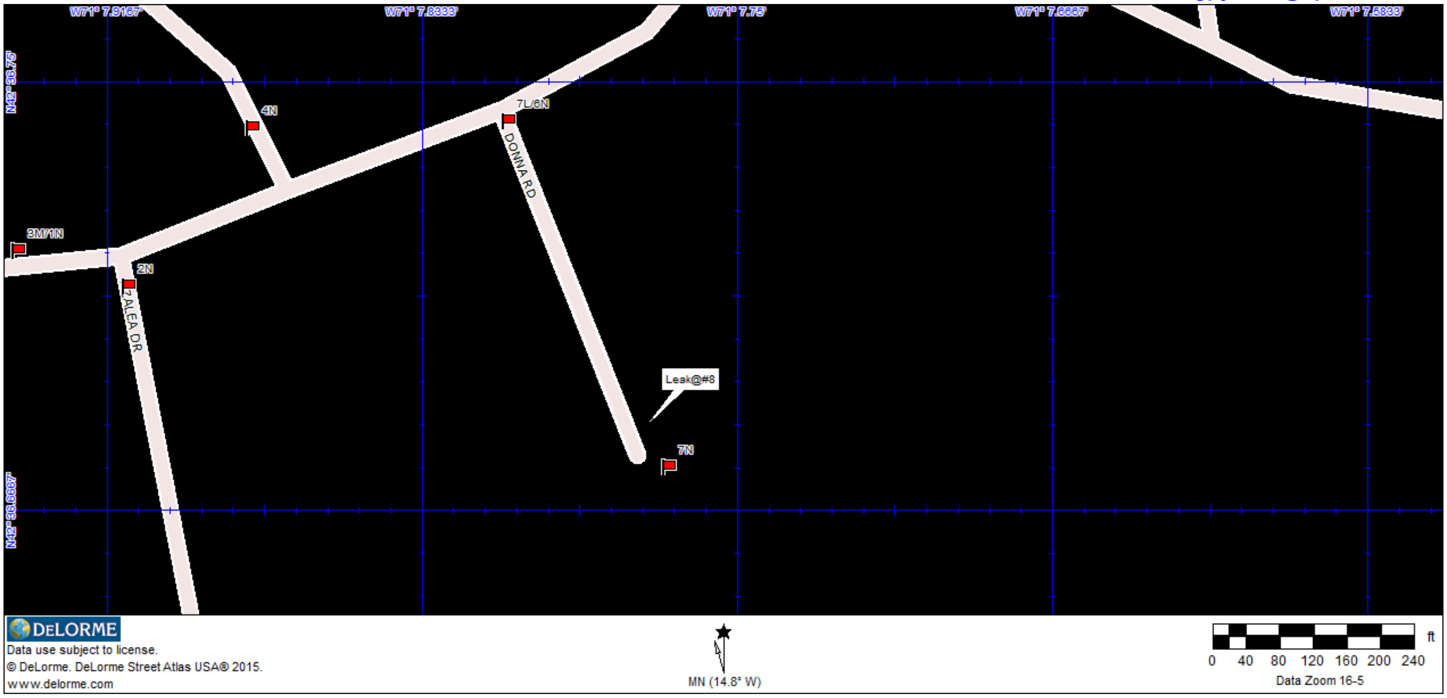
Leak worksheet



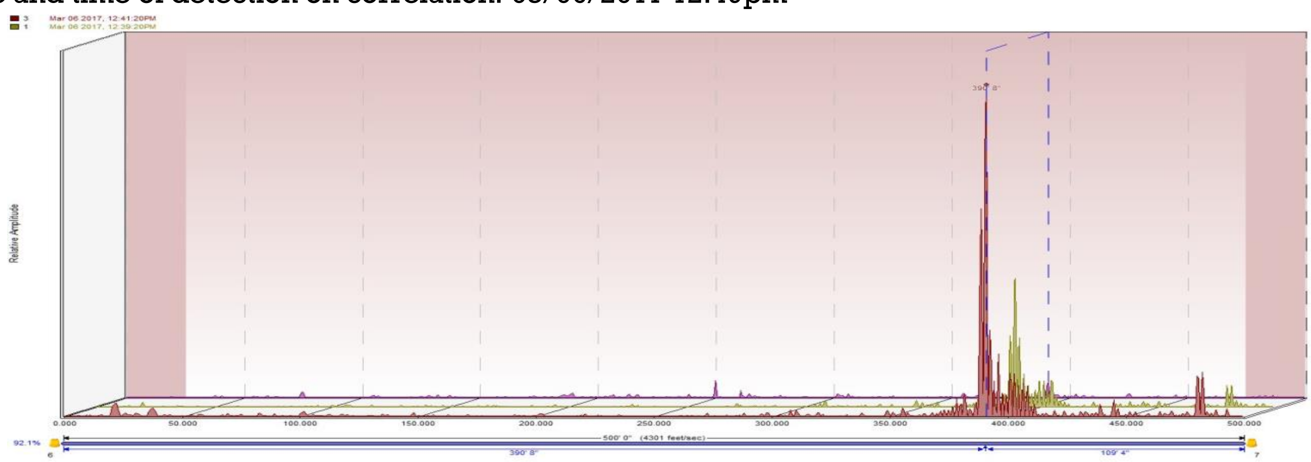
System Name: Andover Water Department's Distribution System, East High Zone

Location:8 Donna Road, Andover, Service Leaking, Box to Cellar

Approx. Size: 2-4 GPM

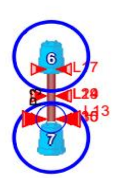
Pipe Material 1" Copper

Date and time of detection on correlation: 03/06/2017 12:49pm



Pipe ID	Length	Diameter	Material	Sound Velocity
P3	500' 0"	3"	Cast Iron	4301 feet/sec

Leak ID	Leak Position	Correlation Between	Confidence	Recording Time
L13	390' 3" from 6	6 -> 7	90.2%	Mar 06 2017, 12:39:20PM
L14	249' 7" from 6	6 -> 7	81.3%	Mar 06 2017, 12:40:20PM
L15	390' 8" from 6	6 -> 7	92.1%	Mar 06 2017, 12:41:20PM
L17	424' 11" from 7	7 -> 4	74.9%	Mar 06 2017, 12:40:20PM
L29	249' 7" from 6	6 -> 7	81.3%	Mar 06 2017, 12:40:20PM
L30	390' 8" from 6	6 -> 7	92.1%	Mar 06 2017, 12:41:20PM



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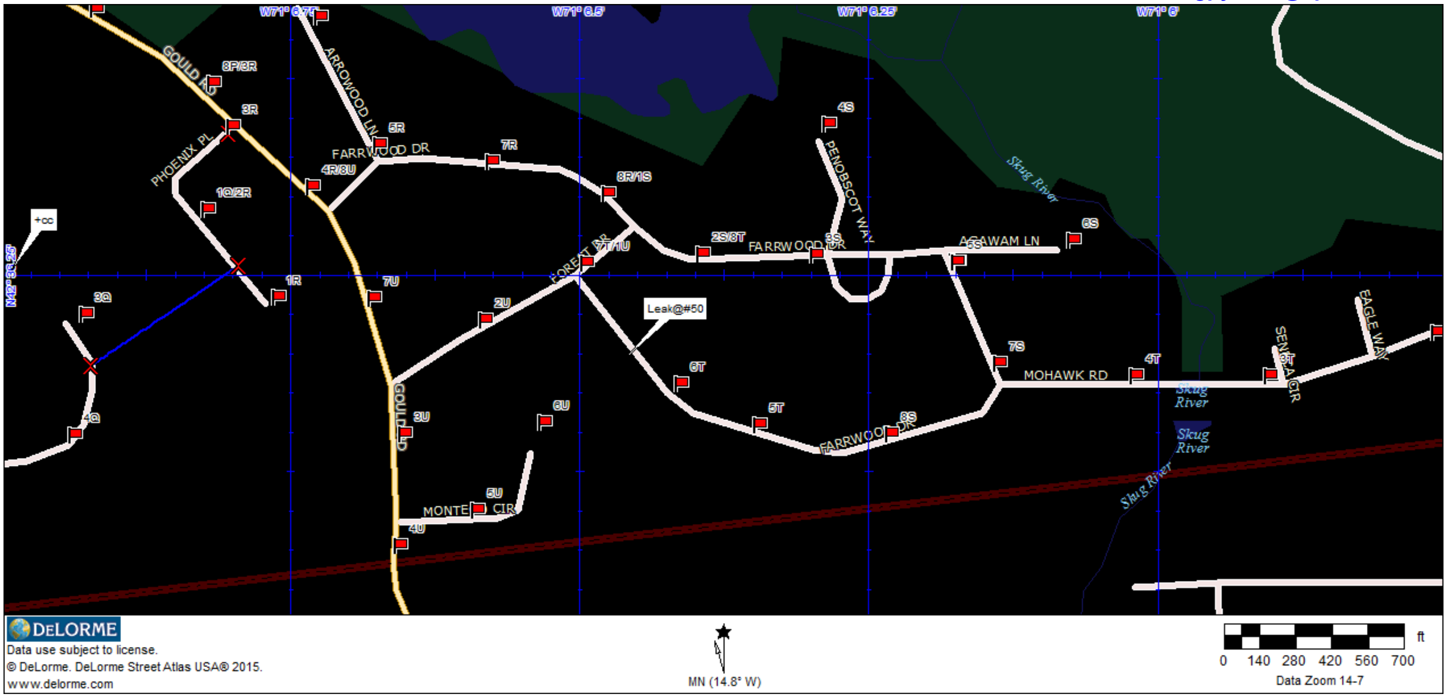
Leak worksheet



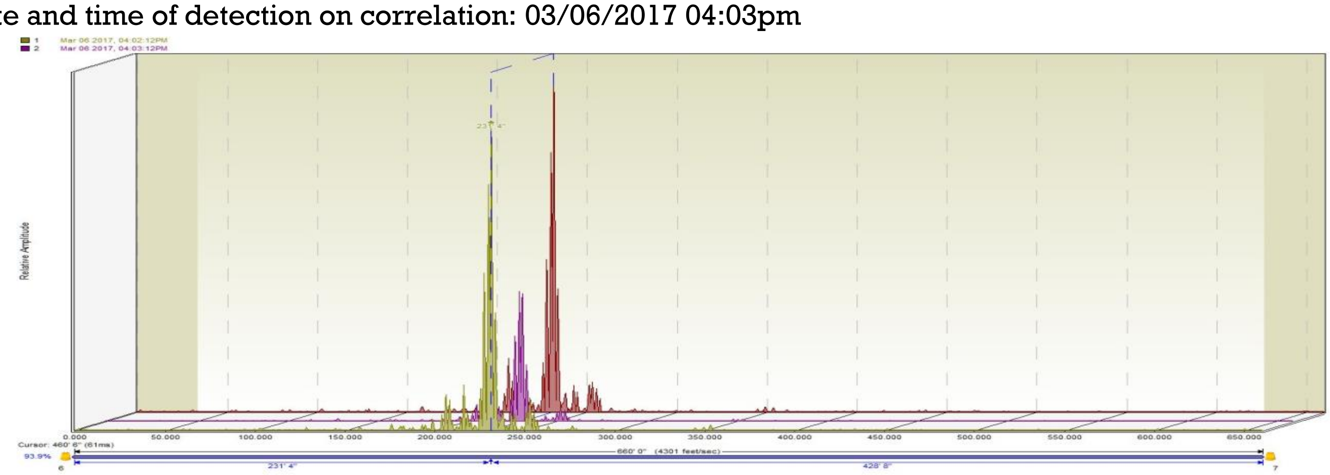
System Name: Andover Water Department's Distribution System, East High Zone

Location: 50 Farrwood Drive, Andover, Service Leaking, Main to Box

Approx. Size: 2-4 GPM

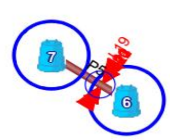
Pipe Material 1" Copper

Date and time of detection on correlation: 03/06/2017 04:03pm



Pipe ID	Length	Diameter	Material	Sound Velocity
P5	660' 0"	3"	Cast Iron	4301 feet/sec

Leak ID	Leak Position	Correlation Between	Confidence	Recording Time
L19	231' 4" from 6	6 -> 7	93.9%	Mar 06 2017, 04:02:12PM
L20	229' 7" from 6	6 -> 7	92.9%	Mar 06 2017, 04:03:12PM
L21	231' 4" from 6	6 -> 7	94.0%	Mar 06 2017, 04:04:12PM
L22	218' 9" from 6	6 -> 8	90.2%	Mar 06 2017, 04:02:12PM
L23	218' 3" from 6	6 -> 8	86.6%	Mar 06 2017, 04:03:12PM
L24	218' 9" from 6	6 -> 8	89.5%	Mar 06 2017, 04:04:12PM
L40	229' 7" from 6	6 -> 7	92.9%	Mar 06 2017, 04:03:12PM
L41	231' 4" from 6	6 -> 7	93.9%	Mar 06 2017, 04:04:12PM



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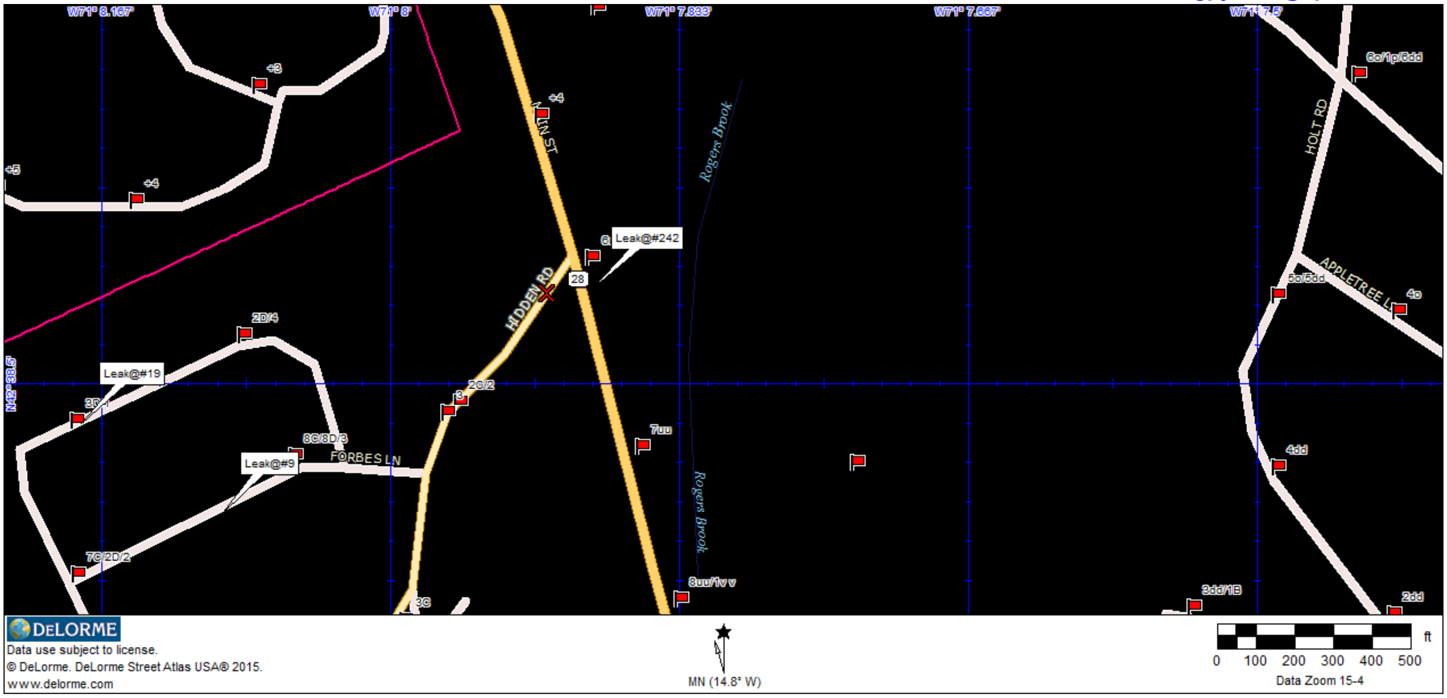
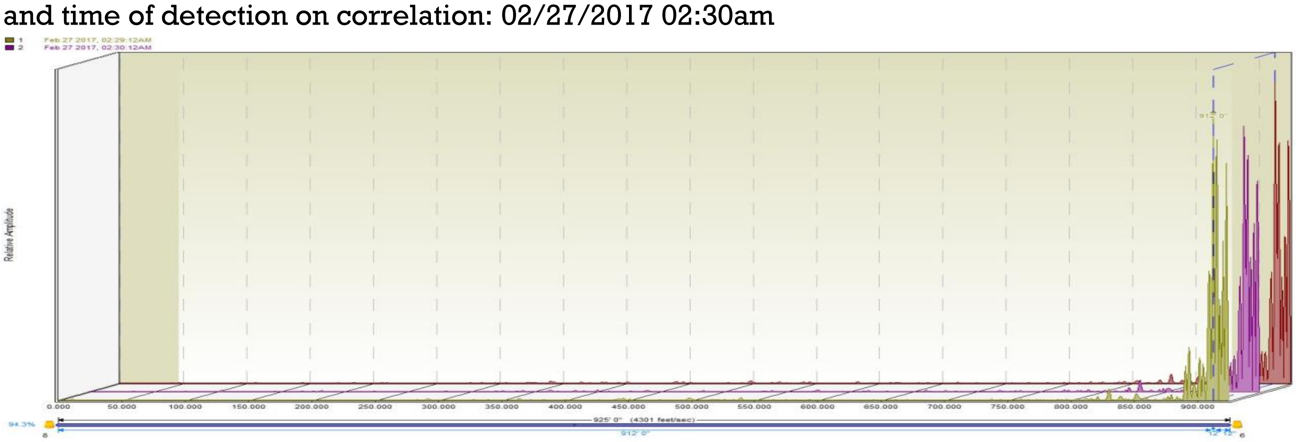


System Name: Andover Water Department's Distribution System, East High Zone
Location 242 S. Main Street, Andover, Service Leaking, Main to Box
Approx. Size: 2-4 GPM
Pipe Material 1" Copper
Date and time of detection on correlation: 02/27/2017 02:30am



Pipe ID	Length	Diameter	Material	Sound Velocity
P6	515' 0"	3"	Cast Iron	4301 feet/sec
P7	410' 0"	3"	Cast Iron	4301 feet/sec

Leak ID	Leak Position	Correlation Between	Confidence	Recording Time
L25	16' 2" from 6	6 -> 7	91.1%	Feb 27 2017, 02:29:12AM
L26	16' 2" from 6	6 -> 7	91.3%	Feb 27 2017, 02:30:12AM
L27	16' 2" from 6	6 -> 7	90.9%	Feb 27 2017, 02:31:12AM
L28	37' 3" from 7	7 -> 8	76.9%	Feb 27 2017, 02:29:12AM
L29	15' 3" from 7	7 -> 8	74.3%	Feb 27 2017, 02:30:12AM
L30	3' 2" from 7	7 -> 8	77.0%	Feb 27 2017, 02:31:12AM
L31	912' 0" from 8	8 -> 6	94.3%	Feb 27 2017, 02:29:12AM
L32	912' 5" from 8	8 -> 6	94.0%	Feb 27 2017, 02:30:12AM
L33	912' 5" from 8	8 -> 6	94.2%	Feb 27 2017, 02:31:12AM
L34	912' 5" from 8	8 -> 6	94.0%	Feb 27 2017, 02:30:12AM
L35	912' 5" from 8	8 -> 6	94.2%	Feb 27 2017, 02:31:12AM

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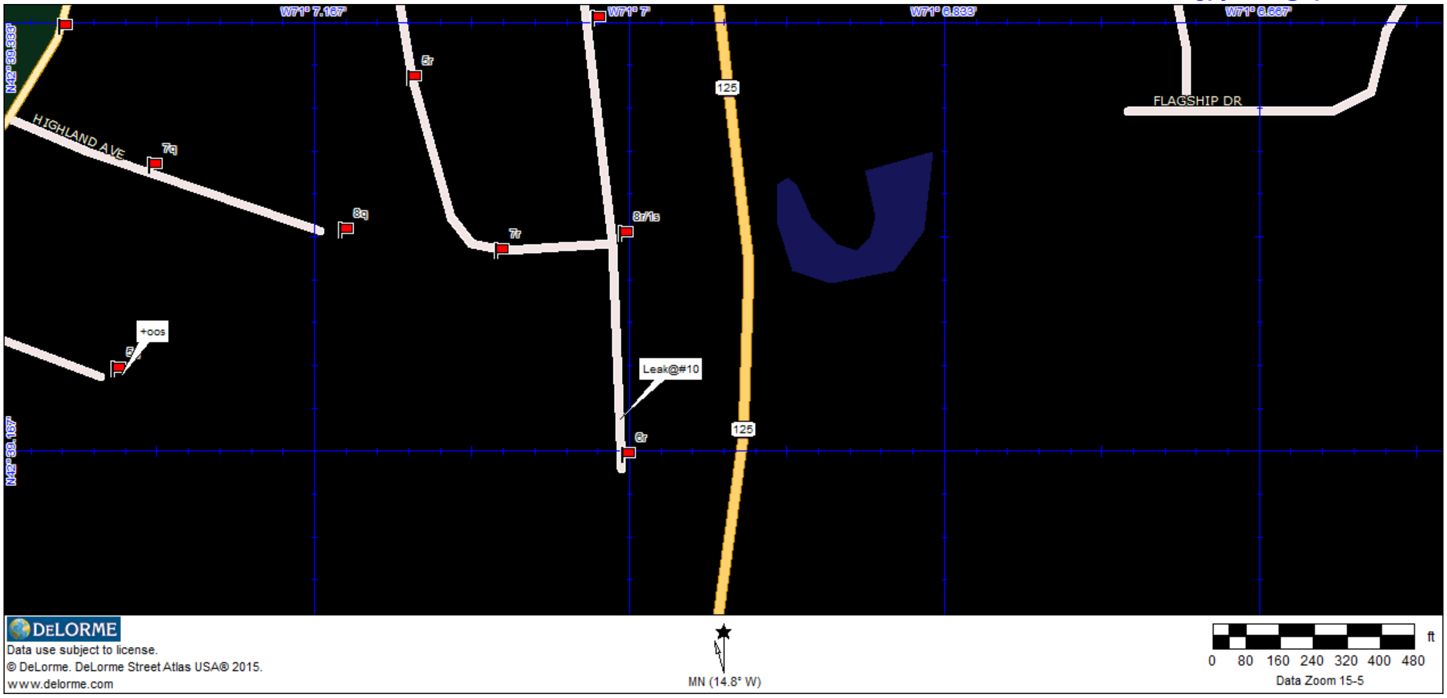


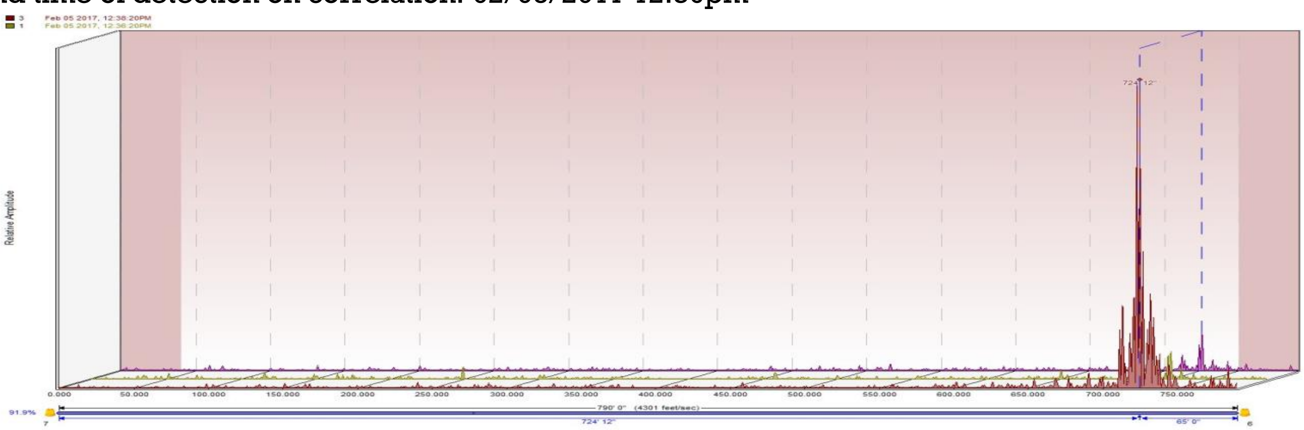
System Name: Andover Water Department's Distribution System, East High Zone

Location 37 Kathleen Drive, Andover, Service Leaking, Box to Cellar

Approx. Size: 1-3 GPM

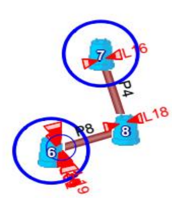
Pipe Material 1" Copper

Date and time of detection on correlation: 02/05/2017 12:36pm



Pipe ID	Length	Diameter	Material	Sound Velocity
P4	280' 0"	3"	Cast Iron	4301 feet/sec
P8	510' 0"	3"	Cast Iron	4301 feet/sec

Leak ID	Leak Position	Correlation Between	Confidence	Recording Time
L16	21' 6" from 7	7 -> 8	68.2%	Feb 05 2017, 12:36:20PM
L18	259' 10" from 7	7 -> 8	79.1%	Feb 05 2017, 12:38:20PM
L19	725' 5" from 7	7 -> 6	79.6%	Feb 05 2017, 12:36:20PM
L20	724' 12" from 7	7 -> 6	83.6%	Feb 05 2017, 12:37:20PM
L21	724' 12" from 7	7 -> 6	91.9%	Feb 05 2017, 12:38:20PM
L31	54' 3" from 6	6 -> 8	70.9%	Feb 05 2017, 12:36:20PM
L32	44' 4" from 6	6 -> 8	69.9%	Feb 05 2017, 12:37:20PM
L33	51' 12" from 6	6 -> 8	88.0%	Feb 05 2017, 12:38:20PM
L34	724' 12" from 7	7 -> 6	83.6%	Feb 05 2017, 12:37:20PM
L35	724' 12" from 7	7 -> 6	91.9%	Feb 05 2017, 12:38:20PM



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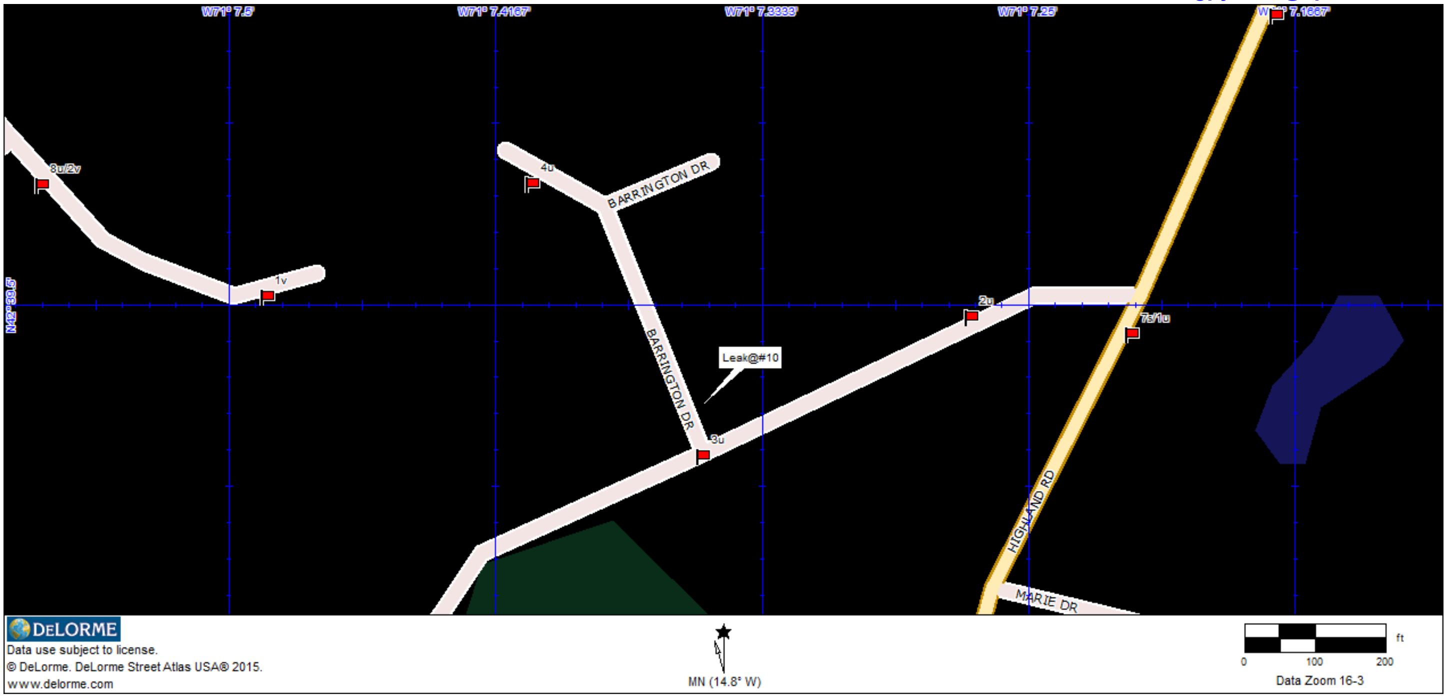
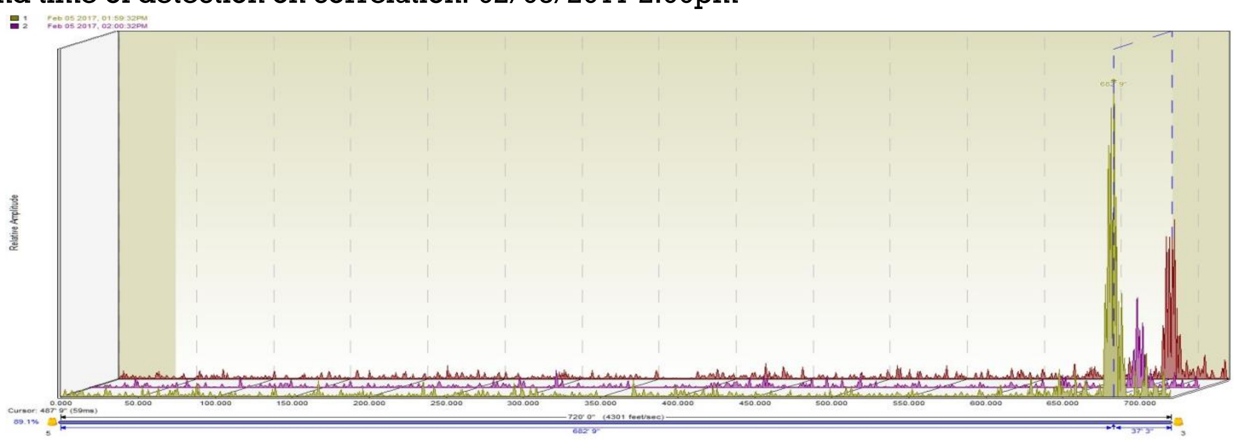
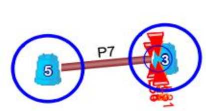


System Name: Andover Water Department's Distribution System, East High Zone
Location 10 Morningside Drive, Andover, Service Leaking, Box to Cellar
Approx. Size: 2-4 GPM
Pipe Material 1" Copper
Date and time of detection on correlation: 02/05/2017 2:00pm



Pipe ID	Length	Diameter	Material	Sound Velocity
P7	720' 0"	3"	Cast Iron	4301 feet/sec

Leak ID	Leak Position	Correlation Between	Confidence	Recording Time
L31	682' 9" from 5	5 -> 3	89.1%	Feb 05 2017, 01:59:32PM
L32	679' 8" from 5	5 -> 3	84.1%	Feb 05 2017, 02:00:32PM
L33	684' 7" from 5	5 -> 3	85.8%	Feb 05 2017, 02:01:32PM
L34	635' 10" from 5	5 -> 2	84.6%	Feb 05 2017, 01:59:32PM
L35	635' 4" from 5	5 -> 2	80.9%	Feb 05 2017, 02:00:32PM
L36	635' 10" from 5	5 -> 2	82.3%	Feb 05 2017, 02:01:32PM
L37	679' 8" from 5	5 -> 3	84.1%	Feb 05 2017, 02:00:32PM
L38	684' 7" from 5	5 -> 3	85.8%	Feb 05 2017, 02:01:32PM



Town of Andover Massachusetts

Department of Public Works

Water System Leak Detection Survey Report

Bancroft Low Pressure Zone

2017

Prepared By

<u>Arthur Pyburn & Sons Inc.</u>

Technical Services

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July 30, 2017

Town of Andover
Department of Public Works
397 Lowell Street
Andover, MA 01810

The following is a summary of leak detection performed on 100 miles of the “East High Zone” of the Andover Water Department’s distribution system.

The pages that follow are the individual reports for each leak.

During the course of this survey leaks were found at the following locations.

Services found to be leaking:
250 North Main Street, Service Leaking (box to cellar), 10-15gpm, Repaired
29 Sutherland Street, Service Leaking (box to cellar), 2-4gpm
56 Carmel Road, Service Leaking (box to cellar), 2-4gpm
64 Spring Grove Road, Service Leaking (box to cellar), 2-4gpm
4 Dundas Ave, Service Leaking, (box to cellar), 2-4gpm
10 Apache Drive. Service Leaking (main to Box), 3-5gpm Repaired

The total leakage due to service leaks is estimated to be between 21 and 36 gallons per/min.

In conclusion, 6 leaks were located during the course of this survey. The total of estimated leakage from the leaks found during this survey is approximately 21 to 36 gallons per/min.

The leakage amounts noted in this report are only estimates and require confirmation during the repair of the leaks.

Respectfully Submitted by Gregory Pyburn

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Leak worksheet

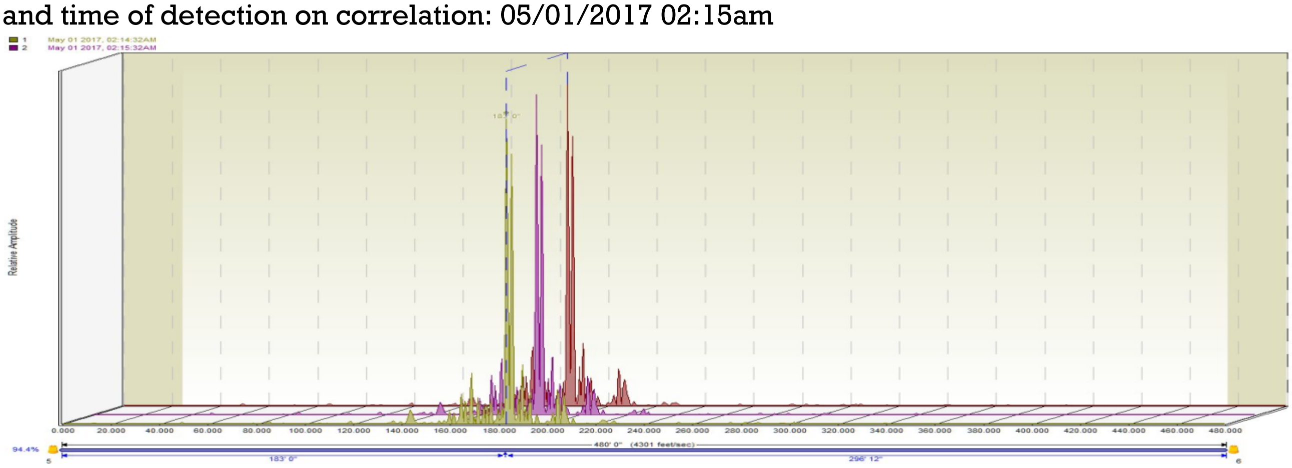
System Name: Andover Water Department's Distribution System, Bancroft Low Zone

Location: 250 N. Main Street, Andover, Service Leaking, Repaired

Approx. Size: 10-15 GPM

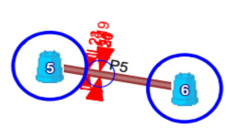
Pipe Material 1" Copper

Date and time of detection on correlation: 05/01/2017 02:15am



Pipe ID	Length	Diameter	Material	Sound Velocity
P5	480' 0"	3"	Cast Iron	4301 feet/sec

Leak ID	Leak Position	Correlation Between	Confidence	Recording Time
L19	183' 0" from 5	5 -> 6	94.4%	May 01 2017, 02:14:32AM
L20	183' 0" from 5	5 -> 6	94.4%	May 01 2017, 02:15:32AM
L21	183' 0" from 5	5 -> 6	94.5%	May 01 2017, 02:16:32AM
L23	140' 8" from 5	5 -> 7	85.2%	May 01 2017, 02:15:32AM
L24	140' 8" from 5	5 -> 7	84.4%	May 01 2017, 02:16:32AM
L34	183' 0" from 5	5 -> 6	94.4%	May 01 2017, 02:15:32AM
L35	183' 0" from 5	5 -> 6	94.5%	May 01 2017, 02:16:32AM



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Leak worksheet

System Name: Andover Water Department's Distribution System, Bancroft Low Zone
Location: 29 Sutherland Street, Andover, Service Leaking, Box to Cellar
Approx. Size: 2-4 GPM
Pipe Material 1" Copper
Leak detected during the audit of noise logger recordings. No correlations available. Located using ground microphone.

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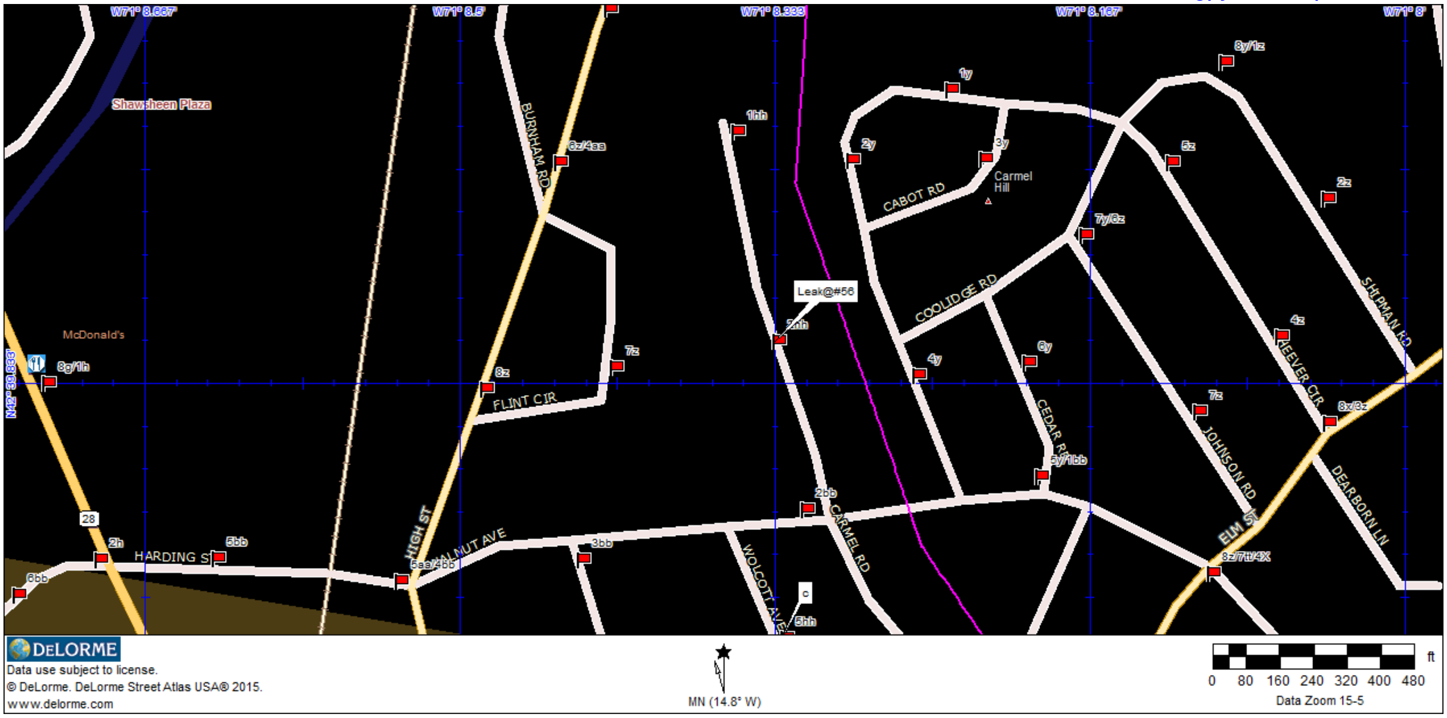
Leak worksheet



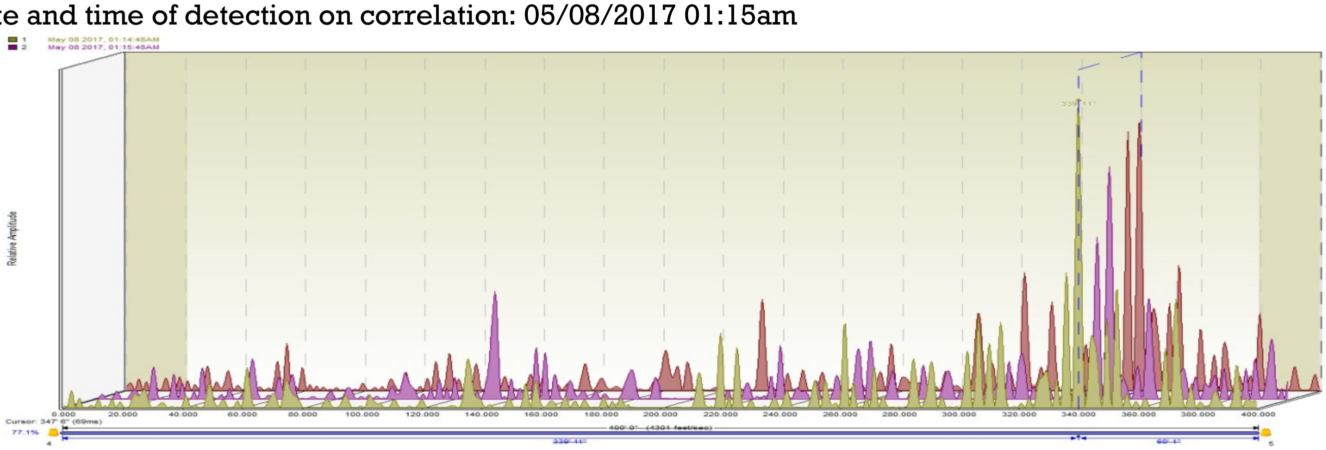
System Name: Andover Water Department's Distribution System, Bancroft Low Zone

Location: 56 Carmel Road, Andover, Service Leaking, Box to Cellar

Approx. Size: 2-4 GPM

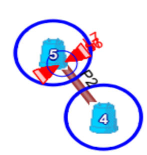
Pipe Material 1" Copper

Date and time of detection on correlation: 05/08/2017 01:15am



Pipe ID	Length	Diameter	Material	Sound Velocity
P2	400' 0"	3"	Cast Iron	4301 feet/sec

Leak ID	Leak Position	Correlation Between	Confidence	Recording Time
L7	339' 11" from 4	4 -> 5	77.1%	May 08 2017, 01:14:48AM
L8	339' 11" from 4	4 -> 5	74.8%	May 08 2017, 01:15:48AM
L9	335' 5" from 4	4 -> 5	76.4%	May 08 2017, 01:16:48AM
L46	339' 11" from 4	4 -> 5	74.8%	May 08 2017, 01:15:48AM
L47	339' 6" from 4	4 -> 5	75.9%	May 08 2017, 01:16:48AM



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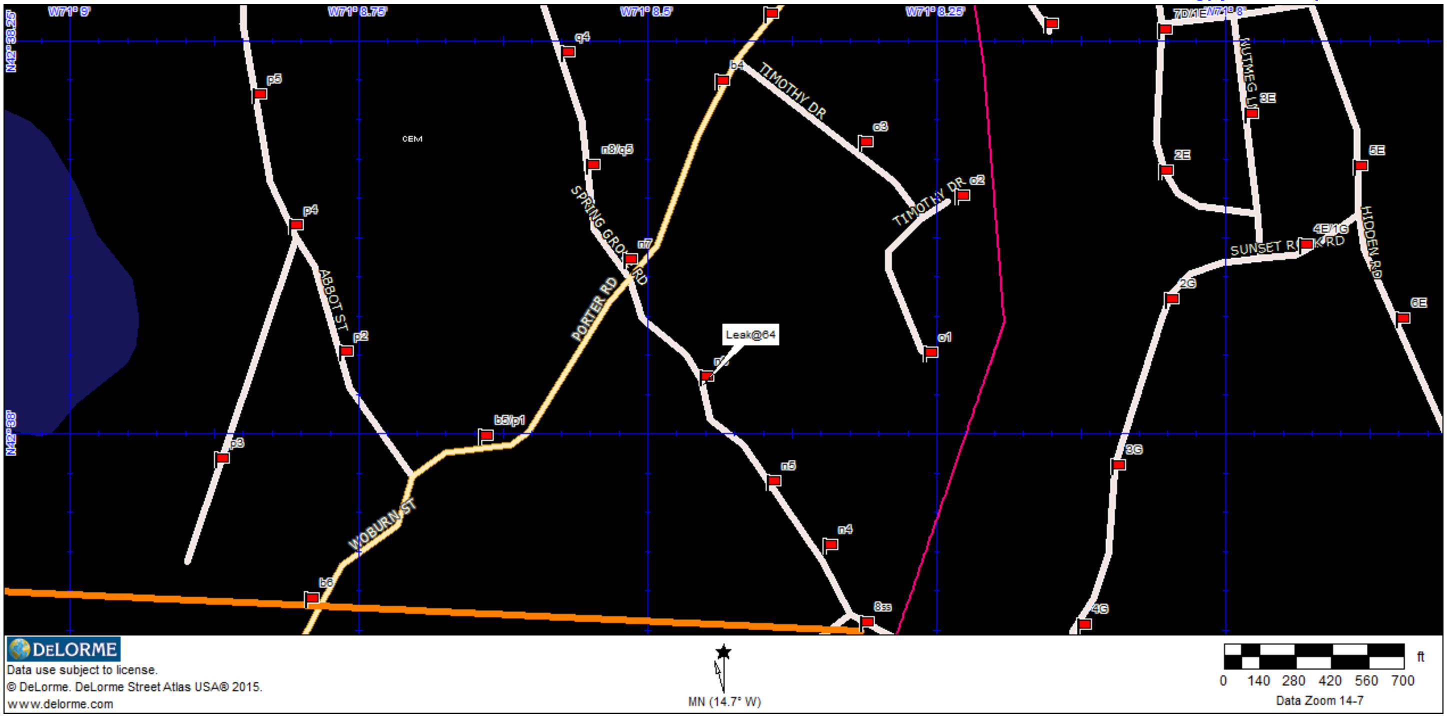
Leak worksheet



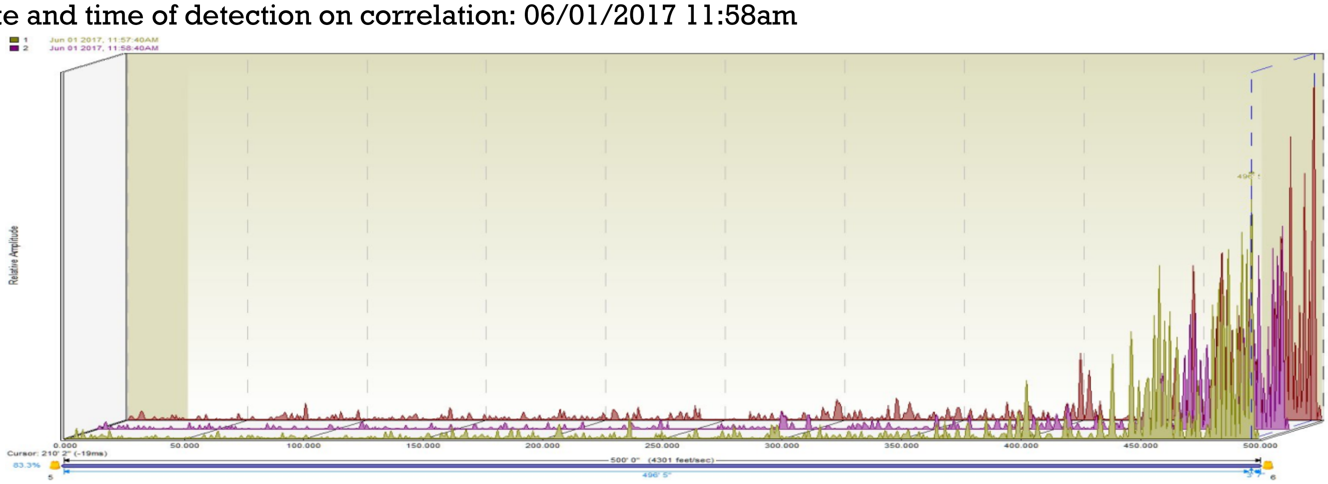
System Name: Andover Water Department's Distribution System, Bancroft Low Zone

Location: 64 Spring Grove Road, Andover, Service Leaking, Box to Cellar

Approx. Size: 2-4 GPM

Pipe Material 1" Copper

Date and time of detection on correlation: 06/01/2017 11:58am



Pipe ID	Length	Diameter	Material	Sound Velocity
P5	500' 0"	3"	Cast Iron	4301 feet/sec

Leak ID	Leak Position	Correlation Between	Confidence	Recording Time
L19	496' 5" from 5	5 -> 6	83.3%	Jun 01 2017, 11:57:40AM
L20	496' 5" from 5	5 -> 6	82.6%	Jun 01 2017, 11:58:40AM
L21	496' 5" from 5	5 -> 6	84.4%	Jun 01 2017, 11:59:40AM
L34	496' 5" from 5	5 -> 6	82.6%	Jun 01 2017, 11:58:40AM
L35	496' 5" from 5	5 -> 6	84.4%	Jun 01 2017, 11:59:40AM

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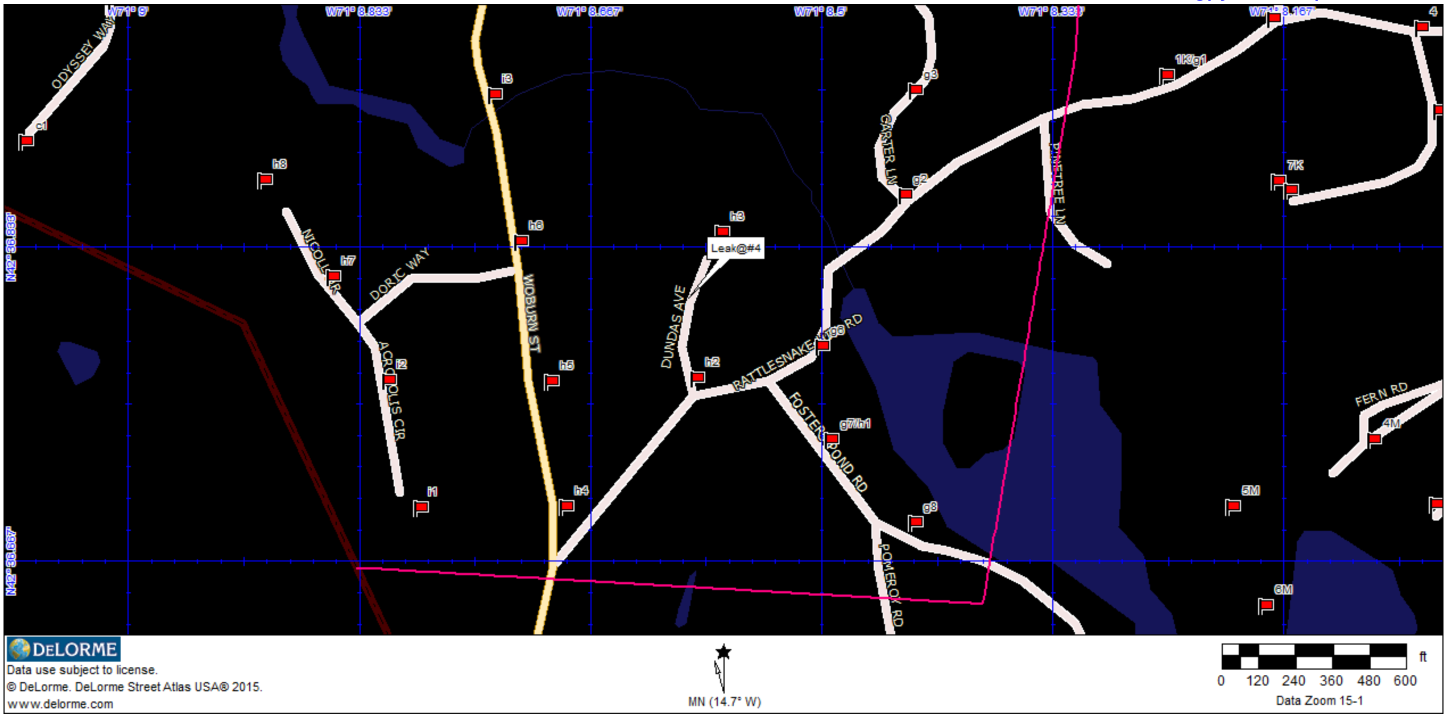
Leak worksheet



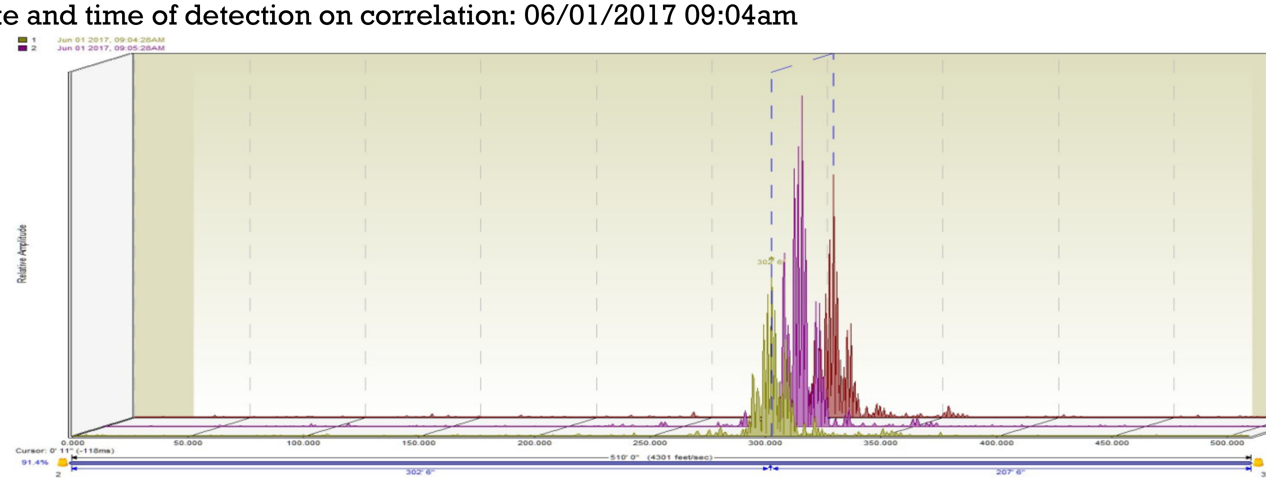
System Name: Andover Water Department's Distribution System, Bancroft Low Zone

Location: 4 Dundas Ave, Andover, Service Leaking, Box to Cellar

Approx. Size: 2-4 GPM

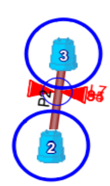
Pipe Material 1" Copper

Date and time of detection on correlation: 06/01/2017 09:04am



Pipe ID	Length	Diameter	Material	Sound Velocity
P2	510' 0"	3"	Cast Iron	4301 feet/sec

Leak ID	Leak Position	Correlation Between	Confidence	Recording Time
L7	302' 6" from 2	2 -> 3	91.4%	Jun 01 2017, 09:04:28AM
L8	302' 6" from 2	2 -> 3	93.0%	Jun 01 2017, 09:05:28AM
L9	302' 6" from 2	2 -> 3	92.0%	Jun 01 2017, 09:06:28AM
L34	302' 6" from 2	2 -> 3	93.0%	Jun 01 2017, 09:05:28AM
L35	302' 6" from 2	2 -> 3	92.0%	Jun 01 2017, 09:06:28AM



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Leak worksheet

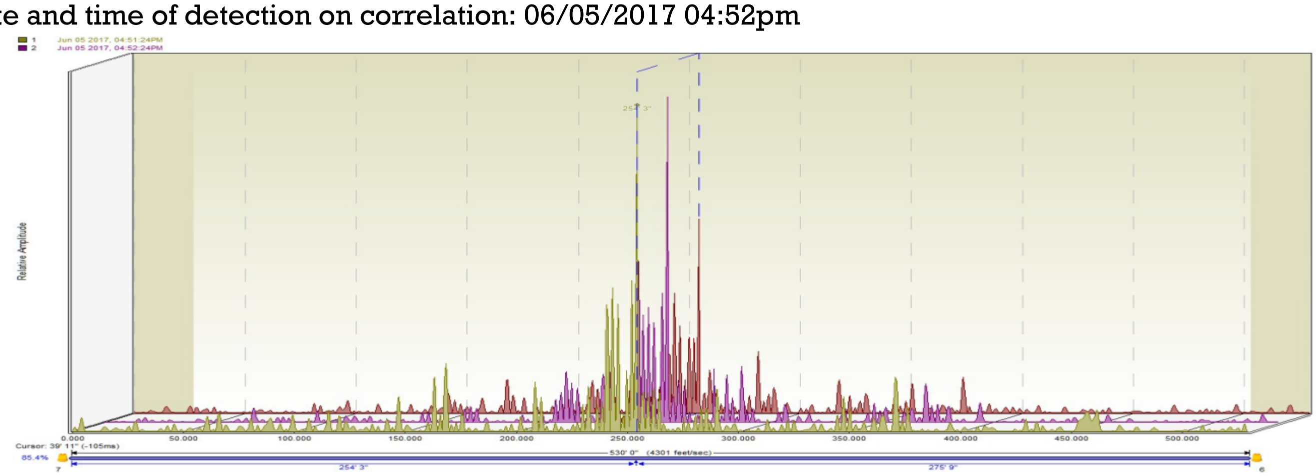
System Name: Andover Water Department's Distribution System, Bancroft Low Zone

Location: 10 Apache Ave, Andover, Service Leaking, Main to Box

Approx. Size: 3-5 GPM

Pipe Material 1" Copper

Date and time of detection on correlation: 06/05/2017 04:52pm



Pipe ID	Length	Diameter	Material	Sound Velocity
P9	530' 0"	3"	Cast Iron	4301 feet/sec

Leak ID	Leak Position	Correlation Between	Confidence	Recording Time
L28	662' 6" from 5	5 -> 7	75.0%	Jun 05 2017, 04:51:24PM
L29	670' 1" from 5	5 -> 7	81.5%	Jun 05 2017, 04:52:24PM
L31	254' 3" from 7	7 -> 6	85.4%	Jun 05 2017, 04:51:24PM
L32	254' 3" from 7	7 -> 6	86.2%	Jun 05 2017, 04:52:24PM
L33	259' 2" from 7	7 -> 6	84.6%	Jun 05 2017, 04:53:24PM
L34	254' 3" from 7	7 -> 6	86.2%	Jun 05 2017, 04:52:24PM
L35	254' 3" from 7	7 -> 6	83.7%	Jun 05 2017, 04:53:24PM

Town of Andover Massachusetts

Department of Public Works

Water System Leak Detection Survey Report

West High Pressure Zone

2017

Prepared By

<u>Arthur Pyburn & Sons Inc.</u>

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April 10, 2017

Town of Andover
Department of Public Works
397 Lowell Street
Andover, MA 01810

The following is a summary of leak detection performed on 65 miles of the “West High Zone” of the Andover Water Department’s distribution system.

The pages that follow are the individual reports for each leak.

During the course of this survey leaks were found at the following locations.

Services found to be leaking:

8 Forest Hill Drive, Service Leaking main to box, 1-3gpm
20 Brady Loop, Service Leaking box to cellar 2-4gpm
7 Brady Loop, Service Leaking box to cellar, 2-4gpm
6 Ridge Hill Way, Service Leaking box to cellar, 2-4gpm
33 Pleasant Street, Service Leaking box to cellar, 2-4gpm
8 Greybirch Rd, Service Leaking box to cellar, 2-4gpm
4 Apollo Circle, Service Leaking main to box, 2-4gpm (Repaired 4/22)
10 Serenity Lane, Service Leaking Main to box, 1-3gpm
7 Joseph St, Service Leaking Main to box, 1-3gpm (Repaired 2/18)

Hydrants found to be leaking:
Hydrant-1298, (Corrected 2/22)
Hydrant-365, (Corrected 2/8)
HYD off of Ledge Road, in baseball field parking lot, (Corrected 2/11)

The total leakage due to service and Hydrant leaks is estimated to be between 16.5 and 36 gallons per/min.

Main Line leaks:

River Road at 1776 St

The leakage due to main leaks is estimated to be between 4 and 8 gallons per/min.

In conclusion, 13 leaks were located during the course of this survey. The total of estimated leakage from the leaks found during this survey is approximately 20.5 to 44 gallons per/min.

The leakage amounts noted in this report are only estimates and require confirmation during the repair of the leaks.

Respectfully Submitted by Gregory Pyburn

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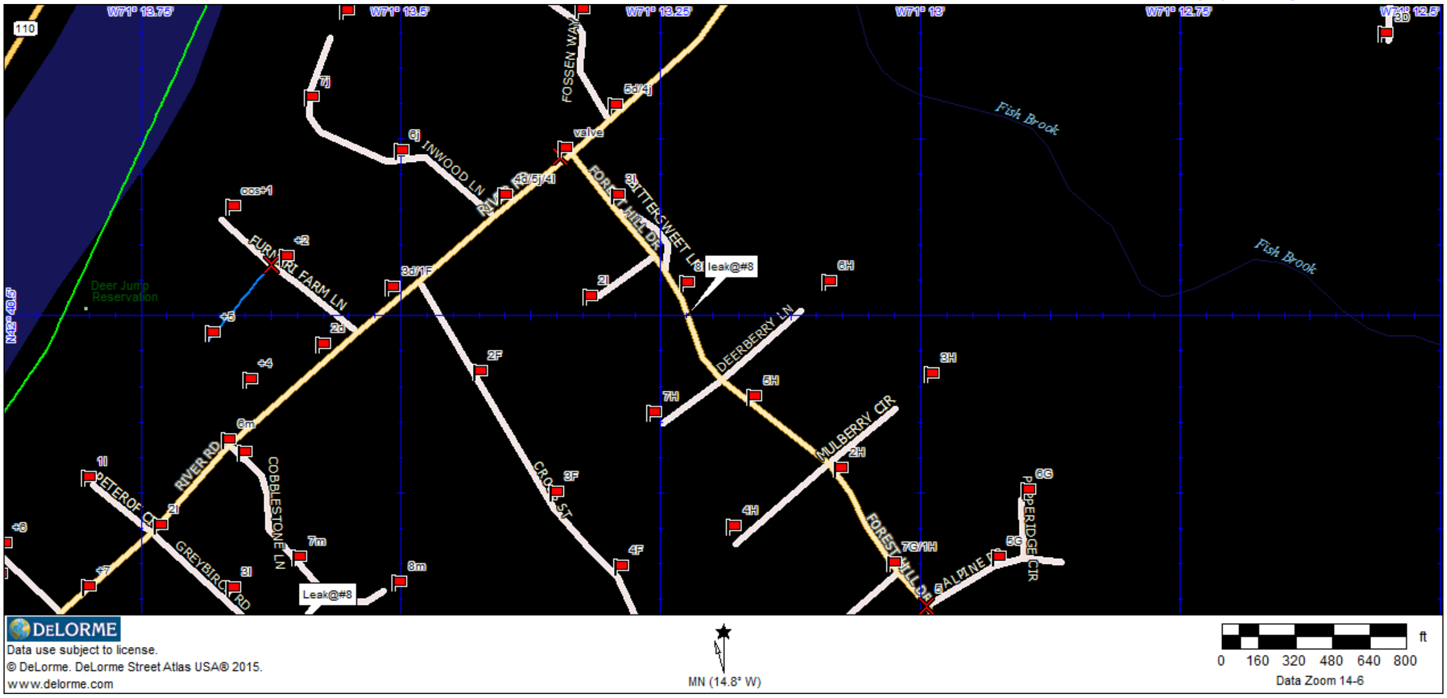
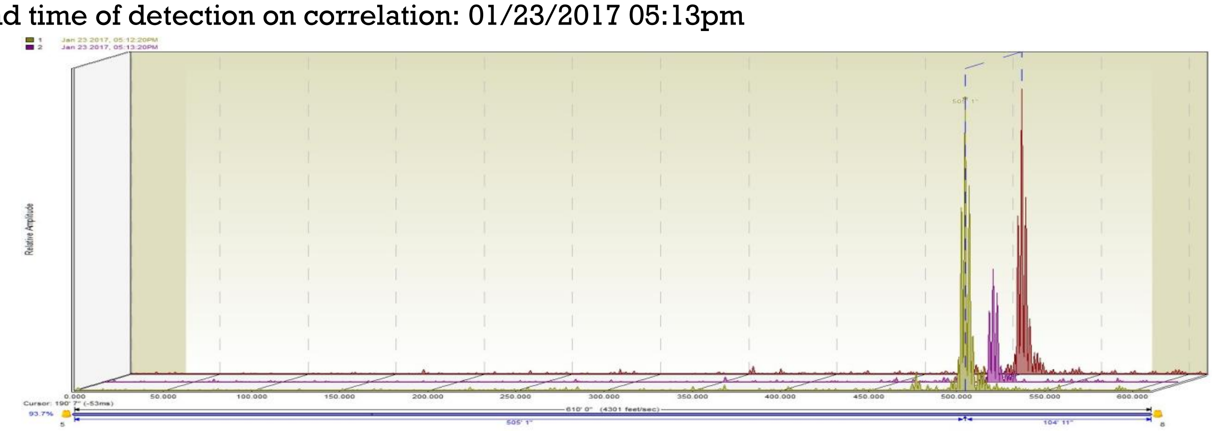
Leak worksheet

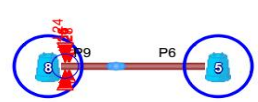


System Name: Andover Water Department's Distribution System, West High Zone
Location: 8 Forest Hill Drive, Andover, Service Leaking, main to box
Approx. Size: 1-3 GPM
Pipe Material 1" Copper
Date and time of detection on correlation: 01/23/2017 05:13pm



Pipe ID	Length	Diameter	Material	Sound Velocity
P6	170' 0"	3"	Cast Iron	4301 feet/sec
P9	440' 0"	3"	Cast Iron	4301 feet/sec

Leak ID	Leak Position	Correlation Between	Confidence	Recording Time
L24	505' 1" from 5	5 -> 8	93.7%	Jan 23 2017, 05:12:20PM
L25	505' 1" from 5	5 -> 8	91.7%	Jan 23 2017, 05:13:20PM
L26	505' 1" from 5	5 -> 8	93.6%	Jan 23 2017, 05:14:20PM
L27	668' 2" from 7	7 -> 8	87.3%	Jan 23 2017, 05:13:20PM
L28	667' 3" from 7	7 -> 8	83.8%	Jan 23 2017, 05:14:20PM
L34	505' 1" from 5	5 -> 8	91.7%	Jan 23 2017, 05:13:20PM
L35	505' 1" from 5	5 -> 8	93.6%	Jan 23 2017, 05:14:20PM



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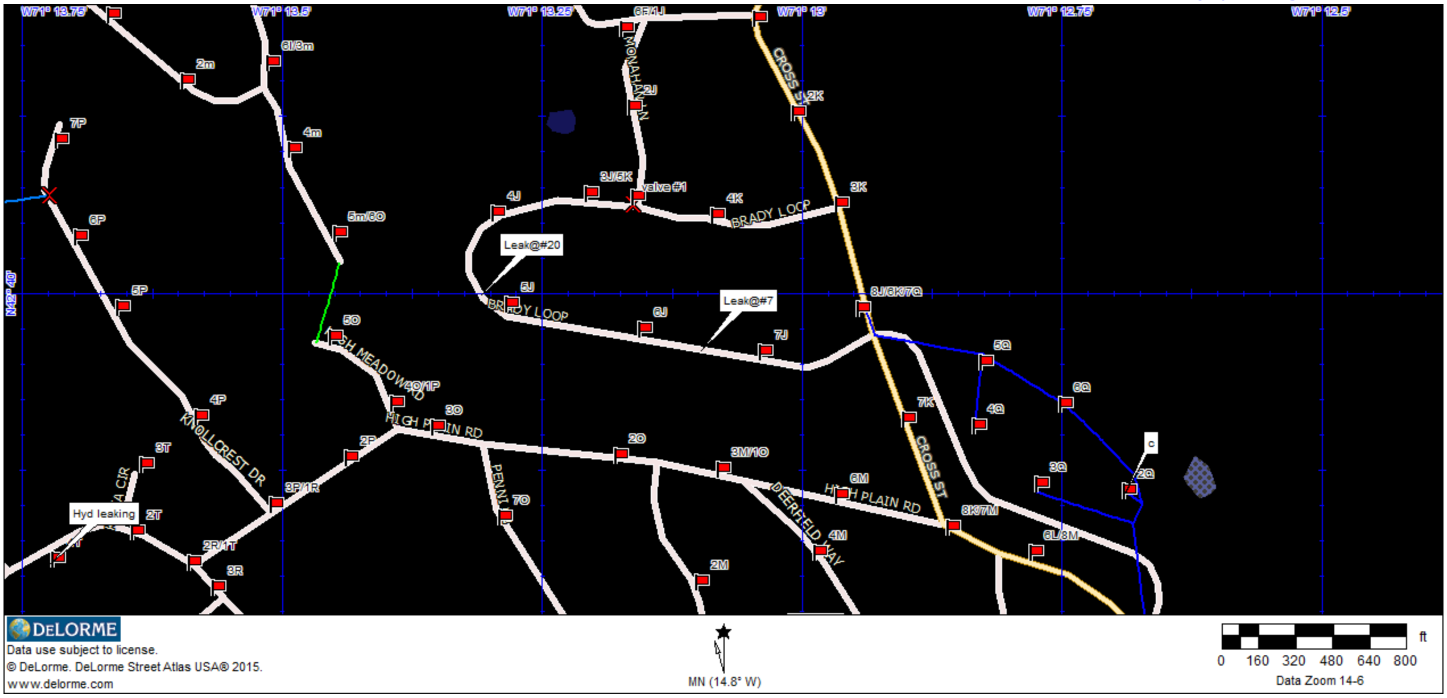
Leak worksheet



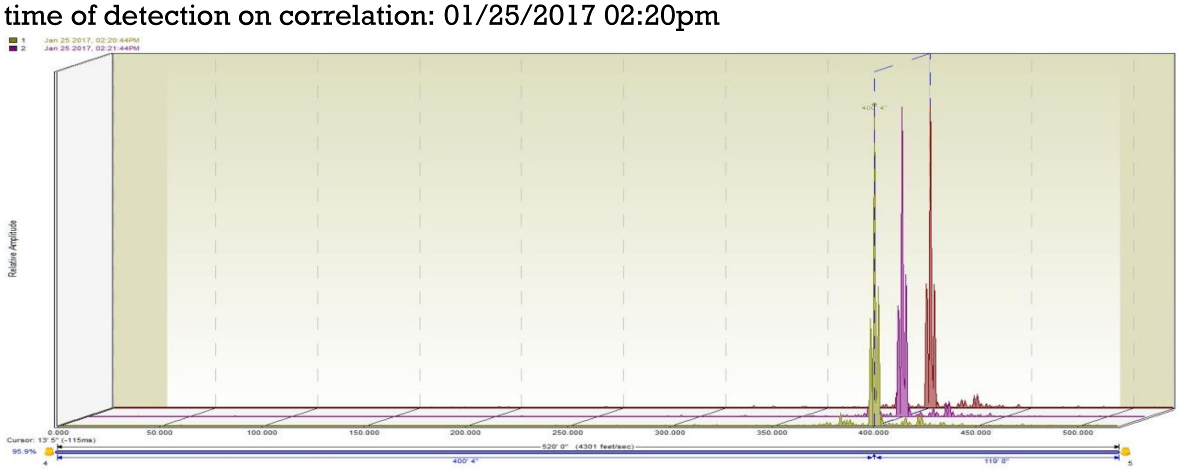
System Name: Andover Water Department's Distribution System, West High Zone

Location: 20 Brady Loop, Andover, Service Leaking, Box to Cellar

Approx. Size: 2-4 GPM

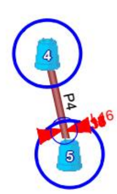
Pipe Material 1" Copper

Date and time of detection on correlation: 01/25/2017 02:20pm



Pipe ID	Length	Diameter	Material	Sound Velocity
P4	520' 0"	3"	Cast Iron	4301 feet/sec

Leak ID	Leak Position	Correlation Between	Confidence	Recording Time
L13	818' 2" from 3	3 -> 5	84.6%	Jan 25 2017, 02:20:44PM
L14	818' 2" from 3	3 -> 5	85.5%	Jan 25 2017, 02:21:44PM
L15	818' 7" from 3	3 -> 5	86.9%	Jan 25 2017, 02:22:44PM
L16	400' 4" from 4	4 -> 5	95.9%	Jan 25 2017, 02:20:44PM
L17	400' 4" from 4	4 -> 5	95.9%	Jan 25 2017, 02:21:44PM
L18	400' 4" from 4	4 -> 5	95.8%	Jan 25 2017, 02:22:44PM
L34	400' 4" from 4	4 -> 5	95.9%	Jan 25 2017, 02:21:44PM
L35	400' 4" from 4	4 -> 5	95.8%	Jan 25 2017, 02:22:44PM



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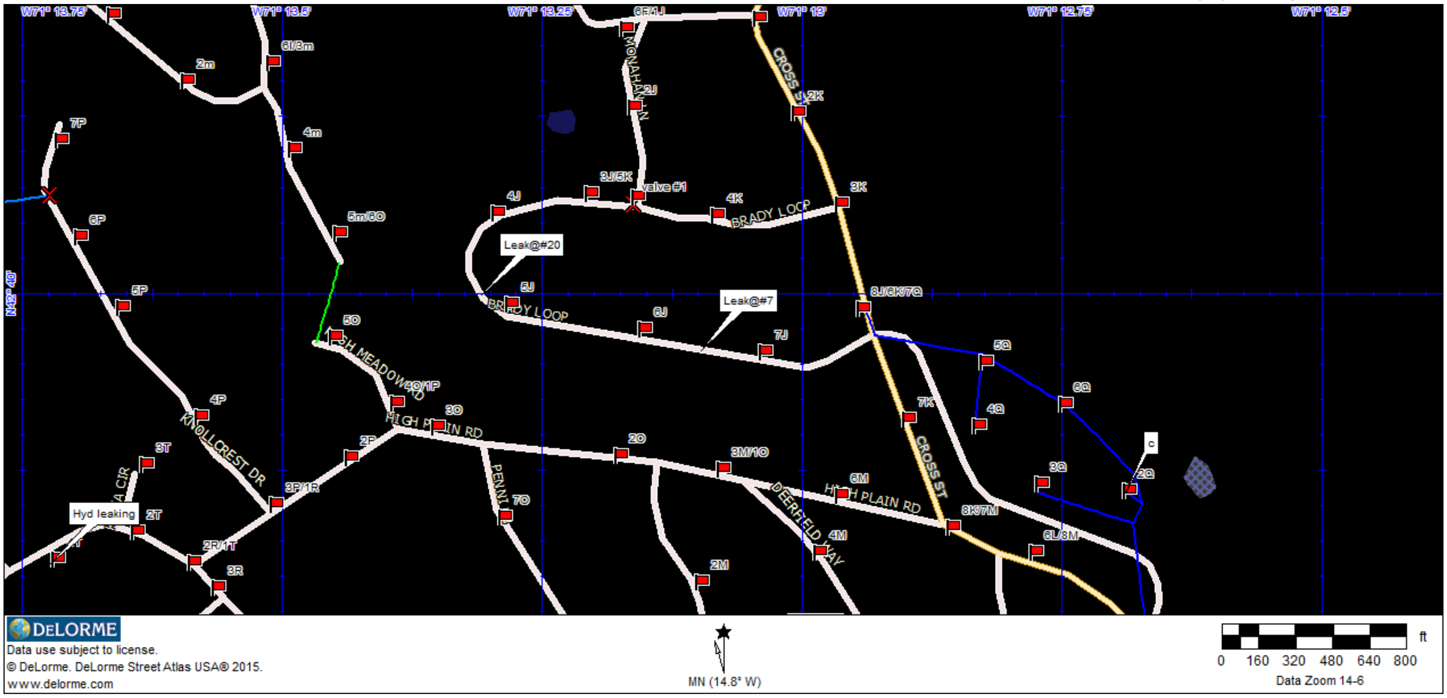
Leak worksheet



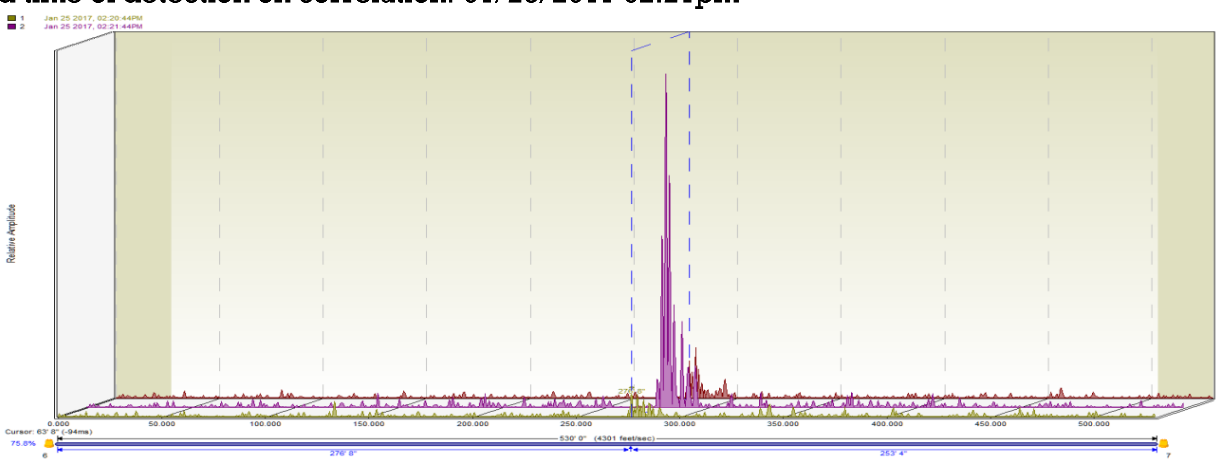
System Name: Andover Water Department's Distribution System, West High Zone

Location: 7 Brady Loop, Andover, Service Leaking, Box to Cellar

Approx. Size: 2-4 GPM

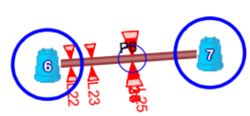
Pipe Material 1" Copper

Date and time of detection on correlation: 01/25/2017 02:21pm



Pipe ID	Length	Diameter	Material	Sound Velocity
P6	530' 0"	3"	Cast Iron	4301 feet/sec

Leak ID	Leak Position	Correlation Between	Confidence	Recording Time
L22	659' 5" from 5	5 -> 7	69.4%	Jan 25 2017, 02:20:44PM
L23	727' 7" from 5	5 -> 7	72.0%	Jan 25 2017, 02:21:44PM
L25	276' 8" from 6	6 -> 7	75.8%	Jan 25 2017, 02:20:44PM
L26	279' 4" from 6	6 -> 7	90.4%	Jan 25 2017, 02:21:44PM
L27	279' 10" from 6	6 -> 7	81.7%	Jan 25 2017, 02:22:44PM
L34	279' 4" from 6	6 -> 7	90.4%	Jan 25 2017, 02:21:44PM
L35	279' 10" from 6	6 -> 7	81.7%	Jan 25 2017, 02:22:44PM



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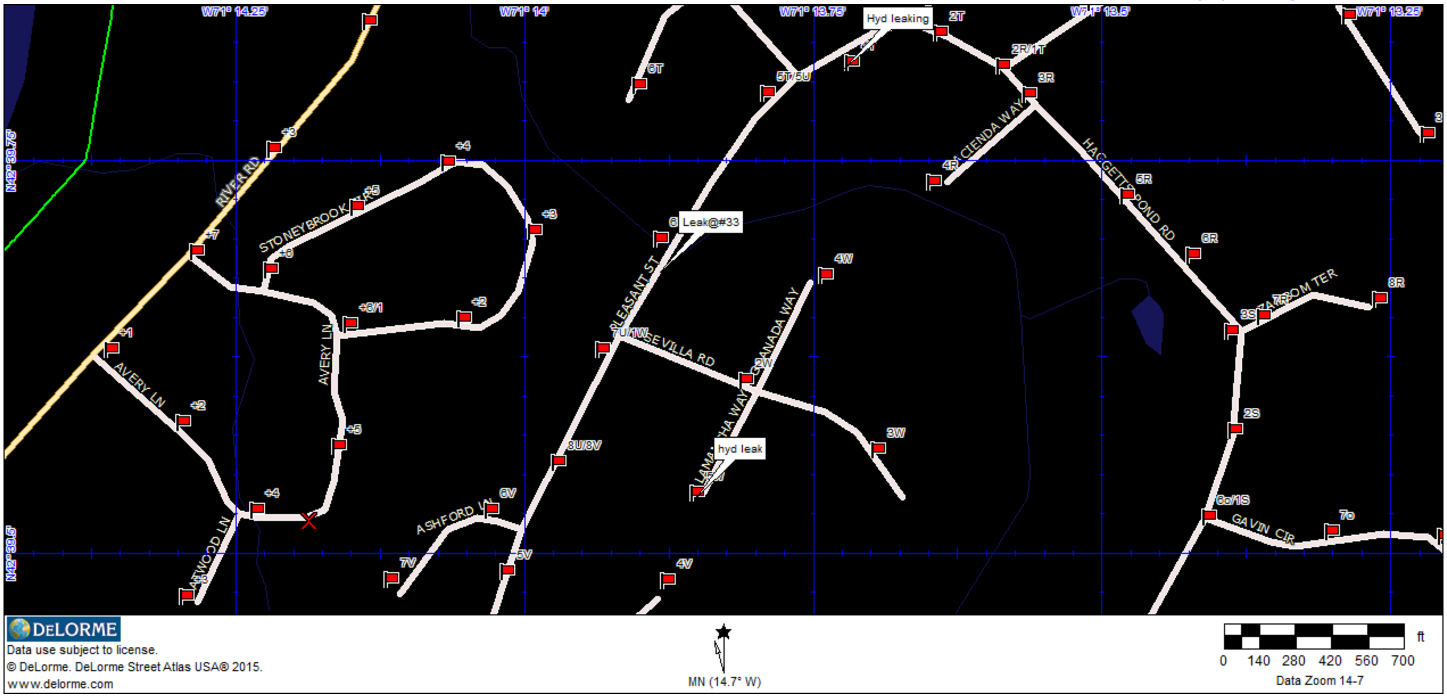
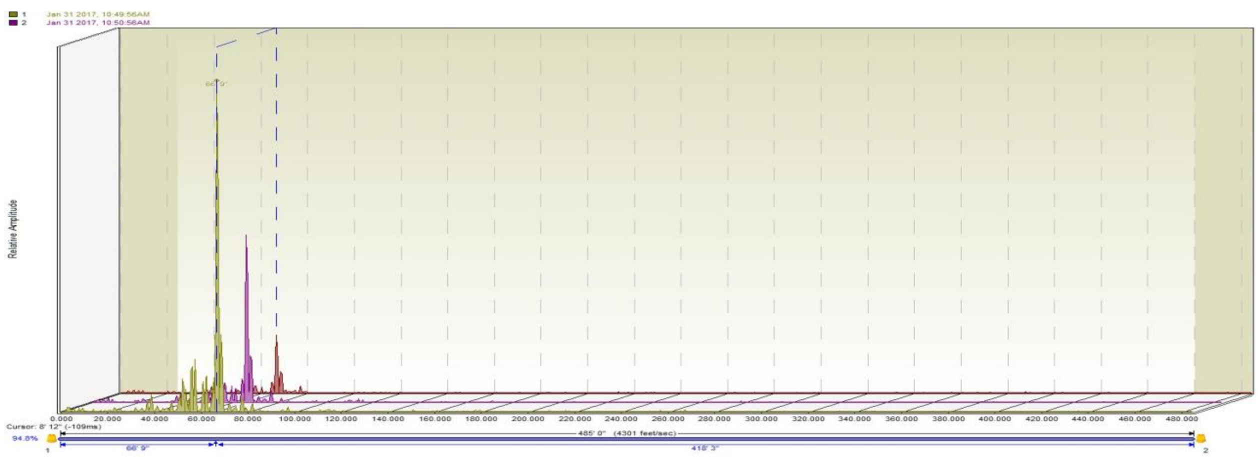
Leak worksheet

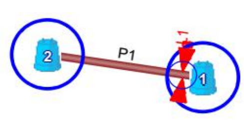


System Name: Andover Water Department's Distribution System, West High Zone
Location: 33 Pleasant Street, Andover, Service Leaking, Box to Cellar
Approx. Size: 2-4 GPM
Pipe Material 1" Copper
Date and time of detection on correlation: 01/31/2017 10:54am



Pipe ID	Length	Diameter	Material	Sound Velocity
P1	485' 0"	3"	Cast Iron	4301 feet/sec

Leak ID	Leak Position	Correlation Between	Confidence	Recording Time
L1	66' 9" from 1	1 -> 2	94.8%	Jan 31 2017, 10:49:56AM
L2	66' 9" from 1	1 -> 2	94.5%	Jan 31 2017, 10:50:56AM
L3	66' 9" from 1	1 -> 2	92.9%	Jan 31 2017, 10:51:56AM
L4	66' 9" from 1	1 -> 2	94.2%	Jan 31 2017, 10:50:56AM
L5	66' 9" from 1	1 -> 2	91.7%	Jan 31 2017, 10:51:56AM



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Leak worksheet

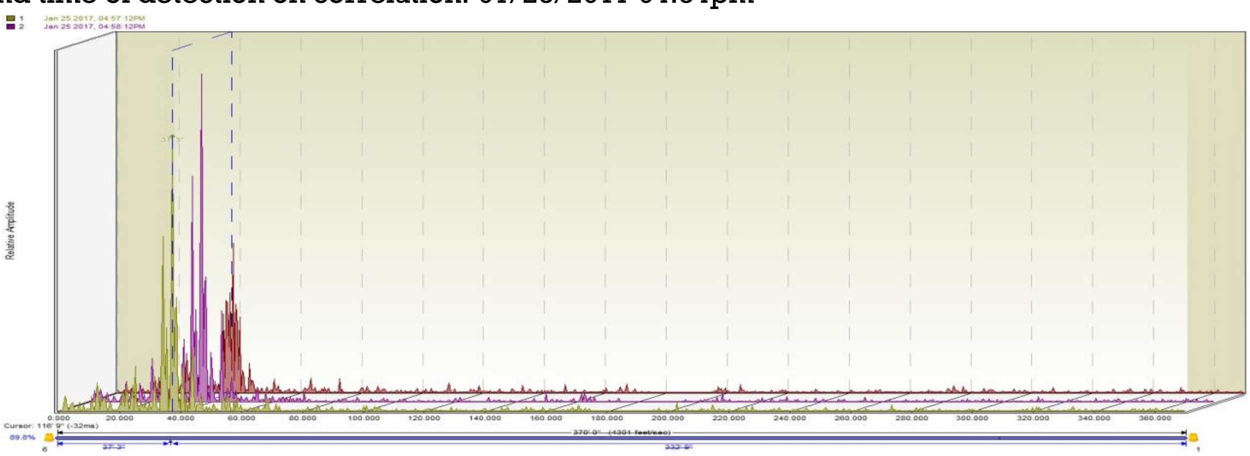
System Name: Andover Water Department's Distribution System, West High Zone

Location: 6 Ridge Hill Way, Andover, Service Leaking, Box to Cellar

Approx. Size: 2-4 GPM

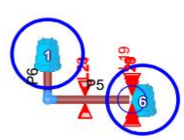
Pipe Material 1" Copper

Date and time of detection on correlation: 01/25/2017 04:54pm



Pipe ID	Length	Diameter	Material	Sound Velocity
P5	310' 0"	3"	Cast Iron	4301 feet/sec
P6	60' 0"	3"	Cast Iron	4301 feet/sec

Leak ID	Leak Position	Correlation Between	Confidence	Recording Time
L19	37' 3" from 6	6 -> 1	89.8%	Jan 25 2017, 04:57:12PM
L20	37' 3" from 6	6 -> 1	90.8%	Jan 25 2017, 04:58:12PM
L21	37' 9" from 6	6 -> 1	87.3%	Jan 25 2017, 04:59:12PM
L23	193' 4" from 6	6 -> 2	68.7%	Jan 25 2017, 04:58:12PM
L24	186' 2" from 6	6 -> 2	71.2%	Jan 25 2017, 04:59:12PM
L28	37' 3" from 6	6 -> 1	90.8%	Jan 25 2017, 04:58:12PM
L29	37' 9" from 6	6 -> 1	87.3%	Jan 25 2017, 04:59:12PM



Arthur Pyburn & Sons Inc.
Technical Services

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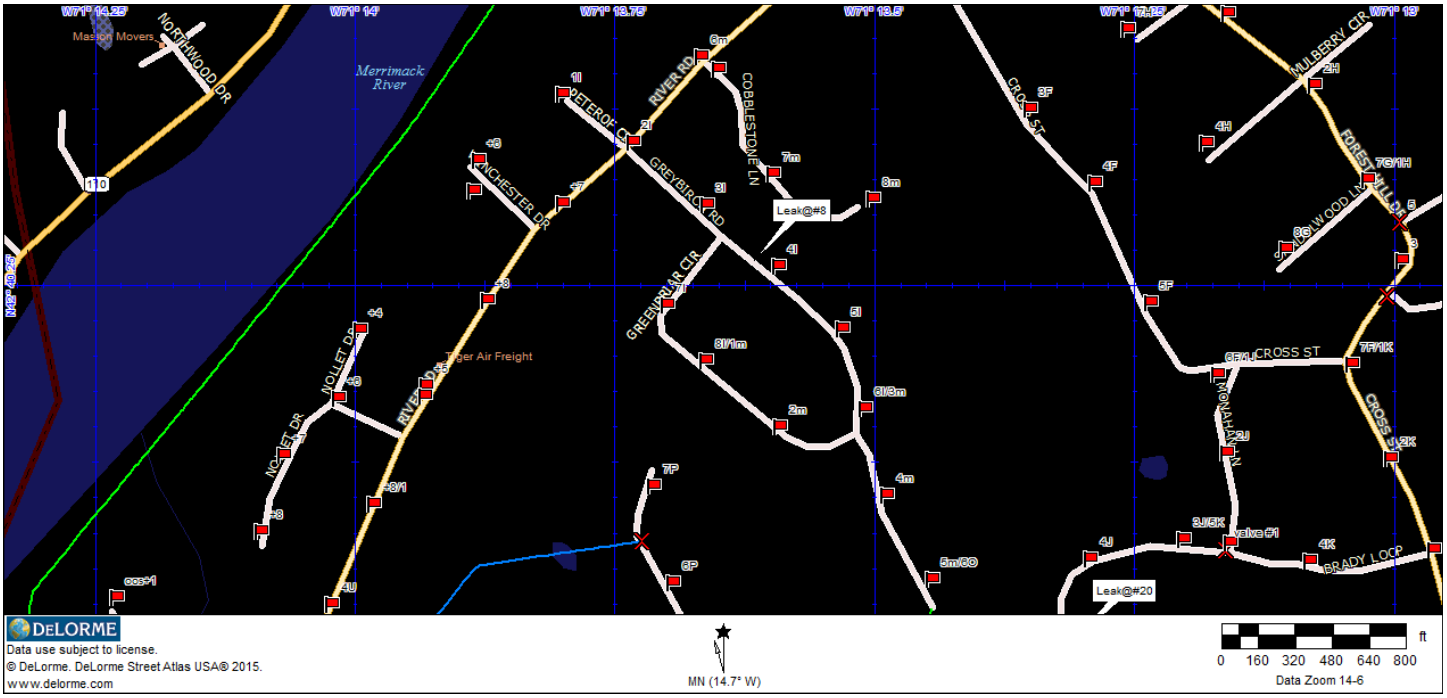
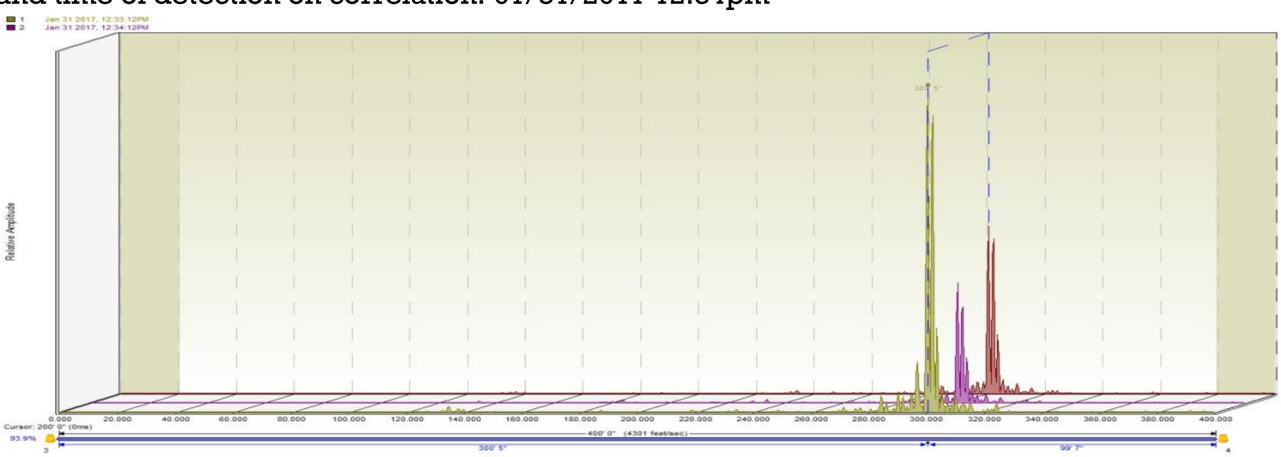
Leak worksheet

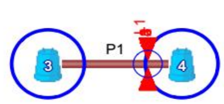


System Name: Andover Water Department's Distribution System, West High Zone
Location: 8 Greybirch Road, Andover, Service Leaking, Box to Cellar
Approx. Size: 2-4 GPM
Pipe Material 1" Copper
Date and time of detection on correlation: 01/31/2017 12:34pm



Pipe ID	Length	Diameter	Material	Sound Velocity
P1	400' 0"	3"	Cast Iron	4301 feet/sec

Leak ID	Leak Position	Correlation Between	Confidence	Recording Time
L1	300' 5" from 3	3 -> 4	93.9%	Jan 31 2017, 12:33:12PM
L2	300' 5" from 3	3 -> 4	92.9%	Jan 31 2017, 12:34:12PM
L3	300' 5" from 3	3 -> 4	93.5%	Jan 31 2017, 12:35:12PM
L4	300' 5" from 3	3 -> 4	92.9%	Jan 31 2017, 12:34:12PM
L5	300' 5" from 3	3 -> 4	93.4%	Jan 31 2017, 12:35:12PM



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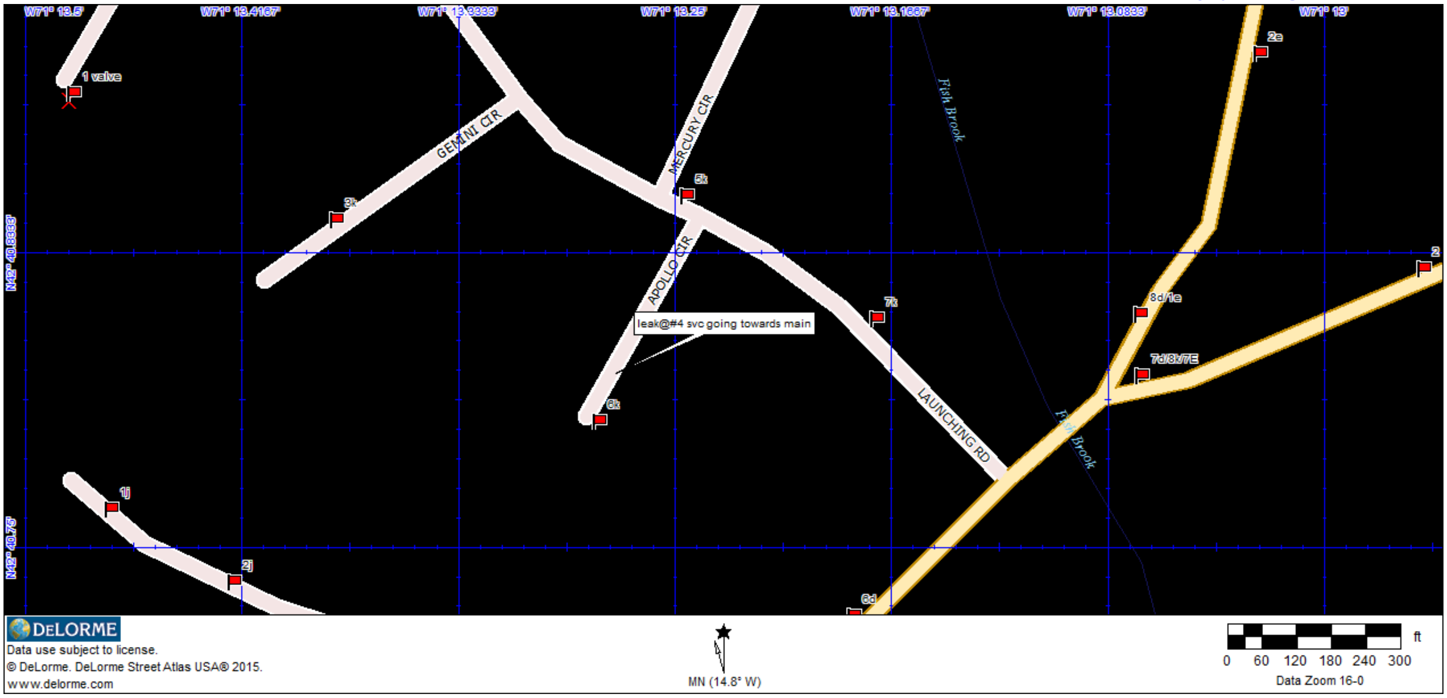
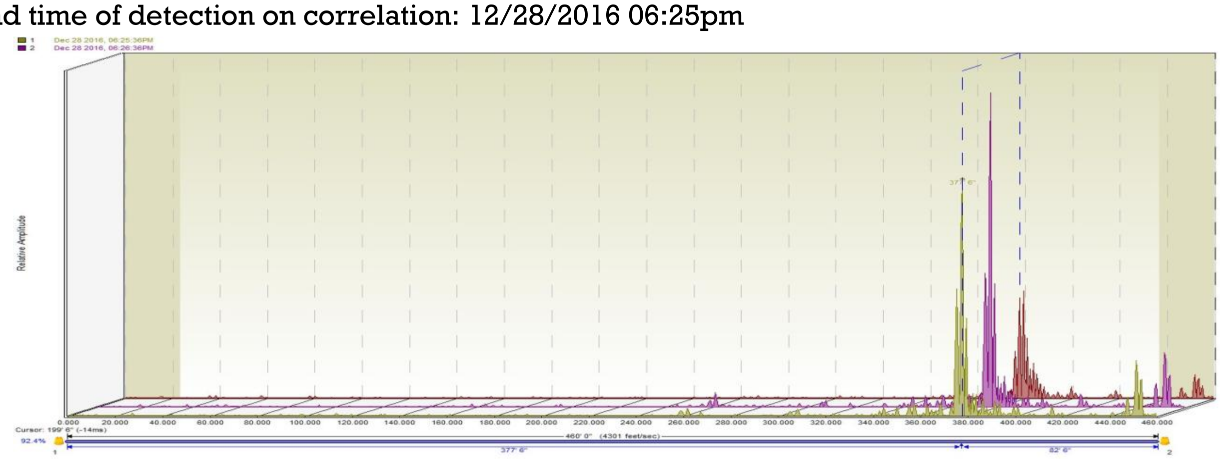
Leak worksheet

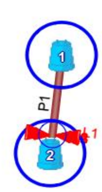


System Name: Andover Water Department's Distribution System, West High Zone
Location: 4 Apollo Circle, Andover, Service Leaking, Main to Box
Approx. Size: 2-4 GPM
Pipe Material 1" Copper
Date and time of detection on correlation: 12/28/2016 06:25pm



Pipe ID	Length	Diameter	Material	Sound Velocity
P1	460' 0"	3"	Cast Iron	4301 feet/sec

Leak ID	Leak Position	Correlation Between	Confidence	Recording Time
L1	377' 6" from 1	1 -> 2	92.4%	Dec 28 2016, 06:25:36PM
L2	377' 6" from 1	1 -> 2	93.1%	Dec 28 2016, 06:26:36PM
L3	379' 4" from 1	1 -> 2	90.9%	Dec 28 2016, 06:27:36PM
L4	377' 6" from 1	1 -> 2	93.1%	Dec 28 2016, 06:26:36PM
L5	379' 4" from 1	1 -> 2	90.9%	Dec 28 2016, 06:27:36PM



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Leak worksheet

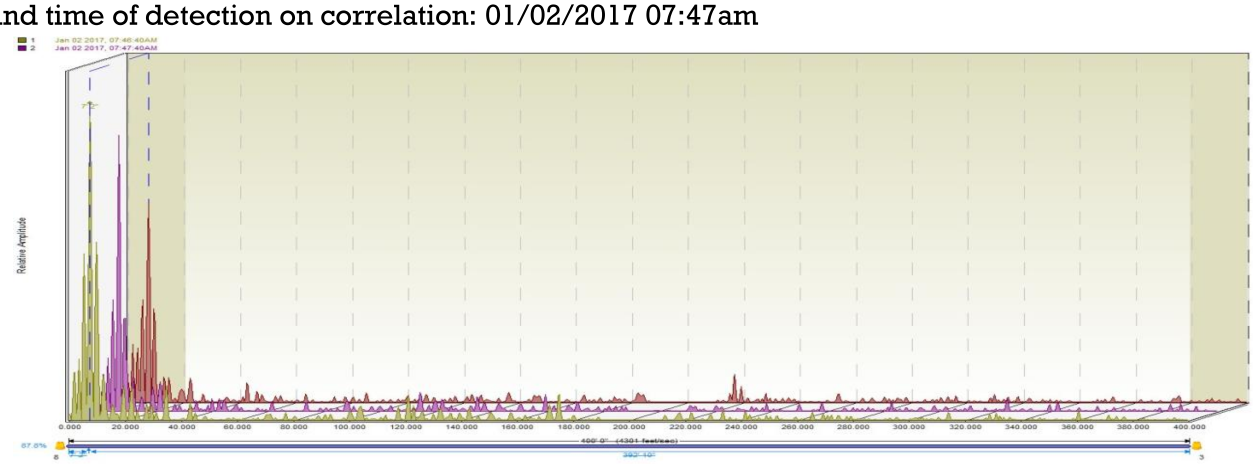
System Name: Andover Water Department's Distribution System, West High Zone

Location: 10 Serenity Lane, Andover, Service Leaking, Main to Box

Approx. Size: 1-3 GPM

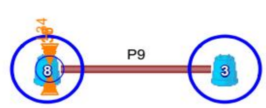
Pipe Material 1" Copper

Date and time of detection on correlation: 01/02/2017 07:47am



Pipe ID	Length	Diameter	Material	Sound Velocity
P9	400' 0"	3"	Cast Iron	4301 feet/sec

Leak ID	Leak Position	Correlation Between	Confidence	Recording Time
L34	7' 2" from 8	8 -> 3	87.8%	Jan 02 2017, 07:46:40AM
L35	7' 2" from 8	8 -> 3	88.1%	Jan 02 2017, 07:47:40AM
L36	7' 2" from 8	8 -> 3	86.7%	Jan 02 2017, 07:48:40AM
L37	7' 2" from 8	8 -> 3	88.1%	Jan 02 2017, 07:47:40AM
L38	7' 2" from 8	8 -> 3	86.7%	Jan 02 2017, 07:48:40AM



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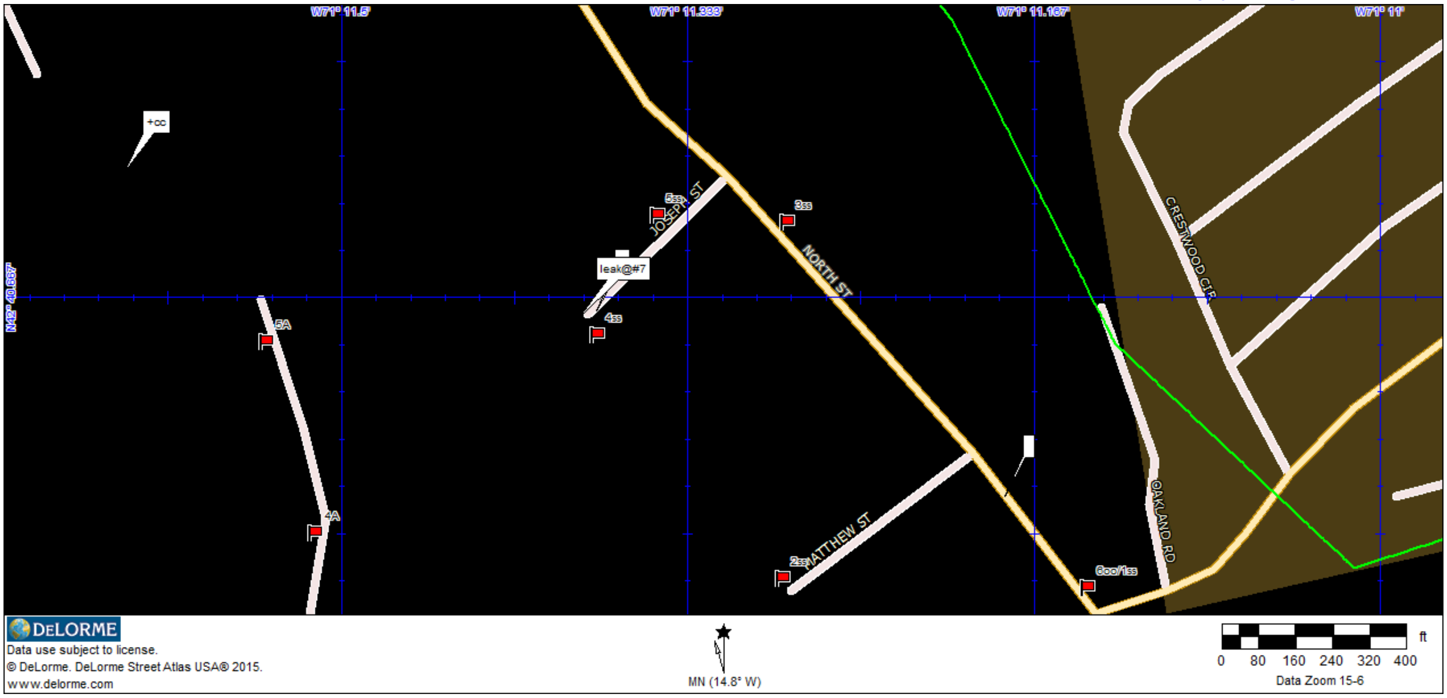
Leak worksheet



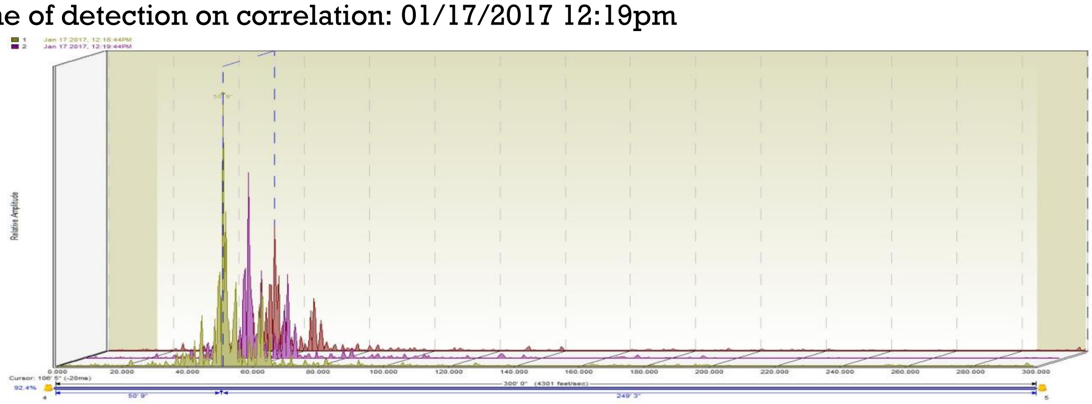
System Name: Andover Water Department's Distribution System, West High Zone

Location: 7 Joseph Street, Andover, Service Leaking, Repaired

Approx. Size: 1-3 GPM

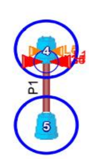
Pipe Material 1" Copper

Date and time of detection on correlation: 01/17/2017 12:19pm



Pipe ID	Length	Diameter	Material	Sound Velocity
P1	300' 0"	3"	Cast Iron	4301 feet/sec

Leak ID	Leak Position	Correlation Between	Confidence	Recording Time
L1	50' 9" from 4	4 -> 5	92.4%	Jan 17 2017, 12:18:44PM
L2	50' 9" from 4	4 -> 5	91.2%	Jan 17 2017, 12:19:44PM
L3	50' 9" from 4	4 -> 5	90.0%	Jan 17 2017, 12:20:44PM
L4	8' 6" from 4	4 -> 3	83.9%	Jan 17 2017, 12:18:44PM
L5	8' 6" from 4	4 -> 3	84.0%	Jan 17 2017, 12:19:44PM
L34	50' 9" from 4	4 -> 5	91.2%	Jan 17 2017, 12:19:44PM
L35	50' 9" from 4	4 -> 5	90.0%	Jan 17 2017, 12:20:44PM



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Leak worksheet

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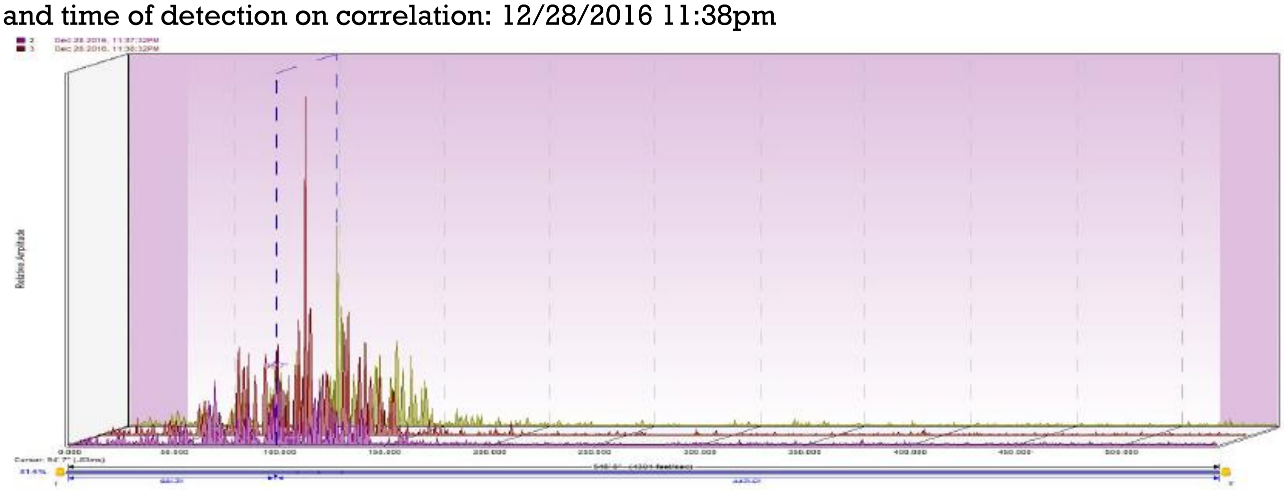
System Name: Andover Water Department's Distribution System, West High Zone

Location: 1776 Drive / River Road, Andover, Main Leaking,

Approx. Size: __

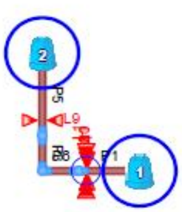
Pipe Material 1" Copper

Date and time of detection on correlation: 12/28/2016 11:38pm



Pipe ID	Length	Diameter	Material	Sound Velocity
P1	110' 0"	3"	Cast Iron	4301 feet/sec
P3	11' 0"	3"	Cast Iron	4301 feet/sec
P5	415' 0"	3"	Cast Iron	4301 feet/sec
P6	10' 0"	3"	Cast Iron	4301 feet/sec

Leak ID	Leak Position	Correlation Between	Confidence	Recording Time
L1	98' 7" from 1	1 -> 2	86.2%	Dec 28 2016, 11:36:32PM
L2	98' 7" from 1	1 -> 2	81.6%	Dec 28 2016, 11:37:32PM
L3	98' 2" from 1	1 -> 2	88.8%	Dec 28 2016, 11:38:32PM
L4	93' 9" from 1	1 -> 3	69.0%	Dec 28 2016, 11:36:32PM
L6	98' 3" from 1	1 -> 3	84.8%	Dec 28 2016, 11:38:32PM



Town of Andover Massachusetts

Department of Public Works

Water System Leak Detection Survey Report

East High Pressure Zone

2018

Prepared By

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June 25, 2018

Town of Andover
Department of Public Works
397 Lowell Street
Andover, MA 01810

The following is a summary of leak detection performed on 53 miles of the "East High Zone" of the Andover Water Department's distribution system. Cross country lines were also checked

The pages that follow are the individual reports for each leak.

During the course of this survey leaks were found at the following locations.

Services found to be leaking:

12 Blueberry Hill Rd, Service leaking, box to cellar, 2-4gpm
5 Sawyers Lane, Service leaking, Box to cellar, 2-4gpm
225 S. Main St. Service leaking, 2-4 gpm

In conclusion, 3 leaks were located during the course of this survey. The total of estimated leakage from the leaks found during this survey is approximately 6 to 12 gallons per/min.

The leakage amounts noted in this report are only estimates and require confirmation during the repair of the leaks.

Respectfully Submitted by Gregory Pyburn

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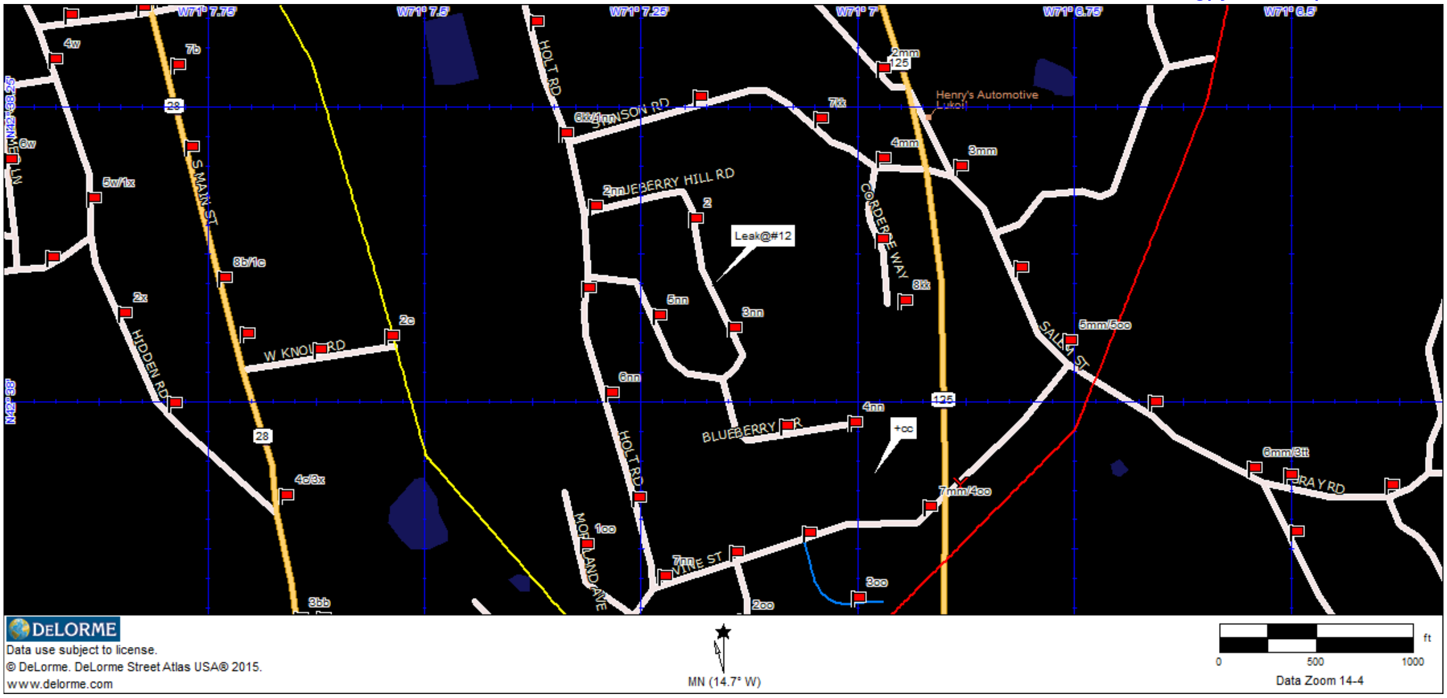
Technical Services

Leak worksheet



System Name: Andover Water Department's Distribution System, East High Zone

Location: 12 Blueberry Hill Road, Andover,

Approx. Size: 2-4 GPM

Pipe Material 1" Copper

Leak detected during the audit of noise logger recordings. No correlations available. Located using ground microphone.

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Leak worksheet

System Name: Andover Water Department's Distribution System, East High Zone
Location: 5 Sawyers Lane, Andover,
Approx. Size: 2-4 GPM
Pipe Material 1" Copper
Leak detected during the audit of noise logger recordings. No correlations available. Located using ground microphone.

Arthur Pyburn & Sons Inc.

Technical Services

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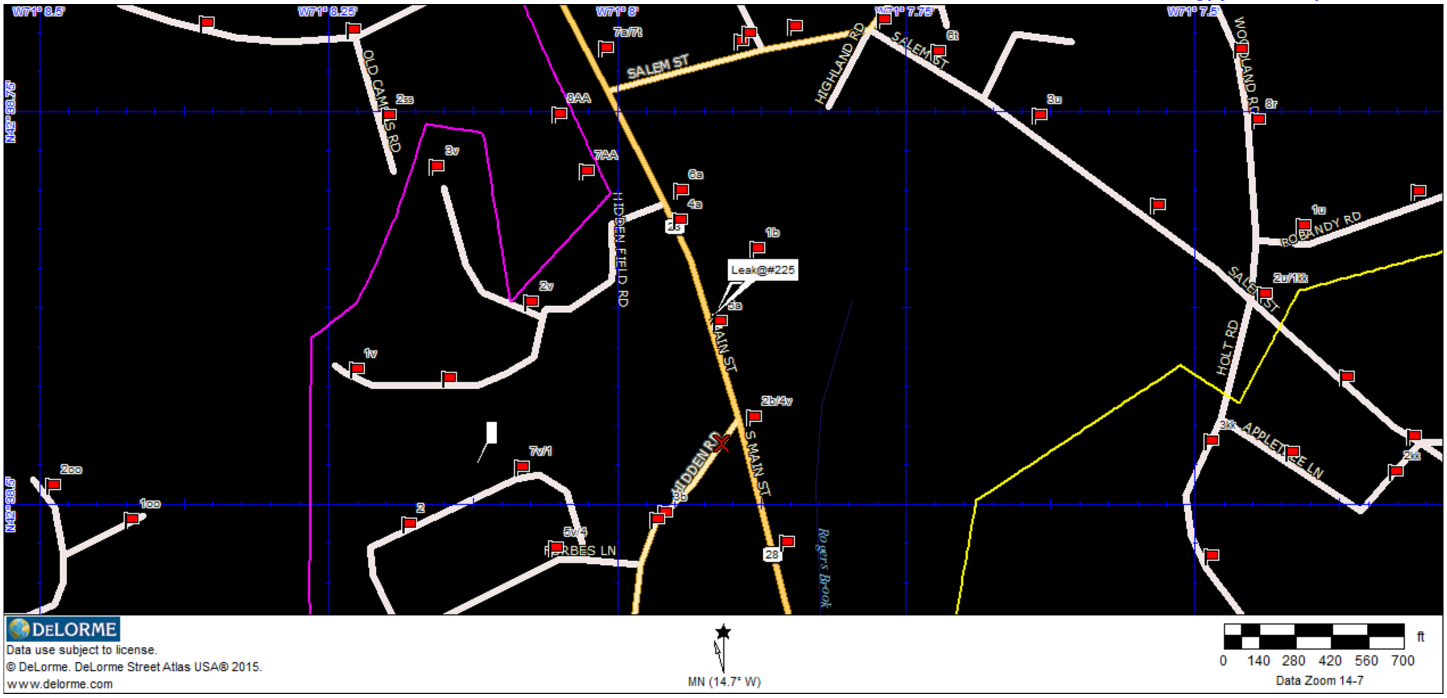
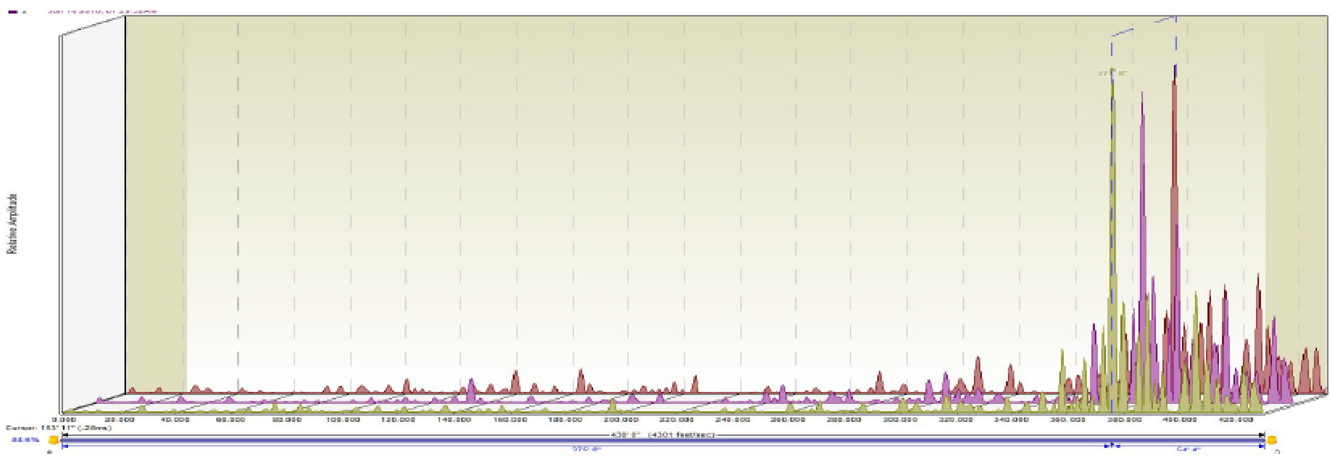
Leak worksheet

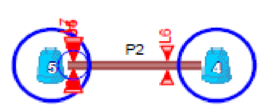


System Name: Andover Water Department's Distribution System, East High Zone
Location: 225 S. Main Street, Andover,
Approx. Size: 2-4 GPM
Pipe Material 1" Copper
Date and time of detection on correlation: 06/10/18 01:30am



Pipe ID	Length	Diameter	Material	Sound Velocity
P2	430' 0"	3"	Cast Iron	4301 feet/sec

Leak ID	Leak Position	Correlation Between	Confidence	Recording Time
L6	1331' 7" from 3	3 -> 5	71.9%	Jun 10 2018, 01:30:52AM
L7	375' 8" from 4	4 -> 5	84.6%	Jun 10 2018, 01:28:52AM
L8	375' 3" from 4	4 -> 5	83.2%	Jun 10 2018, 01:29:52AM
L9	375' 3" from 4	4 -> 5	83.0%	Jun 10 2018, 01:30:52AM
L34	375' 3" from 4	4 -> 5	83.2%	Jun 10 2018, 01:29:52AM
L35	375' 3" from 4	4 -> 5	83.0%	Jun 10 2018, 01:30:52AM



Town of Andover Massachusetts

Department of Public Works

Water System Leak Detection Survey Report

Central Low Zone

2018

Prepared By

Arthur Pyburn & Sons Inc.

Technical Services

564 Haverhill Street ◆ Rowley, MA 01969

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Arthur Pyburn & Sons Inc.

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July 30, 2018

Town of Andover
Department of Public Works
397 Lowell Street
Andover, MA 01810

The following is a summary of leak detection performed on 100 miles of the "Central Low Zone" of the Andover Water Department's distribution system.

The pages that follow are the individual reports for each leak.

During the course of this survey leaks were found at the following locations.

Services and Hydrants and Main found to be leaking:
11 Cardinal Lane, Service Leaking, Main to box, 2-4gpm, repaired 8-18-18
25 Bradley Road, Main Leaking, 8-10gpm, repaired 6-14-18
6 Acropolis Cir, Service Leaking, Box to cellar, 2-4gpm
5 Wyncrest Rd, Service Leaking, Box to cellar, 2-4gpm
Hydrant 1699, Leaking ½ to 1gpm, replaced
Hydrant 893, Leaking ½-1gpm, repaired 5-3-18

In conclusion, 6 leaks were located during the course of this survey. The total of estimated leakage from the leaks found during this survey is approximately 15 to 24 gallons per/min.

The leakage amounts noted in this report are only estimates and require confirmation during the repair of the leaks.

Respectfully Submitted by Gregory Pyburn

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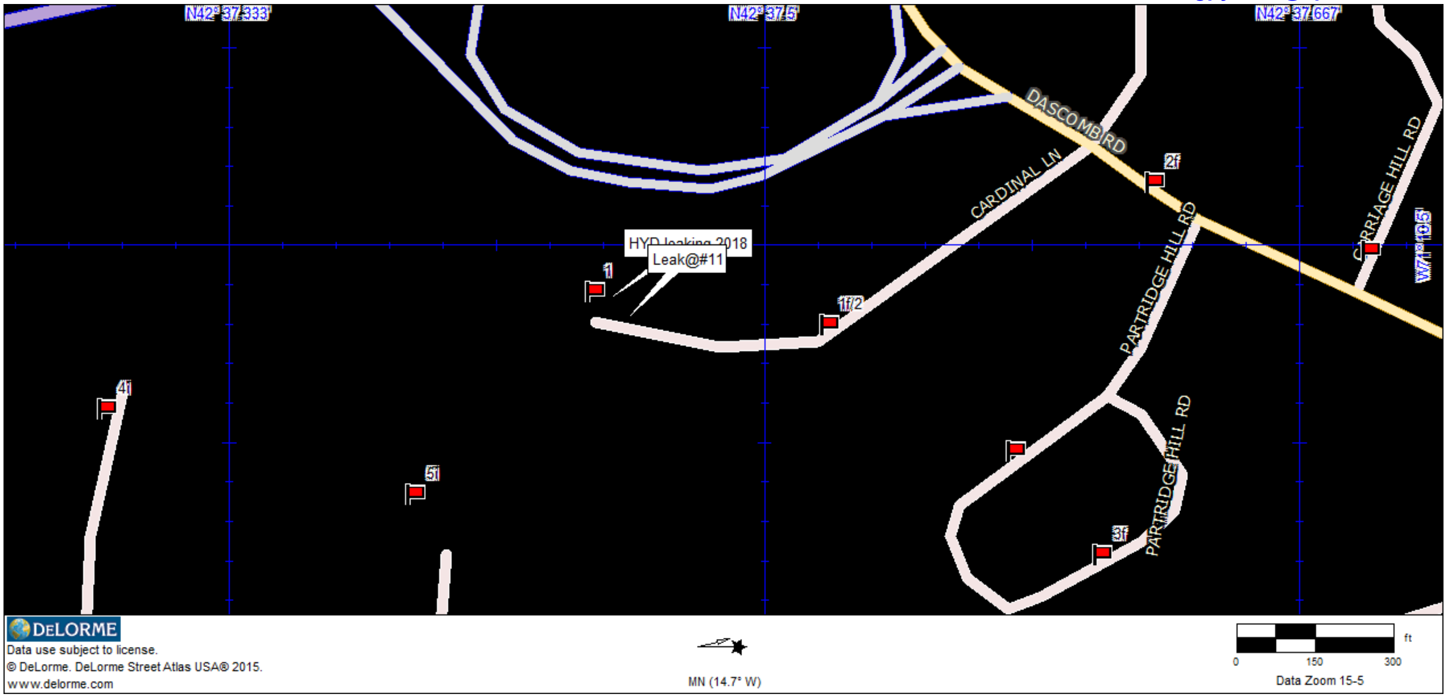
gpyburn@apsitech.com

Leak worksheet



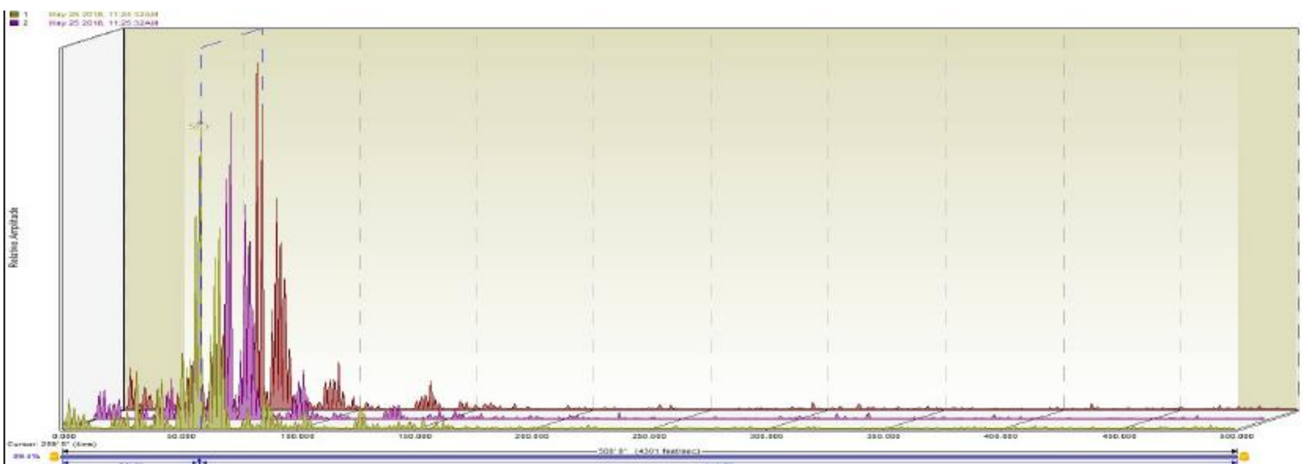
System Name: Andover Water Department's Distribution System, West High Zone

Location: 11 Cardinal Lane, Andover, Service Leaking,

Approx. Size: 2-4 GPM

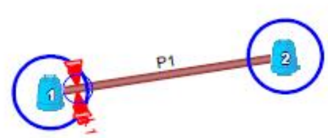
Pipe Material 1" Copper

Date and time of detection on correlation: 05/19/18 11:25am



Pipe ID	Length	Diameter	Material	Sound Velocity
P1	500' 0"	3"	Cast Iron	4301 feet/sec

Leak ID	Leak Position	Correlation Between	Confidence	Recording Time
L1	58' 3" from 1	1 -> 2	89.4%	May 25 2018, 11:24:32AM
L2	58' 3" from 1	1 -> 2	89.4%	May 25 2018, 11:25:32AM
L3	56' 5" from 1	1 -> 2	89.7%	May 25 2018, 11:26:32AM
L4	58' 3" from 1	1 -> 2	89.4%	May 25 2018, 11:25:32AM
L5	56' 5" from 1	1 -> 2	89.7%	May 25 2018, 11:26:32AM



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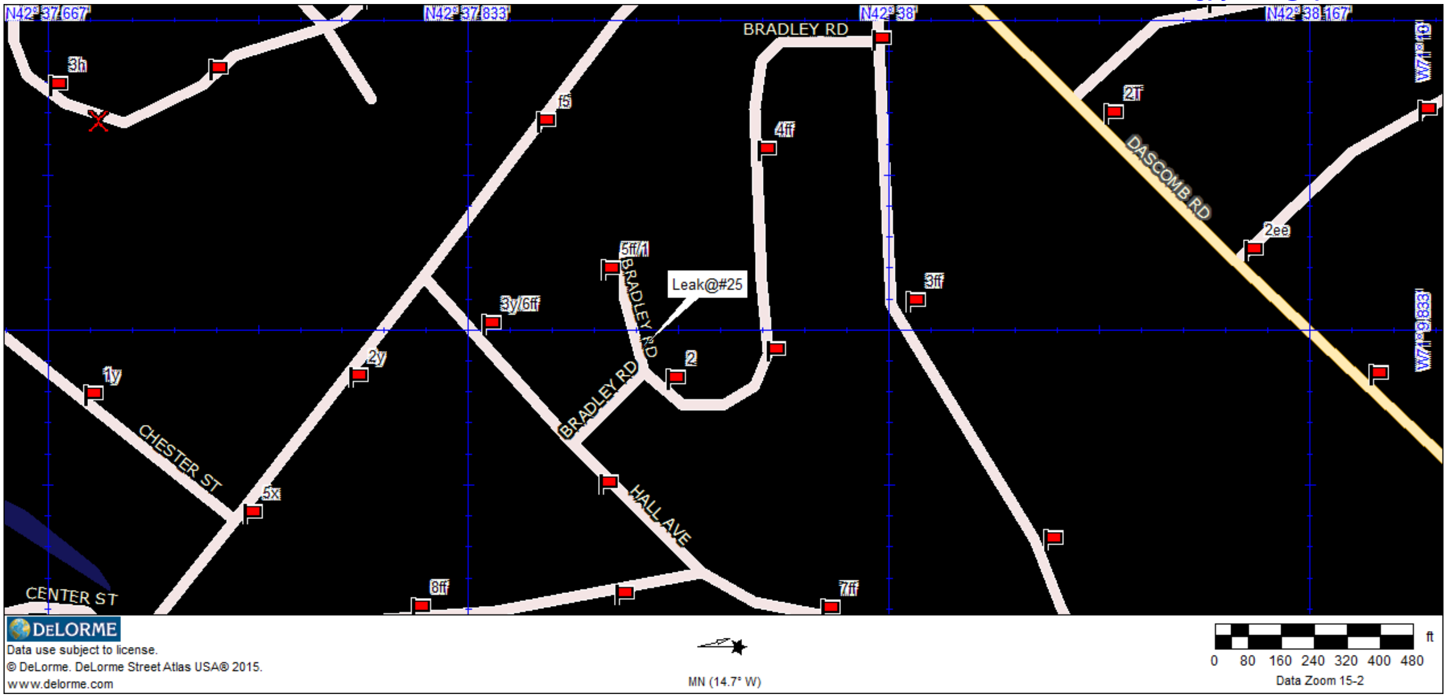
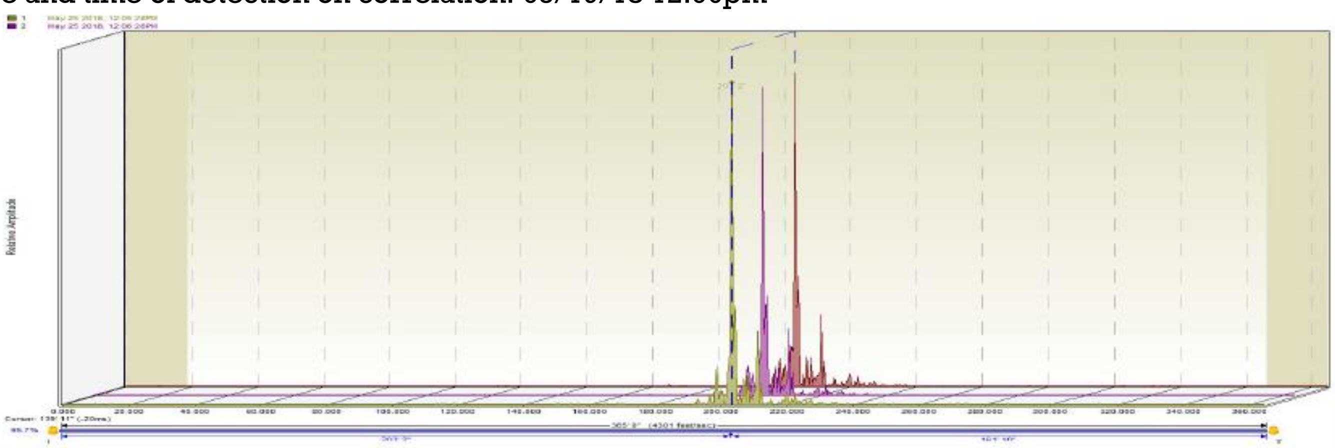
gpyburn@apsitech.com

Leak worksheet

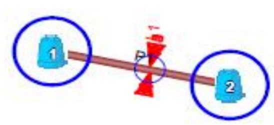


System Name: Andover Water Department's Distribution System, West High Zone
Location: 25 Bradley Road, Andover, Main Leaking,
Approx. Size: 8-10GPM
Pipe Material CI
Date and time of detection on correlation: 05/19/18 12:06pm



Pipe ID	Length	Diameter	Material	Sound Velocity
P1	365' 0"	3"	Cast Iron	4301 feet/sec

Leak ID	Leak Position	Correlation Between	Confidence	Recording Time
L1	203' 2" from 1	1 -> 2	95.7%	May 25 2018, 12:05:28PM
L2	203' 2" from 1	1 -> 2	95.8%	May 25 2018, 12:06:28PM
L3	203' 2" from 1	1 -> 2	95.6%	May 25 2018, 12:07:28PM
L4	203' 2" from 1	1 -> 2	95.8%	May 25 2018, 12:06:28PM
L5	203' 2" from 1	1 -> 2	95.6%	May 25 2018, 12:07:28PM



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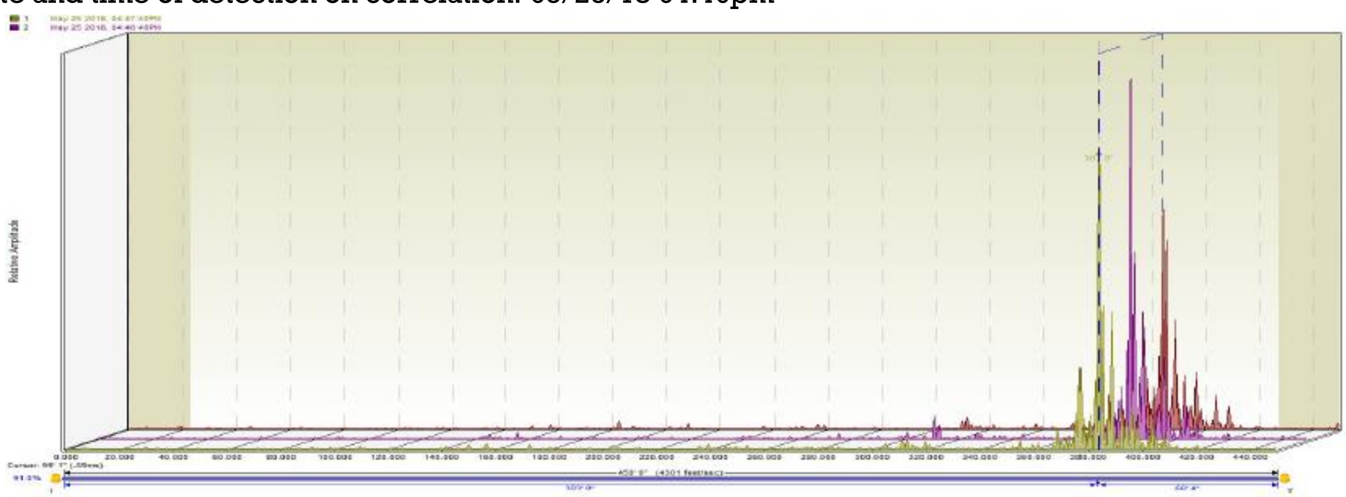
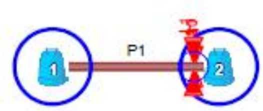
Leak worksheet

System Name: Andover Water Department's Distribution System, West High Zone
Location: 6 Acropolis Circle, Andover, Service Leaking,
Approx. Size: 2-4 GPM
Pipe Material 1" Copper
Date and time of detection on correlation: 05/25/18 04:46pm



Pipe ID	Length	Diameter	Material	Sound Velocity
P1	450' 0"	3"	Cast Iron	4301 feet/sec

Leak ID	Leak Position	Correlation Between	Confidence	Recording Time
L1	383' 8" from 1	1 -> 2	91.0%	May 25 2018, 04:47:40PM
L2	384' 1" from 1	1 -> 2	91.7%	May 25 2018, 04:48:40PM
L3	384' 1" from 1	1 -> 2	90.0%	May 25 2018, 04:49:40PM
[illegible]	[illegible]	[illegible]	[illegible]	[illegible]



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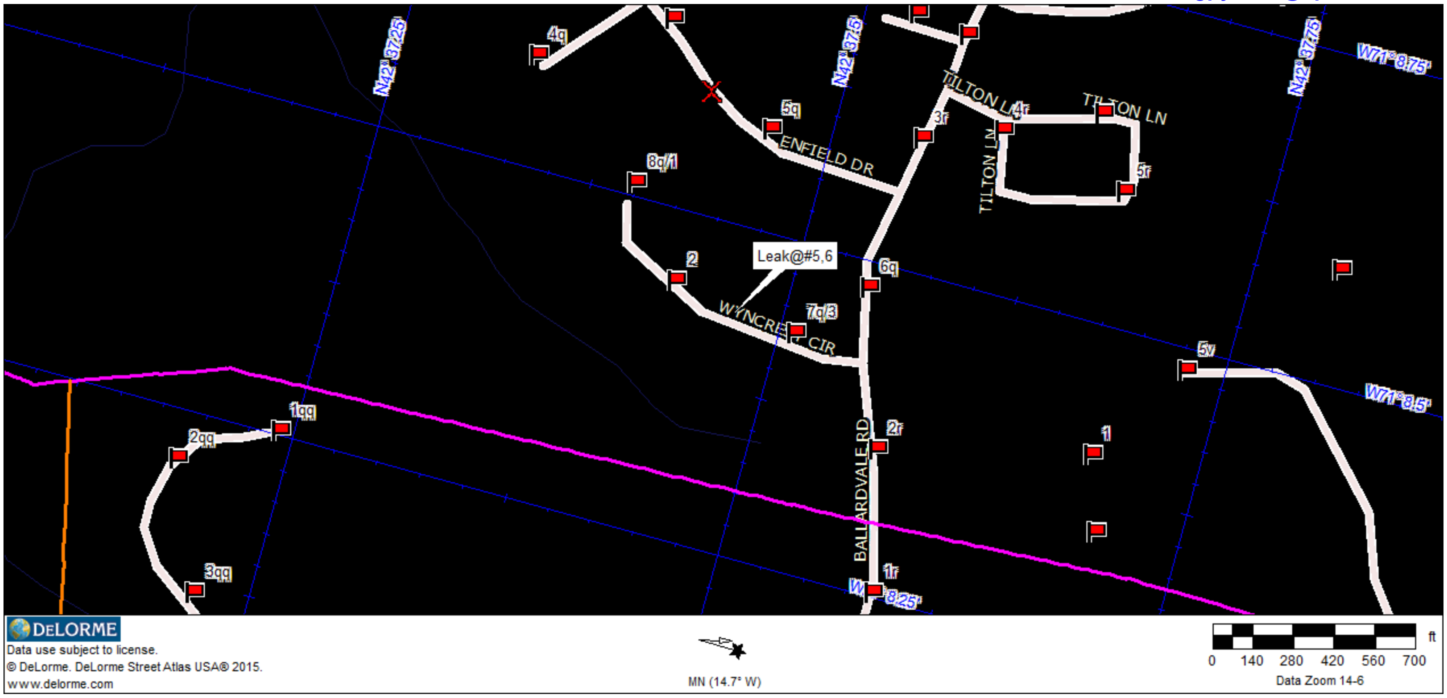
Leak worksheet



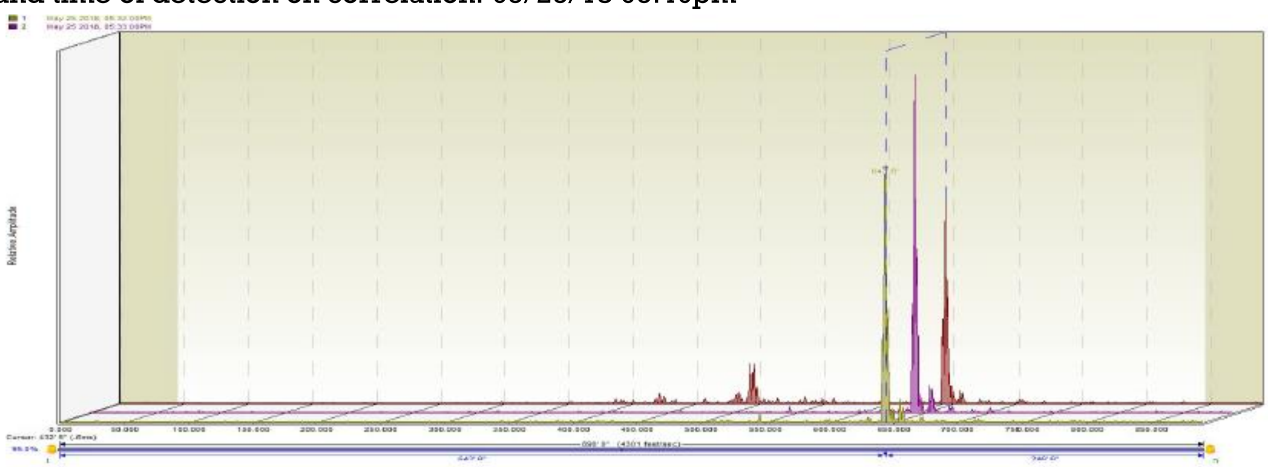
System Name: Andover Water Department's Distribution System, West High Zone

Location: 5 Wyncrest Circle, Andover, Service Leaking,

Approx. Size: 2-4 GPM

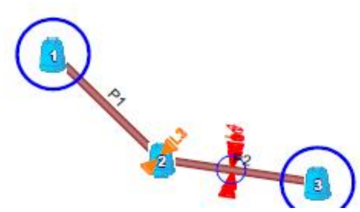
Pipe Material 1" Copper

Date and time of detection on correlation: 05/25/18 05:46pm



Pipe ID	Length	Diameter	Material	Sound Velocity
P1	440' 0"	3"	Cast Iron	4301 feet/sec
P2	450' 0"	3"	Cast Iron	4301 feet/sec

Leak ID	Leak Position	Correlation Between	Confidence	Recording Time
L1	433' 9" from 1	1 -> 2	86.6%	May 25 2018, 05:32:00PM
L2	433' 9" from 1	1 -> 2	86.7%	May 25 2018, 05:33:00PM
L3	434' 2" from 1	1 -> 2	88.1%	May 25 2018, 05:34:00PM
L4	643' 6" from 1	1 -> 3	95.0%	May 25 2018, 05:32:00PM
L5	643' 6" from 1	1 -> 3	95.5%	May 25 2018, 05:33:00PM
L6	643' 6" from 1	1 -> 3	93.5%	May 25 2018, 05:34:00PM
L7	209' 4" from 2	2 -> 3	95.4%	May 25 2018, 05:32:00PM
L8	209' 4" from 2	2 -> 3	95.1%	May 25 2018, 05:33:00PM



Town of Andover Massachusetts

Department of Public Works

Water System Leak Detection Survey Report

West High Pressure Zone

2018

Prepared By

<u>Arthur Pyburn & Sons Inc.</u>

Technical Services

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August 10, 2018

Town of Andover
Department of Public Works
397 Lowell Street
Andover, MA 01810

The following is a summary of leak detection performed on 65 miles of the "West High Zone" of the Andover Water Department's distribution system.

The pages that follow are the individual reports for each leak.

During the course of this survey leaks were found at the following locations.

Services found to be leaking:

10 Briarwood Cir, Service Leaking, 1-3gpm
20 Brady Loop, Service Leaking box to cellar 2-4gpm
28 Brady Loop, Service Leaking box to cellar, 2-4gpm
6 Ridge Hill Way, Service Leaking box to cellar, 2-4gpm
11 Starr Ave E, Service Leaking, Main to Box, 2-4gpm, Repaired 7-26-18

Hydrants found to be leaking:

Hydrant-1246, (Corrected 6/5)

The total leakage due to service and Hydrant leaks is estimated to be between 10 and 20 gallons per/min.

In conclusion, 6 leaks were located during the course of this survey. The total of estimated leakage from the leaks found during this survey is approximately 10 to 20 gallons per/min.

The leakage amounts noted in this report are only estimates and require confirmation during the repair of the leaks.

Respectfully Submitted by Gregory Pyburn

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Leak worksheet

1065 Summer Street ◆ Lynnfield, MA 01940
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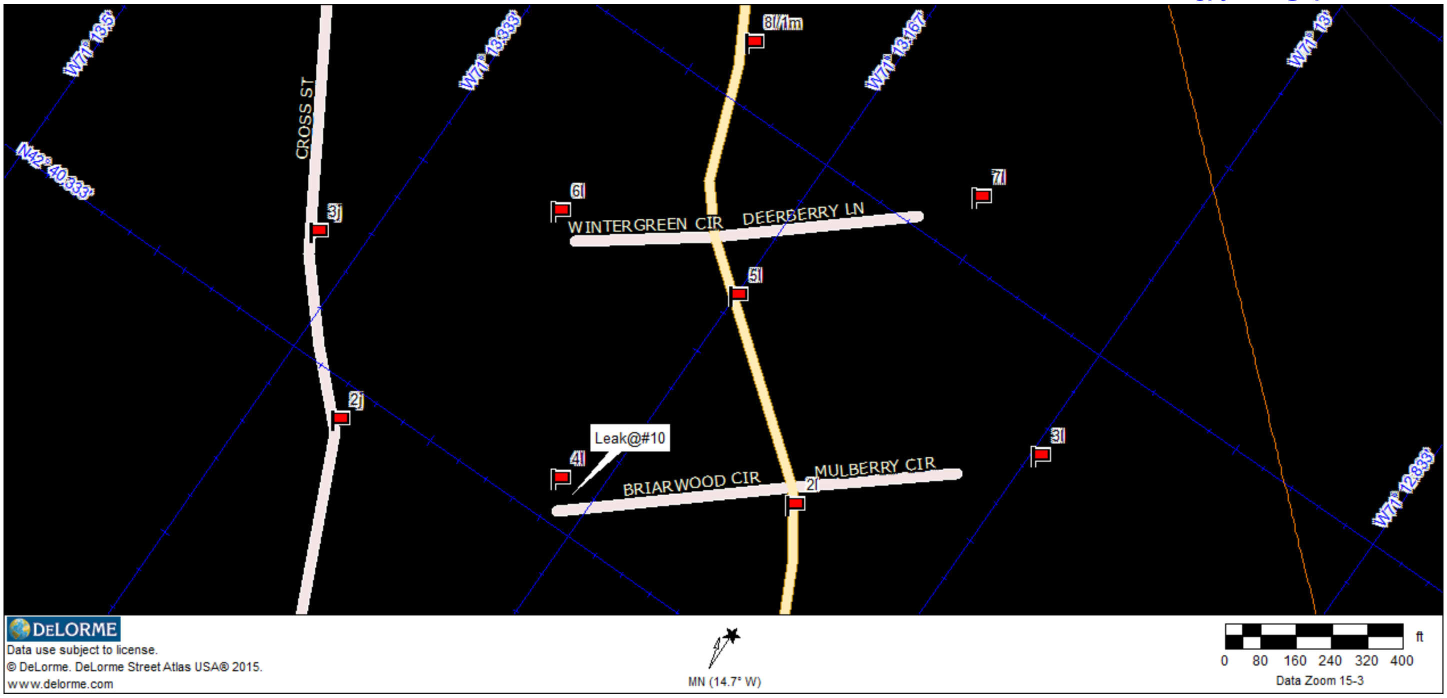

System Name: Andover Water Department's Distribution System, West High Zone
Location: 10 Briarwood Circle, Andover, Service Leaking,
Approx. Size: GPM
Pipe Material 1" Copper
Leak detected during the audit of noise logger recordings. No correlations available. Located using ground microphone.
Discovered on 4-10-18

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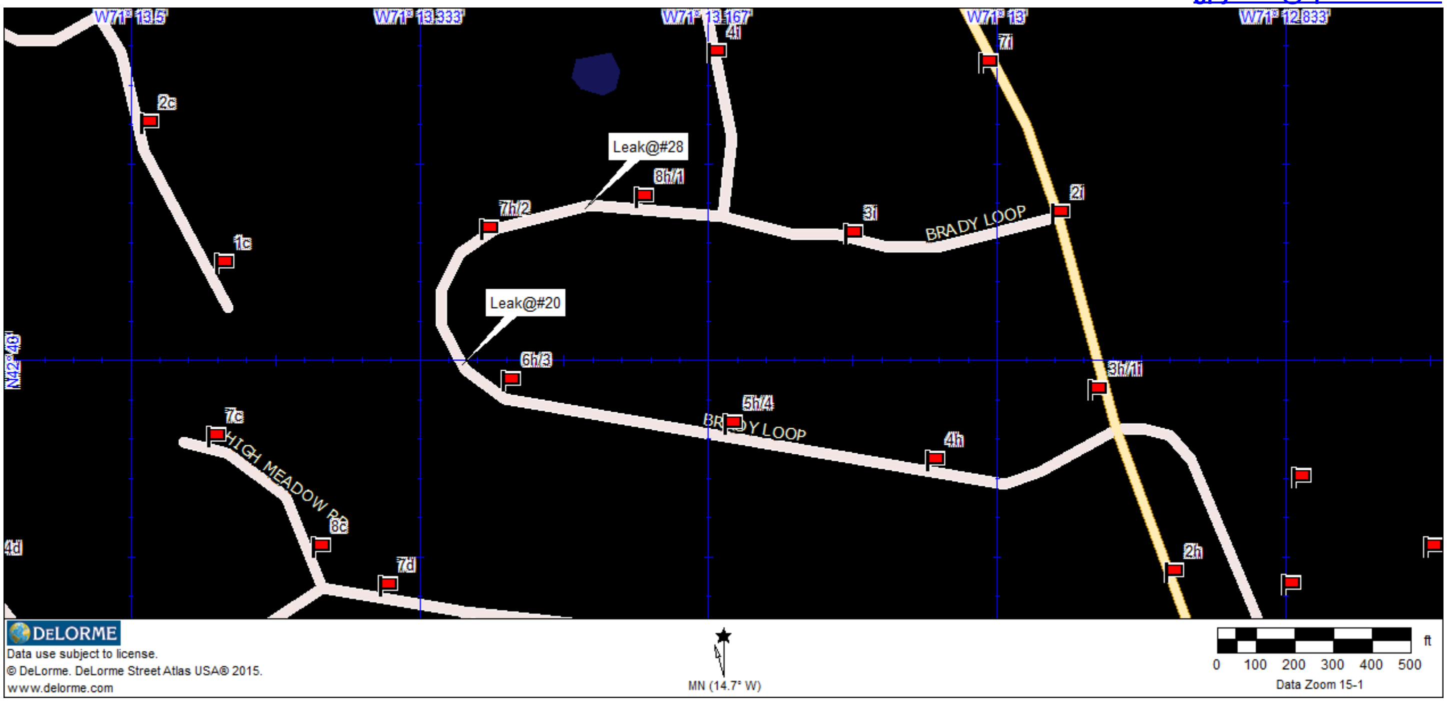


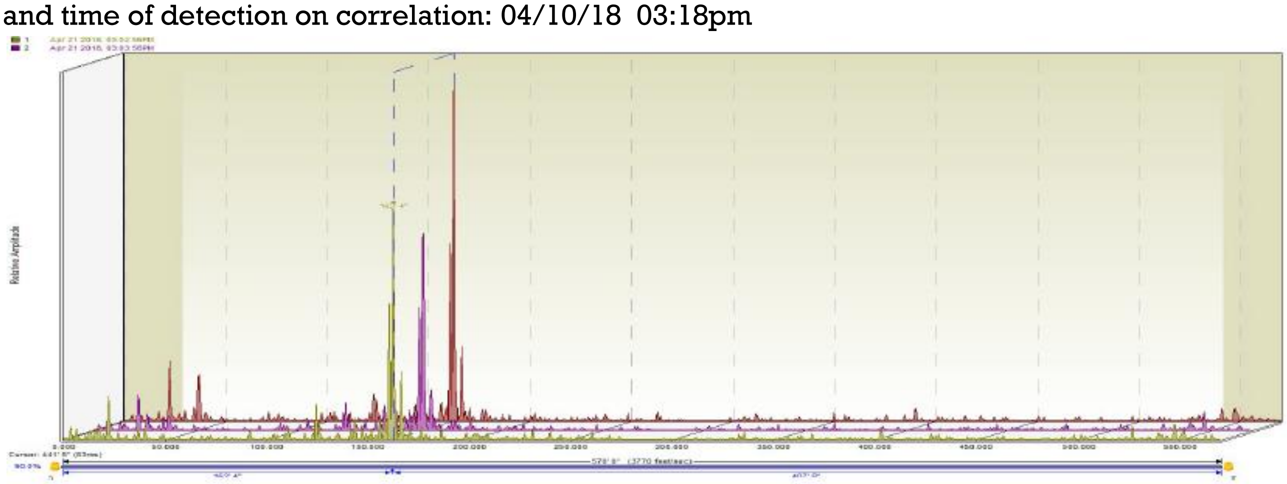
System Name: Andover Water Department's Distribution System, West High Zone

Location: 20 Brady Loop, Andover, Service Leaking,

Approx. Size: 2-4 GPM

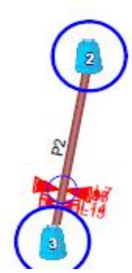
Pipe Material 1" Copper

Date and time of detection on correlation: 04/10/18 03:18pm



Pipe ID	Length	Diameter	Material	Sound Velocity
P2	570' 0"	12"	Cast Iron	3770 feet/sec

Leak ID	Leak Position	Correlation Between	Confidence	Recording Time
L7	162' 4" from 3	3 -> 2	90.0%	Apr 21 2018, 03:02:56PM
L8	162' 4" from 3	3 -> 2	89.4%	Apr 21 2018, 03:03:56PM
L9	162' 4" from 3	3 -> 2	91.5%	Apr 21 2018, 03:04:56PM
L14	725' 8" from 4	4 -> 2	68.5%	Apr 21 2018, 03:03:56PM
L15	713' 6" from 4	4 -> 2	71.4%	Apr 21 2018, 03:04:56PM
L16	162' 4" from 3	3 -> 2	89.4%	Apr 21 2018, 03:03:56PM
L17	162' 4" from 3	3 -> 2	91.5%	Apr 21 2018, 03:04:56PM



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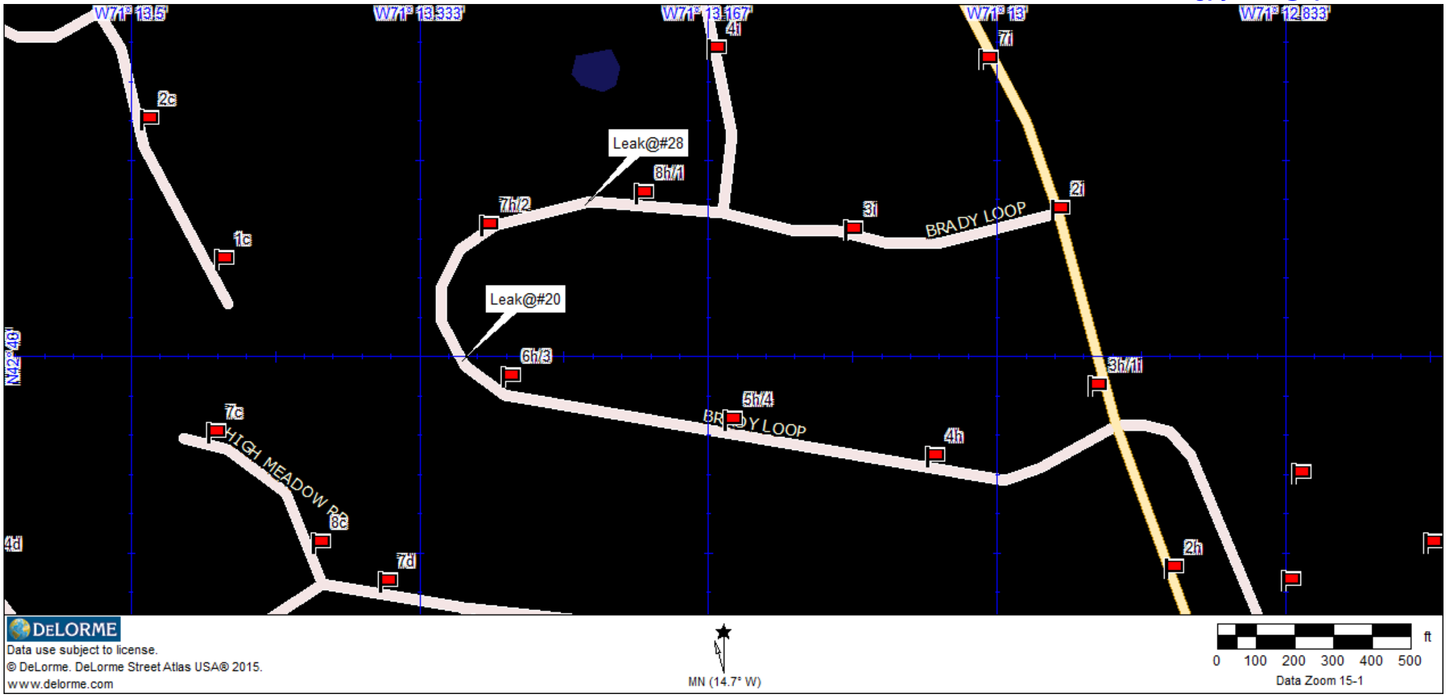


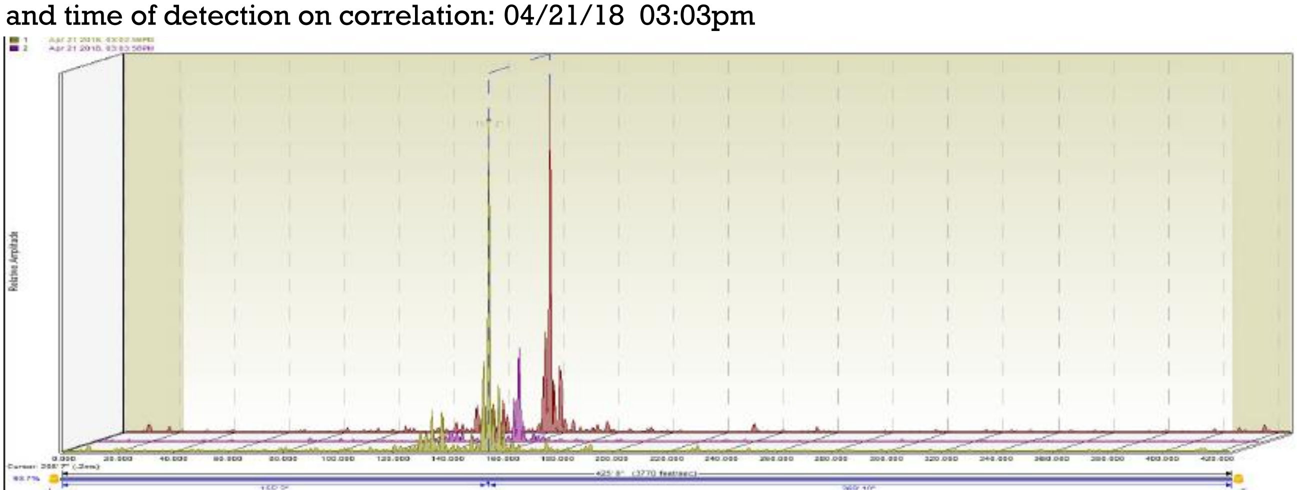
System Name: Andover Water Department's Distribution System, West High Zone

Location: 28 Brady Loop, Andover, Service Leaking,

Approx. Size: 2-4 GPM

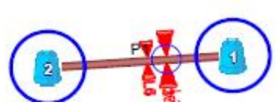
Pipe Material 1" Copper

Date and time of detection on correlation: 04/21/18 03:03pm



Pipe ID	Length	Diameter	Material	Sound Velocity
P1	425' 0"	12"	Cast Iron	3770 feet/sec

Leak ID	Leak Position	Correlation Between	Confidence	Recording Time
L1	155' 2" from 1	1 -> 2	93.7%	Apr 21 2018, 03:02:56PM
L2	155' 2" from 1	1 -> 2	90.8%	Apr 21 2018, 03:03:56PM
L3	155' 2" from 1	1 -> 2	93.7%	Apr 21 2018, 03:04:56PM
L4	198' 5" from 1	1 -> 3	81.5%	Apr 21 2018, 03:02:56PM



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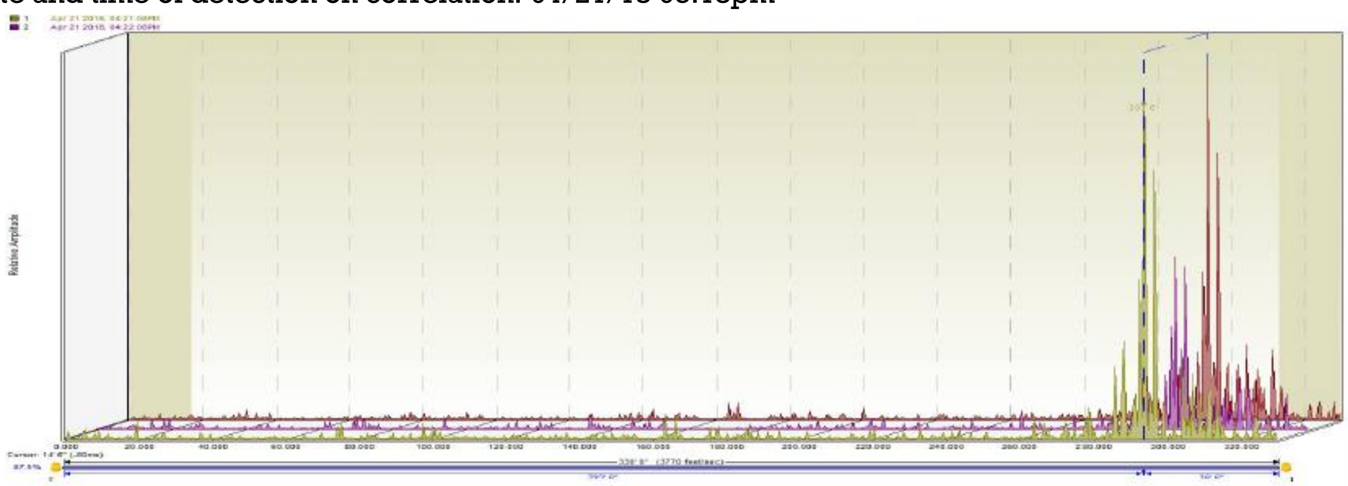
System Name: Andover Water Department's Distribution System, West High Zone

Location: 6 Ridge Hill Way, Andover, Service Leaking,

Approx. Size: 2-4 GPM

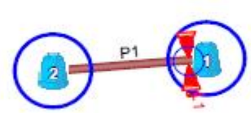
Pipe Material 1" Copper

Date and time of detection on correlation: 04/21/18 03:18pm



Pipe ID	Length	Diameter	Material	Sound Velocity
P1	330' 0"	12"	Cast Iron	3770 feet/sec

Leak ID	Leak Position	Correlation Between	Confidence	Recording Time
L1	293' 6" from 2	2 -> 1	87.5%	Apr 21 2018, 04:21:08PM
L2	293' 6" from 2	2 -> 1	84.4%	Apr 21 2018, 04:22:08PM
L3	293' 6" from 2	2 -> 1	88.6%	Apr 21 2018, 04:23:08PM



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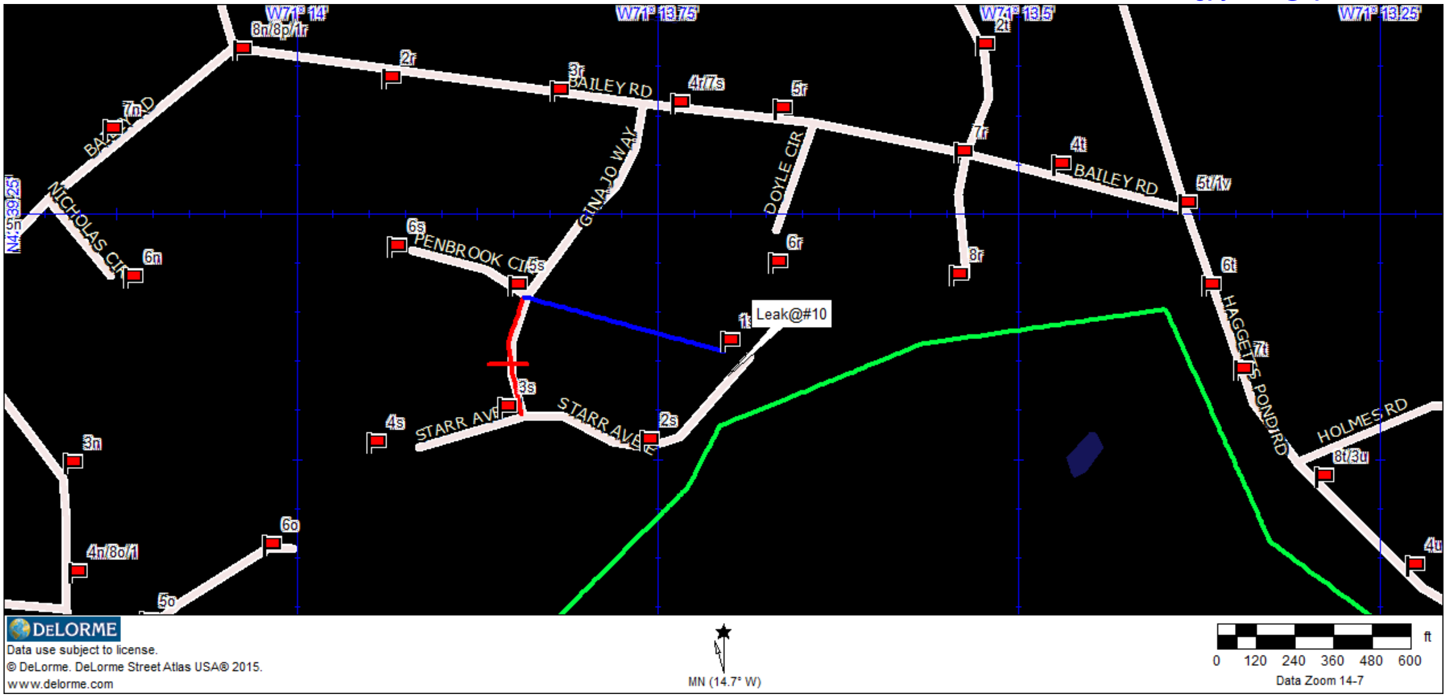
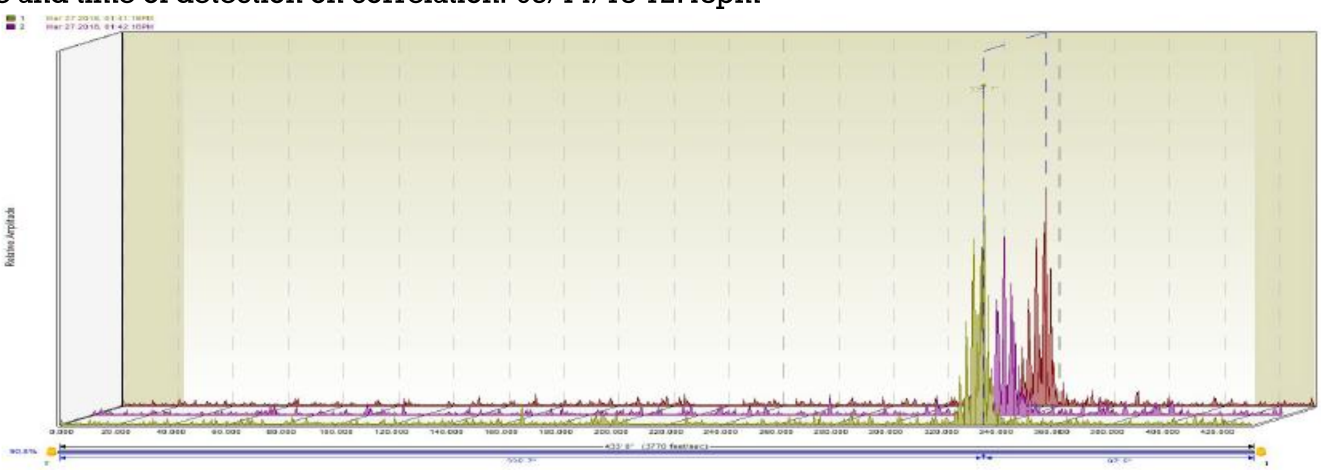
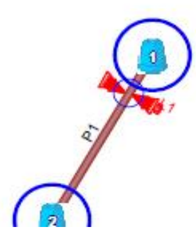


System Name: Andover Water Department's Distribution System, West High Zone
Location: 11 Starr Ave E., Andover,
Approx. Size: 2-4 GPM
Pipe Material 1" Copper
Date and time of detection on correlation: 03/14/18 12:48pm



Pipe ID	Length	Diameter	Material	Sound Velocity
P1	433' 0"	12"	Cast Iron	3770 feet/sec

Leak ID	Leak Position	Correlation Between	Confidence	Recording Time
L1	335' 7" from 2	2 -> 1	90.8%	Mar 27 2018, 01:41:16PM
L2	331' 8" from 2	2 -> 1	89.1%	Mar 27 2018, 01:42:16PM
L3	331' 8" from 2	2 -> 1	89.7%	Mar 27 2018, 01:43:16PM
L4	332' 0" from 2	2 -> 1	85.6%	Mar 27 2018, 01:42:16PM
L5	335' 7" from 2	2 -> 1	88.1%	Mar 27 2018, 01:43:16PM



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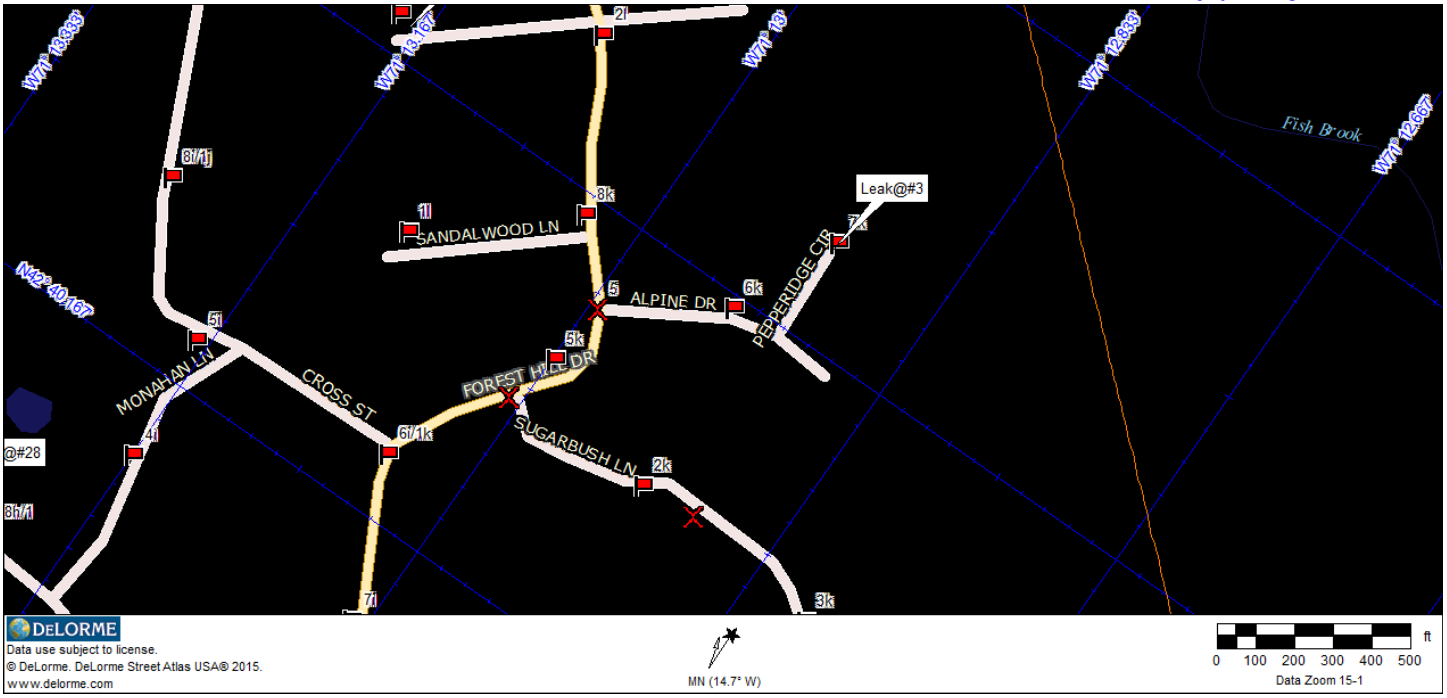


System Name: Andover Water Department's Distribution System, West High Zone
Location: Pepperidge Cir, Andover, Hydrant Leaking,
Approx. Size: GPM
Pipe Material
Leak detected during the audit of noise logger recordings. No correlations available. Located using ground microphone.
Located on 4-18-18

SUMMARY OF CONTINUED LEAKS FOR CY 2017

DMA #	#	Address	Notes	Leak (gpm)	Found	Repair date	Duration/Days	Gallons Lost	Comments	Zone	Found by:	T (town)	P (private)
2	6	Acropolis Cir		3	5/25/2018					Central	LD	P	Central Low LD Report July 2018
1	16	Blueberry Hill Rd		2	2/9/2016					East	LD	unk	
1	5	Boston Rd		2	3/6/2017					East	LD	P	East High LD Report May 2017
2	25	Bradley Road		9	5/19/2018	**6/14/2018**	26	336,960		Central	LD	Town	Central Low LD Report July 2018
3	7	Brady Loop		3	1/25/2017					West	LD	P	West LD Report Apr 2017
3	20	Brady Loop	first found 1/15/2015, again 1/25/17	6	4/10/2018					West	LD	P	Leaking since at least 2013, West LD Report Apr 2017, July 2018
3	18	Brady Loop			11/13/2016						WS	P	
3	28	Brady Loop		3	4/21/2018					West	LD	P	West LD Report July 2018
3	10	Briarwood Cir		2	4/10/2018					West	LD	P	West LD Report July 2018
1	6	Cameron Rd		3	2/3/2017					East	LD	P	East High LD Report May 2017
2	11	Cardinal Lane		3	5/19/2018	**8/18/2018**	91	393,120		Central	LD	Town	Central Low LD Report July 2018
2	8	Cassimere		2	4/29/2014					Central	LD	P	
1	187	Chestnut St	Middlesex first found 12/5/14	2	1/27/2016					East	LD	P	
1	11	Downing Street			1/25/2016					East	LD	P	
1	163	Elm Street	first found 1/26/16	3	2/27/2017					East	LD	P	East High LD Report May 2017
1	9	Forbes Lane		2	3/5/2017					East	LD	P	East High LD Report May 2017
1	47	Glenwood Road		3	3/6/2017					East	LD	P	East High LD Report May 2017
2		High Vale Lane - church			4/12/2016					Central	LD	P	
1	10	Ivanhoe Lane		3	2/15/2017					East	LD	P	East High LD Report May 2017
2	17	Juliette St			2/1/2016						WS	P	
1	20	Karlton Cr			3/5/2017						WS	P	
1	37	Kathleen Drive		2	2/5/2017					East	LD	P	East High LD Report May 2017
1	10	Morningside Dr	first found 12/2/14	3	2/5/2017					East	LD	P	East High LD Report May 2017
1	7	Olympia Cr	under contract w/Colombo		5/10/2017						WS	P	Homeowner leaks found by WS
1	28	Orchard Crossing		3	3/5/2017					East	LD	P	East High LD Report May 2017
1	3	Parnussus Place		2	3/13/2017					East	LD	P	East High LD Report May 2017
3	33	Pleasant St		3	UNK					West	LD	P	West LD Report Apr 2017
3	6	Ridge Hill Way	first found 1/25/17	3	4/21/2018					West	LD	P	West LD Report Apr 2017,July 2018
2	10	Rock-O-Dundee		2	4/22/2016					Central	LD	P	
1	304	Salem Street		2	2/3/2017					East	LD	P	East High LD Report May 2017
1	5	Sawyer Lane	first found 3/16/16	2	2/3/2017					East	LD	P	East High LD Report May 2017
1	3	Sleepy Hollow			1/22/2017						WS	P	Homeowner leaks found by WS
1	332	South Main St	originally fixed, but leaks again	2	11/11/2014					East	LD	P	
1	99	Spring Grove Rd			11/16/2016						WS	P	
3	11	Starr Ave E		3	3/14/2018	**7/26/2018**	134	578,880		West	LD	P	West LD Report July 2018
1	33	Stinson Rd		3	2/9/2016					East	LD	P	
2	56	Union St		4	6/2/2014					Central	LD	P	
1	6	Weathersfield Dr	first found 11/28/14	2	3/5/2017					East	LD	P	East High LD Report May 2017
2	5	Wyncrest Cr	first found 3/5/15	2	5/25/2018		2015, 2016, 2017, 2018			Central	LD	P	Central Low LD Report July 2018
		HYDRANTS	Notes	Leak (gpm)	Found	Repair date	Duration/Days	Gallons Lost	Comments	Zone	Found by:	T (town)	P (private)
2		1699		1	unk	unk				Central	LD	Town	Central Low LD Report July 2018
2		893		1	unk	unk				Central	LD	Town	Central Low LD Report July 2018
3		1246			4/18/2018	6/5/2018				West	LD	Town	West LD Report July 2018
		MAIN LINE LEAKS	Notes	Leak (gpm)	Found	Repair date	Duration/Days	Gallons Lost	Comments	Zone	Found by:	T (town)	P (private)

SUMMARY OF CONTINUED LEAKS FOR CY 2017

DMA #	#	Address	Notes	Leak (gpm)	Found	Repair date	Duration/Days	Gallons Lost	Comments	Zone	Found by:	T (town)	P (private)
1	11	Alison Way	B. Watson		1/10/2017	**5/18/2017**	128	368,640			WS	P	Homeowner leaks found by WS
3	4	Apollo Circle		3	12/28/2016	**4/22/2017**	115	496,800		West	LD	**Town**	West LD Report Apr 2017
1	3	Archer	Reilly	2	12/20/2016	**1/26/2017**	37	106,560			WS	P	*to be included in 2017 ASR*
1	3	Athena Cr	Middlesex		2/7/2017	**2/27/2017**	20	57,600			WS	P	Homeowner leaks found by WS
1	16	Blueberry Hill Rd		2	2/9/2016					East	LD	unk	
1	5	Boston Rd		2	3/6/2017					East	LD	P	East High LD Report May 2017
3	19	Brady Loop	Buddy Watson	2	12/14/2017	**1/9/2017**	26	74,880			WS	P	Homeowner leaks found by WS
3	7	Brady Loop		3	1/25/2017					West	LD	P	West LD Report Apr 2017
3	20	Brady Loop	first found 1/15/2015	6	1/25/2017					West	LD	P	Leaking since at least 2013, West LD Report Apr 2017
3	18	Brady Loop			11/13/2016						WS	P	
1	50	Brookfield Rd	B.Watson (Replacing 6/29/17)		5/9/2017	**6/7/2017**	29	83,520			WS	P	Homeowner leaks found by WS, **Shut off 6/7/2017**
1	6	Cameron Rd		3	2/3/2017					East	LD	P	East High LD Report May 2017
2	8	Cassimere		2	4/29/2014					Central	LD	P	
1	187	Chestnut St	Middlesex first found 12/5/14	2	1/27/2016					East	LD	P	
2	101	Chestnut St	J.White		2/21/2017	**3/8/2017**	15	43,200			WS	P	Homeowner leaks found by WS
1	7	Coventry Lane	Mike Reilly		1/30/2017	**2/22/2017**	23	66,240			WS	P	Homeowner leaks found by WS
3	85	Cross St	Middlesex Site Prep		5/12/2017	**6/9/2017**	28	80,640			WS	P	Homeowner leaks found by WS, **Shut off 5/12/2017**
1	8	Donna Rd	CK Trucking	3	3/6/2017	**4/14/2017**	39	168,480		East	LD	P	East High LD Report May 2017
1	8	Downing St	Mike Colombo		1/5/2017	**1/6/2017**	1	2,880			WS	P	Homeowner leaks found by WS, **Shut off 1/5/17**
1	11	Downing Street			1/25/2016					East	LD	P	
1	163	Elm Street	first found 1/26/16	3	2/27/2017					East	LD	P	East High LD Report May 2017
1	20	Embassy Lane	Town-owned - 20 Chatham Rd	3	2/16/2017	**7/6/2017**	140	604,800		East	LD	**Town**	East High LD Report May 2017
1	2	Embassy Lane	B.Watson		11/16/2016	**1/25/2017**	70	201,600			WS	P	Homeowner leaks found by WS
2	5	Enfield Dr	Unknown		4/13/2017	**4/14/2017**	1	2,880			WS	P	Homeowner leaks found by WS
1	50	Farrwood Drive		3	3/6/2017	**4/14/2017**	39	168,480		East	LD	T	East High LD Report May 2017
1	3	Fern Rd	M.Colombo		2/3/2017	**2/6/2017**	3	8,640			WS	P	Homeowner leaks found by WS
1	9	Forbes Lane		2	3/5/2017					East	LD	P	East High LD Report May 2017
3	8	Forest Hill Drive		2	1/23/2017	**8/1/2017**	189	544,320		West	LD	**Town**	West LD Report Apr 2017
1	3	Glenwood Rd	B.Watson		3/22/2017	**4/10/2017**	19	54,720			WS	P	Homeowner leaks found by WS
1	47	Glenwood Road		3	3/6/2017					East	LD	P	East High LD Report May 2017
3	8	Greybirch Rd	B.Watson	3	1/31/2017	**3/9/2017**	37	159,840		West	LD	P	West LD Report Apr 2017
2		High Vale Lane - church			4/12/2016					Central	LD	P	
1	10	Ivanhoe Lane		3	2/15/2017					East	LD	P	East High LD Report May 2017
3	7	Joseph St		2	1/17/2017	**2/18/2017**	32	92,160		West	LD	**Town**	West LD Report Apr 2017
2	17	Juliette St			2/1/2016						WS	P	
1	20	Karlton Cr			3/5/2017						WS	P	
1	37	Kathleen Drive		2	2/5/2017					East	LD	P	East High LD Report May 2017
1	2	Lavender Hill Lane	Middlesex Site Prep		12/30/2016	**1/25/2017**	26	74,880			WS	P	Homeowner leaks found by WS
2	38	Mary Lou Lane	Jason White		1/1/2017	**1/6/2017**	5	14,400			WS	P	Homeowner leaks found by WS, **Shut off 1/1/17**
2	19	McKenney Cr	Middlesex	2	12/15/2016	**1/19/2017**	35	100,800			WS	P	Homeowner leaks found by WS
2	6	Midland Cr	M.Colombo		4/6/2017	**4/12/2017**	6	17,280			WS	P	Homeowner leaks found by WS
1	10	Morningside Dr	first found 12/2/14	3	2/5/2017					East	LD	P	East High LD Report May 2017
2	250	North Main St	Mike Reilly		1/30/2017	**6/15/2017**	136	391,680			WS	P	Homeowner leaks found by WS
2	4	Olde Berry Rd	Middlesex Site Prep		4/10/2017	**5/24/2017**	44	126,720			WS	P	Homeowner leaks found by WS
1	7	Olympia Cr	under contract w/Colombo		5/10/2017						WS	P	Homeowner leaks found by WS
1	28	Orchard Crossing		3	3/5/2017					East	LD	P	East High LD Report May 2017
1	3	Parnussus Place		2	3/13/2017					East	LD	P	East High LD Report May 2017
2	2	Penacook Cr	Mike Colombo		4/17/2017	**4/24/2017**	7	20,160			WS	P	Homeowner leaks found by WS
3	33	Pleasant St		3	UNK					West	LD	P	West LD Report Apr 2017
1	89	Rattlesnake Hill Rd	T.Bateson		1/28/2017	**1/31/2017**	3	8,640			WS	P	Homeowner leaks found by WS

DMA #	#	Address	Notes	Leak (gpm)	Found	Repair date	Duration/Days	Gallons Lost	Comments	Zone	Found by:	T (town)	P (private)
3	6	Ridge Hill Way		3	1/25/2017					West	LD	P	West LD Report Apr 2017
2	10	Rock-O-Dundee		2	4/22/2016					Central	LD	P	
1	20	Sagamore Dr	M. Colombo		3/31/2017	**5/2/2017**	32	92,160			WS	P	Homeowner leaks found by WS
1	310	Salem St	Middlesex site prep		4/15/2017	**5/8/2017**	23	66,240			WS	P	Homeowner leaks found by WS
1	304	Salem Street		2	2/3/2017					East	LD	P	East High LD Report May 2017
3	16	Samos Lane	DELR 4/8/17		4/5/2017	**NO LEAK**	0				WS	P	Homeowner leaks found by WS
3	5	Sandalwood	Jim Watson		UNK	**5/4/2017**					WS	P	Homeowner leaks found by WS
1	5	Sawyer Lane	first found 3/16/16	2	2/3/2017					East	LD	P	East High LD Report May 2017
3	10	Serenity Lane		2	1/2/2017	**7/13/2017**	192	552,960		West	LD	**Town**	West LD Report Apr 2017
1	1	Sleepy Hollow	B. Watson		2/2/2017	**3/5/2017**	31	89,280			WS	P	Homeowner leaks found by WS
1	3	Sleepy Hollow			1/22/2017						WS	P	Homeowner leaks found by WS
1	242	South Main St		3	2/27/2017	**3/18/2017**	19	82,080		East	LD	**Town**	East High LD Report May 2017
1	332	South Main St	originally fixed, but leaks again	2	11/11/2014					East	LD	P	
1	99	Spring Grove Rd			11/16/2016						WS	P	
1	33	Stinson Rd		3	2/9/2016					East	LD	P	
2	30	Sutherland St	J.Watson	5	3/19/2016	**3/9/2017**	355	2,556,000		Central	LD	P	
2	16	Timothy Dr	M.Colombo		2/21/2017	**3/8/2017**	15	43,200			WS	P	Homeowner leaks found by WS
2	56	Union St		4	6/2/2014					Central	LD	P	
2	8	Warwick Cr	NOTE : This leak is going through meter...NO UAW		5/16/2017	**6/23/2017**	38	0			WS	P	
1	6	Weathersfield Dr	first found 11/28/14	2	3/5/2017					East	LD	P	East High LD Report May 2017
2	109	Woburn St	Middlesex	3	12/13/2016	**1/31/2017**	49	141,120			WS	P	*to be included in 2017 ASR*
2	4	Worthen Place	M. Colombo	4	3/19/2016	**1/17/2017**	303	872,640			LD	P	*to be included in 2017 ASR*
2	5	Wyncrest Cr		2	3/5/2015					Central	LD	P	
								8,637,120					
		HYDRANTS	**Notes**	**Leak (gpm)**	**Found**	**Repair date**	**Duration/Days**	**Gallons Lost**	**Comments**	**Zone**	**Found by:**	**T (town)**	**P (private)**
3	1298	Hydrant		26	1/2/2017	**2/22/2017**	51	1,909,440		West	LD	**Town**	West LD Report Apr 2017
3	365	Hydrant		26	1/2/2017	**2/8/2017**	37	1,385,280		West	LD	**Town**	West LD Report Apr 2017
3	Ledge Rd	Hydrant	in Baseball Field parking lot	26	1/2/2017	**2/11/2017**	40	1,497,600		West	LD	**Town**	West LD Report Apr 2017
		MAIN LINE LEAKS	**Notes**	**Leak (gpm)**	**Found**	**Repair date**	**Duration/Days**	**Gallons Lost**	**Comments**	**Zone**	**Found by:**	**T (town)**	**P (private)**
3		River Rd @ 1776 Street		6	unk - use 1/2/2017	**7/22/2017**	201	1,736,640		West	LD	**Town**	West LD Report Apr 2017

G

WRIGHT-PIERCE
Engineering a Better Environment

APPENDIX G
District Management Plans

DROUGHT MANAGEMENT PLAN

Andover, Massachusetts
Water Department – PWSID 3009000
September 11, 2011
Revised May 2015

Table of Contents

APPENDICES

FIGURES

1.0 INTRODUCTION

Virtually every region of the United States has experienced drought and its adverse effects on public water supply systems. Even the relatively "water-rich" Commonwealth of Massachusetts, which under normal conditions receives between 40 and 50 inches of annual precipitation, is at risk of drought. Massachusetts's droughts have ranged from extended periods of multi-year dry weather events such as experienced in the mid 1960's to seasonal events such as the dry spring and summer of 1999, and the dry summer of 2010. History reinforces that climatic changes create uncertainty and risk to our water resources. Furthermore, the vulnerability of public water systems to drought is increasing as the population and water demands increase.

A Drought Management Plan (DMP) is a document that accomplishes the following, (1) defines the conditions under which a drought induced water emergency exists, and (2) specifies the actions that are to be taken in response. Drought indicators are parameters used to assess the status of water supplies. Some examples of indicators include: pumping capacity, storage tank elevations, reservoir levels, stream flow, groundwater levels and precipitation conditions. Drought stage triggers act as benchmarks to provide warning signals of impending water shortages; and, are developed using historical data that established water supply fluctuations distinguishing normal and water shortage conditions. Water restrictions that correspond with particular drought stages are then enforced to allow a predictable consistent response to water shortages or drought conditions.

This DMP approaches drought management recognizing that water supplies must be managed jointly along with water demands. Since drought is a natural phenomenon over which we have little, if any control it is necessary for resource planners to anticipate the occurrence of drought, consider the impacts of drought on our water supply system, and develop plans to mitigate the impacts of drought. The basic goal(s) of a drought management plan is to preserve essential public services and minimize the adverse impacts of a water supply emergency on the public's health and safety, economic activities, environmental resources, and individual lifestyle.

2.0 OVERVIEW OF WATER SUPPLY

With the exception of a few houses using private wells, the Town of Andover's residents, businesses, and industry are served by the Town's municipal drinking water supply drawn from a combination of three surface water sources. Each of these sources is discussed below.

2.1 Haggetts Pond

Haggetts Pond represents Andover's major water source of water supply and storage. It is a 220-acre glaciated natural pond located southeast of the intersection of interstates Routes 93 and 495 in Essex County Andover, Massachusetts. The pond has a draw down capacity of 6 feet and a safe yield, defined as the amount of water that can be drawn during the severest drought on record, of 1.1 million gallons per day. The total watershed area of Haggetts Pond covers 1,422 acres.

2.2 Fish Brook

Fish Brook is a 5.25-mile long stream, which arises in wetlands near Haggetts Pond and from the ponds in Indian Ridge Country Club. Fish Brook flows to the Merrimack River, roughly parallel to Route 93. The mouth of the brook has been impounded to retain its flow and a pump station located at the impoundment delivers water through a 24-inch water line upstream to Haggetts Pond. The Fish Brook Pumping Station is treated as a reservoir without storage capacity. Water is available for capture, but not storage, and inflow to Fish Brook is represented by flow data from the Merrimack River. The Fish Brook Watershed area covers 2,450 acres.

2.3 Merrimack River

The Merrimack River is a major river that borders the Town of Andover on the northeast that is drainage for a 5,000 square mile watershed. Water is drawn from the Merrimack River, at the Fish Brook Station, and pumped into Haggetts Pond. This water makes up the remainder of the Town of Andover's average daily demand not supplied directly from Haggetts Pond.

3.0 DISTRIBUTION

Source water transferred from Fish Brook and the Merrimack River into Haggetts Pond is drawn into the Water Treatment Plant. The plant has a design capacity to treat 24 million gallons per day (mgd) of raw water, and an operational capacity of 18 mgd. The raw water is processes via physical and chemical treatments. The water treatment plant assures a safe and consistent quality product to benefit the individual lifestyles of each consumer. Following treatment, the finished water is distributed to three different storage locations in Town.

Andover currently has 14 million gallons of storage capacity for processed (or finished) water. Six million gallons of storage exists at the Bancroft storage tanks on Bancroft Road adjacent to the Bancroft School. Four million gallons of finished water is pumped to the Wood Hill Storage Tanks located off of Haggetts Pond Road, and 4 million gallons of storage is available in the two Prospect Tanks, located at the top of Ward Hill Reservation. Combined, these storage tanks provide water to meet the need of consumers throughout the Town of Andover. Refer to Figure 3-1 for a schematic of the distribution and storage facilities.

The volume of raw water withdrawn from the water supply and processed through the Water Treatment Plant during CY 2014 was 7.6 mgd or approximately 2.80 billion gallons for the year. The volume of treated water that was delivered through 250 miles of underground distribution system pipes to end users for CY 2014 was 7.1 mgd or approximately 2.6 billion gallons. During CY 2014, 55% of the town's water demand was for residential use, followed by 20% commercial and 19% industrial. The remaining 6% is used for municipal and other miscellaneous uses. The town's average per capita residential water use for calendar year 2014 was 75 gallons per day.

Figure 3-1. Schematic of Andover Water Division Distribution and Storage Facilities

4.0 DROUGHT INDICATORS

4.1 Water Supply

Andover's water supply is from three sources, Haggetts Pond, Fish Brook and the Merrimack River, with the pond serving as the primary storage reservoir. Analyses of the inflow and outflow of water can help to indicate drought conditions. Reservoir inflow is represented by precipitation, surface runoff, and ground water discharge; and in the case for Haggetts Pond, water that is pumped from the Fish Brook Station which represents flow from both Fish Brook and the Merrimack River. Outflow consists of withdrawals, evaporation and releases. Indicators of drought may include: Wet well level of the Fish Brook Pumping Station, and the level of Haggetts Pond. This is discussed further in Sections 7 and 8 of this document. The level of the wet well at Fish Brook Pumping Station is measured, recorded and reported continuously by the SCADA system.

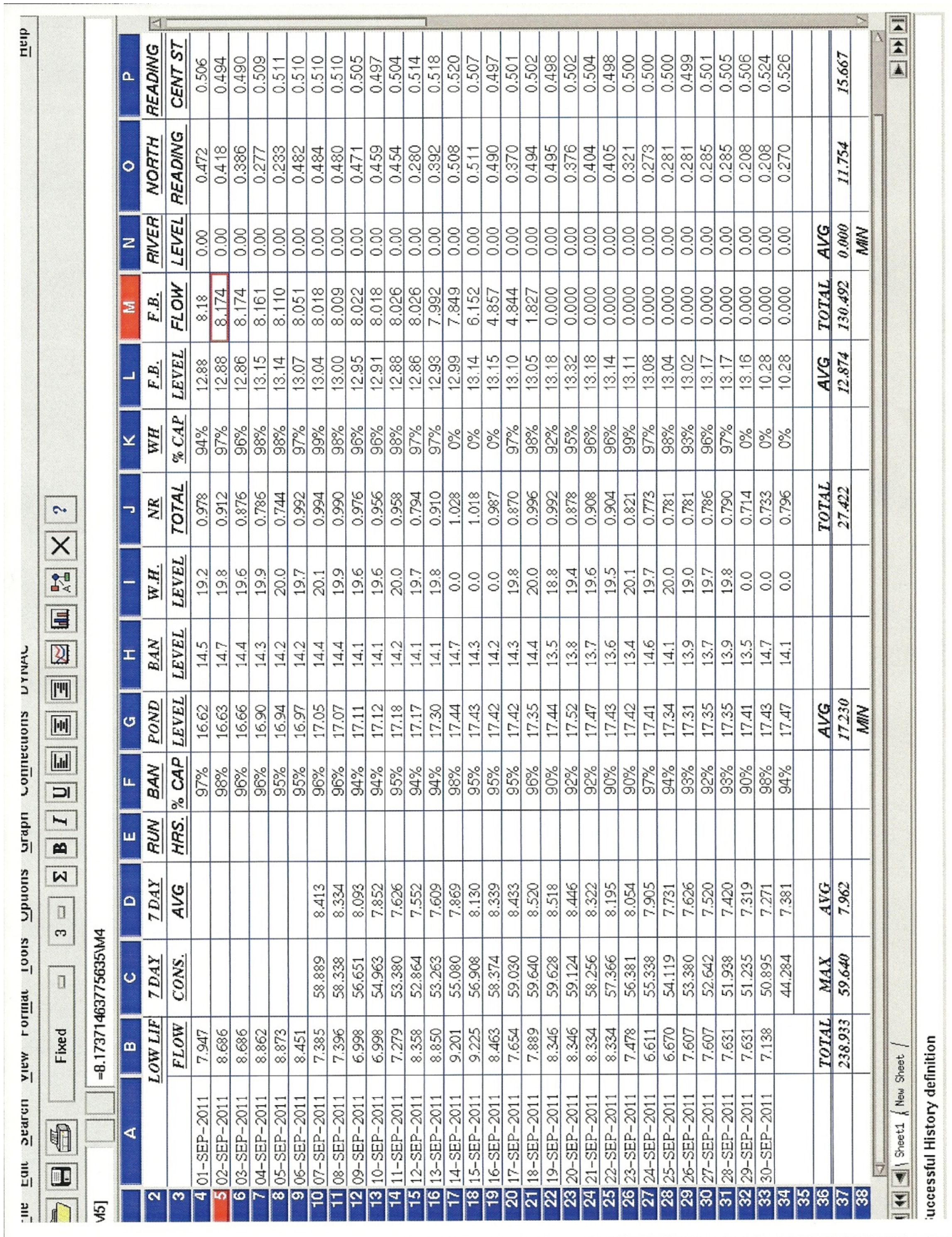
4.2 Distribution/Demand

Seasonal variation should be considered, as the demand for water is lower in the months of November through April and higher during May through October. Indicators of drought would include the following: the raw water operations demand and the distribution storage capacity. This is discussed further in Sections 9 and 10 of this document. The raw water operations demand and the distribution storage volumes are measured, recorded and reported in real-time by the SCADA system.

4.3 Palmer Drought Index

The Palmer Index is a widely used scale for measuring drought conditions. It is based on soil moisture supply and demand and long-term records of temperature and precipitation. Normal weather has an index value of zero, in all seasons in any climatic region. Droughts have negative index values while wet periods have positive values. Consecutive negative values provide initial warning of a developing drought. Many communities use the Palmer Index to trigger phases of their drought management plans. This is discussed further in Section 11 of this document; and the Palmer Drought Index is presented in Appendix B.

The plan's effectiveness is directly related to the frequency of monitoring indicator levels. Indicator levels should be monitored on a monthly basis during wet seasons and daily during dry seasons or periods of high demand to determine the actions and procedures for responding to a drought-related condition in advance of an actual emergency. Frequent monitoring will also lessen any perception that the utility's actions are ill considered or arbitrary. Notification of monitoring results must be made available to the appropriate utility manager and/or decision makers. Drought indicators including the pump station wet well level, storage tank capacity, and raw water operational demand are tracked in real-time using the plant's SCADA system. The Phase I watch levels are closely monitored and recorded. An example of the SCADA screen is shown in Figure 4-1.



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	A	B	C	D	E	F	G	H	I	J	K	L	M	N	O	P
2		LOW LIF	7 DAY	7 DAY	RUN	BAN	POND	BAN	W.H.	NR	WH	F.B.	F.B.	RIVER	NORTH	READING
3		FLOW	CONS.	AVG	HRS.	% CAP	LEVEL	LEVEL	LEVEL	TOTAL	% CAP	LEVEL	FLOW	LEVEL	READING	CENT ST
4	01-SEP-2011	7.947				97%	16.62	14.5	19.2	0.978	94%	12.88	8.18	0.00	0.472	0.506
5	02-SEP-2011	8.686				98%	16.63	14.7	19.8	0.912	97%	12.88	8.174	0.00	0.418	0.494
6	03-SEP-2011	8.686				96%	16.66	14.4	19.6	0.876	96%	12.86	8.174	0.00	0.386	0.490
7	04-SEP-2011	8.862				96%	16.90	14.3	19.9	0.786	98%	13.15	8.161	0.00	0.277	0.509
8	05-SEP-2011	8.873				95%	16.94	14.2	20.0	0.744	98%	13.14	8.110	0.00	0.233	0.511
9	06-SEP-2011	8.451				95%	16.97	14.2	19.7	0.992	97%	13.07	8.051	0.00	0.482	0.510
10	07-SEP-2011	7.385	58.889	8.413		96%	17.05	14.4	20.1	0.994	99%	13.04	8.018	0.00	0.484	0.510
11	08-SEP-2011	7.396	58.338	8.334		96%	17.07	14.4	19.9	0.990	98%	13.00	8.009	0.00	0.480	0.510
12	09-SEP-2011	6.998	56.651	8.093		94%	17.11	14.1	19.6	0.976	96%	12.95	8.022	0.00	0.471	0.505
13	10-SEP-2011	6.998	54.963	7.852		94%	17.12	14.1	19.6	0.956	96%	12.91	8.018	0.00	0.459	0.497
14	11-SEP-2011	7.279	53.380	7.626		95%	17.18	14.2	20.0	0.958	98%	12.88	8.026	0.00	0.454	0.504
15	12-SEP-2011	8.358	52.864	7.552		94%	17.17	14.1	19.7	0.794	97%	12.86	8.026	0.00	0.280	0.514
16	13-SEP-2011	8.850	53.263	7.609		94%	17.30	14.1	19.8	0.910	97%	12.93	7.992	0.00	0.392	0.518
17	14-SEP-2011	9.201	55.080	7.869		98%	17.44	14.7	0.0	1.028	0%	12.99	7.849	0.00	0.508	0.520
18	15-SEP-2011	9.225	56.908	8.130		95%	17.43	14.3	0.0	1.018	0%	13.14	6.152	0.00	0.511	0.507
19	16-SEP-2011	8.463	58.374	8.339		95%	17.42	14.2	0.0	0.987	0%	13.15	4.857	0.00	0.490	0.497
20	17-SEP-2011	7.654	59.030	8.433		95%	17.42	14.3	19.8	0.870	97%	13.10	4.844	0.00	0.370	0.501
21	18-SEP-2011	7.889	59.640	8.520		96%	17.35	14.4	20.0	0.996	98%	13.05	1.827	0.00	0.494	0.502
22	19-SEP-2011	8.346	59.628	8.518		90%	17.44	13.5	18.8	0.992	92%	13.18	0.000	0.00	0.495	0.498
23	20-SEP-2011	8.346	59.124	8.446		92%	17.52	13.8	19.4	0.878	95%	13.32	0.000	0.00	0.376	0.502
24	21-SEP-2011	8.334	58.256	8.322		92%	17.47	13.7	19.6	0.908	96%	13.18	0.000	0.00	0.404	0.504
25	22-SEP-2011	8.334	57.366	8.195		90%	17.43	13.6	19.5	0.904	96%	13.14	0.000	0.00	0.405	0.498
26	23-SEP-2011	7.478	56.381	8.054		90%	17.42	13.4	20.1	0.821	99%	13.11	0.000	0.00	0.321	0.500
27	24-SEP-2011	6.611	55.338	7.905		97%	17.41	14.6	19.7	0.773	97%	13.08	0.000	0.00	0.273	0.500
28	25-SEP-2011	6.670	54.119	7.731		94%	17.34	14.1	20.0	0.781	98%	13.04	0.000	0.00	0.281	0.500
29	26-SEP-2011	7.607	53.380	7.626		93%	17.31	13.9	19.0	0.781	93%	13.02	0.000	0.00	0.281	0.499
30	27-SEP-2011	7.607	52.642	7.520		92%	17.35	13.7	19.7	0.786	96%	13.17	0.000	0.00	0.285	0.501
31	28-SEP-2011	7.631	51.938	7.420		93%	17.35	13.9	19.8	0.790	97%	13.17	0.000	0.00	0.285	0.505
32	29-SEP-2011	7.631	51.235	7.319		90%	17.41	13.5	0.0	0.714	0%	13.16	0.000	0.00	0.208	0.506
33	30-SEP-2011	7.138	50.895	7.271		98%	17.43	14.7	0.0	0.733	0%	10.28	0.000	0.00	0.208	0.524
34			44.284	7.381		94%	17.47	14.1	0.0	0.796	0%	10.28	0.000	0.00	0.270	0.526
35																
36		TOTAL	MAX	AVG			AVG			TOTAL		AVG	TOTAL	AVG		
37		238.933	59.640	7.962			17.230			27.422		12.874	130.492	0.000	11.754	15.667
38							MIN							MIN		

Sheet1 New Sheet

uccessful History definition

Figure 4-1. SCADA Screen

5.0 DROUGHT STAGES AND RESPONSE

5.1 Description of Drought Stages

A series of four stages of drought management will be used to guide the Town of Andover Water Division through the levels of action needed. These are based on the severity of a particular water shortage or drought. A drought stage level can change in one of three ways after it is has been reached. If conditions reach the criteria for the next drought level, the severity will be increased. If conditions persist, but do not reach the next level, the drought response will response action will remain constant. If conditions improve, the severity can be reduced based on either site-specific information or on progress toward returning to normal. Mitigation measures are described in more detail in the following section.

American Water Works Association (AWWA) recommends managing water demand during a water shortage as a staged or phased approach, with increasing levels of savings in each successive phase. The actions taken in Phase I are in anticipation of the drought continuing and having the community benefit from increased carryover. The subsequent phases are in response to increasing supply shortages. Phase II uses some mandatory measures, and Phase IV includes extensive restrictions that would be initiated in extreme circumstances. Efforts made to reduce water consumption in the first three Phases will save residents and businesses from the potential hardships of extreme water shortages.

DROUGHT STAGE	LEVEL	RESPONSE ACTION
Phase I	Watch	Initiate Public Awareness of Drier than Normal Conditions and Encourage Voluntary Conservation by Largest Users, Restrict Outside Water Use at Municipal Facilities.
Phase II	Warning	Continue Public Awareness of Drier than Normal Conditions and Encourage Voluntary Conservation of All Users. Mandatory Conservation for Targeted Largest Users.
Phase III	Emergency	Mandatory Restrictions with By Law in Effect.
Phase IV	Critical	Maximum Mandatory Restrictions.

Phase I (Watch) involves the voluntary conservation where the municipal's 25 largest water users will be contacted and asked to implement their conservation practices. A list of major water users is updated annually. Also, restrict outside water use at municipal facilities. The demand reduction goal in this Phase is 10%-15% water use.

Phase II (Warning) implements a mandatory restriction of the water system's 25 largest users in conjunction with an appeal for voluntary conservation to all public users. Methods to appeal to the public may include: radio, cable television, newspapers, printed flyers, and bill stuffers. The demand reduction goal in this Phase is 15%-25% water use.

Phase III (Emergency) implements the Town of Andover Water Use Restriction By-Law adopted by the Town of Andover during an Annual Town Meeting held on April 29, 2002. The by-law establishes enforceable limitations on the use of municipal water during periods of water shortages or drought conditions. The purpose of the by-law is to protect, preserve and maintain public health, safety and welfare when water supply conservation is mandated or water supply emergency has been declared. The by-law is included in Appendix A. The demand reduction goal in this Phase is 25%-40% water use.

Phase IV (Critical) of the DMP implements maximum response to a water supply emergency. All Phases of the Drought Management Plan for conservation measures and restrictions are intensified. The by-law will enforce maximum limitations on municipal water use and emergency public agency actions will commence. The demand reduction goal in this Phase is greater than 40% water use.

5.2 Public Education

Public education and outreach during a water supply shortage is a critical component of the drought management plan. The dissemination of information regarding the existing water supply shortage and current water demand will help the customers understand the need to curtail water usage so that water-use reduction goals can be achieved. Keep in mind that the water supply situation is unpredictable and may change month-to-month. Even as precipitation increases, the effect on the water supply may not be immediate.

Initially, the Town Manager and the Assistant Town Manager will be notified by the Water Division of the need to implement the Drought Management Plan, what actions will be taken, including a request to all municipal users to curtail water consumption. A decrease in municipal usage, such as restricting outdoor watering sets an example for the public and promotes cooperation and commitment. Secondly, industry and retail customers will be asked to reduce their water usage. Frequent briefings to the news media; including postings on the town website, public service announcements, postings on electronic display boards positioned on main roads in town, and postings in the local newspapers will be made to ensure timely and accurate communication. Appeals to the general public for water conservation will be made on a regular basis, with updates on the situation of the water supply, proposed actions and actions already taken to mitigate supply shortages, and how well customers are meeting the intended goals.

5.3 Enforcement

Enforcement of the water use restrictions put in place based on Phase III or Phase IV of the Drought Stages will be in accordance with Chapter 9 of the Water Restriction By-Law, which states the following, "any person violating this by-law shall be subject to a warning for the first offense and thereafter shall be liable to the Town in the amount of $50 for the second violation and $100 for each subsequent violation…"

5.4 Reduction in Drought Levels

As actual and forecasted supply conditions improve, the Town may move to a lower Drought Stage Phase, or return to "normal use." The public and water customers will be notified of current drought conditions and the reduction in drought levels. A given drought action level can change when the conditions that led to the specific emergency have ended.

6.0 DROUGHT TRIGGERING LEVELS

6.1 Fish Brook Pumping Station

Water that is pumped from the Fish Brook Station represents flow from both Fish Brook and the Merrimack River. The various phases of the drought management plan would be triggered based on the wet well level (measured in feet) of the pump station. The typical/normal operating range of the Fish Brook Pumping Station wet well is between 10.0 and 12.5 feet. See Figure 6-1.

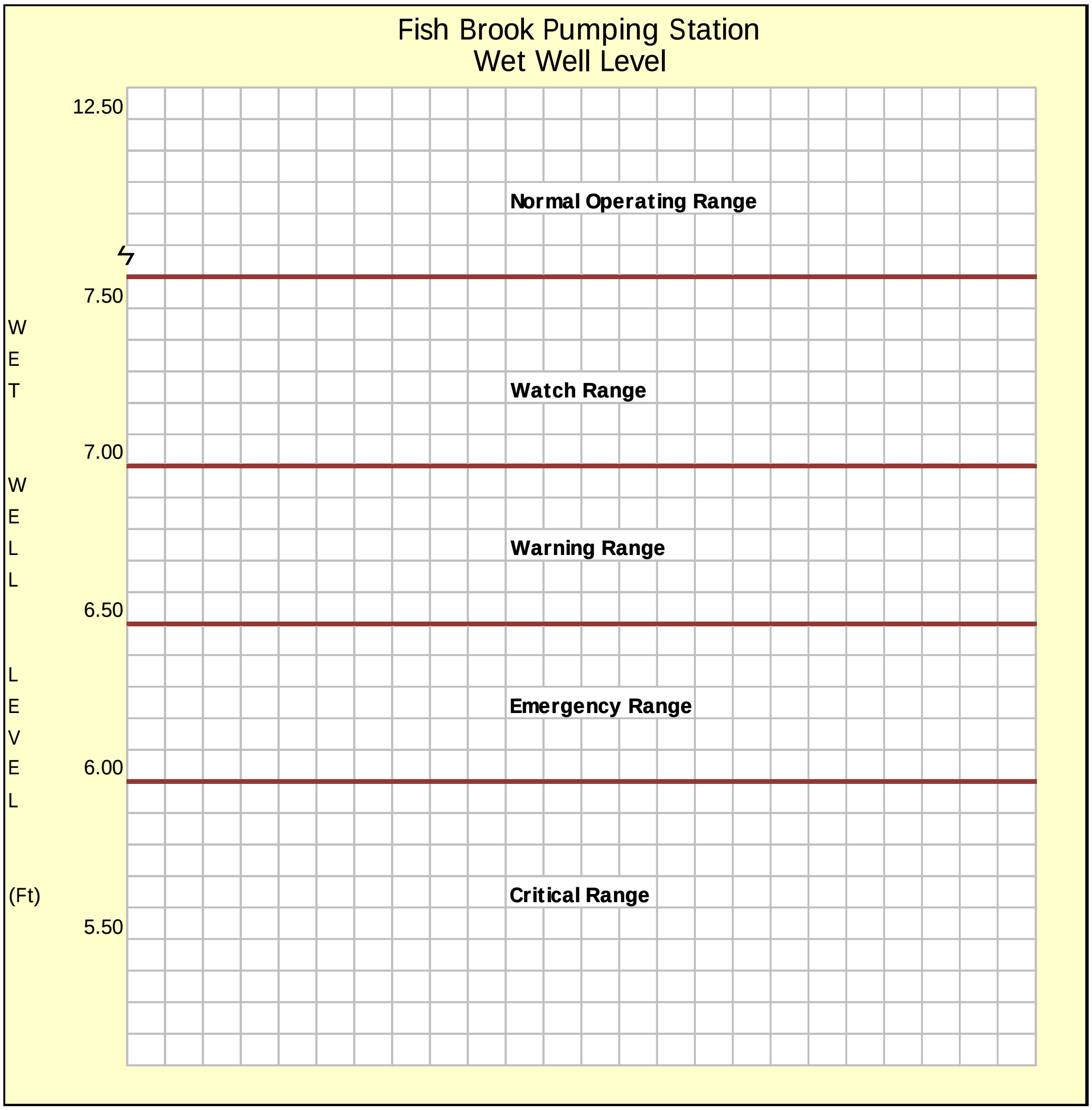

Figure 6-1. Drought Indicator: Fish Brook Pumping Station Wet Well Level

Fish Brook Pumping Station		
Phase	**Level**	**Trigger Level (5 day consecutive), ft**
Phase I	Watch	7.1 – 7.6
Phase II	Warning	6.6 – 7.0
Phase III	Emergency	6.0 – 6.5
Phase IV	Critical	Less than 6.0

6.2 Haggetts Pond Reservoir

Haggetts Pond is full at 117.6 ft (elevation) and the level should not drop below 113.5 ft (elevation) according to the engineering prints for the low lift flow. The various phases of the drought management plan would be triggered based on the level (measured in feet) of the reservoir. See Figure 6-2.

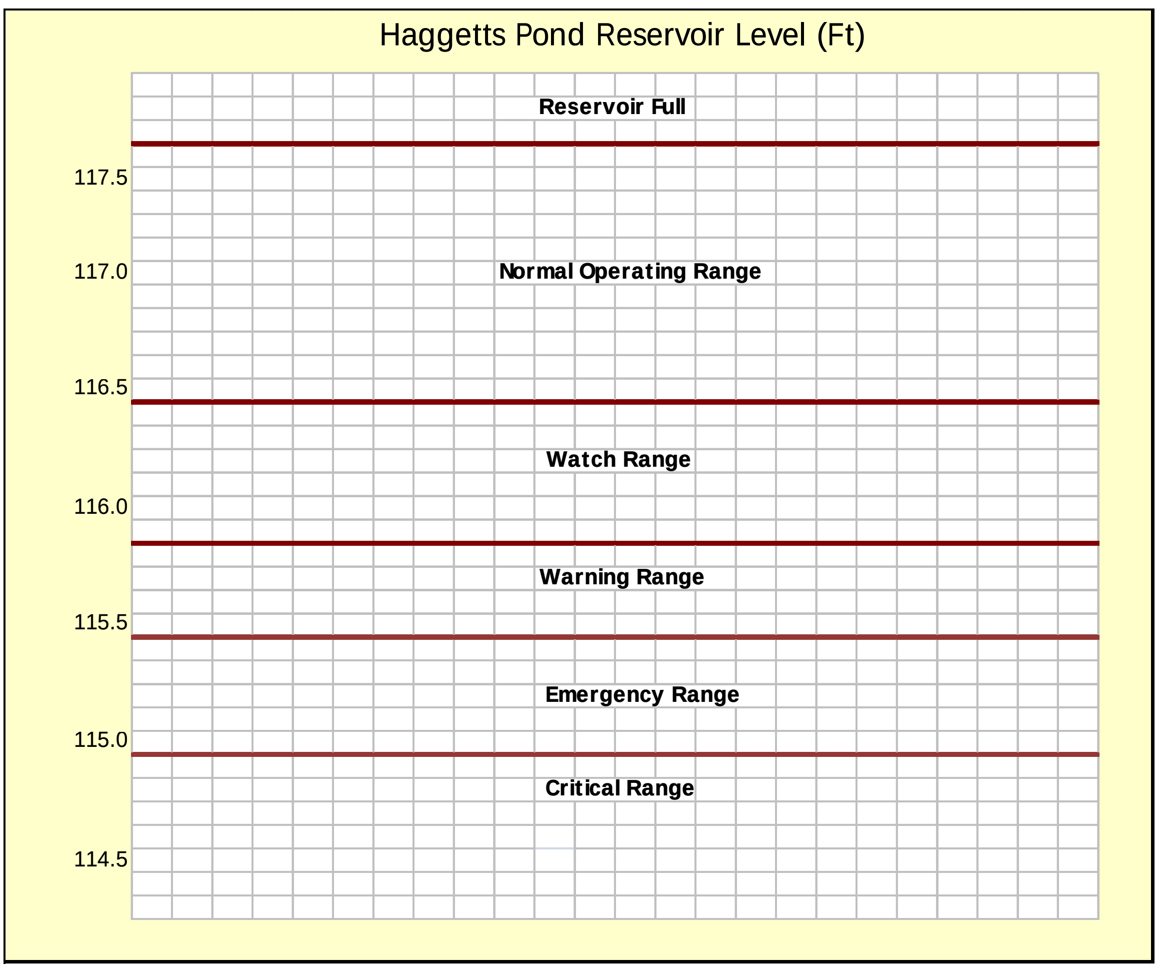

Figure 6-2. Drought Indicator: Haggetts Pond Reservoir Level

Haggetts Pond Reservoir		
Phase	**Level**	**Trigger Level (5 day consecutive), ft**
Phase I	Watch	115.9 – 116.4
Phase II	Warning	115.5 – 115.8
Phase III	Emergency	115.0 – 115.4
Phase IV	Critical	Less than 115.0

6.3 Raw Water Operations Demand

The average daily water volume pumped by the low lift pumps at the water treatment plant is 7.6 mgd. A daily peak volume of raw water pumped during the warmer months (May to September) may be as high as 14 mgd. The various phases of the drought management plan would be triggered based on the demand for raw water to be pumped at the water treatment plant for seven consecutive days. Refer to Figure 6-3.

Raw Water Operations Demand		
Phase	**Level**	**Trigger Level (5 day consecutive), mgd**
Phase I	Watch	12.5 – 13.1
Phase II	Warning	13.2 – 13.9
Phase III	Emergency	14.0 – 14.9
Phase IV	Critical	15.0 - >

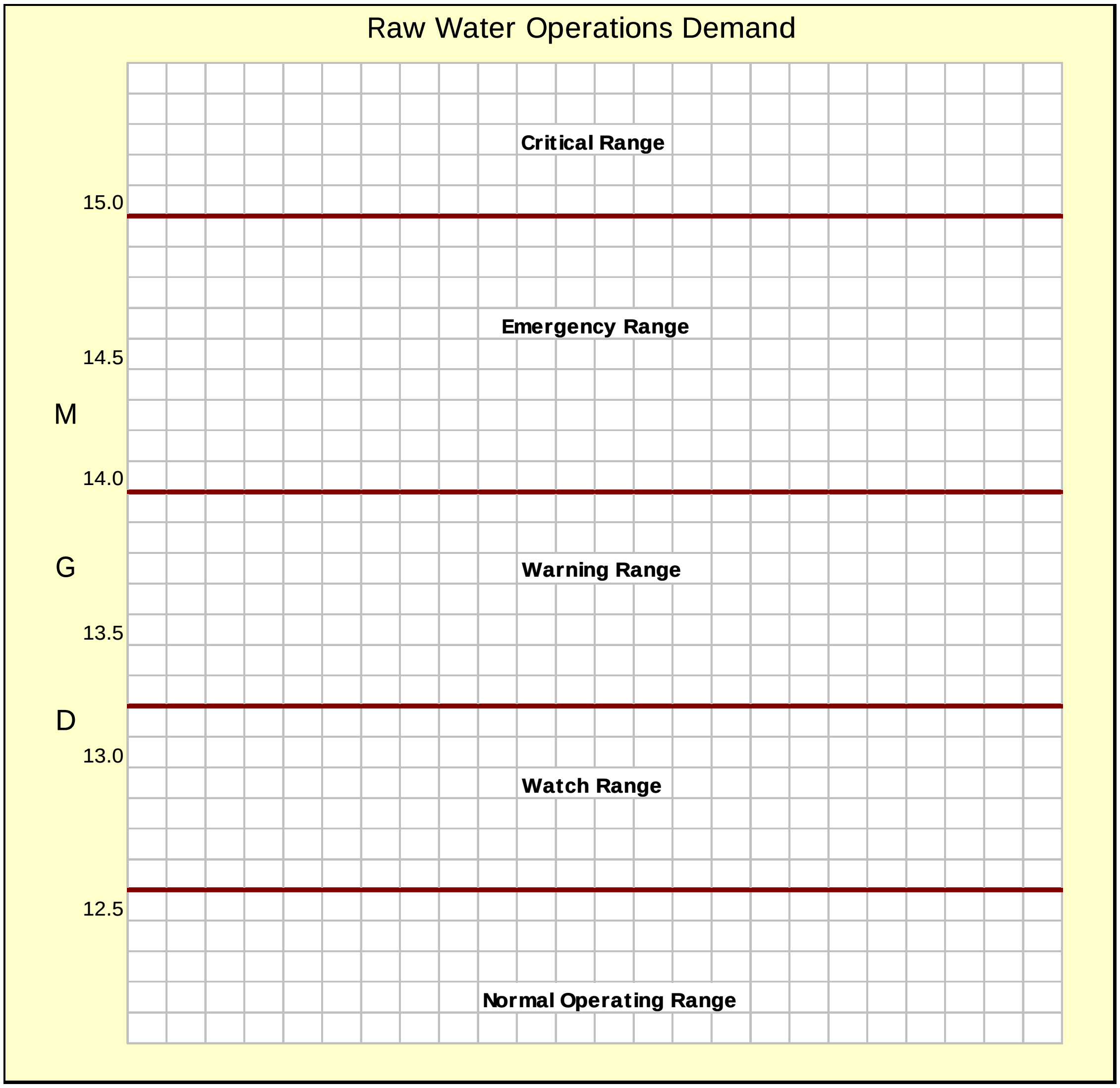

Figure 6-3. Drought Indicator: Raw Water Operations Demand

6.4 Distribution Storage Capacity

Andover currently has 14 million gallons of storage capacity for processed (or finished) water. Combined, these storage tanks provide water to meet the need of consumers throughout the Town of Andover. Six million gallons of storage exists at the Bancroft Storage Tanks. Four million gallons of finished water is pumped to the two Wood Hill Storage Tanks, and 4 million gallons of storage is available in the two Prospect Tanks.

Figure 6-4 illustrates the drought trigger level for the entire distribution storage capacity of Andover's water system. Response actions to each Phase of the drought management plan would be triggered when plant operations cannot maintain the percentage of distribution storage for three consecutive days.

Distribution Storage Capacity for Entire System		
Phase	**Level**	**Trigger Level (% full for 3 consecutive days)**
Phase I	Watch	94.0 – 90.1
Phase II	Warning	90.0 – 88.1
Phase III	Emergency	88.0 – 85.1
Phase IV	Critical	Less than 85.0

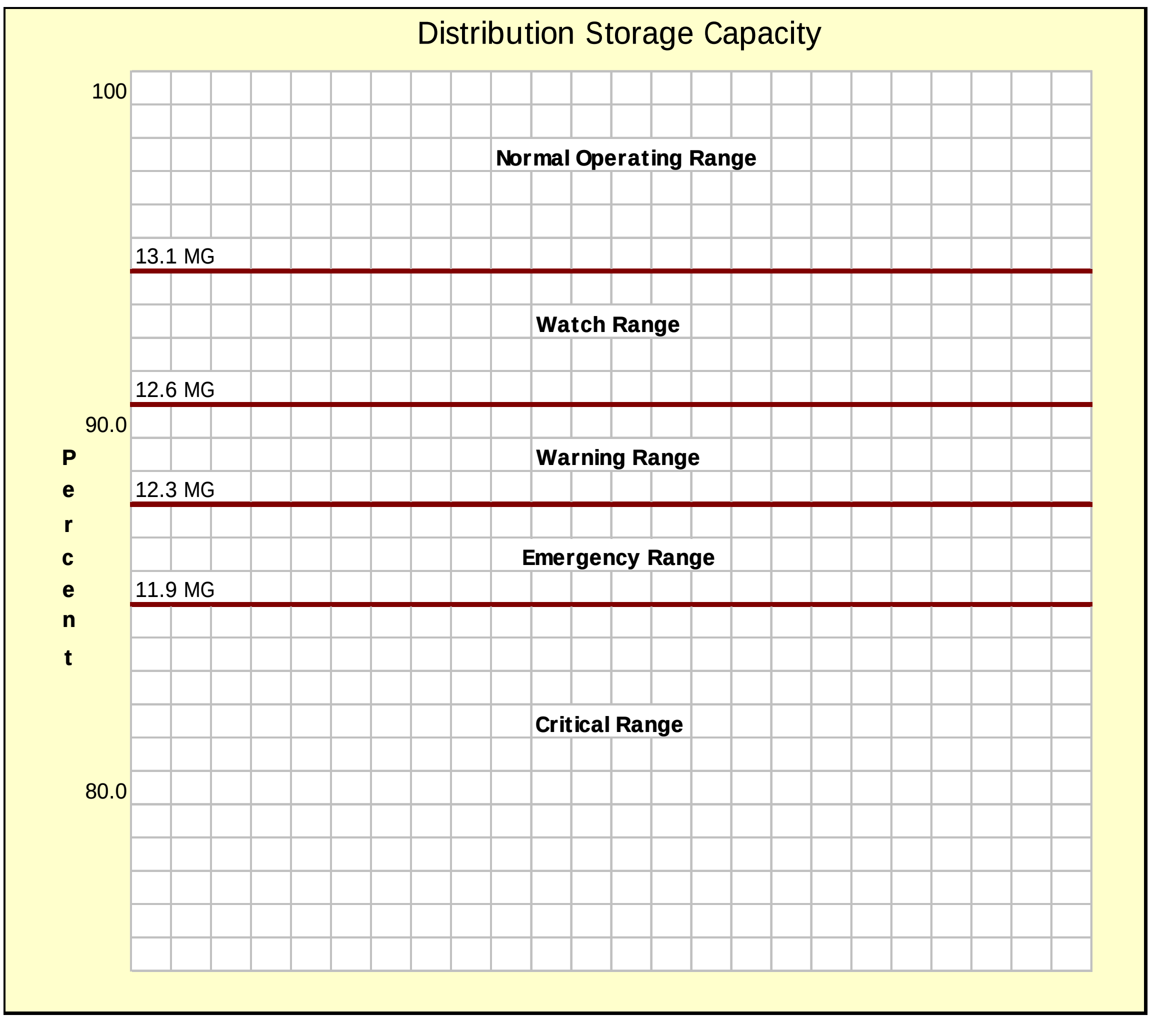

Figure 6-4. Drought Indicator: Distribution Storage Capacity for Entire System

There are, however, three pressure zones that make-up the entire distribution capacity: Bancroft Storage Reservoir, Wood Hill Storage Tanks and the Prospect Storage Tanks. A problem with storage capacity in any of these three zones could trigger response actions for the drought management plan. There is a critical level (corresponding to volume of finished water in each tank) that must be maintained for each storage tank. This is detailed in the table below. Phase II (Warning) response of the DMP is immediately triggered if the finished water level falls below this level for any one of the storage tanks, for three consecutive days. Phase II implementation includes a mandatory restriction of the water system's 25 largest users in conjunction with an appeal for voluntary conservation to all public users. Methods to appeal to the public may include: radio, cable television, newspapers, printed flyers, and bill stuffers. The goal in Phase II is a 15%-25% reduction in water use.

Storage Tank	Critical Tank Level
Bancroft Storage Reservoir	11 feet (for 3 consecutive days)
Wood Hill Storage Tanks	15 feet (for 3 consecutive days)
Prospect Storage Tanks	10.5 feet (for 3 consecutive days)

6.5 Palmer Drought Index

The Palmer Drought Index is calculated based on precipitation and temperature data, as well as the local available water content of the soil. It is useful as a drought monitoring tool and may be used to trigger actions associated with Drought Contingency Plans by providing decision makers with a measurement of the abnormality of recent regional weather. It provides an opportunity to place current conditions in historical perspective while providing spatial and temporal representations of historical droughts. The objective of the index is to provide measurements of moisture conditions that are standardized to comparisons between regional locations and months of the year. Weekly index values are available on the Climatic prediction Center website at http://www.drought.gov/drought/content/products-current-drought-and-monitoring-drought-indicators/palmer-drought-severity-index

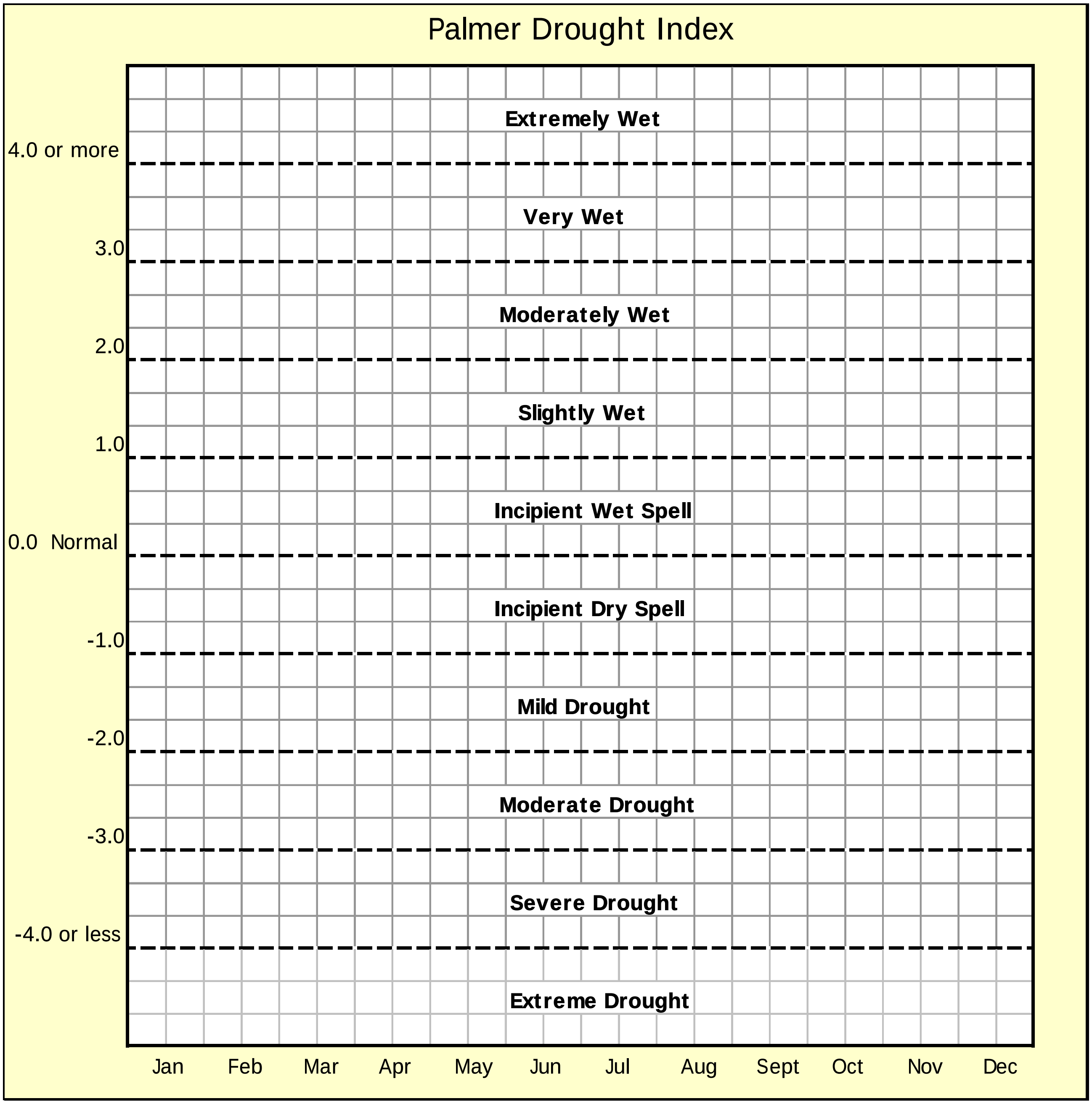

Figure 6-5. Drought Indicator: Palmer Drought Index

7.0 PLAN ASSESSMENT

As with all aspects of a drought plan, the assessment criteria for conservation and restriction measures must be updated as the utility gains actual experience with the effectiveness of measured implementation.

The DMP is designed for the Water Division to serve as a guideline for levels of action needed to respond to a particular water shortage or drought condition. In any voluntary or mandatory water use curtailment, equity in enforcement of the water reduction goals is of real concern to consumers. For this reason, everything possible must be done to eliminate any perception of inequity in the program. Enforcement must be directed toward achieving the goals of the DMP. It is also important to emphasize that the Water Division and other Town Departments should set a positive example by complying with water use restrictions and taking all reasonable measures to reduce water use during all phases of the plan.

Appendix A
Water Restriction By-Law

CODE OF THE TOWN OF ANDOVER MASSACHUSETTS, v20 Updated 08-30-2008

PART II BY-LAWS

Article XV, WATER

Article XV, WATER

[HISTORY: Adopted by the Town of Andover 4-29-2002 Annual Town Meeting, Art. 40. Amendments noted where applicable.]

§ 1. Authority.

This by-law is adopted by the Town under its police powers to protect public health and welfare and its powers under Massachusetts General Laws Chapter 40, Section 21 et seq. and implements the Town's authority to regulate water use pursuant to Massachusetts General Laws Chapter 41, Section 69B. This by-law also implements the Town's authority under Massachusetts General Laws Chapter 40, Section 4lA, conditioned upon a declaration of water supply emergency issued by the Massachusetts Department of Environmental Protection.

§ 2. Purpose.

The purpose of this by-law is to protect, preserve and maintain public health, safety and welfare whenever there is in force a state of water supply conservation or state of water supply emergency by providing for enforcement of any duly imposed restrictions, requirements, provisions or conditions imposed by the Town or by the Massachusetts Department of Environmental Protection.

§ 3. Definitions.

As used in this by-law, the following terms shall have the meanings indicated:

DIRECTOR -- The Director of Public Works for the Town of Andover.

PERSON -- Any individual, corporation, trust, partnership or association, or other entity.

PUBLIC WATER SUPPLY SYSTEM -- The Andover municipal water supply system withdrawing water from Haggetts Pond.

STATE OF WATER SUPPLY CONSERVATION -- A state of water supply conservation declared by the Town pursuant to § 4 of this by-law.

STATE OF WATER SUPPLY EMERGENCY -- A state of water supply emergency declared by the Massachusetts Department of Environmental Protection under Massachusetts General Laws Chapter 21G, Sections 15 through 17.

WATER USERS OR WATER CONSUMERS -- All public and private users of the Town's public water system, irrespective of any person's responsibility for billing purposes for water used at any particular facility/location.

§ 4. Declaration of state of water supply conservation.

The Town, through the Board of Selectmen, may declare a state of water supply conservation within the Town's public water supply system upon a determination by the Director that a shortage of water exists and conservation measures are appropriate to ensure an adequate supply of water to all water consumers. Public notice, of a state of water supply conservation shall be given under § 6 of this by-law before it may be enforced.

§ 5. Restricted water uses.

A declaration of a state of water supply conservation may include one or more of the following restrictions, conditions or requirements limiting the use of water either Town-wide or as limited by the Selectmen as necessary to protect the public water supply. The applicable restrictions, conditions or requirements shall be included in the public notice required under § 6.

1. Outdoor water use hours: Outdoor water use by water users is permitted only during daily periods of low demand, at night or early morning.

2. Odd/even day outdoor water use: Outdoor water use by water users with odd-numbered addresses is restricted to odd numbered days. Outdoor water use by water users with even-numbered addresses is restricted to even-numbered days.

3. Outdoor water use ban: Outdoor water use by water users is prohibited.

4. Filling swimming pools: Filling of swimming pools is prohibited.

5. Automatic sprinkler use: The use of automatic sprinkler systems is prohibited.

§ 6. Public notification of state of water supply conservation.

Notification of any provision, restriction, requirement or condition imposed by the Town as part of a State of Water Supply Conservation shall be published in a newspaper of general circulation within the Town, or by such other means reasonably calculated to reach and inform all users of Town water of the state of water supply conservation. Any restriction imposed under § 5 shall not be effective until such notification is provided. Notification of the State of Water Supply Conservation shall also be simultaneously provided to the Massachusetts Department of Environmental Protection.

§ 7. Termination of state of water supply conservation; notice.

A state of water supply conservation may be terminated by vote of the Board of Selectmen upon a determination that the water supply shortage no longer exists. Public notification of the termination of a state of water supply conservation shall be given in the same manner required by § 6.

§ 8. State of water supply emergency; compliance with DEP orders.

Upon notification to the public that the Massachusetts Department of Environmental Protection has issued a state of water supply emergency, no person shall violate any provision, restriction, requirement or condition or any order approved or issued by the Department intended to bring about an end to the state of water supply emergency.

§ 9. Violation and penalties.

Any person violating this by-law shall be subject to a warning for the first offense and thereafter shall be liable to the Town in the amount of $50 for the second violation and $100 for each subsequent violation, which shall inure to the Town for such uses as the Board of Selectmen may direct. Fines shall be recovered by indictment, or on complaint before the District Court, or by noncriminal disposition in accordance with Section 21D of Chapter 40 of the provisions of the Massachusetts General Laws. For purposes of noncriminal disposition, the enforcing person(s) shall be any police officer of the Town of Andover. Each day of violation shall constitute a separate offense.

§ 10. Severability.

The invalidity of any portion or provision of this by-law shall not invalidate any other portion or provision thereof.

Appendix B
Palmer Drought Severity Index

The Palmer Index was developed by Wayne Palmer in the 1960s and uses temperature and rainfall information in a formula to determine dryness. It has become the semi-official drought index.

The Palmer Index is most effective in determining long term drought—a matter of several months—and is not as good with short-term forecasts (a matter of weeks). It uses a 0 as normal, and drought is shown in terms of minus numbers; for example, minus 2 is moderate drought, minus 3 is severe drought, and minus 4 is extreme drought. At present, Texas, eastern New Mexico and Georgia are at a minus 4.0 point.

The Palmer Index can also reflect excess rain using a corresponding level reflected by plus figures; i.e., 0 is normal, plus 2 is moderate rainfall, etc. At present, South Dakota and sections of New England are at a plus 4.0 level.

The advantage of the Palmer Index is that it is standardized to local climate, so it can be applied to any part of the country to demonstrate relative drought or rainfall conditions. The negative is that it is not as good for short term forecasts, and is not particularly useful in calculating supplies of water locked up in snow, so it works best east of the Continental Divide.

For weekly monitoring of Palmer Drought index go to:

Weekly maps: http://www.cpc.ncep.noaa.gov/products/analysis_monitoring

Palmer Classifications	
4.0 or more	extremely wet
3.0 to 3.99	very wet
2.0 to 2.99	moderately wet
1.0 to 1.99	slightly wet
0.5 to 0.99	incipient wet spell
0.49 to -0.49	near normal
-0.5 to -0.99	incipient dry spell
-1.0 to -1.99	mild drought
-2.0 to -2.99	moderate drought
-3.0 to -3.99	severe drought
-4.0 or less	extreme drought

TOWN OF ANDOVER, MASSACHUSETTS

SURFACE WATER SUPPLY PROTECTION PLAN

Prepared by:

Town of Andover, Massachusetts
Water Department

NOVEMBER 2012

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1.0 INTRODUCTION

This document is a revision to the comprehensive Surface Water Supply Protection Plan (SWSPP) plan for the Town of Andover's Haggetts Pond, Fish Brook, and Merrimack River drinking water sources. The original plan was developed by the Town of Andover Water Department in 2004 using funding from the DEP Source Water Protection Grant Program, and was prepared in accordance with the Massachusetts DEP "Guidelines and Policies for Public Water Systems", and "Developing a Local Surface Water Supply Protection Plan" (revised May 2000).

The Massachusetts Department of Environmental Protection (DEP), under the guidelines of the federal Safe Drinking Water Act (SDWA) Amendments of 1996, developed a Source Water Assessment Program whose purpose was to provide detailed information on potential threats to public water supply sources. The SDWA Amendments required states to: delineate surface and groundwater protection areas; inventory land uses in these areas; determine the susceptibility of water supplies to contamination from these uses; and to publicize the results. This document is an expansion of that effort. A comprehensive SWSPP is considered to significantly enhance the protection of a water supply by identifying the potential sources and pathways of contamination, and provide actions and a time-line to address them.

What is SWAP?

The Source Water Assessment Program (SWAP), established under the federal Safe Drinking Water Act, requires every state to:

- Inventory land uses within the recharge areas of all public water supply sources;
- Assess the susceptibility of drinking water sources to contamination from these land uses; and
- Publicize the results to provide support for improved protection.

Historically, the Town of Andover has been an industry, leader making continual improvements to its water system. Andover continually strives to implement proactive measures to ensure that drinking water delivered to customers meets all federal and state drinking water standards. Today's complex environment requires a more integrated approach than the past, an approach that addresses all aspects of water quality, and related natural resource management. Therefore, a more recent objective of the water department is to monitor the environment from watershed to tap in an effort to *prevent* and detect potential problems, and correct them before they impact the consumer. This wider approach enables the town to sustain environmental improvements, meet the goals important to the community, and contribute to the Massachusetts statewide watershed protection efforts.

Surface Water Supply Protection

The Andover SWSPP includes recommendations for modifications to watershed monitoring, treatment plant operations, local regulations and non-regulatory measures regarding land uses, local road salting practices, emergency response planning and preparedness, educational programs, and inter-community cooperation on water supply issues. The plan provides many benefits to Andover and surrounding communities who purchase Andover water including: increased protection against waterborne diseases; possible drinking water treatment cost savings; possible avoidance of water treatment disinfection by-products formation; good public information and relations; and is considered an integral part of multiple barrier drinking water protection. It takes many levels of protection to ensure tap water is safe to drink. A variety of safeguards from the drinking water source to the consumer's tap form multiple barriers against contamination. These include assessing the vulnerability of drinking water sources to contamination, adopting community programs to protect supplies, making sure water is treated by qualified operators, ensuring the integrity of the distribution system, meeting regulations that control the level of contaminants in tap water, and making information available to the public on drinking water quality.

Susceptibility and Water Quality

Susceptibility is a measure of a water supply's potential to become contaminated due to land uses and activities within its recharge area.

A sources susceptibility to contamination does not imply poor water quality.

Water suppliers protect drinking water by chemically treating, filtering, disinfecting, and monitoring for more than 100 chemicals.

Actual water quality is best reflected by the results of regular water tests. To learn more about Andover water quality, refer to the annual Consumer Confidence Report.

Debate exists over the effectiveness of a SWSPP. This report assumes the approach of making source water assessments available to the public, coupled with outreach and technical assistance leads to higher public awareness, and in turn, a higher rate of local preventative actions to lower risks of contamination of public water supplies. Do source water contamination efforts make a difference for public health? Environmental trends cannot be measured right away, and thus trends in susceptibility of public water supplies relative to protection actions taken, and trends in potential contaminant threats must be measured over time. These trends together could give a sense of how source water protection lowers the risks to public health based on the assumption that by lowering the susceptibility of a water supply to contamination, and reducing the number of threatening contaminants, one is reducing the risk to public health. The assumption is that if you decrease the risk of contamination of the source, you decrease the risk of human health threats. Ultimately, a raised local awareness and subsequent preventative actions targeted at identified problems is key to the effectiveness of a SWSPP.

This report identifies the area of land that most directly contributes the raw water used in the drinking water process, the major potential sources of contamination to drinking water supplies, describes the susceptibility of those water supplies, and informs the public about the results of the analysis. The assessment protocol used in protecting drinking water consists of a series of steps of which are outlined in this report. The SWSPP is divided into five main sections and the overall methodology of the study included the following steps:

- Delineation of the watershed area and a thorough description and inventory of the community water resources.

- Inventory of facilities and activities within the delineated area that represent a potential source of contamination to the watershed through existing land uses, and an assessment of their potential threat to water quality.

- Analysis of local, state, and federal water resource protection measures, including the zoning of undeveloped land and determination of the extent to which new permitted land uses could affect the water supply in the future.

- Agenda for public education geared towards local watershed protection to help the community understand potential threats and identify priority needs to safeguard water supplies.

- Recommendation of additional water supply protection measures to insure long-term quality of drinking water sources.

Each section contains summaries addressing particular issues, and impacts relevant to the management of the town's surface water supplies. This document uses the "watershed approach" in addressing issues, which combines the functions of municipal services in ensuring the health of our water resources. It integrates the way we manage water "from cradle to grave," provides an ecological context for water programs, and protects our water resources in a team framework.

2.0 DELINEATION

In order to adequately protect the drinking water supply for the Town of Andover, it is necessary to know which land areas contribute groundwater or surface water recharge to the drinking water reservoir. A watershed, sometimes referred to as drainage basin, transports water from upland areas to receiving waters through runoff, recharge or interflow. The watersheds of Fish Brook and Haggetts Pond are defined here as the geographic area in which water drains from precipitation that falls within the watershed, runs over land, and flows into brooks or creeks that then carry flow to these surface waters. Surface water, as its name implies, is water that flows over the surface of the land.

What is a Watershed?

A watershed is the land area that catches and drains rainwater down-slope into a river, lake or reservoir. As water travels down from the watershed area it may carry contaminants from the watershed to the drinking water supply source. For protection purposes, watersheds are divided into protection Zones A, B, and C.

Zone A: is the most critical for protection efforts. It is the area 400 feet from the edge of the reservoir and 200 feet from the edge of the tributaries draining into it.

Zone B: is the area one-half mile from the edge of the reservoir but does not go beyond the outer edge of the watershed.

Zone C: is the remaining area in the watershed not designated as Zones A or B.

Watersheds come in different sizes and local watersheds are actually sub-watersheds or sub-basins of larger, regional ones. Watersheds are used as planning units through federal, state, and local governments, with the recognition that natural boundaries like watersheds do not generally conform to political boundaries. It is quite common for watersheds to extend beyond town or county lines, requiring a cooperative approach between communities. However, it is important to consider the watershed as a unit because pollution anywhere in that unit may impact downstream resources.

The water supply study area of this project was delineated using the most current available information on watershed recharge areas, including zoning overlay districts that have been adopted by the community for water resource protection. The water supply study area encompasses a total of 3,872 acres, and includes land only within the town boundary, a fact that simplifies protection efforts. None of the recharge areas for the Fish Brook/Haggetts Pond watershed are located outside of the community; however, supplemental water required to fill the town reservoir is withdrawn from the Merrimack River, whose watershed area extends far beyond the town boundary as well as the state boundary. This highlights the need for cooperation and coordination among communities upstream for management and protection of the town water supply.

2.1 Mapping

Delineation of the Fish Brook and Haggetts Pond watersheds define the boundaries of water contributing to the drinking water reservoir, and the boundaries of this study as depicted in the following maps. In most cases, a geographic information systems (GIS) approach is used in mapping, where a computer system capable of assembling, storing, manipulating, and displaying geographically referenced information plots the watershed data.

What is a GIS map?

Geographic information system (GIS) mapping is a computer-based method of mapping a geographic distribution of data. This is conceptually the same as sticking pins in a wall map, a simple but powerful method of displaying patterns.

1. Fish Brook/Haggetts Pond Watershed Protection Overlay District Map (WPOD.)
   Map prepared by the Town of Andover Engineering Department. Available to view at Water Treatment Plant.

   This map represents the most current data from the Town of Andover and MassDEP's GIS database and delineates the Zones A, B, and C as defined in 310 CMR 22.02(1).

   The WPOD was established for the following purposes:

   - To define all the lands that create the catchment or drainage areas of Fish Brook and Haggetts Pond as part of their natural or man-made drainage system.

   - To preserve and protect surface and groundwater resources in the Fish Brook/Haggetts Pond Watershed for the health, safety, and welfare of its people.

   - To protect the community from detrimental use, and development of land, and waters within the Watershed Protection Overlay District.

2. Resource Waters - **(**Figure 2-4 of this document).
   Map created by Comprehensive Environmental, Inc.

   Contains the locations of the Town of Andover's surface supply sources as defined in 310 CMR 22.00.

3. Land Use - (See Appendix C).
   Map dated January 31, 2012 prepared by Andover Planning Dept.

   This map represents the most current Town of Andover data to date captured, analyzed, and displayed in GIS format. The Land Use Map includes organized categories of residential, agriculture, commercial, industrial, open space and miscellaneous properties in the town.

4. Andover Water Department Source Water Assessment Program Map
   Map dated October 11, 2011 prepared by MassDEP. Available to view at Water Treatment Plant.

   This map represents current Town of Andover data on MassDEP regulated facilities located within the town. The facilities are divided into categories of air quality, fuel dispenser, groundwater discharge, NPDES discharge, hazardous material release site, toxic user, underground storage tank site. Land use is detailed on the map, and the Haggetts Pond and Fishbrook watershed boundaries are delineated on this map.

5. Haggetts Pond Bathymetric Map - **(**Figure 2-7 of this document).

   Map dated October 2007 prepared by CR Environmental, Inc. under contract with Andover Water Department.

   Using a 200-kHz echo sounder and DGPS positioning, this map represents the morphometry of Haggetts Pond, and is used to determine physical parameters of Haggetts Pond surface water withdrawal such as draw down capacity, hydraulic residence time, and firm yield. It is a three-dimensional representation of the subsurface data collected.

6. Haggetts Pond Depth Contour Map - **(**Figure 2-8 of this document).

   Map dated October 2002 prepared by Andover Water Department

   This map represents the depth and contour lines of Haggetts Pond, and is used to determine volumes of water at various depths in the Haggetts Pond water column. The map is a two-dimensional representation of three-dimensional data.

7. Septic System Management Project Map
   Map dated January 11, 2005 prepared by the Town of Andover Engineering Department. Available to view at Water Treatment Plant.

Using selective indicators, this map identifies environmentally sensitive areas, and characterizes subsurface sewage disposal systems according to their water supply sensitivity.

8. Zoning Districts Map - (See Appendix C).

Map dated January 30, 2012, prepared by Town of Andover Planning Department, for the Towns 2012 Master Plan.

This map provides zoning delineations that identify restrictions and regulations as authorized by G.L c. 40A for all buildings or structures, and the use of all premises in the town.

2.2 Water Use and Population

Protection of local water supply sources is vitally important to the community given that all of the drinking water comes from local sources. The ability of the community to retain the current level of self-sufficiency in water supply partially depends on how they collectively manage existing and future development within the watershed. The municipal water supply in Andover serves approximately 99 percent of the resident population in town solely on surface water supplies, and services a considerable commercial and industrial base located within both communities. Additionally, Andover provides drinking water to the neighboring town of North Reading through two active interconnections. The town of Andover does not have adequate emergency sources of water, and in all probability could not rely on neighboring communities to supplement demands.

Table 2-1 provides statistics relevant to the Andover water system, and pertinent to this study. In 2011, the combined average water withdrawal for the community was 6.5 million gallons per day (mgd) obtained solely from surface water. The water system is registered and permitted by DEP Water Management Program to withdraw a volume of 8.51 mgd on an annual average daily basis. Therefore, in 2011 the system realized 77 percent of its permitted withdrawal.
Peak demand for water supply was reached in 2010; a year with extended heat waves. Over the last five years, average day demand (ADD) for Andover has fluctuated between 5.6 mgd and 6.4 mgd, while the maximum day fluctuated between 10 mgd and 13 mgd. ADD is the total amount of water consumed during the calendar year divided by the number of days in the year, and maximum day demand (MDD) is literally the maximum amount of water pumped on any day of the year. Maximum day demands are usually experienced in the hottest week of the year

occurring some time during the month of August, and are influenced by the length of the heat wave, and local conservation measures.

The amount of process water used at the treatment plant accounts for the difference between the average day surface water withdrawal and the average day water demand (treated). Process water includes water required for cooling of the water treatment plant ozone equipment, and water required to clean carbon filters (i.e., backwash).

Figure 2-1. Average Indoor Water Use

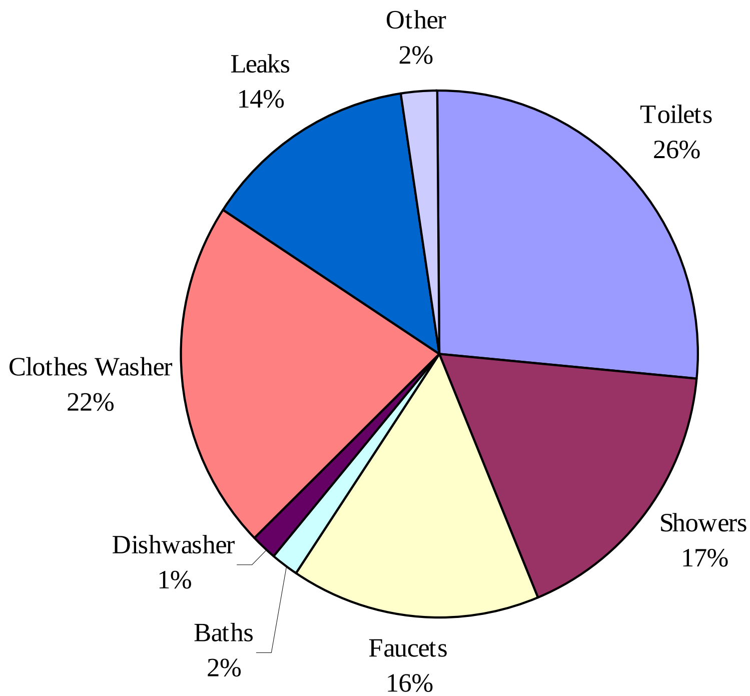
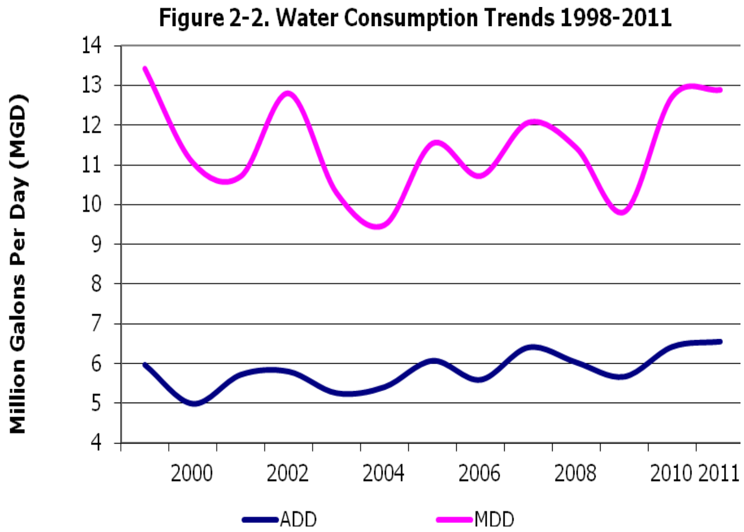


Table 2-1. 2011 Municipal Water Supply Statistics

Water Obtained From Surface Water	100 %
Water Obtained From Groundwater	0 %
Individual Source Statistics	
Haggetts Pond Withdrawal	2,641 MG/Yr
Merrimack River Withdrawal	1,369 MG/Yr
Fish Brook Withdrawal	*Represented by the Merrimack River data*
Andover Population	33,201
Average Day Surface Water Withdrawal	6.55 MGD
Treatment Plant Process Water	~324 MG/Yr
Average Day Water Demand (Treated)	5.61 MGD
Maximum Day Water Demand (Treated)	12.89 MGD

Plant process water accounts for the difference between the average day surface water withdrawal and the average day water demand (treated).



ADD is the total amount of water consumed during the calendar year divided by the number of days in the year, and maximum day demand (MDD) is literally the maximum amount of water pumped on any day of the year.

Water usage for the community is disaggregated into main categories annually for DEP statistical reporting. While the Andover system has increased its total water use over the years, percentage values for each category of use remain relatively the same, and represent a fairly consistent pattern as depicted in Table 2-2 below.

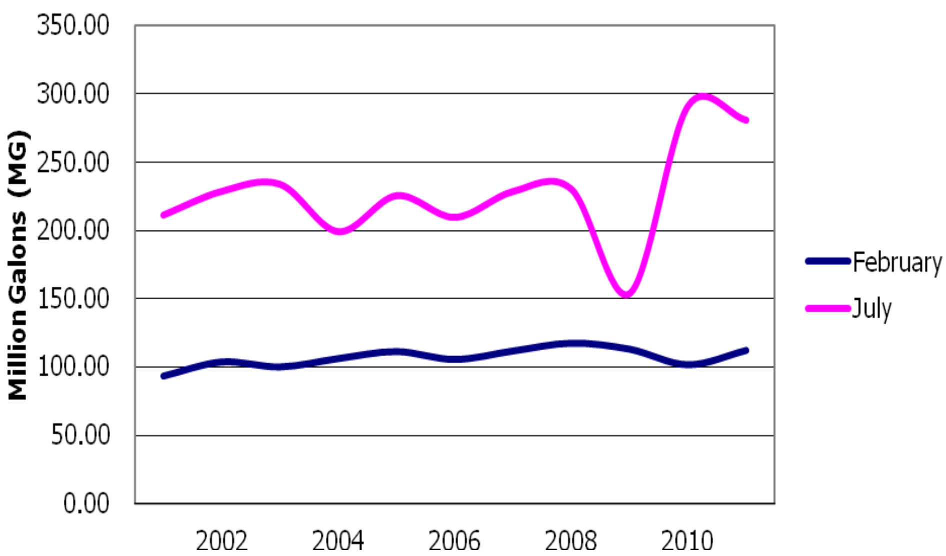
Table 2-2. Typical Water Use Pattern

Sector	Percent %
Residential	41
Industrial	15
Commercial	16
Other	28

While the system has increased its total water use over the years, percentage values have remained relatively the same, and represent a fairly consistent pattern of use. The "other" category includes water sold to the Town of North Reading.

Many households of the Andover community maintain higher-than-average indoor and outdoor water use. Higher use may be attributed to the affluence of the community, where affluent customers generally consume more goods and services than non-affluent customers. For example, affluent homes contain more luxury appliances such as hot tubs and whirlpool baths, multiple-head showers, fish tanks, fountains, and pools that demand water not only for operation, but also for maintenance and cleaning. The magnitude of seasonal fluctuations in water use is also historically high in Andover, and can be seen in Figure 2-3. Though it is not well documented, the gap that exists between variations in seasonal water use is highly attributed to outdoor water uses such as lawn watering. In the summer months, particularly during extended hot and dry weather, the water system experiences peak demands 1.5 to 3.0 times higher than average demand on a winter day. Generally, the water system has the capacity to meet peak demands, but when peak use is particularly high or lasts for a sustained period of time, a water use restriction bylaw triggers to limit customer use.

Figure 2-3. Variations in Seasonal Water Use 2000-2011



The magnitude of seasonal fluctuations in water use is historically high for the community. The gap between variations in seasonal water use is highly attributed to outdoor water uses such as lawn watering.

Future water supply needs are based upon population projections and anticipated future industrial and commercial growth within the system. Consideration is also made for the sale of water to neighboring community North Reading. Projected water consumption for North Reading is based upon historical use, and the existing intermunicipal agreement rather than population projections. Projected Andover water consumption by North Reading is based on 1.5 MGD.

Historic growth in Andover has slowed to less than 1% per year over the last decade, indicative of the fact that the Town is approaching the build out population. The 2012 Andover Master Plan states that, based on zoning requirements and land use, the full build out population for Andover is represented by a population level of 37,000. It is estimated that build out could be reached by the year 2030, which is later than projected by the 1992 Master Plan. It is important to note that as populations increase, potable water demands increase and more water is withdrawn from the watershed.

In 2002, the Town hired Camp, Dresser and McKee (CDM) to investigate and report on future water needs for the community. Following a review of historical data, past population and water consumption projections, CDM projected the following build out statistics for Andover to 2025:

Table 2-3. Andover Buildout Statistics

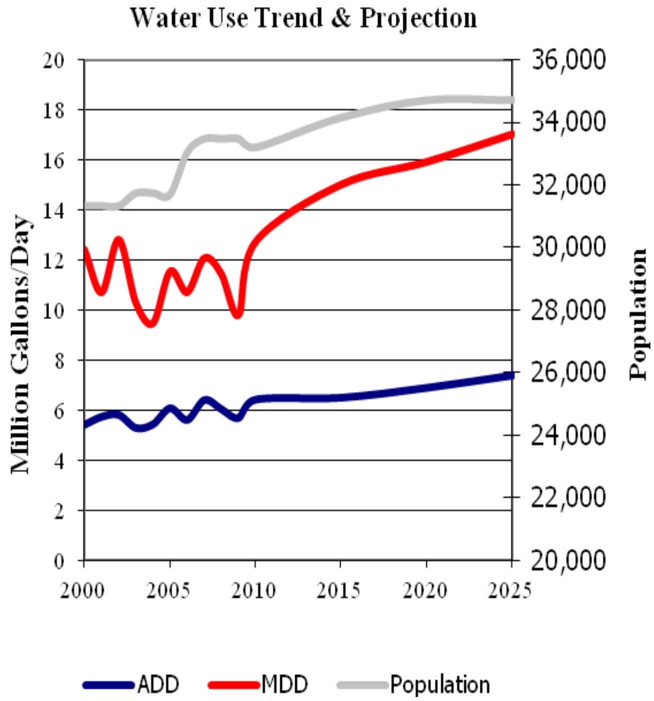
Population	34,700
Average Daily Water Consumption	
Residential	2.410 MGD
Industrial/Agricultural	1.300 MGD
Commercial	1.500 MGD
Municipal	0.590 MGD
North Reading	1.568 MGD
Total, System Wide	7.368 MGD

A final report adopted a ratio of 2.3 for peak (MDD) to average demands (ADD) based on historical records, which result in a maximum projected consumer demand of 17 MGD by the year 2025, and a maximum daily surface water withdrawal of 18 MGD. The difference is accounted for in the water treatment plant processing.

Table 2.4. Water Use Trend & Projection

Year	Andover Population	Average Daily Demand in MGD (ADD)	Maximum Day Demand in MGD (MDD)
2000	31,344	5.4	12.4
2001	31,344	5.7	10.7
2002	31,344	5.8	12.8
2003	31,750	5.3	10.3
2004	31,750	5.4	9.5
2005	31,709	6.1	11.5
2006	33,042	5.6	10.7
2007	33,475	6.4	12.1
2008	33,475	6.0	11.4
2009	33,475	5.7	9.8
2010	33,201	6.4	12.7
2015	34,150	6.5	15.0
2020	34,700	6.9	15.9
2025	34,700	7.4	17.0

Projected



2.3 Watershed Characteristics

The topography of Andover is such that water drains, or sheds into three significant river basins. Nearly the entire northwestern part of Andover has drainage movement towards the Merrimack River that flows into Lawrence just north of Andover. The central portion of Andover, containing most of the concentrated residential development, has land area that contributes drainage and flow to the Shawsheen River. The Shawsheen runs north through Andover and into Lawrence before emptying into the Merrimack. Drainage from the eastern portion of Andover flows generally eastward to the Ipswich River. Of particular importance is the drainage, flow, and stage height of the Merrimack River since it supplements the town's drinking water supply through a man-made diversion.

Urbanization alters the landscape, and causes major effects in drainage, manifested by a lowered groundwater table, and changes how stormwater runoff is introduced into receiving bodies of water. Man-made alterations in water management practices, akin to changes in inputs and outputs, dramatically change the characteristics of a watershed. For example, the Fish Brook/Merrimack River water diversion alters a water budget by taking water from one area and replenishing it into Haggetts Pond via a man-made pathway. Both land and water use can alter natural drainage systems, and alter wildlife habitat through both decreases and increases in the quantity of flows of water, and the pathways water takes to get to its ultimate destination in a watershed.

Land surface characteristics play an important role in the volume and rate of water moving through a watershed. Similarly, land uses are central to the amount of pollutants introduced in the water moving through a watershed. Increases in population produce a greater usage of supportive mechanisms such as roadways and septic systems. In addition, greater numbers of people generally mean more litter, more pesticide and fertilizer usage, and more land use changes. All of these increases lead to higher pollutant loadings in the watershed, and ultimately into water systems.

2.4 Water Resources

The ultimate goal of the Town’s watershed protection program is to improve water quality of receiving waters, particularly those contributing to the drinking water supply, by preventing and/or minimizing pollutant loadings from runoff. Figure 2-4 shows the resource waters with drainage basins in the town of Andover. The largest body of water is Haggetts Pond, located in the Fish Brook/Haggetts Pond watershed. A few much smaller ponds are located in the Shawsheen River watershed. A medium sized stream called Fish Brook flows northwest through the major wetlands area in town before it empties into a man-made lagoon prior to the Merrimack River, and upstream of the Shawsheen. The Merrimack River is the northwestern boundary of the town until it flows into Lawrence just north of Andover, and the Shawsheen River runs north through Andover and into Lawrence before emptying into the Merrimack River.

Andover Water Resources

Baker Meadows Pond	*Frye Pond Hussy*	*Rabbit Pond*
Bear Pond	*Gravel Pit Pond*	*Rogers Brook*
Rackett Pond	*Haggetts Pond*	*Pinnacle Brook*
Collins Pond	*Hussey Brook*	*Pomps Pond*
Field Pond	*Hussy Pond*	*Shawsheen River*
Fish Brook	*Lowell Jct. Pond*	*Skug River*
Fosters Pond	*Merrimack River*	

Public Water Supplies

The Town of Andover Water Department maintains and operates three public water supply sources. All the surface water supplies are located within the Merrimack River basin. Haggetts Pond Reservoir (01S) and Fishbrook Station (02S) water supply protection areas are located entirely within Andover. The intake for the Merrimack River (03S) is also located in Andover.

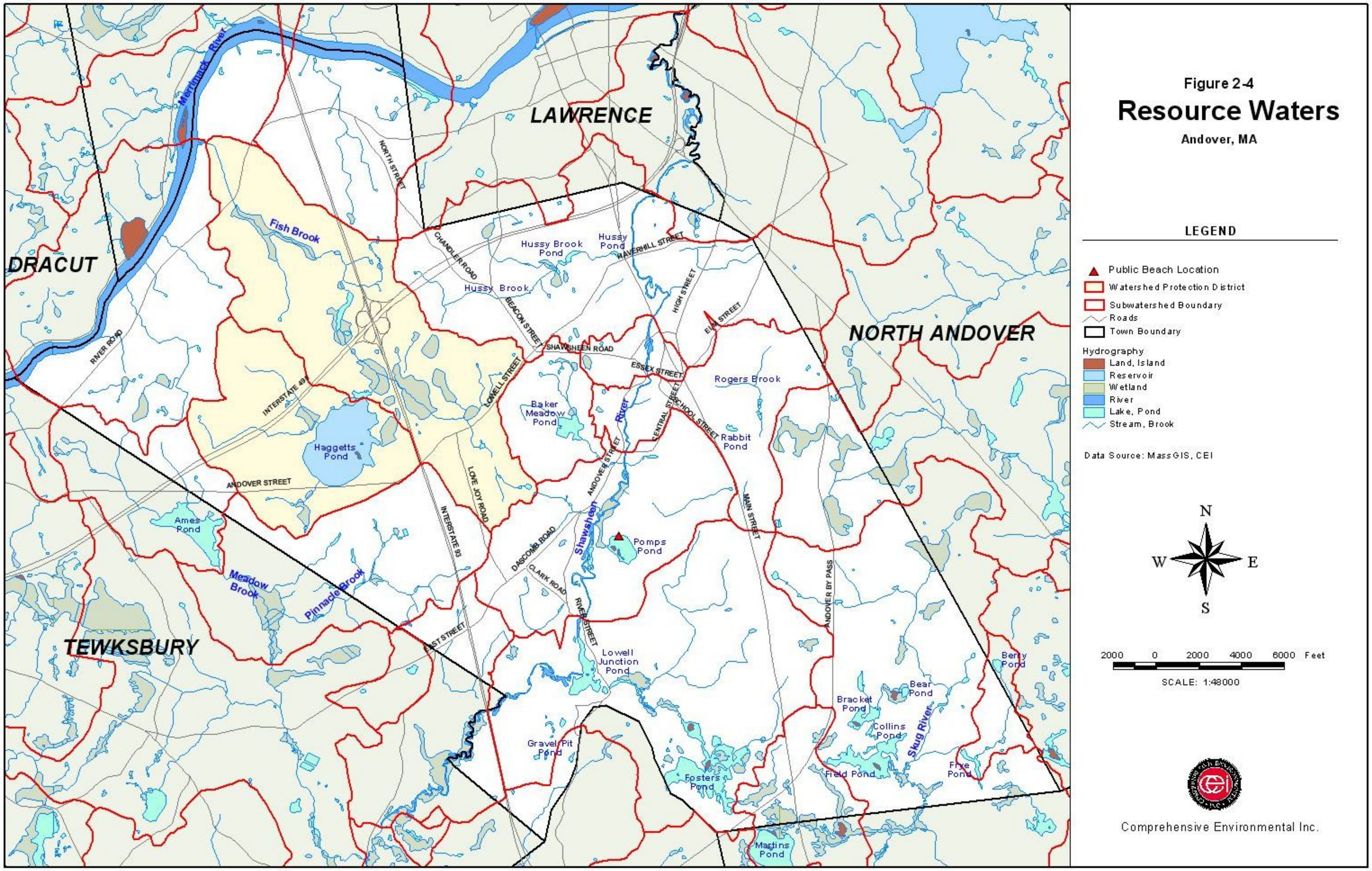


Figure 2-4
Resource Waters
Andover, MA
LEGEND
Public Beach Location
Watershed Protection District
Subwatershed Boundary
Roads
Town Boundary
Hydrography
Land, Island
Reservoir
Wetland
River
Lake, Pond
Stream, Brook
Data Source: MassGIS, CEI
N
E
S
W
2000 0 2000 4000 6000 Feet
SCALE: 1:48000
Comprehensive Environmental Inc.
LAWRENCE
NORTH ANDOVER
DRACUT
TEWKSBURY
Merrimack River
Fish Brook
Hussy Brook Pond
Hussy Pond
Hussy Brook
Baker Meadow Pond
Haggetts Pond
Ames Pond
Meadow Brook
Pinnacle Brook
Pomps Pond
Shawsheen River
Rogers Brook
Rabbit Pond
Lowell Junction Pond
Gravel Pit Pond
Fosters Pond
Field Pond
Bracket Pond
Collins Pond
Bear Pond
Skug River
Frye Pond
Berry Pond
Martins Pond
RIVER ROAD
NORTH STREET
CHANDLER ROAD
BEACON STREET
SHAWSHEEN ROAD
HAVERHILL STREET
HIGH STREET
ELM STREET
ESSEX STREET
CENTRAL STREET
SCHOOL STREET
LOWELL STREET
INTERSTATE 495
INTERSTATE 93
ANDOVER STREET
LOVE JOY ROAD
DASCOMB ROAD
CLARK ROAD
RIVER STREET
EAST STREET
MAIN STREET
ANDOVER BY PASS

DEP was responsible for monitoring the state waters, identifying those waters that are impaired, and developing a plan to bring them back into compliance with the Massachusetts Surface Water Quality Standards. The list of impaired waters, better known as the "303d list," identifies river, lake, and coastal waters and the reasons for impairment.

Once a waterbody has been identified as impaired, DEP is required by the Federal Clean Water Act to essentially develop a "pollution budget" designed to restore the health of the impaired waterbody. The process of developing this budget, generally referred to as a Total Maximum Daily Load (TMDL), includes identifying the causes (types of pollutant) and source(s) (where the pollutants come from) of the pollutant from direct discharges (point sources) and indirect discharges (non-point sources), determining the maximum amount of the pollutant that can be discharged to a specific water body to meet water quality standards, and developing a plan to meet that goal.

The integrated list format assesses waters defining it as one of the following five categories:

1. Unimpaired and not threatened for all designated uses;
2. Unimpaired for some uses and not assessed for others;
3. Insufficient information to make assessments for any uses;
4. Impaired or threatened for one or more uses but not needing a TMDL; and
5. Impaired or threatened for one or more uses and requiring a TMDL

Eleven water bodies in Andover were identified as Category 5 waters on the list of 303d waters, waters that are unable to meet the water quality standards for their intended uses. Waters listed in Category 5 are those found with the presence of one or more “pollutants” from a source that was not considered to be natural.

The stormwater management plan for the Town gives greater attention to these waters and provides an opportunity to improve water quality. Table 2-5 lists and describes the impaired waters currently found in Andover.

Table 2-5. Massachusetts 303(d) List of Impaired Waters for Andover

Category 1 "Unimpaired"

Massachusetts is currently listing no waters in this category due to the issuance by MA Department of Public Health of a statewide health advisory pertaining to the consumption of fish. This advisory precludes any waters from being in full support of the fish consumption use.

Category 2 "Attaining some uses; other uses not assessed"

Name	Segment ID	Description	Size	Uses Attained
Unnamed Tributary (8349030)	MA83-16	Also known as Fosters Brook – Outlet Fosters Pond, Andover through River Street Pond to confluence with Shawsheen River at Lowell Junction Pond, Andover	1.0 miles	-Primary Contact -Secondary Contact

Category 3 "No Uses Assessed"

Name	Segment ID	Description	Size	Assessment Date
Bakers Meadow Pond	MA83022	Andover	21.2 acres	April 97
Hussey Brook Pond	MA83008	Andover	0.54 acres	April 97

Category 4a "TMDL is Completed"

Name	Segment ID	Description	Size	Date Assessed	Pollutant Addressed by TMDL
Unnamed Tributary (8349105)	MA83-15	Also known as Pinnacle Brook, small wetland east of Rt. 93, Andover, to confluence with Meadow Brook, Tewksbury	2.1 miles	Sept 02	Pathogens

Category 4b "Waters Expected to Attain All Designated Uses in the Near Future"

No water bodies identified as Category 4b

Category 4c "Impaired Not Caused by a Pollutant"

Name	Segment ID	Description	Size	Date Assessed	Pollutant Addressed by TMDL
Field Pond	MA92019	Andover	56.7 acres	April 97	Exotic Species
Gravel Pit Pond	MA83007	Andover (Hussey Brook Pond East)	4.6 acres	unknown	Exotic Species

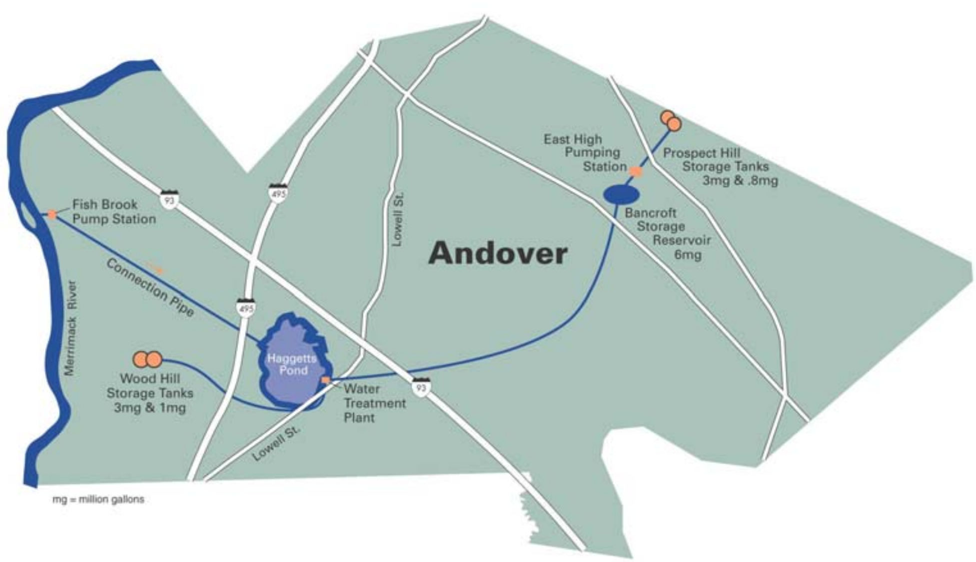
Category 5 "Waters Requiring a TMDL"

Name	Segment ID	Description	Size	Date Assessed	Pollutant Addressed by TMDL
Brackett Pond	MA92004	Andover	15.7 acres	April 97	Turbidity
Collins Pond	MA92010	Andover	2.1 acres	April 97	Noxious aquatic plants, Turbidity
Frye Pond	MA92023	Andover	7.3 acres	April 97	Noxious aquatic plants
Fosters Pond	MA83005	Andover, Wilmington	109 acres	Sept 02	Metals, Exotic species, Organic enrichment/ Low DO
Haggetts Pond	MA84022	Andover	221 acres		Metals
Hussey Pond	MA83009	Andover	1.4 acres	April 97	Noxious aquatic plants
Lowell Junction Pond	MA83011	Ballardvale Andover	35.3 acres	April 97	Metals, Noxious aquatic plants, exotic species
Merrimack River	MA84A-03	Andover	1.7 miles	2008	Metals, Nutrients, Pathogens
Pomps Pond	MA83014	Andover	24.6 acres	Sept 02	Metals, Exotic species
Rabbit Pond	MA83015	Andover	1.9 acres	April 97	Turbidity
Rogers Brook (8349050)	MA83-04	Outlet of first unnamed impoundment upstream of Morton Street, Andover to confluence of Shawsheen River	1.3 miles	April 97	Pathogens, Turbidity [EPA Approval Obtained]

Salem Pond	MA92057	North Andover/ Andover	14.7 acres		Turbidity
Shawsheen River (8349000)	MA83-18	Burlington Water department surface water intake, Billerica to the Ballardvale Impoundment dam, Andover, (Formerly part of segment MA83-02 and all of MA83-03, changed for 2004 cycle)	10.1 miles	Sept. 02	Metals, Organic enrichment/low DO, Pathogens EPA Approval
Shawsheen River (8349000)	MA83-19	Outlet of Ballardvale Impoundment, Andover to the confluence with the Merrimack River, Lawrence. (Formerly part of segment MA83-02 and all of MA83-03, changed for 2004 cycle)	8.4 miles	Sept. 02	Organic enrichment/low DO, Pathogens EPA Approval

With the exception of a few houses using private wells, residents, businesses, and industry are served by the town's municipal drinking water system drawn from a combination of three surface water sources. Locations of the three sources are depicted below in Figure 2-5 as the Merrimack River, Fish Brook, and Haggetts Pond. GIS base maps designate these three surface water sources as 3009000-01S, 3009000-02S, and 3009000-03S. Descriptions of each follow.

Figure 2-5. Andover's Water System



Haggetts Pond (PWSID 3009000-01S)

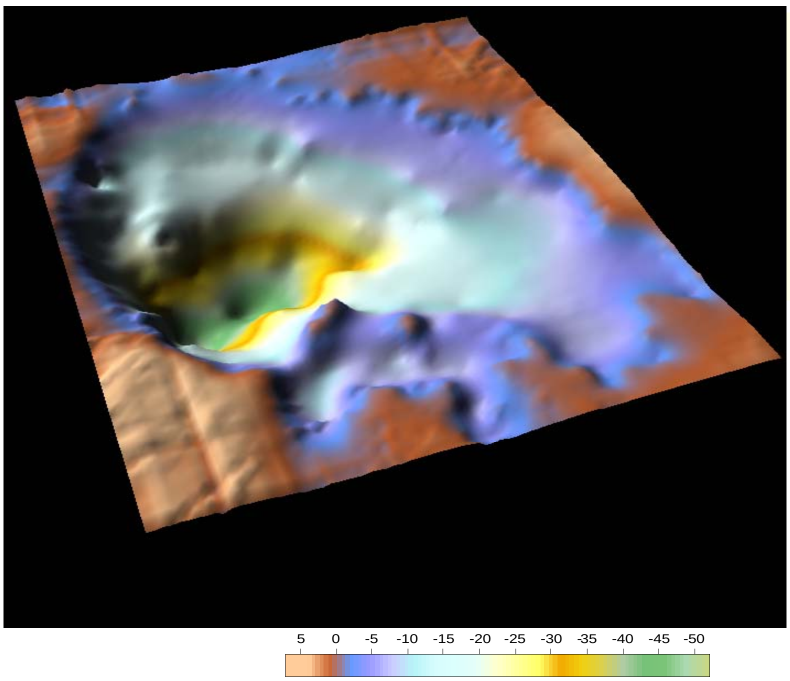
Figure 2-6. Haggetts Pond

Haggetts Pond is located in the town of Andover, Essex County, Massachusetts at latitude 42 degrees and 38 minutes north and longitude 71 degrees and 12 minutes west, or southeast of the intersection of Interstate Routes 93 and 495, and within the Merrimack River watershed. This 220-acre glaciated natural pond is the largest body of water in Andover. The surface area of Haggetts Pond, including an allowance of 30 percent of swamp areas as effective water surface area, is equal to approximately 20 percent of the total watershed area. The normal high water level is 117.65 ft above mean sea level. The drought period of 1957 afforded an opportunity to make observations relative to the yield of Haggetts Pond. Its safe yield, defined as the amount of water, which can be drawn during the severest drought on record, is 1.1 million gallons per day with a draw down capacity of six feet. The Pond has a shoreline length or (circumference) of approximately 15,000 ft, a maximum pond length of 4375 ft, and a maximum width of 3000 ft. The shoreline development value of Haggetts Pond equals 1.36 indicating minimal irregularity from a circular shape. The total watershed area of the reservoir covers 1422 acres, and the relative size of watershed area to surface water supply area is 5.5. This ratio of surface areas is a major factor influencing the pond's trophic state. Inflows to a surface water supply with a large drainage basin are more likely to collect dissolved nutrients posing a greater risk to contamination. Haggetts Pond is considered a low risk to watershed contamination based upon this size ratio.

The reservoir is defined as a Class A surface water source by the Massachusetts Surface Water Quality Standards, 314 CMR 4.00. Definitions for protection zones are incorporated into the Massachusetts Drinking Water Regulations for surface water supply protection areas, and these zones are delineated on the GIS maps.

Zone A includes (a) the land area between the surface water source and the upper boundary of the bank; (b) the land area within a 400-foot lateral distance from the upper boundary of the bank of the surface water supply; and (c) the land area within a 200-foot lateral distance from the upper boundary of the bank of a tributary. Zone B includes the land area within one-half mile of the upper boundary of the bank of the surface water supply or edge of watershed whichever is less. However, Zone B always includes the land area within a 400-foot lateral distance from the upper boundary of the bank of the surface water source. Zone C is the land area not designated as Zone A or B within the watershed of Haggetts Pond.

Figure 2.7. Bathymetric Map of Haggetts Pond

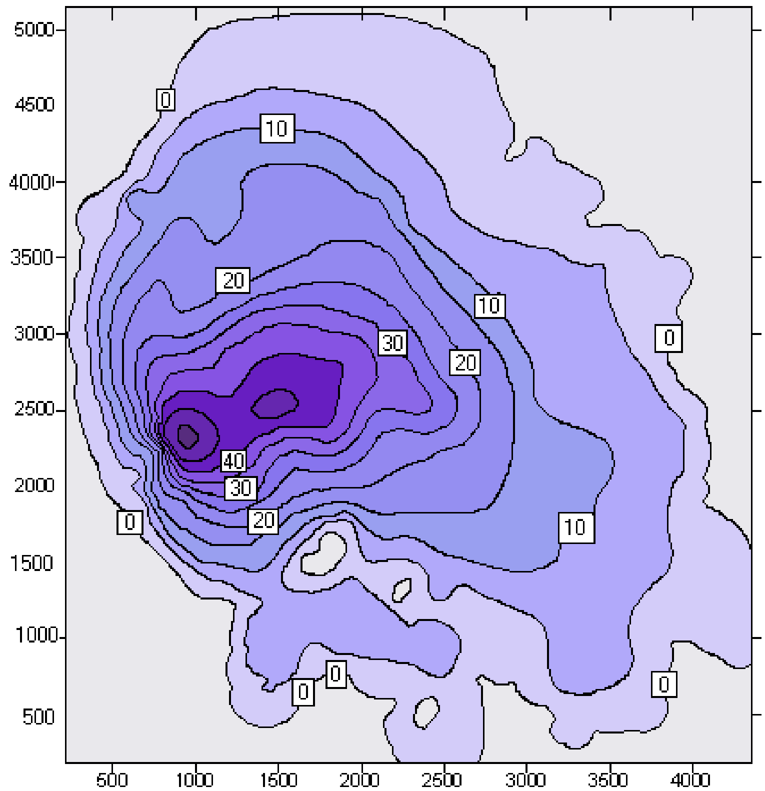


Using Surfer 8 software, this map represents the morphometry of Haggetts Pond. It identifies the physical parameters of Haggetts Pond that help determine draw down capacity, hydraulic residence time, and firm yield.

The reservoir's morphometry is a function of the underwater contour lines, the surface area, the shape of the reservoir, and its geologic origin. Haggetts Pond's morphometry is important because it characterizes its structure physically, chemically, and biologically as well as influences the quality within the water column. The pond basin, as opposed to the drainage basin, is the portion that holds water. The topography of the surrounding area provides clues to the basin's morphometry, but specific details such as depth and contour of the bottom are required to establish the structure of the reservoir.

The Town of Andover produced both bathymetric and depth contour maps of Haggetts Pond in the summer of 2002 that determined the reservoir's structure. The calculations and graphics of both maps depicted in Figure 2.7 and Figure 2.8 were performed using Surfer 8 Software. Volume determinations are based on over 1000 sampling sites identifying GPS locations with accompanying depth measurements.

Figure 2.8. Depth Contour Map of Haggetts Pond



The depth contour map is a two-dimensional representation of three-dimensional data. It represents the depth and contour lines of Haggetts Pond, and is used to determine volumes of water at various depths in the water column.

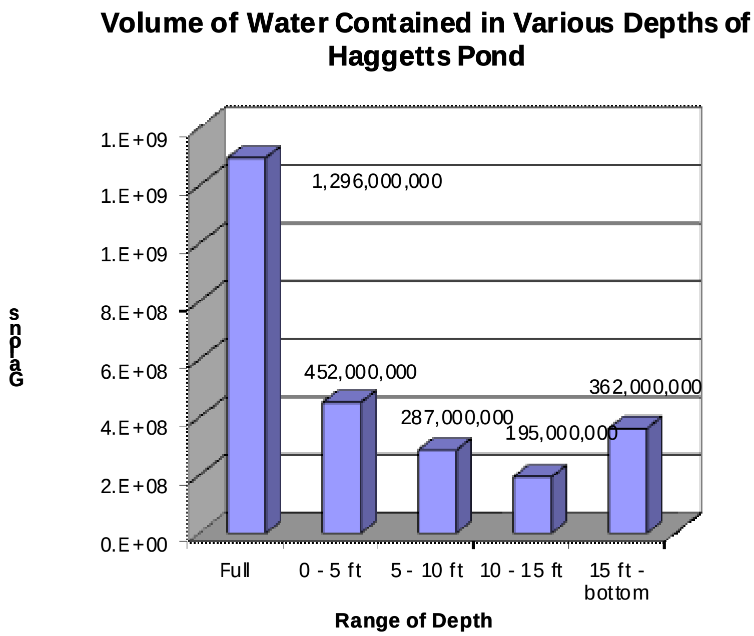


Table 2-6.
Volume of Haggetts Pond

Specific Depth	Volume (gallons)
0 ft (Full)	1,296,000,000
0 - 5 ft	452,000,000
5 - 10 ft	287,000,000
10 - 15 ft	195,000,000
15 - Bottom	362,000,000

Ponds are typically designated as lentic environments because they contain relatively still waters, in contrast to flowing, or lotic systems such as rivers or streams. Since large volumes of water are periodically input to Haggetts Pond from Fish Brook and the Merrimack River diversion, and similarly large volumes of water are continually withdrawn from the pond at the water treatment plant, Haggetts Pond is an atypical pond system. The rate of water exchange or hydraulic residence time, expressed as the ratio between volume and outflow, is approximately 6 months. In comparison, other ponds, lakes and reservoirs may have hydraulic residence times of up to one hundred or more years.

The physical structure of flowing waters may be more easily seen in streams and rivers where the dominant feature is the swift unidirectional water flow. The continual motion or flow is less easily seen in Haggetts Pond, but certainly affects the aquatic environment, and also provides a somewhat unique character among ecosystems. The motion has profound consequences on the chemistry and biology of the reservoir because water movements are key to the distribution of nutrients, dissolved gases, algae, zooplankton, and sediment.

Table 2-7 contains a representative analysis of water from Haggetts Pond before chemical treatment. The water is reasonably low in turbidity and color, and contains only a nominal amount of organic matter. It is moderately soft, and somewhat corrosive, which is corrected by the application of sodium hydroxide at the water treatment plant. The water from Haggetts Pond supply has, in general, been of good quality for drinking, and other domestic uses.

Table 2-7. Typical Water Quality of Haggetts Pond

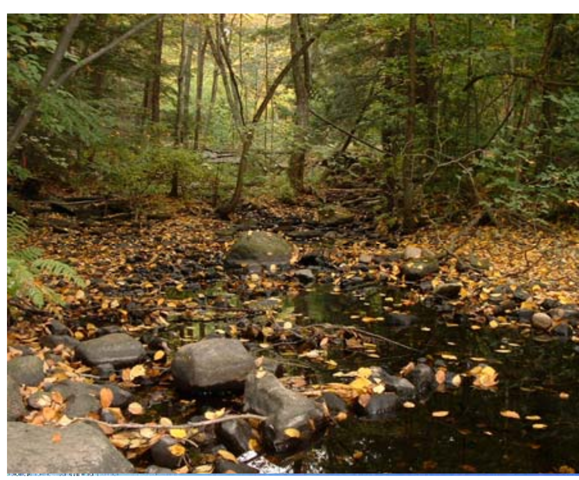
Turbidity	0.62 ntu
Color (Apparent) Color (True)	24 c.u. 16 c.u.
Odor	2
Nitrates	< 1mg/l
Chlorides	79 mg/l
Hardness	32 mg/l
Alkalinity	18 mg/l
pH	6.8
Sodium	60 mg/l
Iron	0.07 mg/l
Manganese	0.02 mg/l
Total Organic Carbon	5.1 mg/l
Conductivity	400 umhos/cm

During the drought year of 1957, the reservoir was drawn down excessively in spite of rigid restrictions on the use of water. Accordingly, a long-range plan for additional storage supply was developed and implemented, which included the diversion from Fish Brook and the Merrimack River to Haggetts Pond.

Fish Brook (PWSID 3009000-02S)

Fish Brook is a 5.25-mile long stream, which arises in wetlands near Haggetts Pond and from the ponds in Indian Ridge Country Club. Fish Brook flows from the country club headwaters through a heavily developed residential area, and through large wetlands where the stream then passes under Interstate 93 and Interstate 495. Fish Brook continues to flow roughly parallel to Route 93 before turning west and flowing into another large wetland area. It finally passes a small residential area and shortly thereafter empties into a holding pond built at the Merrimack River.

Figure 2.9. Fish Brook



During the late 1950s and early 1960s, a time of population growth in Andover, Haggetts Pond lacked sufficient capacity to meet the growing water demands of the population during peak times of the year. To solve the problem, the town built a dam at the mouth of the Fish Brook to create a holding pond in order to separate the Fish Brook water from the Merrimack River water. A pipe was installed connecting the holding pond to Haggetts Pond, approximately one mile upstream, and a pumping and chlorination station was constructed to chlorinate water and transport the water from Fish Brook to Haggetts Pond. This was done at certain times of the year to raise the water level of the pond, and thus increase the town water supply. During the 1970s, again increasing population further depleted the water supply during peak times, and so it became necessary to supplement Haggetts Pond further by pumping water from the Merrimack River to the reservoir. Today, the mouth of Fish Brook has been dammed to retain its flow. A pump station located at the dam delivers water through a 24-inch water line upstream to Haggetts Pond. The Fish Brook Pumping Station remains treated as a reservoir without storage capacity. Thus water is available for capture, but not storage, and inflow to Fish Brook is represented by flow data from the Merrimack River. The Fish Brook Watershed area covers 2,450 acres.

Merrimack River (PWSID3009000-03S)

The Merrimack River is a major river that borders the Town of Andover on the northeast, and is drainage for a 5000 square mile watershed. Water is drawn from the Merrimack River at the Fish Brook Station and pumped into Haggetts Pond. This water makes up the remainder of Andover's 6 mgd average daily demand. Much has been done to remove pollutants in the Merrimack River, especially through industrial wastewater treatment. In the Andover reach of the river, water quality has improved to a Class B surface water source identified as "fishable or swimmable", though there are still periods

Figure 2.10. Merrimack River at Fish Brook Station

when bacteria counts are too high to draw the water into Haggetts Pond. These periods may arise from inadequately treated wastewater and/or combined storm and sewer overflows.

The large size of the Merrimack River watershed and the urbanized land uses associated with the river makes source protection a challenge for this Class B source. Class B water body sources do not have Zone A, B, and C protection areas, as do Class A water body sources. This report does not analyze the strategies to maintain or improve the quality of the Merrimack River water, as the implementation of such policies is largely in the hands of upstream communities, and beyond the scope of this project. This plan addresses the reach of the Merrimack upstream of the water supply intake that directly impacts the quantity and quality of Andover's drinking water supply. The plan's focus is the protection of the combined Fish Brook/Haggetts Pond watershed that lies entirely within the town borders, a fact that simplifies protection strategies. Regarding the Merrimack River, suffice it to say that the Water Department:

Class B River Intakes

Class B water sources do not have Zone A, B, and C protection areas as the Class A sources do. For the purpose of this report, an "Emergency Planning Zone" has been delineated. The Emergency Planning Zone is the land area within 400 feet of both sides of the river intake including all tributary streams.

- Continue to monitor Merrimack River water quality at the intake point and cease pumping when the water quality is unacceptable.
- Treat Merrimack River water with sodium hypochlorite before introduction to Haggetts Pond to reduce the nutrient loading.
- Keep informed about plans for upstream uses that might affect Andover's supply.
- Network with surrounding communities to share information about changes in Merrimack River quality.

River drinking water sources are particularly susceptible to spills and accidental releases from public and private discharges; accidents related to motor vehicles, railroads, boats; fixed site releases at industrial and public facilities; inappropriate use of pesticides and fertilizers; improper disposal of hazardous waste; and illegal dumping of a variety of substances.

2.5 Land Uses

The Massachusetts approach to surface water assessment is to focus susceptibility determinations primarily on land use considering the state's fairly vulnerable hydrogeology, and the significant numbers and types of potential threats within a protection area. A land use focus helps to provide the best information for improving protection programs and is part of the Massachusetts DEP assessment strategy for Class A surface water sources. The GIS map with land use data overlays is included in this plan to delineate, help assess, and prioritize possible threats to the public drinking water source from land use contaminations. This map represents the best available statewide data pertinent to the SWSPP, and was used to identify the areas most vulnerable to contamination. It was generated by the Town of Andover to update the MassGIS data map with any changes known through local knowledge. The Fish Brook/Haggetts Pond Watershed Protection Overlay District map, prepared by the Town of Andover, was used in conjunction with the GIS maps to provide additional information.

Potential Contamination vs. Actual Contamination
It is important to note that a release may never occur from the potential source of contamination provided facilities are using best management practices (BMPs). If BMPs are in place, the actual risk may be lower than the threat ranking identified below. Many potential sources of contamination are regulated at the federal, state and/or local levels, to reduce further risk.

Under the Source Water Assessment Program, Massachusetts DEP was required by EPA in 2003 to create an inventory of potential land contamination sources, and to evaluate their likelihood to adversely impact source waters of public water suppliers. The following table presents various land uses, and activities considered to be potential sources of contamination to drinking water ranked relative to its threat to surface water quality (H=high, M=medium, L=low). It is important to note that the ranking assigned to each of the land uses represents the *relative* risk it could potentially pose to a drinking water source compared to other land uses. The threat assigned to a particular land use is based on, but not limited to, the type and quantity of chemicals used or wastes generated by the business, and the fate and transfer of the pollutants in the soil and water. The land uses considered potential contamination sources are those facilities that typically use, produce, or store contaminants of concern, which if managed improperly, could find their way to a source of drinking water. When looking for particular pollution threats for the Andover public water supply, all land use categories were reviewed. An inventory of such facilities and activities within the Town of Andover was performed as part of this plan, and presented in the following table.

Table 2-8. Inventory of Potential Land Contaminant Sources (2003)

Land Uses	Quantity	Source ID	Threat	Potential Contaminant Sources
Agricultural				
Fertilizer storage or use	Few	03S	M	Leaks, spills, improper handling, or over-application of fertilizers
Livestock operations	1	02S	H	Improper handling of manure (microbial contaminants)
Manure spreading or storage	1	02S	H	Improper handling of manure (microbial contaminants)
Pesticide Storage or Use	Few	03S	H	Leaks, spills, improper handling or over-application
Commercial				
Auto repair shops	5	03S	H	Spills, leaks or improper handling of automotive fluids, and solvents
Cemeteries	Few	02S, 03S	M	Leaks, spills, improper handling, or over-application of pesticides; historic embalming fluids
Dry cleaners	1	03S	H	Leaks, spills, improper handling, or over-application of fertilizers
Funeral homes	Several	03S	L	Leaks, spills, improper handling of hazardous chemicals
Gas/Service stations	12	02S, 03S	H	Spills, leaks, or improper handling or storage of automotive fluids and fuels
Golf courses	7	02S, 03S	M	Over-application or improper handling of pesticides and fertilizers

Printer/Blueprint shops	2	02S, 03S	M	Spills, leaks, or improper handling or storage of printing inks and chemicals
Railroad tracks and yards	4	03G, 03S	H	Over-application or improper handling of herbicides, leaks, or spills of transported chemicals and maintenance chemicals; fuel storage
Sand and gravel mining	Few	03S	M	Spills or leaks from heavy equipment, fuel storage, clandestine dumping
Industrial				
Chemical storage/manufacturer	Numerous	03S	H	Spills, leaks, or improper handling or storage of chemicals or process waste
Electronics manufacturer	1	02S	H	Spills, leaks, or improper handling or storage of chemicals or process waste
Hazardous materials storage	Numerous	02S, 03S	H	Spills, leaks, or improper handling or storage of hazardous materials
Industrial parks	Few	03S	H	Leaks, spills of chemicals from improper
Nuclear power plants	1	03S	H	Spills, leaks, or improper handling of radioactive material
Plastic manufacturer	1	03S	H	Spills, leaks, or improper handling or storage of solvents, resins and process wastes
Residential				
Fuel oil storage	100+	All	M	Spills, leaks, or improper handling of fuel oil
Lawn care/Gardening	100+	All	M	Over-application or improper storage and disposal of pesticides and fertilizers
Septic system	100+	All	M	Microbial contaminants, and improper disposal of hazardous chemicals

Miscellaneous				
Above ground storage tanks	2	01S, 02S	M	Spills, leaks, or improper handling of materials stored in tanks
Aquatic wildlife	100+	All	L	Microbial contaminants
Combined sewer overflow	Several	03S	L	Microbial and non-microbial contaminants including industrial wastewater; improper disposal of hazardous wastes
Composting facilities	1	02S	L	Storage and improper handling of organic material, animal waste and runoff
Fishing/boating	100+	03S	L	Fuel and other chemical spills, microbial contaminants
Landfills and dumps	4	02S, 03S	H	Seepage of leachate
NPDES locations	2	03S	L	Improper disposal of hazardous material and wastes
Oil or Hazardous Material Sites	10	--	02S, 03S	Tier classified oil or Hazardous Materials Sites are not ranked due to their site-specific character.
Road and Maintenance Depots	2	01S, 03S	M	Spills, leaks, or improper handling or storage of deicing materials, automotive fluids, fuel storage, and other chemicals
Schools, Colleges, and Universities	Several	03S	M	Spills, leaks, or improper handling or storage of fuel oil, laboratory, art, photographic, machine shop, and other chemicals
Small Quantity Hazardous Waste Generators	29	02S, 03S	M	Spills, leaks, or improper handling or storage of hazardous materials and waste

Stormwater Drains	100+	All	L	Debris, pet waste, and chemicals in stormwater from roads, parking lots, and lawns
Superfund Sites	1	03S	H	Spills, leaks, or improper handling or storage of oil or hazardous materials and waste
Transmission Line Rights-of-Way	5	03S	L	Construction and corridor maintenance, over-application or improper handling of herbicides
Transportation Corridors	5	All	L	Accidental leaks or spills of fuels and other hazardous materials, over-application or improper handling of pesticides
Underground Storage Tanks	26	02S, 03S	H	Spills, leaks, or improper handling of stored materials
Utility Substation Transformers	1	03S	L	Spill, leaks, or improper handling of chemicals and other materials including PCBs
Very Small Quantity Hazardous Waste Generator	100+	L	02S, 03S	Spills, leaks, or improper handling or storage of hazardous materials and use
Waste Transfer/Recycling Station	3	M	03S	Improper management, seepage, and runoff of water contacting waste materials

The public should be aware that susceptibility does not mean contamination, and that assessment is just a tool to assist in the implement of best management practices (BMPs). Susceptibility of the Andover water system to these contaminants is lessened by water treatment plant processing, watershed protection measures, and zoning laws.

The land use categories for Andover are identified in the land use map included in this document. General land use categories in the Town provide a quick look at land characteristics that influence water quantity and quality. The drainage sub-watershed boundaries are also shown on the map to illustrate the types of land uses found within particular drainage areas. The majority of Andover's land is comprised of residential use, followed by land that is categorized as open space. Most of the Town's commercial and industrial land use occurs along Interstate 93 and Route 28. Commercial and industrial areas pose a threat to water quality due to pollutant loading issues (i.e., high runoff, potential contaminants) that are inherent with such land uses.

2.6 Protected Open Space

Protected open space is permanent protection land areas that will not be sold or developed. Open space is most easily defined as land that for the most part, is free of buildings and other impervious areas. Permanently protected parcels may include lands owned by the water supplier, Conservation Commission, nonprofit land trust, some state agencies, or private property upon which activities are restricted for resource protection through easements, conservation restrictions and other mechanisms. Whether in public or private ownership, it provides for clean water, wildlife habitat and biodiversity, flood storage, scenic vistas, recreation, and education. Twenty-five percent (25%) of the Town is considered permanently protected conservation and passive recreation land.   Protected land parcels in Andover are shown on the Land Use/Protected Open Space Map.

Protection strategies for open space generally include acquisition, conservation easements, land use regulations, and education and management. The 2009 Open Space and Recreation Plan for the Town of Andover contains goals and recommendations that "focus on protecting the land along the Merrimack and Shawsheen Rivers for active and passive recreation opportunities, permanent protection of land for open space when parcels become available, protecting greenway corridors for wildlife and trails among neighborhoods and lands about to be developed, providing recreational opportunities for all residents and improving accessibility for all."

General goals of the Plan that are pertinent to source water protection included the following:

- Protecting the town's water supply and the integrity of other water bodies by emphasizing policies which protect the Haggetts Pond/Fish Brook watershed;
- Consider regional plans and opportunities,
- Refine the land management plan for the Town's more than 2,000 acres under control of the Conservation Commission;

- Educate the public about the Town's open space and recreational opportunities,
- Protect natural and fragile resources through zoning regulations,
- Protect river corridors.

Much of the remaining natural area in Andover includes fragile areas, which are often more costly to the developer, to the environment, and ultimately to the taxpayer to alter, rather than leaving in its natural state. The importance of preserving and managing open space is clearly recognized on the town level, and the public has generally supported these efforts.

2.7 Local Zoning

The zoning bylaws and ordinances for the community were examined in an effort to access the potential impacts of zoning and future development, and their compatibility with water supply protection. Zoning determines the type and intensity of development, which may occur in the future within defined districts of the community. As such, it is one of the most important tools at the community's disposal to insure the long-term protection of its water supplies. By defining critical water resource areas, and restricting future land uses within those areas, the community can insure that incompatible or hazardous land uses do not threaten water quality in the future. Sound management of the land uses in the watershed not only protects public health, it also helps prevent a contamination incident that could cost millions of dollars in treatment and clean-up costs, and severely restrict availability of adequate water supplies.

Andover has a zoning overlay bylaw, established in 1986, with subsequent revisions in 2006 and 2009, specifically to protect the water supply with an established overlay district that regulates land use and land activity. The Watershed Protection Overlay District (WPOD) was established to define all the lands that create the catchment or drainage areas of Fish Brook, and Haggetts Pond, and to preserve and protect surface and groundwater resources within that area. It protects the community from detrimental use, and the development of land, and waters within the WPOD. Local zoning for Andover is shown on the Zoning Districts map, which also contains the towns' sub-watershed boundaries including the Watershed Protection Overlay District.

It is not easy to determine the exact impact of build-out on water quality, though urbanization invariably leads to some degree of degradation. The town's zoning requirements are presented in Table 2-10. Land area calculations covered by each zone in Andover are indicated in Table 2-11. Zoning densities are greatest along Route 28. The majority of the property in town is comprised of undeveloped land, followed by residential uses. The residential districts (SRA, SRB, & SRC) comprise the vast majority of the water study area. High-density residential lots, sizes less than a half acre are nonexistent in Zone A of Haggetts Pond watershed, and less than 5 and 10 percent exist in Zone B and C respectively. These relatively small areas are generally viewed as not posing a threat to water quality. Contrary to that, the headwaters of Fish Brook run through a large area of high density residential lots that extend on through Zones A, B, and C of the Fish Brook watershed. Most of the commercial and industrial properties that generally pose a greater threat to water quality than residential areas due to issues of high runoffs associated with impervious surfaces, and potential contaminants are located along Interstate 93 and Route 28. Of significance is the fact that less than 4 % of the watershed is zoned commercial and industrial. Additionally, 75% of the Haggetts Pond watershed and 30% of the Fish Brook watershed is protected by the public water supply.

The Fish Brook/Haggetts Pond watershed is developed along most of its perimeter, and heavily developed along the southeastern corner where the headwaters of Fish Brook are located. The interior section is occupied mostly by forested land and wetlands. The interchange of Interstate 93 and Interstate 495 was built over a large wetland area about half a mile from Haggetts Pond, where highway runoff drains directly into an adjacent wetland area. Much of the land near Haggetts Pond is comprised of the same wetland. Route 133, another heavily traveled roadway, was built along the southern edge of Haggetts Pond closely situated to the drinking water reservoir.

Table 2-9. Andover Zoning Requirements

Residential Zoning	Minimum Lot (sf)	Frontage (ft)	Right Of Way (ft)	Dwelling Units per Min. Lot
Single Residence A	15,000	115	40	1.00
Single Residence B	30,000	150	40	1.00
Single Residence C	43,560	180	40	1.00
Apartment	15,000	115	40	4.29

Table 2-10. Land Area Calculations by Zone Code

Zone Code	District	Acreage	Percent
SRA	Single Residence A	1476	7.1
SRB	Single Residence B	5792	28.2
SRC	Single Residence C	10,692	52.0
APT	Apartment Residential	75	0.4
LS	Limited Service Business	49	0.2
OP	Office Park Business	12	0.1
GB	General Business	64	0.3
MU	Mixed Use Business	77	0.4
IG	General Industrial	107	0.5
IA	Industrial A	965	4.7
ID	Industrial D	1257	6.1
TOTAL		20,567	

3.0 INVENTORY

Performing an inventory is essential to watershed protection. An inventory involves summarizing and prioritizing private and public land uses and activities, which are or may be an impact on the surface water supply. Examples of land use activities which may have an impact on surface water quality include: on-site septic systems, public and private recreational activities, municipal facilities; uncontained storage of fertilizers, manure, road salt or sand; underground storage tanks, refuse areas, and commercial and industrial permitted facilities.

3.1 Land Use Impacts

Land uses within a water supply area can impact both water quality and water quantity through physical alteration of the environment, which changes drainage patterns and rates of runoff and recharge, and through discharge of contaminants to surface and groundwater. Developed land uses in the area of study area have increased significantly over the last thirty years, and generally associated with developed land uses are a number of potential contamination sources.

Major sources of water quality degradation may include highways, high-density residential developments, septic systems, landfills, agricultural runoff, industrial effluents and wastes, combined sewer overflows, hazardous waste sites, and storm water runoff. Snow removal operations can also contribute contaminants through increases in the levels of oils and salts in water when large snow piles melt. Pollutants associated with motor vehicles generally include petroleum products and oils. Leakage from underground storage tanks (UST) can cause serious long-term ground water pollution. Residential and commercial landscape practices contribute excessive nutrients, pesticides, and herbicides all of which degrade water quality. The degree and kind of water quality impacts land uses have on an area is, however, unique to each area.

3.2 Land Use Categories

GIS mapping allows for a graphic representation of the town-wide inventory, and data pertaining to potential sources of water quality degradation. The Land Use Map represents the most current Town of Andover data to date captured, analyzed, and displayed in GIS format.

Permitted Facilities

There are many MA DEP permitted facilities located within the Town. The facilities are divided into categories of air quality, fuel dispenser, groundwater discharge, landfill, and generator of hazardous waste, toxic user, and recycler, generator of waste oil or PCBs, and industrial wastewater. Some facilities are registered under multiple permits. MA DEP maintains an extensive database listing of all the facilities and their current permitted status.

Underground Storage Tanks

Leaking underground storage tanks threaten to contaminate surface and ground water supplies as well as surface and subsurface soil. In addition to grave environmental consequences, tank seepage into buildings and underground utilities may result in costly cleanups. Some signs of a leaking tank are obvious and include: unusual amounts of water in the tank, unusual odors, petroleum products in basements, malfunctioning heating systems, dead or dying vegetation near the tank and an unusual increase in fuel usage. An inventory of fuel storage tanks located within the Town of Andover was performed as part of this plan. None of the identified tanks are known to leak.

Twelve underground storage tanks are located in the Fish Brook and Haggetts Pond watersheds. Two underground tanks are located in Zone A on the water treatment plant property, and the remainders are in the outskirts of the watershed in Zone C. Removal of underground storage tanks in the watershed is done whenever possible.

Septic Systems

The entire watershed in Andover is serviced by town water, but sewers do not service the same amount of area. The heavily developed section in the southeastern area where the headwaters of Fish Brook are located is one area served by sewer lines. A vast majority

Who regulates septic systems?

Local Boards of Health are the primary regulatory authorities. However, DEP is involved in certain approvals, including: many alternative technology approvals, shared systems, large systems and many variance requests. In addition, DEP is responsible for overseeing local implementation of Title 5, and provides those bodies with training and technical assistance.

of the watershed is dependent on septic systems for sewage disposal.

A typical septic system consists of an underground septic tank, distribution box, and soil absorption system. Septic systems that are not properly sited or maintained are major contributors of pollution of rivers, coastal waters, groundwater, and surface water. Pollutants include harmful pathogens and nutrients that can degrade both recreational and drinking water supplies.

Not enough is known about the cumulative effect of multiple septic systems on a surface water body's watershed. Research into the total watershed nutrient loading from septic systems, and the carrying capacity of a watershed for multiple septic systems would be useful. This is an area of interest that has been identified as an EPA research need for improving source water assessment and protection activities. Susceptibility determinations of this type would require extensive fieldwork, and research that focuses on solving a specific community-level problem.

Septic systems can release bacteria, viruses, nitrogen and phosphorus compounds, endocrine disruptors, algal toxins, heavy metals, and other substances that represent a threat to water quality. In addition to typical pollutants, emerging contaminants such as pharmaceuticals, algal toxins, and endocrine disruptors potentially enter the surface water supply through subsurface sewage disposal.

The town, with objectives to identify, prioritize, monitor, and address the proper installation, operation, maintenance, and upgrade of septic systems, initiated a Local Septic Management Plan (LSMP). The Andover Board of Health in conjunction with the Merrimack Valley Planning Commission mapped out environmentally sensitive areas, and ranked property sites based on the potential environmental impact of their septic systems. Properties were categorized based on hydrogeological and geological conditions. Properties with water supply sensitivity, as defined by the proximity to water supply, watershed, or wetland within the watershed are ranked on the Septic System Management map included with this document. The map identifies a total of 829 septic systems within the Fish Brook and Haggetts Pond watersheds. Ten septic systems are within 200 feet of the drinking water supply, and 10 are within 400 feet of the supply. An additional 45 systems are within 200 feet of a tributary of the water supply, and 89 are within 100 feet of wetlands inside of the water supply protection district.

The LSMP helped identify & prioritize the needs of sewering, which remains an on-going project in town. It is anticipated that 100 properties within the watershed that are on septic systems will soon have the option of sewer.

Agricultural Activities

Agricultural land uses, cropland and pastures comprise about 2% of the combined Fish Brook and Haggetts Pond watersheds. Agricultural activities can be a potential source of microbial contamination from improper manure management. The pesticides and fertilizers associated with agricultural practices also have the potential to contaminate a drinking water source if improperly stored, applied, or disposed. Though agricultural activities have decreased in town with urbanization, several areas still exist. Two operating agricultural lands are located within the Fish Brook watershed, a pig farm and a greenhouse business. Both locations represent a potential threat to Fish Brook water quality. Typically, only one third of the nitrogen added to agricultural land finds its way into crop. The majority is lost to groundwater and surface water. Further investigation of these agricultural sites would benefit the protection of Fish Brook. Recommendations to minimize the impacts of agricultural activities may be found in Section 6 of this document.

Residential Land Uses

What are "BMPs?"

Best Management Practices (BMPs) are measures that are used to protect and improve surface water and groundwater quality. BMPs can be *structural*, such as oil & grease trap catch basins, *nonstructural*, such as hazardous waste collection days, or *managerial*, such as employee training on proper disposal procedures.

Approximately 30% of the combined watersheds consist of residential areas. If managed improperly, activities associated with residential areas can contribute to drinking water contamination. Common potential sources of residential contamination include: septic systems, household hazardous materials, heating oil storage, lawn care practices, and stormwater runoff. Educating residents on best management practices (BMPs) for protecting water supplies is built into the public education program of the water department. Information is included in the annual consumer confidence report (CCR) and posted on the Town's website; and brochures are available at the Town Offices and the public library. Additionally, the Town Engineer and the Water Department collectively sponsor the Greenscapes Program which provides educational material and news articles promoting water conservation and natural and organic alternatives for residential lawn care.

Transportation Corridors

Several major transportation corridors (routes 93 and 495) and other paved and unpaved local roads cross through the watersheds. Possible spills from vehicle accidents are a key concern. In addition, roadway construction, maintenance, and typical highway use can all be potential sources of contamination. Accidents can lead to spills of gasoline and other potentially harmful wastes. De-icing salt, automotive chemicals and other debris on roads are picked up by stormwater and wash into catch basins. Regular street sweeping throughout the Town is done to maintain roadways free of sediment and debris, and catch basins are inspected, maintained, and cleaned on a regular basis. Many issues associated with roadway pollution are addressed in the Town's Stormwater Management Plan. Others are addressed in section 6 of this document.

Chemical and Hazardous Materials Manufacture, Storage and Use

Hazardous waste generation or handling has the potential to be associated with all types of developed land uses. Commercial and industrial uses tend to pose a greater threat by sheer quantity, but increasing controls by state and federal programs support the safer handling of these materials. Residential uses typically generate smaller quantities, but are under less governmental control. Lack of control yields particular concerns regarding improper disposal of residential hazardous waste, and the potential threat to the drinking water supply. To encourage proper disposal, the Department of Public Works offers separate annual collections of household hazardous waste materials, and

CRT and Electronics. This program is considered successful in that it has continually gained increasing participation over the years.

Andover has a significant industrial base, and has several large and small businesses that use hazardous materials, produce hazardous waste products, and/or store large quantities of hazardous materials in storage tanks. The vast majority of commercial and industrial property is located outside the watersheds. Within the watershed, many facilities use best management practices (BMPs), but hazardous materials and waste can be unexpectedly released through spills, leaks or improper handling or storage, and become potential sources of contamination. Facilities that generate hazardous waste are expected to register with MA DEP. Recommendations regarding the management of non-residential chemical and hazardous materials for water supply protection are presented in Section 6 of this document.

Impervious Surfaces, Parking Lots and Roadways

Parking lots and roadways represent a source of pollution to every watershed. These impervious surfaces can transport hydrocarbons into a water basin especially during periods of high runoff. Total organic carbon levels are regularly monitored at the reservoir as a screening indicator for hydrocarbons, and no abnormalities have been detected to date.

At some point, the town, in its land use planning process may consider the direct matter of impervious surfaces. Since impervious cover has such a strong influence on watershed quality, the degree and location of future development, and impervious cover will most likely be critically analyzed in the future. Individual projects can be designed to reduce the amount of impervious cover they create, and increase the natural areas they conserve. Many innovative site-planning techniques have been shown to sharply reduce the impact of new development by reducing impervious surfaces, and their corresponding stormwater pollutant loading while simultaneously reducing the actual cost of site development.

3.3 Public Access/Recreational Impacts

Human impacts from recreation may represent a potential source of waterborne contamination, and disease. Following this, those activities involving potential exposure of human or human wastes are high priority for control in the reservoir area. Public health and safety is also an issue that dictates public activities and recreations that are controlled here.

Town regulations and policies exist that limit public recreation in Haggetts Pond. “No Swimming or Wading” are allowed at any time. Only Town residents with boat plates are allowed on Haggetts Pond for the express purpose of “Fishing only.” Only rowboats are permitted, and no pleasure boats are allowed. No motors of any type may be used.
A policy of “No Ice Fishing”, “No Skating”, or any other related ice activity in regards to the pond exists.

Several established hiking trails follow the perimeter of Haggetts Pond, Fish Brook, and other winding streams. In general, all areas are open to the public from dawn to dusk. The areas and trails generally allow hiking, running, and cross-country skiing. The trails pass beaver-dammed swamps and other wetlands, and by protecting these scenic woodlands. The Andover Village Improvement Society (AVIS) and the Andover Conservation Commission have helped to maintain the quality of Andover's drinking water.

Dogs may be man’s best friend, but they are not always friendly to the environment. Dog waste can be a major source of both pollution and annoyance along popular walking trails. Dog walkers must abide by the current town bylaws regarding leashing and cleanup. It is the dog owner’s responsibility to remove and dispose of any feces left by the dog at all times, whether it is on private or public land. If the dog owner is on public land, or private land not owned by the dog owner, the owner is responsible for having the means of waste removal in his/her possession when with the dog. The Board of Health determines proper disposal, and the enforcing persons are any Andover police officer, or any animal control officer of the town.

3.4 Wildlife Impacts

Minimizing the risk of waterborne disease from pathogens is a top water quality goal for the Andover Water Department. Generally, potential sources of waterborne disease include animal populations (wildlife, farm animals, and domestic animals). The water treatment plant staff actively participates in controlling these sources by minimizing the potential for deposition of wastes in the reservoir area. The staff effectively developed a Geese Deterrent Program and in the past has utilized coyote decoys that scare unwanted birds from the drinking water reservoir. In addition, installed fencing behind the treatment plant and close to the intake structure has successfully reduced the accessibility of the reservoir to other animals. The Chief Chemist at the treatment facility routinely tests for the prevalence of e.coli in the raw water and reports the results to MassDEP on a monthly basis. Wildlife impacts to the drinking water supply presently represent a low threat. Nevertheless, the department continues to reassesses the risk posed by wildlife sources, and methods to control them, and continues to control the occurrence of gulls, geese and other waterfowl through a combination of controls that has decreased fecal coliform levels in the reservoir.

Detailed habitat and species inventories have not been developed in the Andover community. The Massachusetts Division of Fish & Wildlife published a list of the state's amphibians (Cardoza and Mirick 2000), and reptiles and mammals (Cardoza et al. 1999). There is no current publication that documents native plant and animal species found in the Merrimack River watershed. According to the Massachusetts Executive Office of Energy and Environmental Affairs, Haggetts Pond and Fish Brook watersheds (being part of the Merrimack River watershed eco-region) have few rare species (0.1 to 0.5 per square mile). Table 3.2 list species of concern (SC) for the area, ranked by the state. A special concern rank differs from a rank of threatened or endangered.

Table 3-1. Species of Concern

Scientific Name	Common Name	Taxonomic Class	State Rank
Clemmys Guttata	Spotted Turtle	Reptile	SC
Terrapene Carolina	Eastern Box Turtle	Reptile	SC
Crangonyx Aberrans	Mystic Valley Amphipod	Crustacean	SC

3.5 In-Lake Problems

Ponds constantly undergo very slow evolutionary change, reflecting the changes that occur in their watersheds. Human activities, however, can change ponds-for better or worse-in a short time. It is for that reason important to establish a baseline quality of a reservoir. This baseline provides a means of assessing changes in water quality over time and determining the effectiveness of management practices.

Sodium Levels

The MassDEP recommended contaminant level for sodium is 20 ppm; a limit intended primarily to avoid aggravation of hypertension in people who are prone to that condition. The Town's drinking water exceeds the recommended levels of sodium due to its presence in the source water at higher concentrations.

Possibly one of the most documented effects of a single land use on water quality is the use of highway deicing salts. The sodium levels are higher in the winter months due to road surface treatments. Increases in development, expansion of roads, and the use, and storage of more road salt in the watershed contribute to continuing increases. The drainage containing these salts is harmful not only to surface and ground water supplies, but also to soils, plants, fish, and wildlife. Excessive salt concentrations can kill plants, which can no longer be used by wildlife for food and habitat. Salt can also affect the animals themselves.

Andover has a Road Deicing Policy controlling the removal of snow and/or ice by dispensing sand, salt, and other abrasive materials and liquid chemicals on the roadway infrastructure.

Operators of the snow and ice removal equipment are cognizant of designated watershed areas, and are instructed to use the minimum amount of materials required for safe travel within the perimeters of such areas. Equipment is also setup with liquid calcium chloride tanks that dispense calcium chloride instead of sodium chloride.

The Town, concerned with excessive salt use on Interstates 495 and 93, worked with the Massachusetts Department of Transportation (MDOT) to establish low salt application zones. In 2006, a Low Salt Application Zone along Interstates 495 and 93, located within the Fish Brook Watershed was established. The community is also concerned over stockpiles of salt stored by MDOT in the southeast quadrant of the 495 and 93 cloverleaf that is located within the watershed. Additional tests from drainage pipes adjacent to the cloverleaf indicate sodium levels in the thousands of ppm draining to Fish Brook. Data pointedly indicates that the increasing sodium levels are related to the use, and storage of road salt. Recommendations pertaining to rising sodium levels in the watershed are addressed in Section 6.

Backwash Water

Backwash water is defined here as water that is pumped from the clearwell at the water treatment plant into the bottom of a filtration unit in order to fluidize the filtration media, and allow the trapped materials to be washed out of the media into troughs for removal. The troughs collect the wash water from the filters, and a drain channel pipeline conducts the spent backwash water to be discharged. Discharge is to Haggetts Pond through a 30-inch pipe exiting the shoreline behind the old pumping station traveling 130 feet offshore.

A one-year cycle involves approximately 150 million gallons of backwash water being discharged into Haggetts Pond. The quantity and quality of discharge is an issue of concern. Alternatives to this practice include recycling through the treatment process or running it to waste in the sanitary sewer system; both of which have drawbacks associated with them.

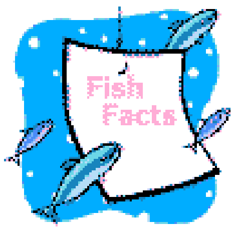
The Clean Water Act requires point sources discharging pollutants into surface waters to obtain a permit with the National Pollutant Discharge Eliminating System (NPDES). The water treatment plant is authorized under NPDES to discharge 1.5 MGD back to Haggetts Pond. The general permit requires weekly monitoring for flow, pH, TSS, and total residual chlorine, and monthly monitoring for aluminum to ensure the quantity, and quality of discharge.

Inorganic tests on the sediment of Haggetts Pond are performed at the treatment plant laboratory to evaluate the effects of backwashing practices. Sediment data collected between 1999 and 2004 indicated elevated levels of digested metals particularly on the western side of the pond. It is important to note, the metals remain in the sediment, and no significant transfer occurs in the water/sediment interface due to the low dissolved oxygen in the lower water depths. Specific attention had been given to the analysis of aluminum since aluminum sulfate is added as a coagulant in the treatment process thereby posing a potential source of increase to the pond through backwashing. No increase of aluminum has been detected in the water intake thus far.

It is estimated that each backwash discharges 10 to 30 of pounds of TSS to the pond amounting to tons per year. More data is required to determine the total affects of backwash water discharge to Haggetts Pond. The treatment plant submitted a Notice of Intent (NOI) for coverage under the National Pollutant Discharge Elimination System (NPDES) Final Potable Water Treatment Facility General Permit (PWTFGP) in December 2009. EPA’s initial review of the NOI noted that the levels of aluminum in the backwash discharges make the treatment plant ineligible for the general permit. EPA will therefore require an individual permit. Additional evaluations are being done by the treatment plant and their consultant to minimize aluminum in the backwash water.

Mercury in Fish and Sediment

Mercury is viewed by many public health experts, scientists and regulators both in Massachusetts, and across the nation as a significant environmental issue. Freshwater fish represent a potential exposure route to mercury for humans and ecological communities. The environmental chemistry of mercury, which leads to its presence in freshwater bodies and sediments, results in the potential for significant bioaccumulation of this metal in fish, and subsequent exposures to humans, and other fish-eating predators.



Mercury is a metal that is persistent once released into the environment. Much of the “new” mercury entering our lakes, streams, and watersheds today is being deposited from the air. The U.S. Environmental Protection Agency (EPA) suggests that between 1,800 and 3,700 pounds of mercury are deposited from the air to the land and water every year in Massachusetts. DEP also estimates that solid waste combustors (incinerators) are the largest source contributor of mercury to the watershed, of which there are presently 3 within a 15 mile radius of the combined watersheds making cause for concern.

Preliminary results from a Fish Toxics Monitoring Program conducted at DEP demonstrate that mercury concentrations tend to be species specific. Mercury levels high enough to be a health concern (>0.5ppm) are usually found in large fish. Bass, which are predators, are apt to be high in mercury. Currently there are no surface waters in the state of Massachusetts listed as “unimpaired” due to the issuance by Massachusetts Department of Public Health statewide advisory pertaining to the consumption of fish.

Public health advisory signs are posted around Haggetts Pond warning of fish contaminated with mercury. The Freshwater Fish Consumption Advisory List put together by DEP lists Haggetts Pond as P1 and P3 status which warns children under 12 years, pregnant women, and nursing mothers not to eat any fish from the pond, and the general public to limit consumption of largemouth bass to two meals per month. All available data to date indicating the type of fish species, and their specific concentrations of mercury, was produced by DEP. The Town of Andover has not conducted any investigations on its own.

Algae Blooms

Algae blooms have periodically plagued the drinking water reservoir over the years during the summer, and early autumn months. The blooms are generally composed of only a few dominant cyanobacteria – also known as blue-green algae, blue-green bacteria, and cyanophytes. Examples include Anabaena, Anacystis, and Microcystis. Cyanobacteria are of interest to the water treatment plant because they produce objectionable taste and odor compounds and cyanotoxins.

Cyanotoxins are now recognized as hazards to human health, and only a few water suppliers at present perform routine monitoring for the presence of cyanotoxins in drinking water. To reduce or eliminate the taste and odors caused by algal blooms, and to remove or inactivate cyanobacteria best management practices (BMPs) are employed at the Andover water treatment plant, which include application of an algaecide to the surface water as soon as the presence of algae is detected, ozonation, powdered activated carbon, and granular activated carbon filtration.

Greater amounts of organic material and nutrients enter the pond through intakes and the surrounding watershed during the warmer season. Populations of all types of organisms increase, and contribute to bottom sediments, and nutrient levels through decomposition. The pond becomes warmer and lower in dissolved oxygen; perfect conditions for algae growth. The blooms cut off light to deeper pond water, thereby increasing rates of death and decomposition. Dissolved oxygen declines, allowing more nutrients such as phosphates to dissolve into the water from the bottom sediments and thus triggering further algae growth, further decomposition, further oxygen completion, and further nutrient dissolution.

Long-term theoretical succession causes the pond to fill in with sediment. The length of time for succession depends upon the size and depth of the water source and the nature and management of the watershed. If the watershed contributes large amounts of nutrients and organic debris, succession occurs faster, especially in a small or shallow pond.

Human activities are known to have an impact upon pond and lake succession. Erosion and sedimentation increase turbidity cutting off light from deeper water levels and introducing more nutrients from the bottom sediments. Landfills, animal feedlots, fertilizer runoff, and septic systems also contribute negatively to cultural eutrophication of a pond, a process that can trigger massive algae blooms. Obviously cultural eutrophication is a process to be avoided in any water source serving as a public drinking water supply.

The long-term status of the pond with respect to the process of eutrophication is not clear from available data. An initial study was performed in 1985, and recommendation will be made later in this document for follow-up.

Invasive Species

Wetlands and their aquatic plants are managed for environmental protection, for recreation and aesthetics, and for the production of renewable resources. Some applicable goals of wetland management pertinent to a surface water assessment plan are: maintenance of water quality, protection from floods, providing a buffer between urban residential and industrial segments to ameliorate pollution impacts, and producing habitats for fish and wildlife.

A number of reputable studies have evaluated wetlands as nutrient traps, and beneficial to drinking water reservoirs. The vegetation of wetlands trap nutrients in the form of biomass, and the soils that have large cation-exchange capacities displace harmless ions in order to retain troublesome nutrients. In effect, wetlands are important to Haggetts Pond and the watershed because they *naturally* filter water acting as a sink to nutrients that lead to poor water quality, and eutrophication.

The density of an invasive species known as purple loosestrife or *Lythrum salicaria* is increasing in the wetland areas surrounding Haggetts Pond watershed, and simultaneously it may be assumed that native species are on the typical decline.   Purple loosestrife presence not only changes the wildlife that inhabits the area, but also alters the ecosystem at a very basic level by increasing organic matter. The main threat is the loss of biodiversity, and the creation of a monolithic stand of purple loosestrife.

Purple loosestrife has no natural enemies in North America, and its expansion, therefore may continue to go unchecked. It impacts other plant life, wetland life, and the general health of lakes, ponds, and surface water bodies. Shallow water bodies, like Haggetts Pond, are particularly at risk, as they seem to promote the spreading of purple loosestrife seeds that float and can actually grow in shallow water. Mature plants can produce up to 2.7 million seeds every year. The seeds are able to move easily by water, vehicles, and wildlife and germination is able to occur under a wide range of temperatures, pH, nutrient levels, and soil types. Left unchecked, with time this invasive species has the potential to fill in the ponds by increasing organic matter and decreasing the volume of water.

The density of purple loosestrife is generally increasing around the surface water supply, but it has not been determined whether or not eradication of the species is necessary. Recommendations regarding invasive species may be found in section 6 of this document.

3.6 Sampling Plan

The water treatment plant laboratory is fully equipped and certified with a variety of instrumentation used to perform tests that help ensure a safe drinking water product. Routine physical, chemical, and bacteriological parameters are monitored throughout the treatment plant process to establish chemical treatment dosages, and to determine plant operation efficiency. Modern instrumentation is used by the laboratory staff to perform highly complex low-level organic and inorganic analyses, and on-line analyzers continuously monitor the water from the reservoir to the tanks in the distribution system. The water treatment plant adheres to a sampling plan that meets all requirements of the Safe Drinking Water Act. However, the plan does not include routine monitoring of the watershed.

The primary goal of a watershed sampling plan is to complement existing monitoring. The purpose is to ensure that water withdrawn from Haggetts Pond for treatment is as free as possible from contaminants, thereby minimizing the costs of treatment, and ensuring public health and safety. Specific objectives of a watershed sampling plan are to:

- Monitor routinely the condition of all source waters in the Andover drinking water supply system;
- Determine where, when, and how water-quality conditions are changing over time;
- Identify actual and potential problems related to source-water quality;
- Evaluate effectiveness of programs to prevent or remediate problems;
- Ensure that all applicable water-quality goals, standards, and guidelines are being met; and
- Provide for rapid response to emerging problems.

A watershed sampling plan would consist of four major elements: (1) routine monitoring of Haggetts Pond, Fish Brook and the Merrimack River during dry weather, (2) event-based monitoring of Fish Brook and the Merrimack River, storm drains, and other outfalls during wet weather; and (3) continuous recording of stage and selected water-quality characteristics of the Merrimack, Ipswich and Shawsheen Rivers. Data should include physical parameters, chemical parameters such as nutrients, and microbiological parameters. Later the plan could be expanded to supplement water quality monitoring with biomonitoring to better understand water quality of tributaries.

Watershed surveys are important to understand the significance of potential sources of contamination and to set priorities among, and within, the various watershed protection programs.

4.0 PROTECTION

The practice of watershed protection is about making choices about what tools or approach to apply and in what combination. Watershed protection tools roughly correspond to the stages of the development cycle from initial land use planning, site design, and construction through home ownership. Management generally needs to apply some form of all options to provide a comprehensive watershed protection program. The tools, however, are applied in different ways depending on what category of sub-watershed is being protected. All of the following tools are essential elements of a comprehensive watershed protection plan, and their goal is to provide the community with a realistic approach for maintaining a quality environment for future generations.

4.1 Land Use Planning

Land use planning ranks as perhaps the single most important watershed protection tool. Watershed planning is best conducted at the sub-watershed scale, where it is recognized that surface water quality is related to land use, and consequently to impervious cover. One of the goals of the Andover community has always been to shift development towards subwatersheds that can support a particular type of land use and/or density. The basic goal of land use is achieved when land use planning redirects development, preserves sensitive areas, and maintains or reduces impervious cover within a given resource area.

Several techniques have been used in Andover to manage land uses such as the zoning of the Watershed Protection Overlay District, large lot zoning, and land conservation. The overlay zoning land use management technique was adopted in 1987 in Andover, and consists of superimposed additional regulatory standards, specifying prohibited uses that are otherwise permitted, and applying specific development criteria onto existing zoning provisions. Here the provisions in the Watershed Protection Overlay District zone incorporate mandatory requirements that restrict development in a way to reach the desired end of water resources protection.

Larger lot zoning is a land use planning technique that the Town of Andover Planning Department uses to try to mitigate the impacts of development on surface water quality. This technique involves zoning land at lower densities to disperse impervious cover over large areas. The Watershed Protection Overlay District is currently zoned as Single Residence C, the largest of residence size districts, which has minimum lot sizes of 1 acre. From the standpoint of watershed protection, large lot zoning is most effective when lots are extremely large (5 to 20 acre lots). While larger lot zoning does tend to reduce the impervious cover, and therefore the amount of stormwater runoff at a particular location, it also spreads development to vast areas. The road networks required to connect these larger lots can actually increase the total amount of imperviousness created for each dwelling unit. In addition, larger lot zoning contributes to regional sprawl. Sprawl-like development increases the expense of providing other community services such as fire protection, water and sewer systems, and school transportation.

4.2 Land Conservation

Land conservation is another land use management technique that is used to preserve critical habitats, aquatic corridors, hydrologic reserve areas, and cultural and historical areas that are important to a community. Andover Village Improvement Society (AVIS), the second oldest land preservation society in the country, marked its 100th anniversary in 1994. AVIS is a non-profit conservation society dedicated to acquiring land, and preserving it in its natural state. They work to preserve open spaces, woodlands, and wetlands in Andover. Presently AVIS controls 30 reservations totaling about 1,100 acres, with over 30 miles of trails for hiking, skiing, or other passive recreational use.

4.3 Stormwater Management

Stormwater is not a contamination source itself, but is a conduit for pollutant transport to tributaries and reservoirs. The Town of Andover recognizes stormwater management as an opportunity to use physical barriers, and processes to provide pretreatment of watershed flows prior to entering the main body of the reservoir, and the Merrimack River/Fish Brook intake. EPA Phase II Stormwater Rule required the town to develop, implement, and enforce a program to reduce pollutants in stormwater runoff entering the municipal storm drain from illicit discharge connections, and construction activities that result in a land disturbance. It sets in motion changing development rules for the community. The regulation leads the town towards another watershed protection tool that seeks to control pollutant loading through stormwater management.

While the specific design objectives for a stormwater management plan are often unique, the general goals for stormwater are often the same: maintain groundwater recharge and quality, reduce stormwater pollutant loads, protect stream channels, prevent increased overbank flooding, and safely convey extreme floods. With the implementation Phase II requirements, and in order to meet the minimum requirements of the EPA NPDES Notice of Intent, Andover adopted a Stormwater Management and Erosion and Sediment Control Bylaw in April 2008. The purpose of the bylaws is to prevent or diminish the impacts of sedimentation and polluted stormwater from land disturbance, land development and redevelopment activities by controlling runoff and preventing soil erosion and sedimentation from site construction and development. The by-law regulates all land disturbance activities in excess of 43,560 square feet by requiring a stormwater management permit issued by the Planning Board. The bylaw is necessary to protect the Town's water bodies and groundwater resources, to safeguard the health, safety, and welfare of the general public and protect the natural resources of the Town.

Illicit Connections

Like most communities, the Town of Andover does not currently have a regulation or bylaw that specifically addresses illicit discharges to its municipal storm drain system. General nuisance law and Title V address pollutant discharges such as sanitary sewage, and discharges containing hazardous materials. Design standards for sanitary sewer systems, and leach field systems are contained within the Board of Health Sanitary Sewer Requirements. These are excellent tools for addressing the limited range of pollutants for which they were intended. However, they do not sufficiently address all non-stormwater discharges to the municipal storm drain system in accordance with the requirements of Phase II. In order to meet the minimum requirements, the

Town’s consultants, Comprehensive Environmental, Inc. (CEI) recommended that the Town adopt a more comprehensive by law or regulation specifically addressing illicit discharges to the municipal storm drain system. It was recommended that the actual prohibition language be adopted as a separate general bylaw so that the standards, and requirements contained or referenced in it will apply throughout the town, similar to other environmental bylaws such as the Wetlands Protection Bylaw. In the interim, the Town promotes public education regarding illicit discharges by including information in the annual Trash and Recycling Guide, and Stormwater Management postings on the Town’s website.

Construction Site Storm Water Runoff Control

The EPA notes that “sediment runoff rates from construction sites are typically 10 to 20 times greater than those of agricultural lands, and 1,000 to 2,000 times greater than those of forest lands. During a short period of time, construction sites can contribute more sediment to streams than can be deposited naturally during several decades. The resulting siltation, and the contribution of other pollutants from construction sites, can cause physical, chemical, and biological harm to our nation’s waters.” (EPA 833-F-00-008, Fact Sheet 2.6, January 2000). Erosion and sediment control plan review is included in Andover’s Subdivision Regulations, various sections of the Zoning By-Law, including special permit and site plan review (Sections 9.4.2.5 and 9.5.4, respectively) and throughout the Conservation Commission Rules and Regulations. The Subdivision Regulations are administered by the Planning Board, and apply only to subdivision review. The Wetland Protection Regulations are administered by the Conservation Commission and are primarily triggered by development activities within 100 feet of a protected resource, as defined in Section 2 of the Wetlands Protection By-Law. While these regulations are effective in ensuring that erosion and sediment controls are incorporated into the review process, they apply only to certain

Silt fences prevent the off site transport of sediment

development applications and do not apply specifically to all site disturbance activities in excess of one acre.

4.4 Staffing

The Town of Andover employs through the Department of Public Works, sufficient, and qualified staffing to perform all operations, maintenance and repairs, monitoring, and inspections of the water system. In addition staff is responsible for the planning, developing, coordination and administration of a variety of source protection, water quality, and water conservation programs for the town.

4.5 Regulatory Controls

Enforcement of State Regulations and State Laws apply throughout the water supply protection area, and act as significant control against potentially polluting activities on private lands. Selected state environmental regulations pertinent to watershed protection are listed in Table 4.1 below.

A host of other local, state, and federal laws and regulations currently exist to regulate the land uses identified as having potential water quality impacts. These laws and regulations are summarized and described below.

Table 4.1. Selected State Regulations Providing Watershed Protection

Act/Regulation	Relevance
Drinking Water Regulations 310 CMR 22.20 B & C	Protects surface water used as sources of drinking water supply from contamination
Title 5	Regulates the siting, design, and inspection of on-site systems; provides a means for attaining adequate function from existing systems (via inspection at property transfers)
MEPA Regulations	Requires comprehensive environmental assessments and public review of major projects
Wetlands Protection Act	Restricts the alteration and/or filling of wetlands; requires review of all projects within 100 feet of wetlands or within the floodplains
Rivers Protection Act	Establishes buffer zones around rivers and streams; within these buffers, development criteria apply
Phase II Stormwater Regulations	Address stormwater issues from development projects under the Notice of Intent process
Forest Cutting Practices Act Regulations	Requires filing of a cutting plan; mandates unaltered buffer strips; provides operational standards including stream crossings

Underground Storage Tanks (UST)

Federal

In 1988, EPA issued UST regulations divided into three sections: technical requirements, financial responsibility requirements, and state program approval objectives. Under technical requirements, UST owners and operators are responsible for reporting, and cleaning up any releases. The financial responsibility regulations are designed to ensure that, in the event of a leak or spill, an owner or operator will have the resources to pay for costs associated with cleaning up releases and compensating third parties. Finally, the EPA recognizes that state and local governments are in the best position to oversee USTs. Subtitle I of RCRA allows state UST programs approved by EPA to operate in lieu of the federal program.

State

The State of Massachusetts is approved to administer and enforce an underground storage tank program in lieu of the federal program. The State's program is now administered by the Massachusetts Department of Environmental Protection (MassDEP). Massachusetts UST regulations may be found in 527 CMR 9.00 which require tank registration, inventory control, non-corrosive tanks, periodic tank testing, and removal of abandoned tanks. Additionally, MassDEP is responsible for the inventory of underground storage tanks per 527 CMR 5.06.

Local

There are no local ordinances governing underground storage tanks.

Wastewater

Federal

The Clean Water Act, which sets standards for discharges through the National Pollutant Discharge Elimination System (NPDES) permit program, regulates industrial and sanitary wastewater discharges to surface waters. EPA and DEP implement the NPDES program jointly.

State

Disposal of sanitary wastewater is regulated by local boards of health under the State Environmental Code (Title 5). The regulations set requirements for the siting and construction of on-site septic systems.

Local

Andover is approximately 50 percent sewered. The town adopted Title 5 regulations, and provides a means for attaining adequate function from existing systems through system inspections at property transfers.

Leachate

Federal

States have jurisdiction over sanitary landfills; however state regulatory programs must meet minimum criteria issued by EPA under Subtitle D of the Resource Conservation and Recovery Act (RCRA). The criteria set minimum requirements for landfill operation, design, groundwater monitoring, and corrective action.

State

DEP's landfill design and operational standards (310 CMR 19.00, Part II) were strengthened in 1990 to afford much greater protection to groundwater. The regulations require an impervious liner, groundwater and surface water monitoring systems, leachate collections systems, stormwater controls, landfill capping, and thirty years of post-closure monitoring. The new regulations address post-closure care of landfills that closed prior to 1990. Since the Ledge Road landfill in Andover was closed prior to 1990, these regulations are important. The regulations require that owners of landfills that were in operation after April 21, 1971, but which ceased operation prior to July 1, 1990, submit to DEP: 1) proof that the facility was closed in accordance with DEP-approved plans; or 2) a final closure and post-closure plan that meets the DEP requirements.

Local

There are no local landfill regulations. The Watershed Protection Overlay District by law prohibits the location of landfills, and the disposals of solid wastes or refuse, other than brush.

Hazardous Waste

Federal

The Resource Conservation and Recovery Act (RCRA) regulates hazardous waste generation, treatment, storage, transportation, and disposal. The EPA has delegated to the Commonwealth of Massachusetts the authority to carry out the program. Title III of the Superfund Amendments and Reauthorization Act (SARA Title III) requires facilities that handle large quantities of hazardous materials to fulfill reporting requirements and/or engage in local emergency response planning. SARA Title III requires companies to submit chemical inventory forms if they handle more than 10,000 pounds of hazardous chemicals. For extremely hazardous chemicals, the reporting threshold is 500 pounds or the threshold quantity, whichever is lower. The federal law does not require companies to change their hazardous materials handling practices, except that it does require companies that handle extremely hazardous chemicals to participate in local emergency planning committees (LEPCs).

State

The Massachusetts Hazardous Waste Management Act (Chapter 21C), and the DEP hazardous waste regulations (310 CMR 30) establish a system of stringent control over hazardous wastes. Licensed transporters and disposal facilities must handle all hazardous wastes, except those generated through normal household activity. Waste generators are classified as large quantity generators if they generate 1,000 kilograms or more per month of non-acutely hazardous wastes. Small quantity generators are defined as those that generate between 100 and 999 kilograms per month of non-acutely hazardous wastes. Very small quantity generators generate less than 100 kilograms per month of non-acutely hazardous wastes. Regulations governing household hazardous waste collection days, permanent household hazardous waste collection centers, and waste oil collection centers are regulated by DEP (310CMR 30.390). Massachusetts has a Right-to-Know law, but it does not require the submission of information to community boards, and so it is not useful for water supply protection.

Local

The town does not have an underground storage tank or hazardous materials by law or regulation. The Watershed Protection Overlay District by law prohibits the disposal of hazardous materials.

Road Salt

Federal/State

There are no state or federal regulations governing the application of road salt, but uncovered storage of salt in water supply protection areas is forbidden by MGL c. 85, section 7A. The policy of the Massachusetts Department of Transportation is to treat all state roads under icy or snowy conditions with 100% salt at an application rate of 240 pounds per lane-mile. The Massachusetts Department of Transportation has adopted a reduced salt policy for several critical watersheds throughout the state, including the roadways that fall within the Haggetts Pond or Fish Brook watersheds.

Local

The town has a Snow and Ice Maintenance Standard Operating Procedure (SOP). The purpose of the SOP is to establish the Town's level of service in respect the removal of snow/ice and provide information on the placement of de-icing chemicals and abrasive materials on the Town's road infrastructure and municipal properties pursuant to the provisions of all applicable Sections of the Massachusetts General Laws. Each storm has individual characteristics that are dealt with accordingly. The Town is continuously reviewing technology available for salt application, often piloting the technology to determine if it's appropriate for the given setting. The Town does pre-wet the ground surface during certain storms within the watershed, and is exploring the use of a brine system.

Pesticides

Federal

EPA regulates the use of pesticides under the authority of two federal statutes: the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), and the Federal Food, Drug, and Cosmetic Act (FFDCA). The EPA tests pesticide products and approves their use, with label instructions for proper use. Beginning in October 2011, EPA required National Pollution Discharge Elimination System (NPDES) permits for the application of pesticides to, over, or near waters within their jurisdiction. This pertains to the application of algaecides to surface water reservoirs. EPA is the NPDES permitting authority for the Commonwealth of Massachusetts.

State

The Massachusetts Pesticide Control Act carefully follows the laws of the Commonwealth to the Federal Insecticide, Fungicide, and Rodenticide Act, Public Law 92-516, and it establishes a regulatory process in the Commonwealth. The exclusive authority in regulating the labeling, distribution, sale, storage, transportation, use and application, and disposal of pesticides in the commonwealth is thoroughly determined by the Pesticide Control Act. Application of pesticides to a Zone I of a public groundwater source is not allowed pursuant to 333 CMR 12.03, and 310 CMR 22.21(1)(b)(4) and (5). Application of pesticides to surface public water sources or their tributaries may only occur with the prior review and written approval of the DEP Drinking Water Program pursuant to 333 CMR 13.03(16) and (21), and 333 CMR 13.05(3)(c)(5).

Additionally, the Massachusetts Rights-of-Way Regulations (333 CMR 11.00) protect public water supplies by requiring protective no-spray and limited spray areas for herbicide applications along rights-of-way (which also may include local and state roads, railroads, utility lines, bike paths, canals, etc.). Public water suppliers, municipal officials, and the public have the opportunity to review and comment on Yearly Operational Plans (YOP) and Vegetation Management Plans (VMP) that are submitted by the utilities to the Massachusetts Department of Transportation (MassDOT), railroads, municipalities, and others who propose to conduct herbicide applications. YOPs and VMPs must be approved by the Massachusetts Department of Agricultural Resources.

Local

The Andover Board of Health had previously established a Pesticide Reduction Task Force (PRTF) to address impacts of pesticide use from residential and commercial landscaping practices. The committee was comprised of town staff, representatives from the League of Women Voters, and private citizens and the group developed a pesticide policy that in August of 2003 was adopted by the Board of Health as a Town Pesticide Use Policy. The long-range objective of the Andover Board of Health is to reduce the exposure of residents to pesticides and pesticide breakdown products.

4.6 Emergency Planning

The management of a town’s water supply system is a complex operation that requires careful planning of procedures not only for daily activities, but also for maintaining quantity, and quality of water during adverse conditions or emergencies. All public water supply functions in Andover are directed toward guaranteeing an uninterrupted supply of quality water to consumers. Good planning does not prevent an emergency from happening, but does enable the water department to respond quickly and effectively.

With the increasing use of both commonplace and exotic chemicals in all phases of everyday life, potential exists for the unexpected contamination of a water supply at any time. Other causes of unexpected disruption to water supplies include equipment failure, physical/natural events, biological contamination, and acts of vandalism/terrorism. If any of these events occur, the water department would be faced not only with correcting the problem from a technical standpoint, but also with informing the proper authorities, and consumers about the nature of the emergency, and the measures that have been taken to solve or minimize its impacts. Therefore, it is essential that the water department have an Emergency Response Plan (ERP) describing the appropriate measures to be taken in case unexpected events occur.

For the past few years the drinking water industry, in cooperation with the EPA, has been working on projects to enhance security and protection. Many of the projects were underway prior to the attacks of September 11th and, subsequently, are already completed. Through these efforts, Andover has taken many straightforward, commonsense actions to increase security, and reduce threats to the water system. The American Water Works Association, the Association of Metropolitan Water Agencies, and other leading professional organizations recommend many of the actions taken by Andover.

In June 2002, the Public Health, Security, and Bioterrorism Preparedness and Response Act ("Bioterrorism Act") enacted provisions to help safeguard the nation's public drinking water systems against terrorist and other intentional acts. Key provisions of the new security-related amendments are summarized below:

1. Requires community water systems serving populations greater than 3,000 to conduct vulnerability assessments and submit them to USEPA;
2. Requires specific elements to be included in a vulnerability assessment;
3. Requires each system that completes a vulnerability assessment to revise an emergency response plan and coordinate (to the extent possible) with local emergency planning committees;
4. Identifies specific completion dates for both vulnerability assessments and emergency response plans.

Under the new regulations, the water department was required to complete, and submit to the EPA a vulnerability assessment by June 30, 2004 and, within six months of that date, develop a new ERP incorporating the results of the vulnerability assessment.

The emergency response procedures were updated through the new regulations using the guidelines established in the Massachusetts DEP Drinking Water Program Handbook for Water Supply Emergencies. It defines protocol, and procedures for the Andover Water Department to follow, in conjunction with local and state personnel in order to respond appropriately to disruption in a continuous supply of safe drinking water to the consumer.

5.0 EDUCATION

Education & outreach programs are designed to develop awareness and stewardship of the public towards local water resources with the objective of bringing program elements together to form one cohesive educational package.

5.1 Educational Activities

Public education is used to build support for regulatory efforts, and is usually critical to the passage of local bylaws and ordinances, or to implement voluntary protection efforts such as water conservation or hazardous waste collection. A complete surface water supply protection program requires more than reliance upon regulatory controls. Non-regulatory techniques including public education enhance protection efforts by focusing on the local issues.

There are many examples where innovative public education programs on water issues have been developed for the Andover community. Previously, the Water Department launched a well-received educational program centered upon protection of local water resources where classroom presentations given by town staff were part of the elementary school curriculum. Classroom presentations provided the students an opportunity to locate water resources on a local ecology map where they learned how these resources are part of the larger hydrologic cycle. They were introduced to pollution topics pertinent to watershed protection including stormwater discharges, groundwater infiltration, and water conservation. Students experimented with a groundwater simulator model to understand how their actions, and specific land uses affect the community's water supply.

Educational field trips to the water treatment plant were common with residents, and students of all ages, and grade levels. Water treatment plant staff instructed on the importance of clean drinking water, and gave guided tours of the drinking water process, and laboratory facility.

With the implementation of the Stormwater Phase II Rule, municipalities were required to distribute educational materials or conduct outreach activities about the impacts of stormwater discharges on local water bodies to the community and businesses/institutions. Various activities within the community have different impacts on stormwater runoff. Areas or common practices where pollutants are most likely to be picked up and conveyed by stormwater runoff degrading nearby bodies of water were identified and educational materials were developed and distributed to the target audiences. Stormwater management information is included in the Recycling and Trash Collection Guide which is revised and distributed to residents on an annual basis. Scout Troops volunteered their time to distribute mark stormwater drains within the Haggetts Pond/Fish Brook Watershed, and distribute door hangers to residential neighborhoods within subwatersheds. The Engineering Department and Community Planning, which includes Conservation, work with businesses and institutions, developers and construction companies to improve stormwater issues at their sites.

The Town of Andover has maintained its membership commitment to the Greenscapes North Shore Coalition. Since its inception in 2007, Greenscapes has provided multiple brochures for distribution, free workshops to educate homeowners about lawn care and landscape practices that protect their water resources; access to their website for additional educational materials; and seasonal newsletters. The Department of Public Works routinely provides updated material related to water resource protection for the Town's website. The Town continues to include information regarding the importance of water resources protection in the annual Consumer Confidence Reports mailed to every household and business in town.

5.2 Coordinated Protection Efforts

The location of Andover is such that local land use has the potential to affect three different river basins: Merrimack, Shawsheen, and Ipswich. The Merrimack basin is of particular importance to Andover since it supplies the town's drinking water. Nevertheless, the Town is well aware of, and involved in coordinated protection efforts of all three basins. The Town's role is to provide these organizations with local updates, and to keep abreast of any new issues that may have an effect on Andover. The Department of Public Works has also taken an active role of being "in the loop" for communication of emergencies and is within the system of communication with state, and local emergency responders. Staff is on call 24-hours/day, 7 days/week for any incidents related to protecting the drinking water. With this philosophy, Andover is at the forefront of a new approach to watershed management: forming true partnerships and using technical assistance to accomplish effective water quality protection.

6.0 CONCLUSION AND RECOMMENDATIONS

To date successful planning and management in Andover has systematically approached techniques to protect water resources with measures that also compliment what is economically and politically acceptable for the community. Management has a critical role in the successful implementation, and ongoing development, and use of the environment. The focus here is on resource management although it should be understood that everyone is a manager of water resources to some extent, and therefore shares in the responsibility of management. Protecting surface water supplies must remain an ongoing task for both municipal officials, and the public. In this section, methods to safeguard Andover's surface water supplies for the future are presented with the intention to build upon the successful care the community has made to date.

6.1 Commitment to Water Quality Protection

Healthy watersheds lead to cleaner water. Maintaining that health requires careful identification and management of human and natural activities that affect water quality. Although federal and state governments provide technical and financial support for watershed protection and restoration efforts, local stakeholders profit when they lead such efforts. By identifying the land uses within the Town's water supply protection area, and the potential sources of contamination, this assessment helps focus protection efforts on appropriate management practices, and drinking water source protection measures that can be accomplished locally.

The water department has a professional staff with an advanced understanding of the water quality, hydrology and hydrodynamics of the drinking water reservoir, potential sources of contamination in the watershed, stormwater issues, and processes affecting water quality to the reservoir. This plan, together with continued commitment and financial resources, represents a progressive water supply protection plan.

6.2 Watershed Protection Strategy

An effective watershed protection program is designed to prevent, identify, and correct potential or existing water quality problems. By using the following four-part strategy, the town can reassure the protection of its water resources now and in the future.

1. Monitoring and surveillance throughout the watershed.

This strategy should complement the extensive program of water quality monitoring of the raw, finished, and distribution system waters that are conducted on a regular basis. Surveillance activities should be year round. Particular focus should include patrolling the pond, and watershed for any illegal activity and/or enforcement of legal controls, and inspections of the intake structure, dams, catch basins and overflows.

Monitoring and surveillance throughout the watershed will help detect any water quality changes in the watershed and pond long before they impact water quality in the system. The collected data should be compiled and analyzed at least annually. Specific watershed sampling sites should be determined and regular sampling of each location committed to.

2. Direct action to correct existing or potential water quality problems

This strategy involves the implementation of Best Management Practices (BMPs). Direct action may be taken on projects designed to reduce polluted runoff, mitigate stormwater impacts, land acquisition projects, and septic system inspections.

3. Continue education of the public and the town staff to prevent future water quality problems

4. Increase advocacy to involve state and local officials in the protection of water resources

6.3 Detailed Recommendations

Backwash Water

Filters at the water treatment plant are washed periodically, and the backwash water is then discharged to Haggetts Pond. A one-year cycle involves approximately 150 million gallons of backwash water containing collected solids being returned to the pond. Although the quantity and quality of discharge is authorized through NPDES permitting, the practice of returning waste to a drinking water reservoir calls for added inspection. Sediment data from area ponds should be used as a baseline comparison to the annual inorganic tests performed on the sediment of Haggetts Pond to further evaluate the effects of backwash water. An investigation into alternative backwash-to-waste methods is being conducted.

Zoning

Andover has a zoning overlay bylaw, established in 1986 with subsequent revisions in 2006 and 2009, specifically to preserve and protect the surface water and ground water resources for the health, safety and welfare of the people and to protect the community from the detrimental use and development of land and waters within the Watershed Protection Overlay District (WPOD). The WPOD was established to define all the lands that create the catchment or drainage areas of Fish Brook, and Haggetts Pond as part of their natural or man-made drainage system. Within the WPOD there are designated priority zones to identify areas where permitted uses and design standards shall apply based upon linear distances from surface waters and their tributaries.

Merrimack River

It is important for the Town to keep informed about plans for upstream uses that might affect Andover's water supply. Upstream uses have both the potential to impact water quantity and quality. Several users, upstream and downstream from the Fish Brook Pumping Station, impact the height of the Merrimack River, which in turn interferes with the ability of the pump station to withdraw water necessary to fill Haggetts Pond. Water quality protection at the river intake should include networking with communities within the combined Merrimack River watershed and the Merrimack River Watershed Council to better manage point and nonpoint sources of pollution. The challenge is great since the Merrimack travels two states thereby posing a wider area for natural resource planning and community organizing. All efforts should continue to protect the river and to monitor and review activities to assess changes in water quality over time and to determine the effectiveness of management practices.

Agricultural

The Town may wish to work with local farms to make them aware of the water supply, and to encourage the use of a U.S. Natural Resources Conservation Service (NRCS) farm plan to protect water supplies. The Massachusetts Department of Food & Agriculture's booklet titled "On Farm Strategies to Protect Water Quality – An Assessment Planning Tool for Best Management Practices" (December 1996) describes technical, and financial assistance programs related to the control of erosion, and to the management of nutrients, pests, manure, grazing and irrigation. The Town's Water Department and Board of Health could work with farmers to ensure pesticides, fertilizers, and manure are being stored within a structure designed to prevent runoff. Both the pig farm and the greenhouse business represent a potential threat to the Fish Brook water supply. The present impact they have on water quality is unclear due to insufficient data. Further investigation is required, and should become part of a watershed sampling plan.

Transportation Corridor

The Town is active with local emergency response teams who ensure that any road spills can be effectively contained. Emergency drills should be conducted that include the appropriate Water Department staff just in case an accident requires the emergency shut down or diversion of any water system components.

Chemical and Hazardous Materials Manufacture, Storage and Use

The town should educate local businesses on BMPs for protecting water supplies and encourage them to use BMPs for handling, storing and disposing of hazardous waste. The Bureau of Resource Protection of DEP has fact sheets available which provide BMPs for common business issues. Additional business education might include Massachusetts's floor drain requirements. A local control program intended to compile information from site-specific surveys of commercial, and industrial facilities would augment a thorough watershed inventory.

Impervious Surfaces

The town, in its land use planning process, should consider the direct matter of impervious surfaces since it has such a strong influence on watershed quality. Parking lots and roadways represent a source of pollution by transporting hydrocarbons, especially during periods of high runoff. It would be wise to consider this in the degree and location of future development. Individual projects could be designed utilizing low impact development techniques (LID) to reduce the amount of impervious cover they create and increase the natural areas they conserve. Many innovative site-planning techniques have been shown to sharply reduce the impact of new development by reducing impervious surfaces and their corresponding stormwater pollutant loading while simultaneously reducing the actual cost of site development.

Wildlife and Habitat

The need exists for habitat information and data. The extent and condition of the wetlands within the watershed require further investigation, as well as an up-to-date inventory of aquatic plants and animal species. An inventory and assessment of non-native plant species, particularly purple loosestrife, and the impacts on native species and natural communities should be conducted.

Security

Drinking water utilities today find themselves facing new responsibilities. While their mission has always been to deliver a dependable and safe supply of water to their customers, the challenges inherent in achieving that mission have expanded to include security and counter-terrorism. Training of water system employees in cooperation with the appropriate public health professionals and law enforcement should be conducted annually, either in-house or with the aid of outside professionals. Training must include an operational approach creating hypothetical hazardous situations that can be addressed through the emergency response procedure. Proper training for an emergency will enable personnel to respond more quickly and effectively if a situation arises.

Pond Management/Algal Blooms

It is recognized that algal blooms generally occur, in part, due to the natural eutrophication process that all lakes, and ponds undergo in warmer seasons when dissolved oxygen is low, and nutrients are high. Cultural eutrophication, on the other hand, is not a natural process, and one that requires attention and preventative measures.

Fish Brook, which flows from the country club headwaters through a heavily developed residential area, has the tendency to pick up excessive nutrient loads, and feed them into the drinking water reservoir through the Merrimack River diversion. Fish Brook in all probability is a major source to the algal blooms in Haggetts Pond. In order to minimize the cultural eutrophication of Haggetts Pond, the town should investigate the implementation of stricter runoff, and infiltration controls along Fish Brook, as well as educate abutters on best management practices in the land areas contributing water to the stream. Volunteers groups normally welcome such challenges and may be an effective and inexpensive way to form such an initiative.

Invasive Species

An invasive plant and animal surveillance of Haggetts Pond should be conducted due to the recent attention given to threats posed by aquatic invasive plants and animals in New England, and the fact that invasive plants and animals are seen to represent an indirect threat to water quality. Local knowledge points out a general rise in the quantity of purple loosestrife around Haggetts Pond. A surveillance program should form a baseline study to map locations, identify any invasive species, and attempt to quantify them in and around Haggetts Pond. It may then be determined whether or not eradication of an invasive species is necessary.

Stormwater

The Town should ensure that businesses do not drain things such as toilets, sinks, appliances, showers, shop floors and industrial process water to the storm drain system. Connections such as these can send oxygen-depleting materials, heavy metals, high temperature water, toxic organic compounds, nutrients and pathogens to the storm drain system, and nearby waterways. Municipal catch basins, and storm drains are designed to carry away stormwater from rain, melting snow or ice, which flows over the land or pavement without soaking into the ground. Unlike the wastewater from our kitchens, and bathrooms, stormwater is not treated before it is released to our waters and can carry pollutants that can seriously harm our local water resources. The Town of Andover should look at enacting an Illicit Discharge Ordinance, which would make it illegal to discharge pollutants to the storm sewer system or to natural waters. An ordinance would prohibit a direct discharge, either manually or through any connecting structure, that carries anything that is not composed entirely of stormwater into the storm sewer system or town waters. One quart of oil dumped from a residential home down the storm drain can contaminate 250, 000 gallons of water. An ordinance would prohibit the dumping of commercial and residential stormwater pollutants such as used motor oil, industrial process water, water from foundation drains, and chlorinated pool water.

Underground Storage Tanks (USTs)

The WPOD amendments included language that referenced MassDEP regulation 310 CMR 22.20B, which includes restrictions for underground storage tanks. Specifically, all underground storage tanks are prohibited from within the Zone A of surface water sources. Above-ground tanks for the storage of liquid hazardous material or liquid propane or liquid petroleum products are prohibited within Zone A, with the exception of the following: normal household use, outdoor maintenance, or the heating of a structure; use of emergency generators; or a response action conducted or performed in accordance with site remediation work. Aboveground storage must be in containers or above ground tanks within a building, or outdoors in covered containers or aboveground tanks in an area that has a containment system designed and operated to hold either 10% of the total storage capacity of all containers, or 100% of the largest container's storage capacity, whichever is greater. These storage requirements do not apply to the replacement of existing tanks or systems for the keeping, dispensing or storing of gasoline provided the replacement is performed in accordance with applicable state and local requirements.

Septic Systems

A Local Septic System Management Plan (LSMP) developed in 2000, mapped environmentally sensitive areas and ranked properties based on the potential environmental impact of their septic systems. A second phase of the plan included a link GIS map information and the tracking database to the Town's Board of Health permitting and Title V inspection database. The purpose of this plan was to identify, prioritize, monitor and address the proper installation, operation, maintenance and upgrade of septic systems in Town.

Road Salt

There are no regulations governing the application of road salt, but uncovered storage of salt in water supply protection areas is forbidden by MGL c.85, section 7A. Mass Highway Department stockpiles large quantities of road deicing sand and salt on the southeast quadrant of the I-495 and I-93 cloverleaf. The topography of the cloverleaf is such that drainage from the salt piles empty into Fish Brook, upstream of the diversion that delivers Fish Brook water to Haggetts Pond. Increasing sodium levels in the drinking water supply are most probably related to the use of and storage of road salt. Most recent sodium tests taken along Fish Brook indicate a rise in sodium concentrations in and around the I-495 and I-93 cloverleaf. The Town must remedy the amassing of salt to protect Fish Brook, which is a vital ecosystem; fish and wildlife depend on it, and in this case, is also a major economic resource as well. Restoration may be accomplished with the implementation of stricter runoff and infiltration controls, improved operation of the salting vehicles that use the storage facility, and/or the removal of the storage shed.

Salt storage located at I-495 and I-93 cloverleaf

Coordinating Local Project Reviews and IDR Meetings

Protecting drinking water supplies is an ongoing task for municipal officials. Once a community establishes water supply protection measures such as bylaws, health regulations and protection plans, proposed land uses and activities must be evaluated in conjunction with the established protection.

Reviewing proposed in-town projects can be challenging when coordinating the requirements between departments. Proposed developments and projects that require review should consider <u>at a minimum</u>:

- Is the project located in a water supply area?
- What condition or performance standards must the project meet to ensure protection?
- Does the project have secondary/accessory uses that pose a threat to water supplies?

Appendix A

Potential Sources of Drinking Water Contamination

Potential Sources of Drinking Water Contamination

Commercial/Industrial Above-ground storage tanks	Arsenic, Barium, Benzene, Cadmium, 1,4-Dichlorobenzene or P-Dichlorobenzene, cis 1,2-Dichloroethylene, trans 1,2-Dichloroethylene, Dichloromethane or Methylene Chloride, Lead, Trichloroethylene (TCE), Tetrachloroethylene or Perchlorethylene (Perc)
Automobile, Repair Shops	Arsenic, Barium, Benzene, Cadmium, Chlorobenzene, Copper, cis 1,2-Dichloroethylene, trans 1,2-Dichloroethylene, 1,4-Dichlorobenzene or P-Dichlorobenzene, Lead, Fluoride, 1,1,1-Trichloroethane or Methyl Chloroform, Dichloromethane or Methylene Chloride, Tetrachloroethylene or Perchlorethylene (Perc), Trichloroethylene (TCE), Xylene (Mixed Isomers)
Boat Repair/ Refinishing/Marinas	Benzene, Cadmium, cis 1,2-Dichloroethylene, Coliform, Cryptosporidium, Dichloromethane or Methylene Chloride, Giardia Lambia, Lead, Mercury, Nitrate, Nitrite, trans 1,2-Dichloroethylene, Tetrachloroethylene or Perchlorethylene (Perc), Trichloroethylene (TCE), Vinyl Chloride, Viruses
Cement/Concrete Plants	Barium, Benzene, Dichloromethane or Methylene Chloride, Ethylbenzene, Lead, Styrene, Tetrachloroethylene or Perchlorethylene (Perc), Toluene, Xylene (Mixed Isomers)
Chemical/Petroleum Processing	Acrylamide, Arsenic, Atrazine, Alachlor, Aluminum (Fume or Dust), Barium, Benzene, Cadmium, Carbofuran, Carbon Tetrachloride, Chlorobenzene, Copper, Cyanide, 2,4-D, 1,2-Dibromoethane or Ethylene Dibromide (EDB), 1,2-Dichlorobenzene or O-Dichlorobenzene, 1,4-Dichlorobenzene or P-Dichlorobenzene, 1,1-Dichloroethylene or Vinylidene Chloride, cis 1,2-Dichloroethylene, Dichloromethane or Methylene Chloride, Di (2-ethylhexyl) adipate, Di(2-ethylhexyl) phthlate, 1,2-Dichloroethane or Ethylene Dichloride, Dioxin, Endrin, Epichlorohydrin, Ethylbenzene, Hexachlorobenzene, Hexachlorocyclopentadiene, Lead, Mercury, Methoxychlor, Polychlorinated Biphenyls, Selenium, Styrene, Sulfate, Tetrachloroethylene or Perchlorethylene (Perc), Toluene, 1,2,4-Trichlorobenzene, 1,1,1-Trichloroethane or Methyl Chloroform, Trichloroethylene (TCE), Vinyl Chloride, Xylene (Mixed Isomers), Zinc (Fume or Dust)
Construction/Demolition	Arsenic, Asbestos, Benzene, Cadmium, Chloride, Copper, Cyanide, cis 1,2-Dichloroethylene, trans 1,2-Dichloroethylene, Dichloromethane or Methylene Chloride, Fluorides, Lead, Selenium, Tetrachloroethylene or Perchlorethylene (Perc), 1,1,1-Trichloroethane or Methyl Chloroform, Trichloroethylene (TCE), Turbidity, Xylene (Mixed Isomers), Zinc (Fume or Dust)
Dry Cleaners	Tetrachloroethylene or Perchlorethylene (Perc), 1,1,1-Trichloroethane or Methyl Chloroform, 1,1,2-Trichloroethane
Dry Goods Manufacturing	Barium, Benzene, Cadmium, Copper, Dichloromethane or Methylene Chloride, Di (2-ethylhexyl) phthlate, Lead, 1,1,1-Trichloroethane or

	Methyl Chloroform, Polychlorinated Biphenyls, Tetrachloroethylene or Perchlorethylene (Perc), Toluene, Trichloroethylene (TCE), Xylene (Mixed Isomers)
Electrical/Electronic Manufacturing	Aluminum (Fume or Dust), Antimony, Arsenic, Barium, Benzene, Cadmium, Chlorobenzene, Copper, Cyanide, Carbon Tetrachloride, 1,2-Dichlorobenzene or O-Dichlorobenzene, 1,2-Dichloroethane or Ethylene Dichloride, cis 1,2-Dichloroethylene, trans 1,2-Dichloroethylene, Dichloromethane or Methylene Chloride, Di (2-Ethylhexyl) phthlate, Ethylbenzene, Lead, Mercury, Polychlorinated Biphenyls, Selenium, Styrene, Sulfate, Tetrachloroethylene or Perchlorethylene (Perc), 1,1,1-Trichloroethane or Methyl Chloroform, 1,1,2-Trichloroethane, Trichloroethylene (TCE), Thallium, Toluene, Vinyl Chloride, Xylene (Mixed Isomers), Zinc (Fume or Dust)
Food Processing	Arsenic, Benzene, Cadmium, Copper, Carbon Tetrachloride, Dichloromethane or Methylene Chloride, Lead, Mercury, Picloram, Tetrachloroethylene or Perchlorethylene (Perc), Toluene, 1,1,1-Trichloroethane or Methyl Chloroform, Trichloroethylene (TCE), Xylene (Mixed Isomers)
Funeral Services/Taxidermy	Glyphosate, Dichloromethane or Methylene Chloride, Nitrate, Nitrite, Total Coliforms, Viruses
Furniture Repair/Manufacturing	Barium, 1,2-Dichloroethane or Ethylene Dichloride, Dichloromethane or Methylene Chloride, Ethylbenzene, Lead, Mercury, Selenium, Trichloroethylene (TCE)
Gas Stations	cis 1,2-Dichloroethylene, trans 1,2-Dichloroethylene, Dichloromethane or Methylene Chloride, Tetrachloroethylene or Perchlorethylene (Perc), Trichloroethylene (TCE)
Graveyards/Cemeteries	Dalapon, Lindane, Nitrate, Nitrite, Total Coliforms, Viruses
Hardware/Lumber/Parts Stores	Aluminum (Fume or Dust), Barium, Benzene, Cadmium, Chlorobenzene, Copper, Dichloromethane or Methylene Chloride, Di(2-ethylhexyl)adipate, Di(2-ethylhexyl) phthlate, 1,4-Dichlorobenzene or P-Dichlorobenzene, Ethylbenzene, Lead, Mercury, Tetrachloroethylene or Perchlorethylene (Perc), 1,1,1-Trichloroethane or Methyl Chloroform, Trichloroethylene (TCE), Toluene, Xylene
Historic Waste Dumps/ Landfills	Atrazine, Alachlor, Carbofuran, cis 1,2-Dichloroethylene, trans 1,2-Dichloroethylene, Diquat, Dalapon, Glyphosate, Dichloromethane or Methylene Chloride, Nitrate, Nitrite, Oxamyl (Vydate), Sulfate, Simazine, Tetrachloroethylene or Perchlorethylene (Perc), Trichloroethylene (TCE)
Home Manufacturing	Arsenic, Barium, Benzene, Cadmium, Chlorobenzene, Copper, Carbon Tetrachloride, 1,2-Dichlorobenzene or O-Dichlorobenzene, cis 1,2-Dichloroethylene, trans 1,2-Dichloroethylene, Dichloromethane or Methylene Chloride, Di(2-ethylhexyl) phthlate, Ethylbenzene, Lead, Mercury, Selenium, Styrene, Tetrachloroethylene or Perchlorethylene (Perc), 1,1,1-Trichloroethane or Methyl Chloroform, Trichloroethylene (TCE), Toluene, Turbidity, Xylene (Mixed Isomers)
Industrial Waste	Acrylamide, Arsenic, Atrazine, Alachlor, Aluminum (Fume or Dust),

Disposal Wells	Ammonia, Barium, Benzene, Cadmium, Carbofuran, Carbon Tetrachloride, Chlorobenzene, Copper, Cyanide, 2,4-D, 1,2-Dibromoethane or Ethylene Dibromide (EDB), 1,2-Dichlorobenzene or O-Dichlorobenzene, 1,4-Dichlorobenzene or p-Dichlorobenzene, 1,1-Dichloroethylene or Dichloromethane or Methylene Chloride, Di(2-ethylhexyl) adipate, Di(2-ethylhexyl) phthlate, 1,2-Dichloroethane or Ethylene Dichloride, Dioxin, Endrin, Epichlorohydrin, Hexachlorobenzene, Hexachlorocyclopentadiene, Lead, Mercury, Methoxychlor, Oxamyl (Vydate), Polychlorinated Biphenyls, Selenium, Styrene, Sulfate, Tetrachloroethylene or Perchlorethylene (Perc), Toluene, 1,2,4-Trichlorobenzene, 1,1,1-Trichloroethane or Methyl Chloroform, Trichloroethylene (TCE), Vinyl Chloride, Xylene (Mixed Isomers), Zinc (Fume or Dust)
Junk/Scraps/Salvage Yards	Barium, Benzene, Copper, Dalapon, cis 1,2-Dichloroethylene, Diquat, Glyphosate, Lead, Polychlorinated Biphenyls, Sulfate, Simazine, Trichloroethylene (TCE), Tetrachloroethylene or Perchlorethylene
Machine Shops	Arsenic, Aluminum (Fume or Dust), Barium, Benzene, Boric Acid, Cadmium, Chlorobenzene, Copper, Cyanide, Carbon Tetrachloride 2,4-D, 1,4-Dichlorobenzene or P-Dichlorobenzene, 1,2-Dichloroethane or Ethylene Dichloride, 1,1-Dichloroethylene or Vinylidene Chloride, cis 1,2-Dichloroethylene, trans 1,2-Dichloroethylene, Dichloromethane or Methylene Chloride, Di(2-ethylhexyl) phthlate, Ethylbenzene, Fluoride, Hexachlorobenzene, Lead, Mercury, Polychlorinated Biphenyls, Pentachlorophenol, Selenium, Styrene, Tetrachloroethylene or Perchlorethylene (Perc), Toluene, 1,1,1-Trichloroethane or Methyl Chloroform, 1,1,2-Trichloroethane, Trichloroethylene (TCE), Xylene (Mixed Isomers), Zinc (Fume or Dust)
Medical/Vet Offices	Arsenic, Acrylamide, Barium, Benzene, Cadmium, Copper, Cyanide, Carbon Tetrachloride, Dichloromethane or Methylene Chloride, 1,2-Dichloroethane or Ethylene Dichloride, Lead, Mercury, Methoxychlor, 1,1,1-Trichloroethane or Methyl Chloroform, Radionuclides, Selenium, Silver, Tetrachloroethylene or Perchlorethylene (Perc), 2,4,5-TP (Silvex), Thallium, Xylene (Mixed Isomers)
Metal Plating/ Finishing/Fabricating	Antimony, Aluminum (Fume or Dust), Arsenic, Barium, Benzene, Cadmium, Carbon Tetrachloride, Chlorobenzene, Chromium, Copper, Cyanide, 1,4-Dichlorobenzene or P-Dichlorobenzene, cis 1,2-Dichloroethylene, trans 1,2-Dichloroethylene, Dichloromethane or Methylene Chloride, Di(2-ethylhexyl) adipate, Ethylbenzene, Lead, Mercury, Polychlorinated Biphenyls, Pentachlorophenol, Selenium, Styrene, Sulfate, Tetrachloroethylene or Perchlorethylene (Perc), , Thallium, Toluene, 1,1,1-Trichloroethane or Methyl Chloroform, 1,1,2-Trichloroethane, Trichloroethylene (TCE), Vinyl Chloride, Xylene (Mixed Isomers), Zinc (Fume or Dust)
Military Installations	Arsenic, Barium, Benzene, Cadmium, Chlorobenzene, 1,2-Dichlorobenzene or O-Dichlorobenzene, 1,2-Dichloroethane or Ethylene Dichloride, cis 1,2-Dichloroethylene, trans 1,2-

	Dichloroethylene, Dichloromethane or Methylene Chloride, Hexachlorobenzene, Lead, Mercury, Methoxychlor, 1,1,1-Trichloroethane or Methyl Chloroform, Radionuclides, Selenium, Tetrachloroethylene or Perchlorethylene (Perc), , Toluene, Trichloroethylene (TCE)
Mines/Gravels Pits	Lead, Selenium, Sulfate, Tetrachloroethylene or Perchlorethylene (Perc), 1,1,1-Trichloroethane or Methyl Chloroform, Turbidity
Motor Pools	cis 1,2-Dichloroethylene, trans 1,2-Dichloroethylene, Dichloromethane or Methylene Chloride
Office Building/Complex	Barium, Benzene, Cadmium, Copper, 2,4-D, Diazinon, 1,2-Dichlorobenzene or O-Dichlorobenzene, Dichloromethane or Methylene Chloride, Diquat, 1,2-Dichloroethane or Ethylene Dichloride, Ethylbenzene, Glyphosate, Lead, Mercury, Selenium, Simazine, Tetrachloroethylene or Perchlorethylene (Perc), 1,1,1-Trichloroethane or Methyl Chloroform, Trichloroethylene (TCE), Vinyl Chloride, Xylene (Mixed Isomers**)**
Photo Processing/Printing	Acrylamide, Aluminum (Fume or Dust), Arsenic, Barium, Benzene, Cadmium, Carbon Tetrachloride, Chlorobenzene, Copper, Cyanide, 1,1-Dichloroethylene or Vinylidene Chloride, cis 1,2-Dichloroethylene, trans 1,2-Dichloroethylene, Dichloromethane or Methylene Chloride, Di(2-ethylhexyl) phthlate, 1,2-Dichlorobenzene or O-Dichlorobenzene, 1,4-Dichlorobenzene or P-Dichlorobenzene, 1,2-Dichloroethane or Ethylene Dichloride, 1,2-Dibromoethane or Ethylene Dibromide (EDB), Heptachlor epoxide, Hexachlorobenzene, Lead, Lindane, Mercury, Methoxychlor, Propylene Dichloride or 1,2-Dichloropropane, Selenium, Styrene, Tetrachloroethylene or Perchlorethylene (Perc), 1,1,1-Trichloroethane or Methyl Chloroform, Toluene, 1,1,2-Trichloroethane, Trichloroethylene (TCE), Vinyl Chloride, Xylene (Mixed Isomers), Zinc (Fume or Dust)
Synthetic/ Plastics Production	Antimony, Arsenic, Barium, Benzene, Cadmium, Carbon Tetrachloride, Chlorobenzene, Copper, Cyanide, 1,2-Dichlorobenzene or O-Dichlorobenzene, 1,4-Dichlorobenzene or P-Dichlorobenzene, 1,2-Dichloroethane or Ethylene Dichloride, cis 1,2-Dichloroethylene, trans 1,2-Dichloroethylene, Dichloromethane or Methylene Chloride, Di(2-ethylhexyl) adipate, Di(2-ethylhexyl) phthlate, Ethylbenzene, Hexachlorobenzene, Lead, Mercury, Methyl Chloroform or 1,1,1-Trichloroethane, Pentachlorophenol, Selenium, Styrene, Tetrachloroethylene or Perchlorethylene (Perk), Toluene, Trichloroethylene (TCE), Vinyl Chloride, Xylene (Mixed Isomers), Zinc (Fume or Dust)
RV/Mini Storage	Arsenic, Barium, Cyanide, 2,4-D, Endrin, Lead, Methoxychlor
Railroad Yards	Atrazine, Barium, Benzene, Cadmium, Dalapon, 1,4-Dichlorobenzene or P-Dichlorobenzene, cis 1,2-Dichloroethylene, trans 1,2-Dichloroethylene, Dichloromethane or Methylene Chloride, Lead, Mercury, Tetrachloroethylene or Perchlorethylene (Perc**),** Trichloroethylene (TCE)

Research Laboratories	Arsenic, Barium, Benzene, Beryllium Powder, Cadmium, Carbon Tetrachloride, Chlorobenzene, Cyanide, 1,2-Dichloroethane or Ethylene Dichloride, 1,1-Dichloroethylene or Vinylidene Chloride, cis 1,2-Dichloroethylene, trans 1,2-Dichloroethylene, Dichloromethane or Methylene Chloride, Endrin, Lead, Mercury, Polychlorinated Biphenyls, Selenium, Tetrachloroethylene or Perchlorethylene (Perc), Thallium, Thiosulfates, Toluene, 1,1,1-Trichloroethane or Methyl Chloroform, Trichloroethylene (TCE), Vinyl Chloride, Xylene (Mixed Isomers)
Retail Operations	Arsenic, Barium, Benzene, Cadmium, 2,4-D, 1,2-Dichloroethane or Ethylene Dichloride, Lead, Mercury, Styrene, Tetrachloroethylene or Perchlorethylene (Perc), Toluene, 1,1,1-Trichloroethane, Vinyl Chloride
Underground Storage Tanks	Arsenic, Barium, Benzene, Cadmium, 1,4-Dichlorobenzene or P-Dichlorobenzene, cis 1,2-Dichloroethylene, trans 1,2-Dichloroethylene, Dichloromethane or Methylene Chloride, Lead, Tetrachloroethylene or Perchlorethylene (Perc), Trichloroethylene (TCE)
Wood Preserving/Treating	cis 1,2-Dichloroethylene, trans 1,2-Dichloroethylene, Lead, Sulfate
Wood/Pulp /Paper Processing	Arsenic, Barium, Benzene, Cadmium, Carbon Tetrachloride, Copper, Dichloromethane or Methylene Chloride, Dioxin, 1,2-Dichloroethane or Ethylene Dichloride, Ethylbenzene, Lead, Mercury, Polychlorinated Biphenyls, Selenium, Styrene, Tetrachloroethylene or Perchlorethylene (Perc), Trichloroethylene (TCE), Toluene, 1,1,1-Trichloroethane or Methyl Chloroform, Xylene (Mixed Isomers)
Residential/Municipal Airports	Arsenic, Barium, Benzene, Cadmium, Carbon Tetrachloride, cis 1,2-Dichloroethylene, Dichloromethane or Methylene Chloride, Ethylbenzene, Lead, Mercury, Selenium, Tetrachloroethylene or Perchlorethylene (Perc), 1,1,1-Trichloroethane or Methyl Chloroform, Trichloroethylene (TCE), Xylene (Mixed Isomers)
Apartments and Condominiums	Atrazine, Alachlor, Coliform, Cryptosporidium, Dalapon, Diquat, *Giardia Lambia*, Glyphosate, Nitrate, Nitrite, Picloram, Sulfate, Simazine, Vinyl Chloride, Viruses
Camp Grounds/RV Parks	Benomyl, Coliform, Cryptosporidium, Diquat, Dalapon, *Giardia Lambia*, Glyphosate, Isopropanol, Nitrate, Nitrite, Picloram, Sulfate, Simazine, Turbidity, Vinyl Chloride, Viruses
Cesspools-Large Capacity	Atrazine, Alachlor, Carbofuran, Coliform, Cryptosporidium, Diquat, Dalapon, Giardia Lambia, Glyphosate, Nitrate, Nitrite, Oxamyl (Vydate), Picloram, Sulfate, Simazine, Vinyl Chloride, Viruses
Drinking Water Treatment Facilities	Atrazine, Benzene, Cadmium, Cyanide, Fluoride, Lead, Polychlorinated Biphenyls, Toluene, Total Trihalomethanes, 1,1,1-Trichloroethane or Methyl Chloroform
Gas Pipelines	cis 1,2-Dichloroethylene, trans 1,2-Dichloroethylene, Dichloromethane or Methylene Chloride, Tetrachloroethylene or Perchlorethylene (Perc), Trichloroethylene or TCE
Golf Courses and Urban Parks	Arsenic, Atrazine, Benzene, Chlorobenzene, Carbofuran, 2,4-D, Diquat, Dalapon, Glyphosate, Lead, Methoxychlor, Nitrate, Nitrite, Picloram, Simazine, Turbidity

Housing Developments	Atrazine, Alachlor, Coliform, Cryptosporidium, Carbofuran, Diquat, Dalapon, Giardia Lambia, Glyphosate, Dichloromethane or Methylene Chloride, Nitrate, Nitrite, Picloram, Simazine, Trichloroethylene (TCE), Turbidity, Vinyl Chloride, Viruses
Landfills/Dumps	Arsenic, Atrazine, Alachlor, Barium, Benzene, Cadmium, Carbofuran, cis 1,2 Dichloroethylene, Diquat, Glyphosate, Lead, Lindane, Mercury, 1,1,1-Trichloroethane or Methyl Chloroform, Dichloromethane or Methylene Chloride, Nitrate, Nitrite, Picloram, Selenium, Simazine, Trichloroethylene (TCE)
Public Buildings	Arsenic, Acrylamide, Barium, Benzene, Beryllium Powder, Cadmium, Carbon Tetrachloride, Chlorobenzene, Cyanide, 2,4-D, 1,2-Dichlorobenzene or O-Dichlorobenzene, 1,4-Dichlorobenzene or P-Dichlorobenzene, Dichloromethane or Methylene Chloride, Di(2-ethylhexyl) phthlate, 1,2-Dichloroethane or Ethylene Dichloride, Endothall, Endrin, 1,2-Dibromoethane or Ethylene Dibromide (EDB), Lead, Lindane, Mercury, Methoxychlor, Selenium, Toluene, 1,1,1-Trichloroethane or Methyl Chloroform, Trichloroethylene (TCE), Vinyl Chloride, Xylene (Mixed Isomers)
Septic Systems	Atrazine, Alachlor, Carbofuran, Coliform, Cryptosporidium, Diquat, Dalapon, Giardia Lambia, Glyphosate, Nitrate, Nitrite, Oxamyl (Vydate), Picloram, Sulfate, Simazine, Vinyl Chloride, Viruses
Sewer Lines	Coliform, Cryptosporidium, Diquat, Dalapon,Giardia Lambia, Glyphosate, Nitrate, Nitrite, Oxamyl (Vydate), Picloram, Sulfate, Simazine, Vinyl Chloride, Viruses
Stormwater Infiltration basins/injection into wells/ Runoff zones	Atrazine, Alachlor, Coliform, Cryptosporidium, Carbofuran, Chlorine, Diquat, Dalapon, Giardia Lambia, Glyphosate, Dichloromethane or Methylene Chloride, Nitrate, Nitrite, Nitrosamine, Oxamyl (Vydate), Phosphates, Picloram, Simazine, Trichloroethylene (TCE), Turbidity, Vinyl Chloride, Viruses
Transportation Corridors (e.g. Roads, railroads)	Dalapon, Picloram, Simazine, Sodium, Sodium Chloride, Turbidity
Utility Stations	Arsenic, Barium, Benzene, Cadmium, Chlorobenzene, Cyanide, 2,4-D, 1,4-Dichlorobenzene or P-Dichlorobenzene, 1,2-Dichloroethane or Ethylene Dichloride, cis 1,2-Dichloroethylene, trans 1,2-Dichloroethylene, Dichloromethane or Methylene Chloride, Lead, Mercury, Picloram, Toluene, 1,1,2,2-Tetrachloroethane, Tetrachloroethylene or Perchlorethylene (Perc), Trichloroethylene (TCE), Xylene (Mixed Isomers)
Waste Transfer/Recycling	Coliform, Cryptosporidium, Giardia Lambia, Nitrate, Nitrite, Vinyl Chloride, Viruses
Wastewater Treatment Facilities/ Discharge locations	Cadmium, Coliform, Cryptosporidium, cis 1,2-Dichloroethylene, trans 1,2-Dichloroethylene, Dichloromethane or Methylene Chloride, Fluoride, Giardia Lambia, Lead, Mercury, Nitrate, Nitrite, Tetrachloroethylene or Perchlorethylene (Perc) Selenium, sulfate, Trichloroethylene (TCE), Vinyl Chloride, Viruses

Agricultural/Rural Auction Lots/Boarding Stables	Coliform, Cryptosporidium, Giardia Lambia, Nitrate, Nitrite, Sulfate, Viruses
Animal Feeding Operations	Coliform, Cryptosporidium, Giardia Lambia, Nitrate, Nitrite, Sulfate, Turbidity, Viruses
Bird Rookeries/Wildlife feeding	Coliform, Cryptosporidium, Giardia Lambia, Nitrate, Nitrite, Sulfate, Turbidity, Viruses
Crops- Irrigated & Non-irrigated	Benzene, 2,4-D, Dalapon, Dinoseb, Diquat, Glyphosate, Lindane, Lead, Nitrate, Nitrite, Picloram, Simazine, Turbidity
Dairy Operations	Coliform, Cryptosporidium, *Giardia Lambia,* Nitrate, Nitrite, Sulfate, Turbidity, Viruses
Drainage Wells, Lagoons and Liquid Waste Disposal – Agricultural	Atrazine, Alachlor, Coliform, Cryptosporidium, Carbofuran, Diquat, Dalapon, Giardia Lambia, Glyphosate, Nitrate, Nitrite, Oxamyl (Vydate), Picloram, Sulfate, Simazine, Vinyl Chloride, Viruses
Managed Forests/ Grass Lands	Atrazine, Diquat, Glyphosate, Picloram, Simazine, Turbidity
Pesticide/ Facilities Fertilizer Storage	Atrazine, Alachlor, Carbofuran, Chlordane, 2,4-D, Diquat, Dalapon, 1,2-Dibromo-3-Chloropropane or DBCP, Glyphosate, Nitrate, Nitrite, Oxamyl (Vydate), Picloram, Simazine, 2,4,5-TP (Silvex)
Rangeland/Grazing lands	Coliform, Cryptosporidium, Giardia Lambia, Nitrate, Nitrite, Sulfate, Turbidity, Viruses
Residential Wastewater Lagoons	Atrazine, Alachlor, Carbofuran, Coliform, Cryptosporidium, Diquat, Dalapon, *Giardia Lambia*, Glyphosate, Nitrate, Nitrite, Oxamyl (Vydate), Picloram, Sulfate, Simazine, Vinyl Chloride, Viruses
Miscellaneous Sources Abandoned drinking water wells (conduits for contamination)	Atrazine, Alachlor, Coliform, Cryptosporidium, Carbofuran, Diquat, Dalapon, Giardia Lambia, Glyphosate, Dichloromethane or Methylene Chloride, Nitrate, Nitrite, Oxamyl (Vydate), Picloram, Simazine, Trichloroethylene (TCE), Turbidity, Vinyl Chloride, Viruses
Naturally Occurring	Arsenic, Asbestos, Barium, Cadmium, Chromium, Coliform, Copper, Cryptosporidium, Fluoride, Giardia Lambia, Iron, Lead, Manganese, Mercury, Nitrate, Nitrite, Radionuclides, Selenium, Silver, Sulfate, Viruses, Zinc (Fume or Dust)

Appendix B

Town of Andover
Fuel Storage Tank Index

Town of Andover Fuel Storage Tank Index

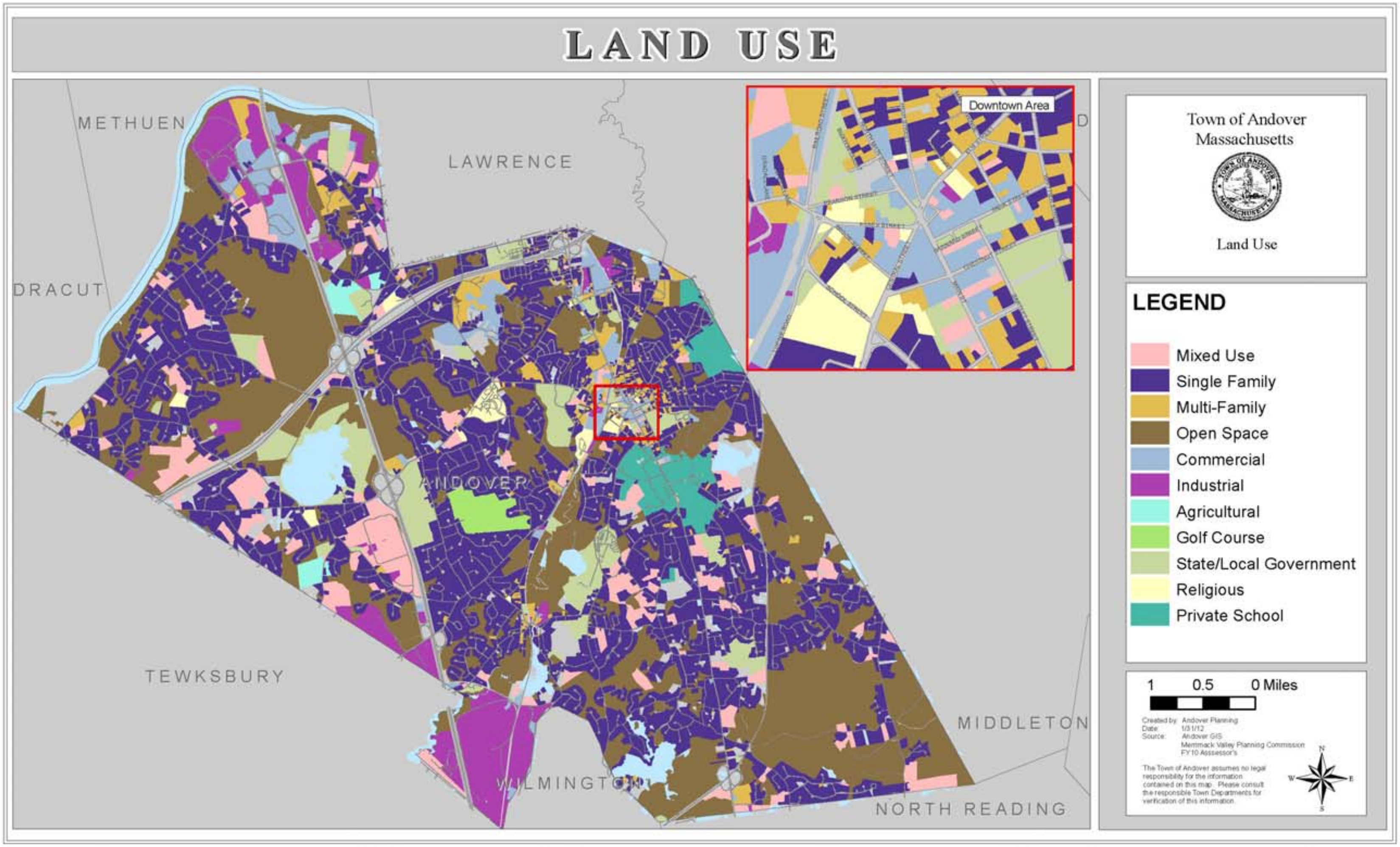
Location	Facility	Above Ground/ Underground Tank	Volume of Tank	Type of Fuel
INSIDE FISH BROOK/HAGGETTS POND WATERSHED				
90 Lovejoy Road	Sanborn Elementary School	U	6,000	fuel oil
309 Lowell Street	Mobil Oil	U	12,000	gasoline
309 Lowell Street	Mobil Oil	U	10,000	gasoline
309 Lowell Street	Mobil Oil	U	6,000	gasoline
397 Lowell Street	Andover WTP	U	3,000	fuel oil
397 Lowell Street	Andover WTP	U	4,000	fuel oil
15 Shattuck Road	Verizon, Corporate Drive	U	15,000	diesel
15 Shattuck Road	Verizon, Corporate Drive	U	15,000	diesel
139 River Road	Mobil Oil	U	10,000	gasoline
139 River Road	Mobil Oil	U	10,000	gasoline
139 River Road	Mobil Oil	U	10,000	gasoline
139 River Road	Mobil Oil	U	10,000	gasoline
Lovejoy Road	Indian Ridge Country Club	A	1,000	gasoline
Lovejoy Road	Indian Ridge Country Club	A	500	diesel
6 Shattuck Road	MKS	A	~650	diesel
7 Shattuck Road	Putnam Investments	A	10,000	diesel
7 Shattuck Road	Putnam Investments	A	10,000	diesel
20 Shattuck Road	Verizon	A	unknown	diesel
Holmes Road	Bell Atlantic (Verizon)	A	330	diesel
333 High Plain Road	High Plain Elementary School	A	10,000	fuel oil

Town of Andover Fuel Storage Tank Index, continued

OUTSIDE FISH BROOK/HAGGETTS POND WATERSHED				
14 N Main Street	Mobil Oil	U	12,000	gasoline
14 N Main Street	Mobil Oil	U	10,000	gasoline
14 N Main Street	Mobil Oil	U	10,000	gasoline
14 N Main Street	Mobil Oil	U	8,000	diesel
Salem Street & Route 125	Axon LLC/Green Valley	U	6,000	gasoline
Salem Street & Route 125	Axon LLC/Green Valley	U	6,000	gasoline
Salem Street & Route 125	Axon LLC/Green Valley	U	6,000	gasoline
30 Lowell Junction Road	TJ Realty Trust	U	6,000	diesel
205 N Main Street	Sunoco	U	1,000	waste oil
205 N Main Street	Sunoco	U	8,000	gasoline
205 N Main Street	Sunoco	U	8,000	gasoline
205 N Main Street	Sunoco	U	8,000	gasoline
205 N Main Street	Sunoco	U	6,000	diesel
205 N Main Street	Sunoco	U	1,000	fuel oil
65 Main Street	Main Street Gulf Station	U	6,000	gasoline
65 Main Street	Main Street Gulf Station	U	6,000	gasoline
65 Main Street	Main Street Gulf Station	U	6,000	gasoline
65 Main Street	Main Street Gulf Station	U	6,000	gasoline
4 Corporate Drive	EISAI	U	1,500	gasoline
43 Lupine Road	George and Willian Henderson	U	3,000	diesel
34 Sunset Rock Road	Pike School	U	10,000	fuel oil
340 Ballardvale Street	DeMoulas Supermarkets	U	6,000	gasoline
340 Ballardvale Street	DeMoulas Supermarkets	U	10,000	diesel
5 Highland Road	Phillips Academy	U	300	diesel
Tantallon Road	Shawsheen Village Pumping Station	U	4,000	fuel oil
4 Old Campus Road	Phillips Academy	U	20,000	fuel oil
4 Old Campus Road	Phillips Academy	U	20,000	fuel oil
6 Old Campus Road	Phillips Academy	U	10,000	gasoline
11 Lewis Street	Town of Andover	U	10,000	gasoline
39 Haverhill Street	Woodworth Chevrolet-Cadillac	U	10,000	gasoline
339 N. Main Street	Woodworth Chevrolet-Cadillac	U	10,000	gasoline
339 N. Main Street	Woodworth Chevrolet-Cadillac	A	350	waste oil
11 Lewis Street	Town of Andover	A	6,000	diesel
27 Elm Street	Bell Atlantic (Verizon)	A	500	diesel
27 Elm Street	Bell Atlantic (Verizon)	A	500	diesel
60 Frontage Road	Dynamics Research Corp	A	250	oil

Appendix C

Land Use and Zoning Districts Maps


LAND USE
METHUEN
LAWRENCE
DRACUT
ANDOVER
TEWKSBURY
WILMINGTON
MIDDLETON
NORTH READING
Downtown Area
Town of Andover
Massachusetts
Land Use
LEGEND
Mixed Use
Single Family
Multi-Family
Open Space
Commercial
Industrial
Agricultural
Golf Course
State/Local Government
Religious
Private School
1
0.5
0 Miles
Created by: Andover Planning
Date: 1/31/12
Source: Andover GIS
Merrimack Valley Planning Commission
FY10 Assessor's
The Town of Andover assumes no legal responsibility for the information contained on this map. Please consult the responsible Town Departments for verification of this information.
N
W
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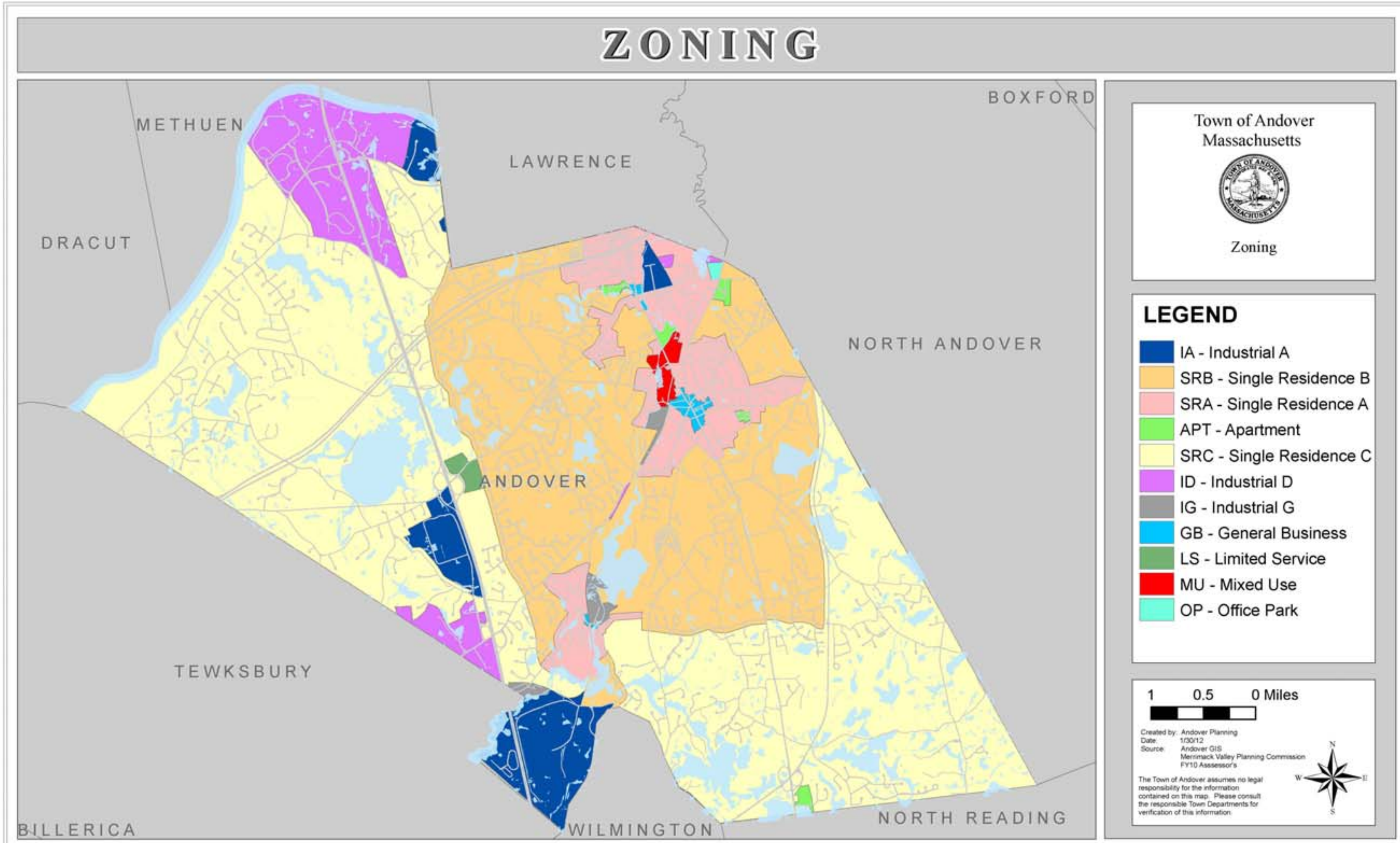
S



ZONING
BOXFORD
METHUEN
LAWRENCE
DRACUT
NORTH ANDOVER
ANDOVER
TEWKSBURY
BILLERICA
WILMINGTON
NORTH READING
Town of Andover
Massachusetts
Zoning
LEGEND
IA - Industrial A
SRB - Single Residence B
SRA - Single Residence A
APT - Apartment
SRC - Single Residence C
ID - Industrial D
IG - Industrial G
GB - General Business
LS - Limited Service
MU - Mixed Use
OP - Office Park
1 0.5 0 Miles
Created by: Andover Planning
Date: 1/30/12
Source: Andover GIS
Merrimack Valley Planning Commission
FY10 Assessor's
The Town of Andover assumes no legal responsibility for the information contained on this map. Please consult the responsible Town Departments for verification of this information.
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Appendix D

Stormwater Pollution Prevention Tips

Stormwater Pollution Prevention Tips

Lawn and Garden

A long-range objective of the Andover Board of Health (BOH) is to reduce the exposure the community to pesticides and pesticide breakdown products that are known or probable health hazards. The BOH promotes natural organic lawn care practices and aims to raise public awareness regarding the benefits of natural organic lawn care both to the environment and to public health.

Pesticides are an easy and effective way to rid your lawn and home of pests. However, many homeowners and consumers are not well informed about pesticides and their uses, therefore the potential for misuse is greater among them. Keep in mind that pesticides are intended to be toxic to the target pest. They are not "safe."

The quality of water resources can become unhealthy as a result of improper, excessive, and unnecessary use of yard chemicals such as pesticides and fertilizers. Since so many people use lawn chemicals, it is important to make sure that they are being used correctly.

Always read and follow the label. The label contains the directions for use including application site and rate, storage and disposal practices, active ingredients, protective equipment needs, the types of pests controlled and the signal words: "Caution", "Warning" or "Danger." Failure to follow the label directions can result in harm to the environment, water, children, animals and you. However, if used properly and according to the label, you can reduce the risk. To further reduce risks from pesticide use:

- Only buy what you need. Read the label to ensure the product you are buying will be effective on the pest.
- When applying pesticides, follow the directions! Only use what you need, more is not better! Be aware of environmentally sensitive areas and areas that are accessible to children and animals.
- Protect yourself. When using pesticides, at a minimum, gloves and long sleeve shirts should be worn. Rubber boots, a hat, goggles and a facemask, respirator or face shield are also recommended.
- Store in areas inaccessible to children, pets or vandals. Storing outside of the house (such as in a shed or garage) is preferable.
- Never pour pesticides down the drain. Do not reuse the container. Dispose of at household hazardous waste events or at a waste facility.

Minimize the use of fertilizers. If you use too much fertilizer or apply it at the wrong time, it can easily wash off your lawn or garden into storm drains and then flow untreated into ponds or streams. Just like in your garden, fertilizer in ponds and streams makes plants grow. In water bodies, extra fertilizer can mean extra algae and aquatic plant growth. Too much algae harms water quality and makes boating, fishing and swimming unpleasant. As algae decay, they use up oxygen in the water that fish and other wildlife need.

Vehicle Leaks

Oil does not dissolve in water. It lasts a long time and sticks to everything from sand to bird feathers. Oil and other petroleum products are toxic to people, wildlife and plants. One pint of oil can make a slick larger than a football field. Oil that leaks from our cars onto roads and driveways is washed into storm drains, and then usually flows directly to a pond or stream. Used motor oil is the largest single source of oil pollution in our lakes, streams and rivers. Americans spill 180 million gallons of used oil each year into our waters. This is 16 times the amount spilled by the Exxon Valdez in Alaska.

To help keep our waters clean:

- Stop drips. Check for oil leaks regularly and fix them promptly. Keep your car tuned to reduce oil use.
- Use ground cloths or drip pans beneath your vehicle if you have leaks or are doing engine work. Clean up spills immediately. Collect all used oil in containers with tight fitting lids. Do not mix different engine fluids.
- Never dispose of oil or other engine fluids down the storm drain, on the ground or into a ditch.
- Recycle used motor oil. Many auto supply stores and gas stations will accept used oil.

Septic Systems

Septic systems require care. The accumulated solids in the bottom of the septic tank should be pumped out every **three to five years** to prolong the life of your system. Septic systems must be maintained regularly to stay working.

Neglect or abuse of your septic system can cause it to fail. Failing septic systems can

- Cause a serious health threat to your family and neighbors,
- Degrade the environment, especially lakes, ponds, streams and groundwater,
- Reduce the value of your property,
- Be very expensive to repair,
- And, put thousands of water supply users at risk if you live in a public water supply watershed and fail to maintain your system.

Be alert to these warning signs of a failing system:

- Sewage surfacing over the drain field (especially after storms),
- Sewage back-ups in the house,
- Lush, green growth over the drain field,
- Slow draining toilets or drains,
- Sewage odors

Tips to Avoid Trouble

DO have your tank pumped out and system inspected every 3 to 5 years by a licensed septic contractor.

DO practice water conservation. Repair dripping faucets and leaking toilets, run washing machines and dishwashers only when full, avoid long showers, and use water-saving features in faucets, showerheads and toilets.

DO learn the location of your septic system and drainage field. Keep a sketch of it handy for service visits. If your system has a flow diversion valve, learn its location, and turn it once a year. Flow diverters can add many years to the life of your system.

DO divert roof drains and surface water from driveways and hillsides away from the septic system. Keep sump pumps and house footing drains away from the septic system as well.

DO take leftover hazardous household chemicals to your hazardous waste collection center for disposal. Use bleach, disinfectants, and drain and toilet bowl cleaners sparingly and in accordance with product labels.

DON'T allow anyone to drive or park over any part of the system. The area over the drainage field should be left undisturbed with only a mowed grass cover. Roots from nearby trees or shrubs may clog and damage your drain lines.

DON'T use your toilet as a trash can by dumping non-degradable materials down your toilet or drains. Also, don't poison your septic system and the groundwater by pouring harmful chemicals down the drain. They can kill the beneficial bacteria that treat your wastewater. Keep the following materials out of your septic system:

NONDEGRADABLES:
grease, disposable diapers, plastics, etc.
POISONS:
gasoline, oil, paint, paint thinner, pesticides, antifreeze, etc.

Waste
Proper waste management protects the environment and workers. Even though your waste may have little value to you, it can still be a threat to the environment. Make sure that wastes awaiting disposal or recycling don't contaminate stormwater runoff and therefore our local waters. That means, for instance, you need to cover oily engine parts stored outdoors and keep your food-grease recycling barrel from overflowing. Even if your wastes will be picked up tomorrow, you need to make sure they are stored properly today, before it rains.

Different agencies and regulations focus on different aspects of waste management. The focus of the department of public works is to make sure that wastes--and other materials--aren't dumped down storm drains or washed into them with rain or wash water. This following provides an overview of proper waste management.

PROPERLY DISPOSE OF WASTES
Before you dispose of something, see if you can use or recycle it instead.

Manage and dispose of hazardous wastes properly. For Information, call the department of public works, (978) 623-8350.

REDUCE WASTE
Reducing waste lowers disposal and waste management costs and helps protect the environment.

Look for ways to prevent waste. For example, keep a good inventory system so you don't buy more chemicals than you can use by their expiration date.

RECYCLE
Re-use or recycle materials whenever you can.

Pet Wastes
It's a health risk to pets and people, especially children. It's a nuisance in our neighborhoods. Pet waste is full of bacteria that can make people sick. If it's washed into the storm drain, the bacteria could enter your drinking water reservoir. Unless people pick up after pets, the waste enters our water resources with no treatment.

Appendix E

Water Supply Protection Checklist

For Coordinating Local Project Reviews

Water Supply Protection Checklist - *For Coordinating Local Project Reviews*

I. Property Owner/Developer

Name ____

Mailing
Address____

Telephone____

II. Location of Proposed Project

1. *Site Address* __________________________________*Assessors map-lot/parcel#*__________
2. *Current zoning*__________________________
3. *Proposed project is located in an Aquifer or Watershed Protection Zoning District (y/n)* _____
4. *Proposed project is located in a DEP designated water supply zone* [i] *(y/n)*______,

Groundwater Source(s):___________________________
(i.e Abbott Well, Tewksbury Hospital)
Zone I _______ Zone II _______ IWPA_______

Surface Water Source: ___________________________
(i.e. Haggetts Pond, Fish Brook)
Zone A_______ Zone B_______ Zone C_______

III. Description of the Proposed Project

1. The Type of proposed use or activity is considered: (check all that apply)

____new development or structure
____expansion of an existing use
____replacement of an existing structure
____other ___________________________

____ a change in use
____ a secondary or accessory use
____ a non-conforming use

2. Describe the proposed project:

____
____
____
____
____
____

3. The proposed project includes the following uses or activities in the **Zone II, IWPA** or **Zone A** of a drinking water source[ii]:

______ a) storage of:

_____ liquid petroleum products
_____ liquid hazardous materials
_____ deicing chemicals
_____ animal manure
_____ commercial fertilizers

_____ b) generation, treatment, storage, or disposal of hazardous waste
_____ c) non-sanitary wastewater treatment or disposal works
_____ d) stockpiling of snow/ice containing deicing chemicals
_____ e) construction of impervious surfaces
____ f) junkyards, automobile graveyards, salvage yards
_____ g) excavation of earth material

In Groundwater Zones IIs or IWPAs

____h) storage of sludge or septage
____i) installation of floor drains
____j) landfills, dumps, monofills
____k) petroleum, fuel or heating oil bulk stations or terminals

In Surface Water Zones A

____ l) solid waste facilities
____m) motor vehicle repair operations
____n) cemeteries
____o) animal standing, stabling or grazing
____p) commercial car washes and outdoor washing of commercial vehicles

4. These activities or uses are controlled through:

Zoning Bylaws/Ordinances ____
Board of Health Regulations ____
General Bylaws/Ordinances ____
Not Controlled____

5. The proposed project is consistent with the local regulatory control (y/n) ______________
(comment)____
____

6. Sensitive features on the project site include:

_____erodible soils/steep slopes ____wetlands ____flood
_____shallow depth to groundwater ____highly permeable soils ____rivers/streams
____ private (homeowner) wells ____shallow fractured bedrock ____other_________

7. The project site/facility has existing threats (or violations) to drinking water supplies:

____improperly abandoned well ____unsealed floor drains

____leaking under/above ground storage tanks ____hazardous waste disposal/storage
____improper hazardous materials storage ____stormwater/flooding
____other____

IV. Attachments [iii]

site plan/design__________ map____________ other_____________________

V. Comments/Additional Information[iv]

____
____
____

This information has been received/reviewed by:

____________________________ __________________
Water Department Reviewer **Date**

ENDNOTES

[i] Identify the water supply areas for all public water supplies. Include the Interim Wellhead Protection Areas (IWPAs) for small water systems, and Zones A and II that may extend into your community from sources located in adjacent municipalities. A proposed project may also be located in overlapping water supply areas for different sources; such as a Zone II and Zone A, or Zone II and IWPA .

[ii] Activities/uses (a-g) impact both surface or groundwater source. Activities/uses (h-k) are applicable to groundwater sources only, and activities/uses (l-p) to surface water sources.
This list is consistent with the land uses/activities identified in MA Wellhead Protection Regulations 310 CMR 22.21(2) and Surface Water Supply Protection Regulations 310 CMR 22.20B and C.

During a project review, officials may determine that existing local controls do not adequately protect a drinking water supply. If a particular land use or activity is insufficiently controlled, or the local protection district map does not cover the water supply area; officials should recommend amending the local controls and map to prevent future similar projects.

To address a potential threat, local entities should provide recommendations for mitigating the project's impact on water quality; such as a relevant board of health regulation, applicable best management practices and technical assistance.

[iii] Attach all relevant plans, maps or other documents that will enable entities to adequately review a proposed project. A map showing the location of the proposed project, the boundaries of the local protection zoning district, and the delineated water supply zones should be included.

[iv] Use this section to provide additional information and explanation, and to identify and describe difficulties with implementing protection controls.

DROUGHT MANAGEMENT PLAN
for the
TOWN OF NORTH READING, MA

November 2013

WRIGHT-PIERCE
Engineering a Better Environment

DROUGHT MANAGEMENT PLAN

NORTH READING, MA

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EXECUTIVE SUMMARY

ES.1 OVERVIEW

The scope of this report was to develop a Drought Management Plan (DMP) for the Town of North Reading based upon specific factors related to the Town's water system. A DMP is a necessary tool for a public water supplier to control increased water demands associated with a drought condition.

Drought conditions can occur any time of year when a water system experiences an increase in demand and reduction in water supply. Many reasons can be found for increases in water demand, but in general they include, deficiencies in precipitation, population growth, climate change, and changes in use (outside watering) and are generally responsible for water supply shortages. Balancing the needs of the Town's residents in regard to water demands can be difficult. The goal of the DMP is to identify a clear descriptive process in which anticipation of an unbalanced condition in the water supply and system demand is identified and measures required to prevent a failure of the water system are implemented.

The Town of North Reading is limited in the amount of water it can provide the residents. A Water Registration regulates the amount of water that can be withdrawn from the Town's wells and an Inter-basin Transfer Act (IBTA) regulates the amount of water that can be purchased from Andover. Therefore water restriction measures are critical during periods of increased water demand to maintain the Town's withdrawals within these regulated limits.

ES.2 SUMMARY OF FINDINGS AND RECOMMENDATION

The Town has an existing program in place for managing its water supply during a drought event. The study reviewed the existing program and assessed its performance based on historical records furnished by the Town and drought indicators. The existing program is a first step in drought management but the plan must be revisited on a periodic basis to assess the performance of said plan. Recommendations are made in the following report to optimize the performance of drought management for the Town of North Reading.

The Town has been active in drought management and has stressed the importance of drought management through the years with public communication through the use of newspapers, signboards, and electronic devices (e.g., the Town's web site on the internet). Communicating the importance of water and sustainable management of water usage during a drought event is critical. However, continued efforts in this regard are recommended to enforce the measures the Town has implemented.

By continuing the efforts of the Town in regards to drought management and incorporating the following recommendations, the Town can more efficiently control the water demand and water supply of their system.

- Mandatory Water Conservation Measures during Normal Drought Conditions.
- Adjustments to the Primary and Secondary Triggers for Andover Water Demand and Sequential 90 degree days.
- Irrigation water usage metered separately and charged a higher rate or annual flat fee.
- Ban on plumbed irrigation systems.
- Providing low cost water reduction devices free of charge.
- Residential water audits provided free of charge.
- Explore supplemental water sources to strengthen the Town’s water supply to meet increasing water demands.

Appendix A includes revised Water Restriction Triggers and Internal Procedures dated 11/12/13 and Water Use Restrictions dated 11/12/13 for the Town’s use based on the recommendations made in this report.

Section 1

Wright-Pierce
Engineering a Better Environment™

SECTION 1

INTRODUCTION

1.1 GENERAL

The Town of North Reading owns and operates a public water supply that provides water to over 95% of the residents and businesses in the Town. The Town's water system consists of seven (7) public wells, approximately 90 miles of water main and three water storage tanks. The Town also purchases a portion of the water supply from the Town of Andover, which is transported to North Reading through two interconnections. Approximately 40% of the water provided by North Reading is obtained from the Town-owned wells and the remaining portion is purchased from Andover.

The Town is limited in the amount of water it can provide the residents. A Water Registration regulates the amount of water that can be withdrawn from the Town wells as well as an Inter-basin Transfer Act (IBTA) permit regulates the amount of water that can be purchased from Andover. The Town is limited to 0.96 (MGD) million gallons of water per day under the Registration and the IBTA limits purchases from Andover to 1.5 MGD. Withdraws or purchases over the permitted values can result in violations and requires the Town to obtain additional water sources and impose strict water usage management at significant expense.

Many reasons can be found for increases in water demand, but in general they include, deficiencies in precipitation, population growth, climate change, and changes in use are generally responsible for water supply shortages. Balancing the needs of the Town's residents in regard to water withdrawals and the need to sustain healthy waterways, can be a challenge. This Drought Management Plan (DMP) will provide a framework for the monitoring and control of water use under stressed conditions and optimize water use throughout the year, allowing the Town to stay in compliance with its permitted water sources and ensuring adequate water supply is available at the most critical times.

A DMP is designed for each water supplier based upon specific factors related to water sources, storage capacity and system use. The use of the term drought refers to a period when a region is deficient in its water supply and any conditions that put a stress on the amount of water supply by the users of that region (system). In simplest terms a DMP provides a series of escalating controls based upon the demand of the users exceeding the amount of water available. This plan is a necessity in order to withstand the hottest and driest years while controlling increased water demands. The plan identifies a clear descriptive process in which anticipation of an unbalanced condition in the water supply/demand may occur and more drastic measures are required to prevent a failure of the water system. The DMP should be considered at any time of the year that increased demands, water supply reductions, emergency conditions, catastrophic system failures, or drought conditions could occur.

Recent occurrences of low water levels in the Town's three water storage tanks have caused great concern for the Town. In particular the Tower Hill tank is most sensitive to changes in water demands and therefor used for reference when analyzing drought impacts. For instance, on July 25, 2011 between 4:00 a.m. and 6:00 a.m., the water storage tank levels dropped significantly within a span of two hours resulting in a reduction in the available water for supply and fire protection of 360,000 gallons and the tank was 66% full. A Water Conservation Notice was brought to the residents' attention on Friday July 22, 2011 which stated the low levels were due to the "record setting hot weather and high water demand". The concern increased when the tanks were unable to recover (refill with water) following the low levels since the daily water use increased. The Boston Globe article "After winter drought, craving April showers" by David Abel on March 31, 2012 provides some insight on the drought situation that North Reading is facing. In April 19, 2012, an article was published in the Town's newspaper ("Transcript") titled "Dry Weather causes DPW to urge water conservation" on the front page, which once again describes the critical need for water conservation. This DMP has been developed in response to these current events.

North Reading's water sources, system demand history, drought history, and water distribution system have been investigated and considered through the process of developing this DMP. Major components pertaining to water shortages and droughts are also explained.

1.2 IPSWICH RIVER WATERSHED

The Ipswich River Watershed provides about 40% of North Reading's water supply. Overall, this watershed provides as a water source to thirteen other communities and includes portions of at least 22 municipalities. The land use consists of approximately 31% residential land, 4.6% commercial land, 41% forest and open space, 2.3% open water, and 21% wetlands. The river has been known to be one of the most stressed rivers in the country since it is notorious for its extreme flow fluctuations between droughts and floods.

The United States Geological Survey (USGS) has records since the year 2000 of the Ipswich River having the highest and lowest fluctuations in their water flows. These high fluctuations are primarily due to the impervious areas that have recently been constructed such as parking lots, roads, roofs, and other areas that have been built in the place of permeable land such as forests and fields over the years. The rainfall that once fed the forests and fields is currently being collected and piped to the river and its tributaries which accounts for the highest and lowest records. Recent proof of these oscillating flows is when the river has caused some major damage to the neighboring communities from flooding in May of 2006 and April of 2007, and yet on the contrary, the river runs dry frequently during the summer. In addition, damage occurs to the aquatic life as a result of these droughts and dramatic fluctuations.

The USGS graphs, Figure 1-1 and 1-2, display the dramatic changes in flow that occur within the Ipswich River. Figure 1-1 depicts streamflow conditions in April of 2007. The daily discharge rose to be as high as 700 cfs and then dropped to be as low as 4.0 cfs in July of 2007 (a change occurring over only 3 to 4 months). Within that short period of time, the daily discharge decreased by an incredible 99%. Figure 1-2 is more recent data from the USGS website (consistently updated) that also shows dramatic changes.

FIGURE 1-1
USGS DATA RECORDED AT SOUTH MIDDLETON, MA

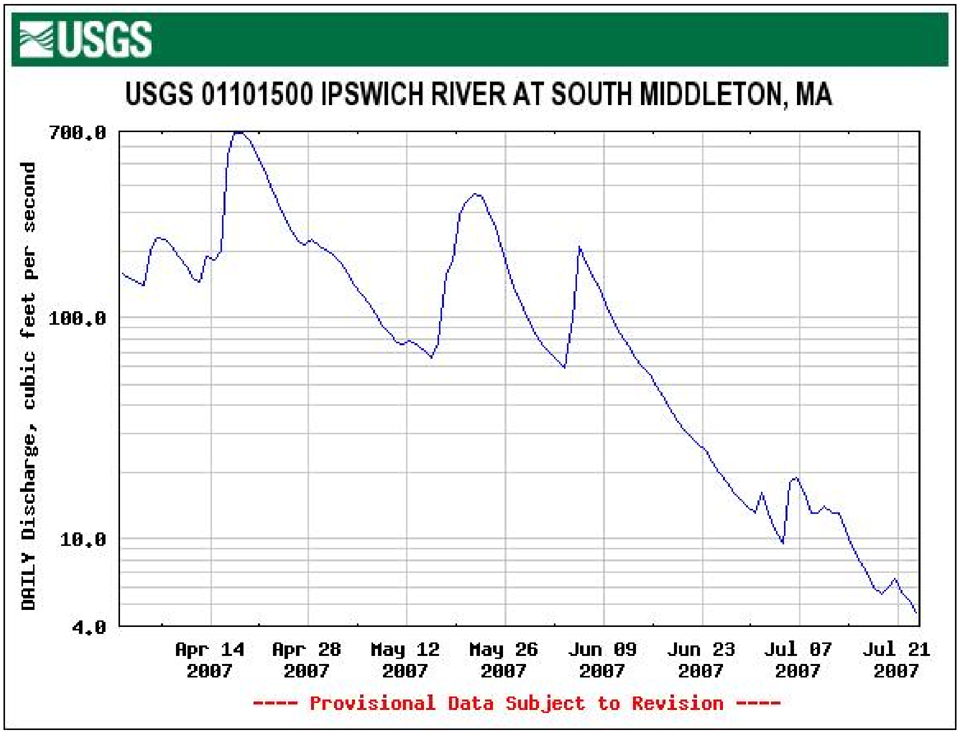
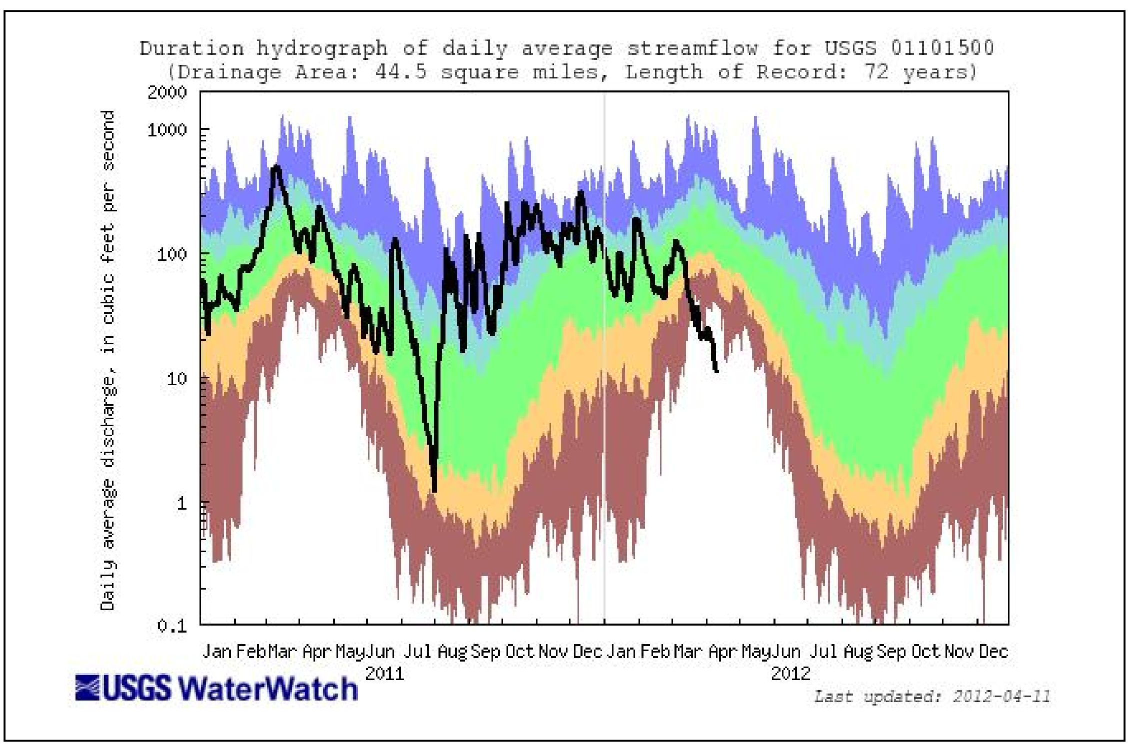


FIGURE 1-2
USGS DATA RECORDED AT SOUTH MIDDLETON, MA



In Figure 1-2, the black line represents the actual flow recorded at South Middleton, MA on the Ipswich River and the colored shading represents the percentile class (brown is <10, orange is 10-24, green is 25-75, teal is 76-90, and blue is >90). Around March of 2011 the daily average discharge reached to about 500 cfs and 4 to 5 months later around July/August 2011 the discharge dropped to almost 1 cfs, more than a two log change in a short time period.

Agencies and organizations such as the Ipswich River Watershed Association, the Massachusetts Department of Environmental Protection (DEP), the Massachusetts Audubon Society, the Reading/ North Reading Stream Team, and other interested parties are seeking alternative ways to minimize impacts to the river. For more information on the watershed, please go to http://www.mass.gov/eea/agencies/dcr/water-res-protection/ipswich-river-watershed/ipswich-river-watershed.html .

These extreme high and low flow conditions impact North Reading's water supply since the Ipswich River aquifers are one of the primary sources of water for the Town.

1.3 WATER SOURCES

The Town of North Reading maintains seven public groundwater well sources and purchases the remaining water from the neighboring Town of Andover to meet demand. Each of these sources has permitted limits of water withdrawal.

1.3.1 Ipswich River Watershed

The main component of the North Reading publically owned water supply is the Ipswich River Watershed. Each of the seven groundwater well sources draws water from this watershed.

1.3.2 Railroad Bed Wells (3213000-01G)

This is one of the seven groundwater wells the Town utilizes. The well is a gravel-packed well that has a depth of about 48.5 feet. This well is approved for a daily volume of 0.5 MGD. This well has a Zone I radius of 400 feet.

1.3.3 Lakeside Boulevard Well #2, #3, #4 (3213000-02G, -03G, -07G)

Well #2, #3, and #4 are gravel packed wells that are 42 feet, 38 feet, and 59 feet deep, respectively. The three wells, combined, have a DEP approval daily pumping rate of 0.9 MGD. These wells have a Zone I radius of 400 feet.

1.3.4 Central Street Wellfield (3213000-04G)

This tubular well field has an average depth of approximately 28 feet. The well field has an approved daily pumping volume of 0.4 MGD. The wells located in the wellfield have a Zone I radius of 250 feet.

1.3.5 Route 125 Well (3213000-05G)

This well is a gravel-packed well that has a depth of about 35 feet. This well is approved for a daily volume of 0.19 MGD. This well has a Zone I radius of 400 feet.

1.3.6 Stickney Well (3213000-06G) (Inactive)

Although this gravel-packed well is currently inactive, it may have the potential to become active. The well was closed in 1978 from volatile organic chemical (VOC) contamination and the Town has considered over the years to activate the well but doing so with the high contamination was not economically feasible. The Stickney Well has an Interim Wellhead Protection Area (IWPA) which connects to the Town of Wilmington. This well has a Zone I radius of 400 feet.

1.3.7 Andover Supply (3213000-01P)

North Reading purchases water from the Andover distribution system at about an average of 0.938 million gallons per day based on 2011 pumping records. Andover's main water source is the Merrimack River Basin. North Reading is able to purchase this water through the Inter-basin Transfer Act (IBTA), in which the Town is permitted to take 1.5 million gallons per day.

More information for each of these sources can be found in Section 2.3 Water Production and Availability. There is always the potential of creating new sources either by making more wells or by connecting to another Town. Residents also have the choice to install their own private well, but must follow North Reading's regulations which can be found at http://www.northreadingma.gov/Pages/NReadingMA_Health/wellreg.

1.4 DISTRIBUTION SYSTEM DEMAND HISTORY

The annual average water demand is approximately 1.4 million gallons per day (MGD) for the whole Town. That demand will increase to on average approximately 1.8 MGD during the summer months and the Town will see daily maximum demands just under 2.5 MGD. These increases are a result of increased outdoor water use.

1.5 DROUGHT MANAGEMENT HISTORY

The Town has stressed the importance of drought management through the years with public communication of newspapers, signboards, and electronic devices (e.g., the Town's web site on the internet). A recent publication in the North Reading "Transcript" on April 19, 2012 (Vol. LVI No. 48) reminding the community on the importance of conserving water. Within the article the Department of Public Works (DPW) urged the Town's residents to conserve water, especially outdoor water use such as landscape maintenance, which is not an essential use for the Town's limited water supply especially in stressed conditions. The limited water supply is critical for human consumption and fire protection.

Over the years North Reading has been metering water use, restricting water use, enforcing fines, performing leak detection, replacing and repairing meters, and using water saving devices. Water restrictions during the summer have been put in place as early as 1990. The Town has encouraged residents to install their own well for their outdoor water use. Leak detection surveys have been performed every couple of years to try to eliminate all unaccounted for water (UAW) by repairing leaks. UAW is defined by MassDEP as the difference between water pumped or purchased and water that is metered or confidently estimated. A drought contingency plan was created in order to enforce fines. Programs were initiated in order to replace and repair meters. Public buildings were required to install water saving devices. On October 11, 2007 a drought advisory was made. On July 22, 2011 North Reading's DPW posted a Water Conservation Notice that asked residents to reduce or stop outdoor water use for seven days and to continue the odd/even water use restrictions that the Town holds at all times.

The Ipswich River Watershed is one of the Town's major water supply sources, so any droughts or shortages occurring to the river will essentially impact the Town as well. Recently on April 16, 2012, the USGS gauge located on the Ipswich River at South Middleton, MA was stated to have a flow rate of 28 cfs. USGS stated this flow rate is the lowest "for this date in the 74 years of record keeping at this gauging station. The previous low flow for this date was 29 cfs recorded in 1966 and the average flow rate for this date is 137 cfs." The Ipswich River is reaching its lowest recorded flows in history, which increases the necessity for the Town to have a conservative drought management plan so the Town will preserve resources, and be able to satisfy the water demand of their system. This also causes concern since these record lows have been reached in April generally a high flow period. Water shortages will continue to be a greater concern/ demand in years to follow.

North Reading has watched these drought conditions get progressively worse over the years. Recent evidence suggests that climate change will result in a greater variation in the consistency and intensity of precipitation, which will negatively impact the available supplies. The Town has been able to reduce consumption over the years, but shortages related to excessive demand continues to occur.

Section 2

SECTION 2

DATA MONITORING

2.1 GENERAL

The first step in developing a framework for the control of water demand involves the monitoring of various systems in the Town's water system as well as larger State-wide indicators of the need to control water demand. Data from sources such as the State indices, the Andover drought status, the Ipswich River flow, the Town's storage tank elevations, and Town usage data (from both local sources and Andover interconnection) are considered when determining the monitoring triggers that will be used as part of the DMP. Defining the monitoring period for the triggers is also extremely important for managing a sustainable water supply through a drought condition. High demand is usually associated with warm weather and reduced rainfall. However a high system demand may occur as a result from commercial/industrial use, water main break or specific non-seasonal spikes related to changes in the overall climate of New England.

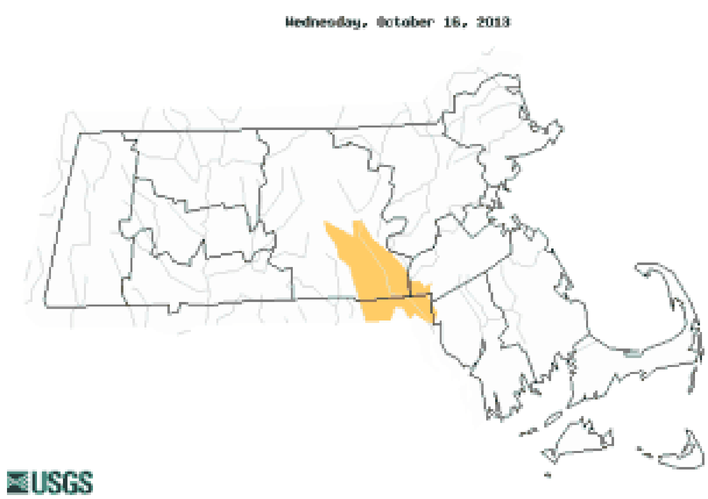
The data monitoring plan should be simple to implement and provide an easy set of responses for the Town to implement the control strategies. A specific set of recommendations is provided in this plan, but the plan must be revisited on a periodic basis to assess the applicability and appropriateness of the recommended measures. Changes in the system, user habits, and changes in the trends will require a review and adjustment of this plan to reflect the most current conditions.

The following describes potential indices, which are available to the Town for the purposes of monitoring system areas as part of the DMP. A sub-set of these indices will be recommended for routine monitoring based upon the sensitivity of the index and its usefulness in understanding North Reading's water demand.

2.1.1 State Indices

Every state has records and data that is interpreted and examined on a routine basis to provide indices for guidance. Comparing averages and outliers in history can help determine and predict future weather patterns and to help prepare when a drought watch or indicate a new drought stage. The state of Massachusetts has a whole webpage dedicated specifically to the "MA Drought Watch". The data provided by the state is strongly considered as one of the drought indicators for this DMP. Please visit the USGS website at http://ma.water.usgs.gov/drought/ for all of the complete up-to-date information on the MA drought status. These comparisons help the Town to determine the best and efficient plan of action to follow in times of need.

FIGURE 2-1
MASSACHUSETTS DROUGHT WATCH - MAP OF BELOW NORMAL STREAMFLOWS
(Example dated 10/16/13)



Explanation - Percentile classes				
Low Extreme hydrologic drought	<=5 Severe hydrologic drought	6-9 Moderate hydrologic drought	10-24 Below normal	Above 25% of normal

All state drought indices and forecasts can be found on the Massachusetts home page at http://www.mass.gov/eea/agencies/dcr/water-res-protection/water-data-tracking/drought-status.html . The drought indices MA uses includes the US drought monitor (the National

Drought Mitigation Center's Drought Monitor Map), Standardized Precipitation Index (Western Regional Climate Center's Index values for MA from the Desert Research Institute, University and Community College System of Nevada), NWS/NOAA's Climate Prediction Center (U.S. Seasonal Drought Outlook), and extended forecasts (National Weather Service Climate Prediction Center's extended forecast; NWS Climate Prediction Center Info: http://www.cpc.noaa.gov/index.php. All state indices and forecasts are consistently updated on their home page every month.

2.1.2 Andover Drought Status

Andover has five drought indicators: Fish Brook Pumping Station wet well level, Haggetts Pond reservoir level, raw water operations demand, distribution storage capacity, and the Palmer Drought Index. Andover is dependent on each of these indicators to guide the Town into the different drought phases to help conserve and reserve water. Since a portion of Andover's water supply is provided to North Reading, Andover's drought status is an important factor to monitor routinely. Any information relating to Andover's drought status, or further information about the Andover water demand and history, can be found on Andover's home page: http://andoverma.gov/.

2.1.3 Ipswich River Flow

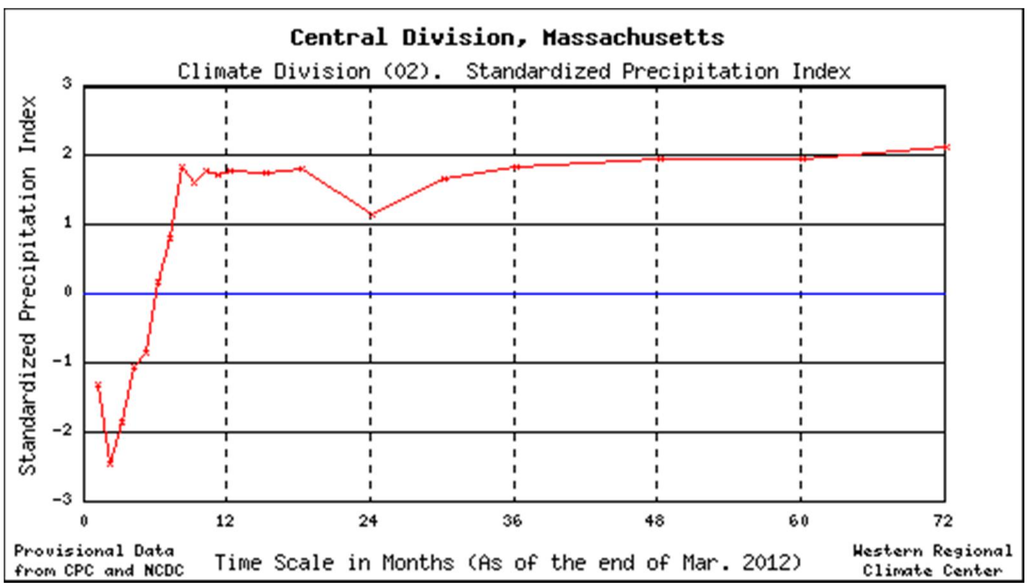
The Ipswich River flow data is a component to help keep North Reading's drought status up-to-date. It provides a strong link to drought conditions, since the Ipswich River is a main source of water for the Town. The data retrieved from the Ipswich River will be analyzed and looked over routinely to determine the region's drought status.

Observation of the Ipswich River historic data has shown that the river has had the greatest hits of shortage during the summer. To find the most recent/updated information and records, the internet provides an accommodating source at this address http://www.mass.gov/eea/agencies/dcr/water-res-protection/ipswich-river-watershed/ .

2.2 PRECIPITATION

The deficiency of precipitation is a precursor for droughts and water shortage. Precipitation is monitored and recorded on a routine basis to determine the average precipitation. The average is compared to the current data to determine whether the precipitation is above or below the average amount. Monitoring precipitation is the most obvious indication of water shortages and drought potential. Each state has a customized standardized precipitation index. An example of the Massachusetts Index is shown below, which the Town would monitor continuously to determine the most current drought stage for North Reading.

FIGURE 2-2
STATE STANDARDIZED PRECIPITATION INDEX
(72 Month look at SPI, period ending March 2012)



The Massachusetts Standardized Precipitation Index, shown above, illustrates the SPI for the past 72 months with the end date of March 2012 as the final point on the index. When the index is negative it signifies drought conditions whereas the positive is wet conditions using probability. The value of zero is the median. The SPI is completely determined upon precipitation. The SPI is very helpful to monitor to determine the scale or severity of the drought, or vice versa. This index accurately illustrates points on a graph for what the index would be for each month of the year and is consistently updated to provide the most accurate results. These results aid in monitoring patterns and allow the Town to compare the current data with the historical average.

Additional information can be found at the following:

- National Drought Mitigation Center, http://www.drought.unl.edu/
- "Climate of 2013- April U.S. Standardized Precipitation Index"

http://lwf.ncdc.noaa.gov/oa/climate/research/prelim/drought/spi.html

2.2.1 Palmer Drought Index

The Palmer Drought Index is one of the five drought indicators that Andover uses to determine their drought status. This index is very helpful since it can reflect conditions of drought or excess rainfall anywhere in the U.S. More information on this index can be found at http://www.drought.gov/nadm/content/palmer-drought-indices . Weekly maps and current monitoring is available at http://www.cpc.ncep.noaa.gov/products/analysis_monitoring. Table 2-1 below is the Palmer Drought Index.

TABLE 2-1
DROUGHT INDICATOR: PALMER DROUGHT INDEX

Palmer Drought Index	
>4.0	Extremely Wet
3.0 to 3.99	Very Wet
2.0 to 2.99	Moderately Wet
1.0 to 1.99	Slightly Wet
0.5 to 0.99	Incipient Wet Spell
0.49 to -0.49	Near Normal
-0.5 to -0.99	Incipient Dry Spell
-1.0 to -1.99	Mild Drought
-2.0 to -2.99	Moderate Drought
-3.0 to -3.99	Severe Drought
-4.0 or less	Extreme Drought

The table above gives an index for the amount of precipitation and the severity associated to the amount.

2.3 WATER PRODUCTION AND AVAILABILITY

North Reading's water supply is derived from seven groundwater well sources and is purchased from the neighboring town of Andover. Each of the well sources in North Reading draws their water from the Ipswich River Watershed. The withdrawal volume from the watershed according to the data from DEP 2012 Public Water Supply Annual Statistical Report (ASR) is listed in Table 2-2 below.

TABLE 2-2
IPSWICH RIVER WATERSHED

IPSWICH RIVER BASIN (WATERSHED) (2012)		
Total Raw Pumped in 2012(MGY)	**Average Daily Withdrawal (MGD)**	**Registered Volume (MGD)**
212,599	0.58	0.96

Overall, this watershed is able to effectively permit the volume of 0.96 MGD of water to the Town of North Reading. More information on the Ipswich River Watershed can be found at http://www.mass.gov/eea/agencies/dcr/water-res-protection/ipswich-river-watershed/ .

There are seven groundwater well sources and only one of those sources is inactive. Table 2-3 gives data for each of these sources. Lakeside Boulevard Well #2, 3, and 4 have a combined pump volume so the data for all three wells are combined under Well #4. The inactive source is the Stickney Well.

TABLE 2-3
2012 ASR DATA ON WELL SOURCES

SourceID	Source Name	Location	Source Watershed	Active	Well Depth	Total Pumped (MG)	Total # of Days Pumped	Max Day Volume	Average Pumped Per Day
3213000-01G	Railroad Bed Wells	Cold Spring Rd	Ipswich	Yes	48.5	98.353	288	0.500	0.342
3213000-03G*	Lakeside Blvd. Well #3	55 Lakeside Blvd.	Ipswich	Yes	38	*	-	*	-
3213000-02G*	Lakeside Blvd. Well #2	55 Lakeside Blvd.	Ipswich	Yes	42	*	-	*	-
3213000-07G*	Lakeside Blvd. Well #4	66 Lakeside Blvd.	Ipswich	Yes	59	56.850	353	0.373	0.161
3213000-04G	Central Street Wellfield	256 Central St.	Ipswich	Yes	28	17.784	341	0.114	0.052
3213000-05G	Route 125 Well	Off Rte 125	Ipswich	Yes	35	40.411	353	0.161	0.114
3213000-06G	Stickney Well	Off Redmond Ave.	Ipswich	No	35	0	0	0	0

Note: * Combined and reported total on Well No. 4

The Railroad Bed Wells on Cold Spring Road is the largest groundwater well contributing source from North Reading with an average volume pumped per day of about 0.342 MGD. The groundwater well source that is the smallest in size and in flow volume is the Central Street Wellfield located at 256 Central Street and in 2012 average volume pumped per day was 0.052 MGD.

North Reading purchases an average of 0.858 MGD from the Andover distribution system. Table 2-4 provides data on the Andover distribution system from the 2012 ASR.

TABLE 2-4
PURCHASED WATER FROM TOWN OF ANDOVER (2012)

ANDOVER SUPPLY (3213000-01P)					
Location	**Active**	**Total Pumped (MG)**	**Total # of Days Used**	**Max Day Volume**	**Average Pumped Per Day (MGD)**
Main St (Rte 28) and Central St (Gould Rd)	Yes	313.028	365	1.502	0.858

The Andover distribution system is a major contributing source to the Town; therefore, monitoring Andover's drought status and data can be a critical factor for the DMP.

2.4 WATER DEMAND

Historical water usage in North Reading was evaluated to determine past water usage trends and characteristics. An analysis of water use in North Reading from 2002 through 2011 was made and used to forecast future demands. Historical water use data was obtained from the City's Annual Statistical Reports (ASR) which is submitted each year to the MassDEP.

Based on information presented in the ASRs, recently in the years of 2009 and 2010, the population served by the water department increased by 185 people, the residential gallons per capita day (RGPCD) increased by 14 gal/person/day, and the net finished water consumption increased by 13.27 MG, as shown in Table 2-5. On top of that, the water demand in the summer season tends to be more with a summer consumption increasing by 9.231 MG. However, North Reading's population remained steady in 2011 and net finish water consumption still increased by 36.898 MG which is largely contributed to an increase in summer water usage which saw a 15% increase in use from the previous year. In 2012, the population held steady and demands dropped off from the previous year but the trend over the past four years is an increase in demand on the water supply. On top of the increasing demands, the Town must maintain adequate supplies for fire flows and other critical events.

TABLE 2-5
DEMAND FROM 2009 TO 2012

Year	2009	2010	2011	2012
Population (served by the PWS)*	14,221	14,406	14,397	14,397
RGPCD (gal/person/day)	51	65	74	72
Net Finished Water Consumption (MG)	476.151	489.422	526.320	510.235
Summer Consumption, June through August (MG)	142.273	151.504	174.746	158.766

Note: * Census data shows Town population being 500 people higher than the listed population in the Table. It has been estimated by the Town that 500 people are serviced from private wells.

The highest demand in North Reading is from residential population with about 80% to 90% of the total metered finished water volume used, and the second highest demand is from the industrial residents, according to the ASRs. See Table 2-6 for the metered finished water use for each division of town.

TABLE 2-6
2009 THROUGH 2012 METERED FINISHED WATER USE

	2009 Metered Finished Water Use			2010 Metered Finished Water Use			2011 Metered Finished Water Use			2012 Metered Finished Water Use		
	# of Service Connections	Total Volume (mgy)	%	# of Service Connections	Total Volume (mgy)	%	# of Service Connections	Total Volume (mgy)	%	# of Service Connections	Total Volume (mgy)	%
Residential	4562	314.10	80.2	4553	343.45	87.7	4578	392.194	88.9	4577	376.464	89.7
Residential Institutions	14	3.31	0.8	14	3.08	0.8	0	0	0	0	0	0
Commercial/Business	181	27.94	7.1	184	25.47	6.5	169	20.172	4.6	176	24.781	5.9
Agricultural	0	0	0.0	0	0	0.0	2	0.105	0.0	0	0	0
Industrial	45	38.16	9.7	40	28.877	7.4	47	19.469	4.4	48	12.868	3.1
Municipal/Institutional/ Nonprofit	19	8.15	2.1	19	7.05	1.8	34	9.234	2.1	28	5.667	1.3
Other	0	0	0.0	0	0	0.0	0	0	0	0	0	0
TOTAL	4821	391.65		4810	407.885		4830	441.174		4829	419.78	

The highest demand can be linked to summer water use from the residential community, which contributes to the highest population and volume of water use in Town.

Commercial/business and Industrial population has been decreasing and at the same time the residential population has been increasing or holding steady, according to the recent data. Therefore, as noted, the total finished water volume has increased which likely is associated with excess residential outdoor water used in the summer.

2.5 TEMPERATURE

An increase in temperature for a long duration can greatly impact and extend a drought condition. Daytime temperatures can also be higher during a drought because the decrease in moisture in the atmosphere leads to less cloud cover and therefore the sun heats the atmosphere quicker. With a decrease in moisture in the air, the tendency for rainfall is also decreased extending a drought condition. The insufficient soil moisture from the lack of precipitation and increased temperatures leads to stress on vegetation and a tendency to increase outdoor watering to counteract the drying effects. This increase in outdoor watering during the summer leads to a high demand on the water system. Therefore an increase in temperature for a long duration should be tracked by a public water supplier and water conservation measures implemented during such periods, to insure a sustainable water supply for essential water use and fire protection.

Temperature readings can be taken from local accurate gauges or obtained daily from the news. When trending historical temperature data, the Global Historical Climatology Network (GHCN) – Daily was used for this purpose. The GHCN-Daily database provides historical records on temperature, precipitation, and snow records over the globe. Historical temperature data for North Reading was obtained from a National Oceanic and Atmospheric Administration (NOAA) Station (GHCND: USC 00196783) located in neighboring Reading. The historical information obtained from this database can be used to analyze the relationship between increased temperatures and drought conditions in the Town.

2.6 MONITORING PROGRAM

This Section has presented several different means of monitoring drought conditions relative to the North Reading water system. Many of the monitoring points overlap and do not provide adequate resolution to be used as specific indicators. Table 2-7 provides an analysis of potential indicators for a drought and is based upon the specific conditions of the North Reading water supply and system characteristics.

TABLE 2-7
POTENTIAL DROUGHT INDICATORS

MONITORING INDICATOR	RATIONALE
Total Water Demand	Indicator of stressed system
Town Storage Tank Elevation	Limits ability of Town to provide water in Emergency
Andover Drought Status	Majority of North Reading water supply / represents a composite of several indices
Andover Water Use*	Manage volumes to less than IBTA Allowances
Ipswich River Flowrate*	Town is an net importer of water into basin
State Drought Watch*	Not as sensitive as other indices
State Precipitation Index*	Not as sensitive as other indices
Sequential Days Over 90 Degrees	Indicator of increase in Outdoor Watering
Palmer Index*	Covered by Andover Drought Status
Town Well Withdrawals	Manage volumes to less than registered volumes

Note: * In cases where these are concerned critical, North Reading should review routine drought indicators to ensure that supplies remain stable and available at current usage rates.

2.6.1 Existing Program

The Town of North Reading has an existing Water Restriction Trigger program in place. Table 2-8 provides a summary of the current water restriction triggers used and monitored by the Town and were obtained from the Water Restriction Triggers and Monitoring Frequency dated August 28, 2012 and Water Restriction Triggers, Internal Procedures dated August 29, 2013.

TABLE 2-8
EXISTING WATER RESTRICTION TRIGGERS

TRIGGER	MONITORING INDICATOR	RATIONALE
PRIMARY	Total Water Demand	Indicator of stressed system
	Town Storage Tank Elevation	Limits ability of Town to provide water in Emergency
	Andover Drought Status	Majority of North Reading water supply / represents a composite of several indices
	Sequential Days Over 90 Degrees	Indicator of increase in Outdoor Watering
SECONDARY	Ipswich River Flowrate	Town is an net importer of water into basin
	State Drought Watch	Not as sensitive as other indices
	State Precipitation Index	Not as sensitive as other indices
	Andover Water Use	Manage volumes to less than IBTA Allowances

The existing triggers were reviewed and an analysis of the indicators was performed on the following triggers.

- Pumping records of local sources
- Withdrawals from Andover interconnections
- Storage tank levels
- Historical temperature data furnished by National Oceanic and Atmospheric Administration (NOAA) based on a local temperature station in Reading Massachusetts.

The following figures, Figure 2-3, 2-4, 2-5 and 2-6, show annual historical trending dating from December 1, 2010 to August 31, 2013 of Total Water Demand, Andover Water Use, Town Storage Tank Elevation, and Temperature Data.

Based on that analysis; changes to the Town's current Water Restriction Triggers are recommended.

2.6.2 Recommended Changes to Monitoring Program

The total water demand for the Town’s system includes essential water use as well as non-essential water use such as outdoor water use during the summer to water lawns and fill swimming pools. The Town currently has a limited supply of water from their local sources and restrictions on their interconnection with Andover through the existing IBTA. Due to limitations on their local water supply due to capacity and water quality issues, the Town relies on the Andover connections to supplement the Town’s supplies when demands exceed the capacity of the wells. Therefor we recommend the Andover Water Use be a primary trigger to provide an early indication of water usage trending upwards and to manage its use within the IBTA.

Temperature, especially consecutive days over 90 degrees, is an indication that outdoor water use will increase but it is not so easily and accurately predicted and does not provide ample time for the Town to enforce water conservation measures to maintain a sustainable supply of water within the system for emergency conditions. Also in an effort to have a manageable number of primary triggers, temperature is recommended to be a secondary trigger.

Table 2-9 Recommended Water Restriction Triggers summarizes the recommended changes to the Town’s existing triggers. Specifics regarding the thresholds and monitoring frequencies are provided in Section 3.

FIGURE 2-3
2010 HISTORICAL WATER RESTRICTION TRIGGERS

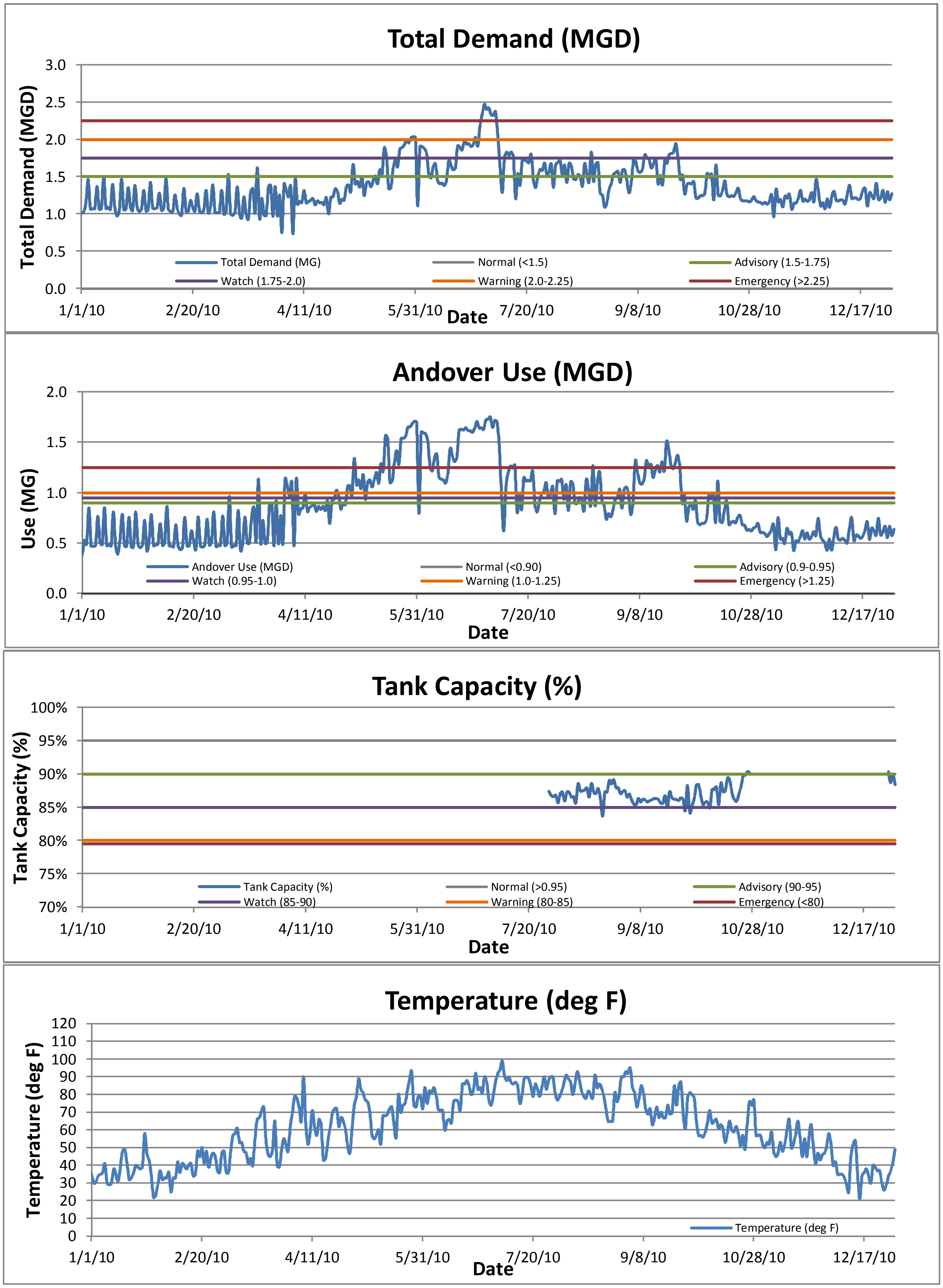


FIGURE 2-4
2011 HISTORICAL WATER RESTRICTION TRIGGERS

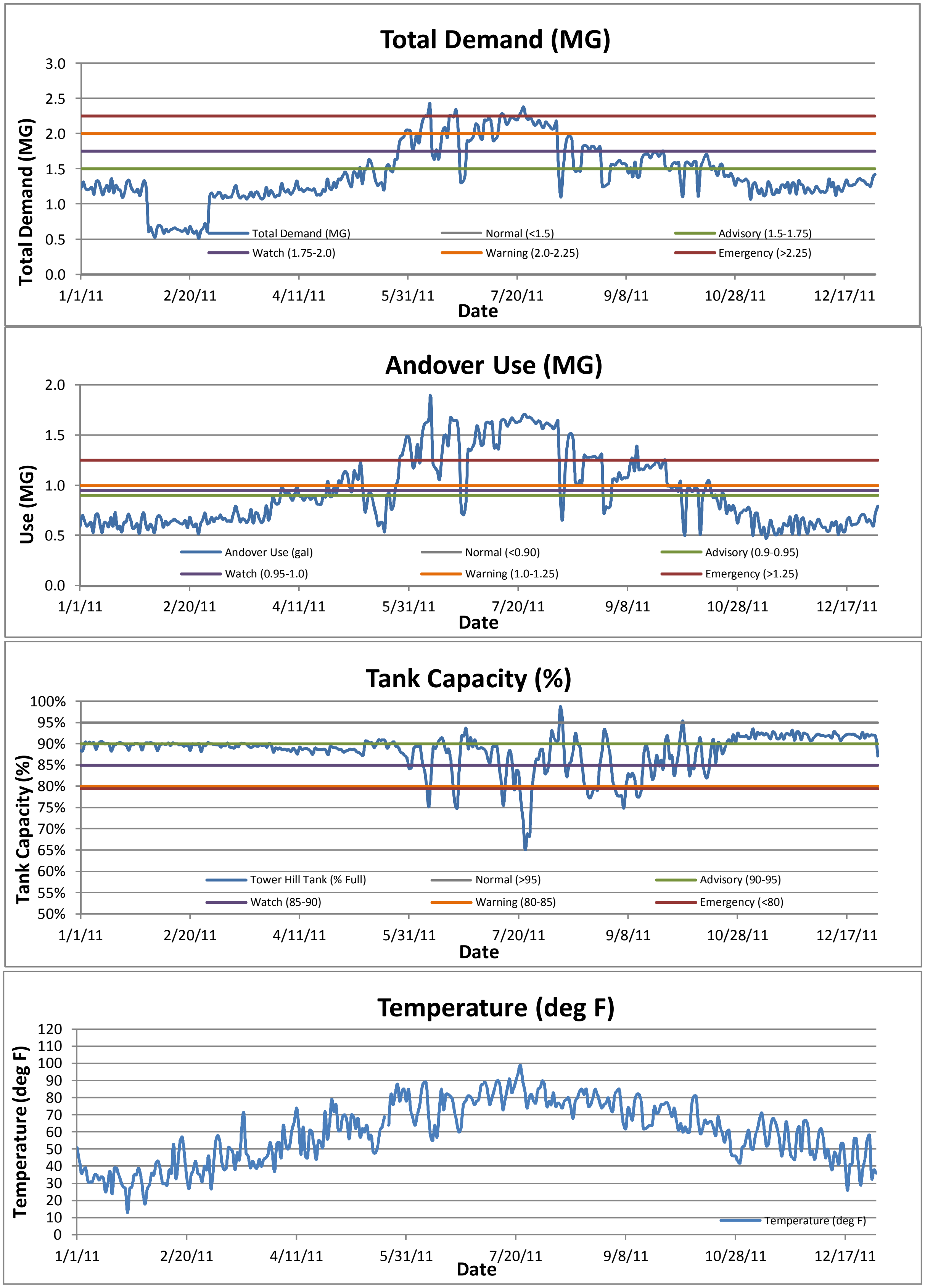
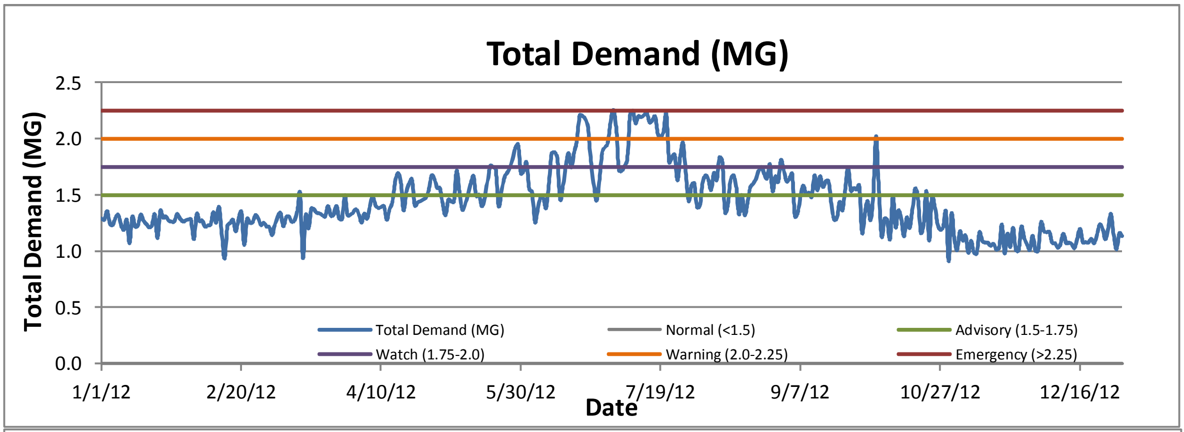
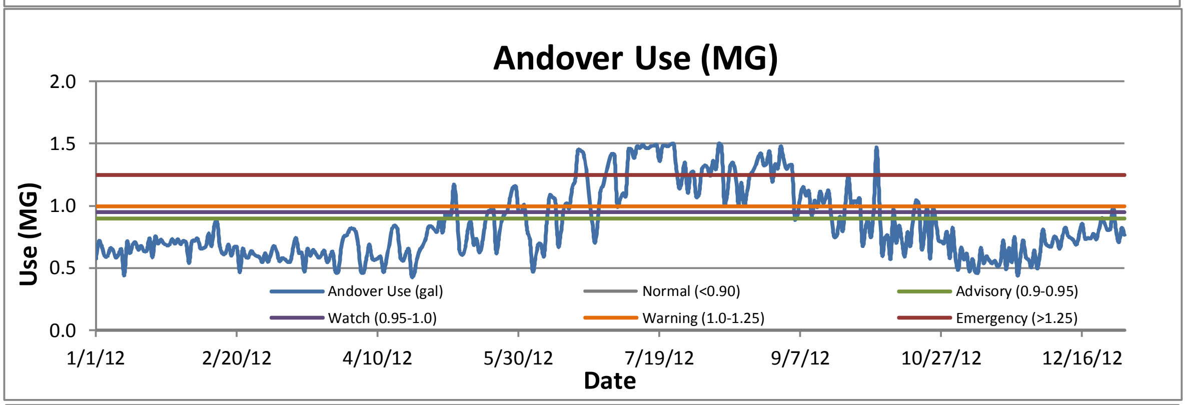
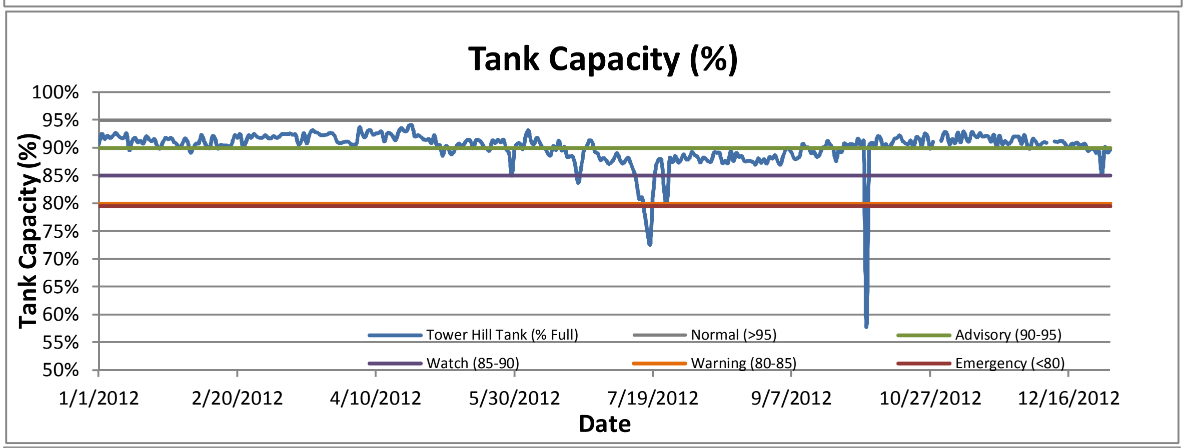


FIGURE 2-5
2012 HISTORICAL WATER RESTRICTION TRIGGERS







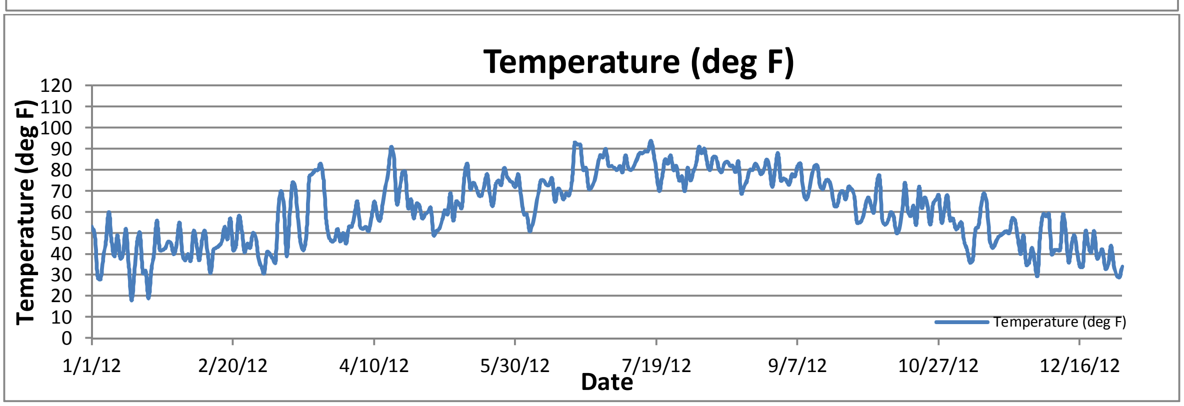
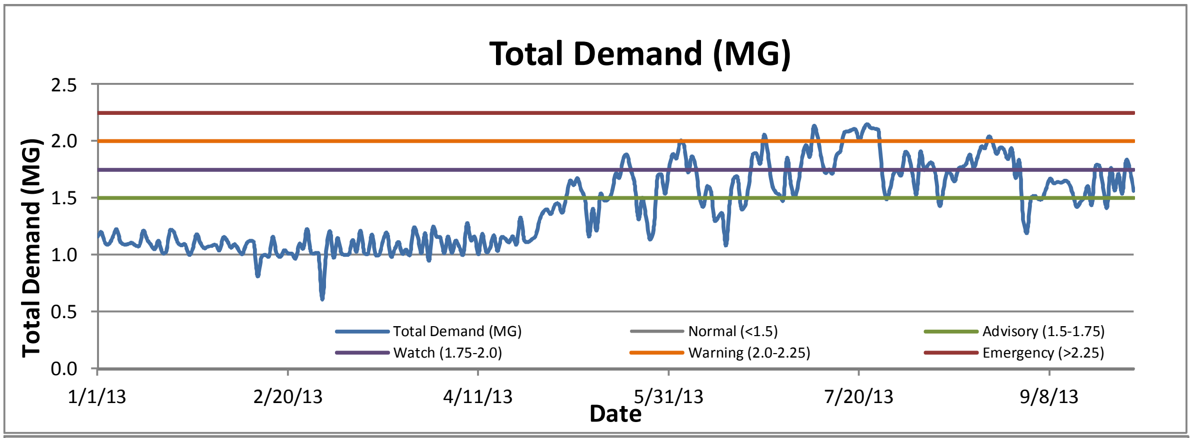
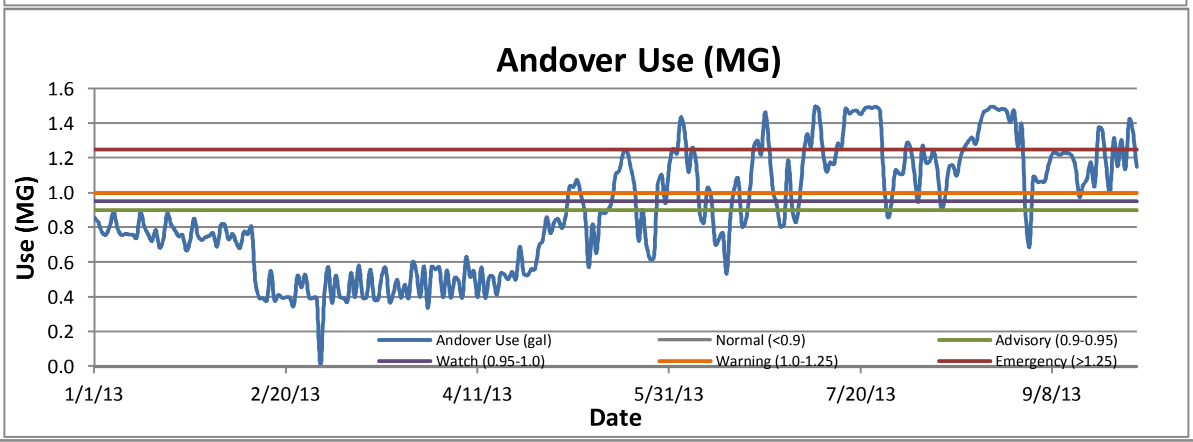
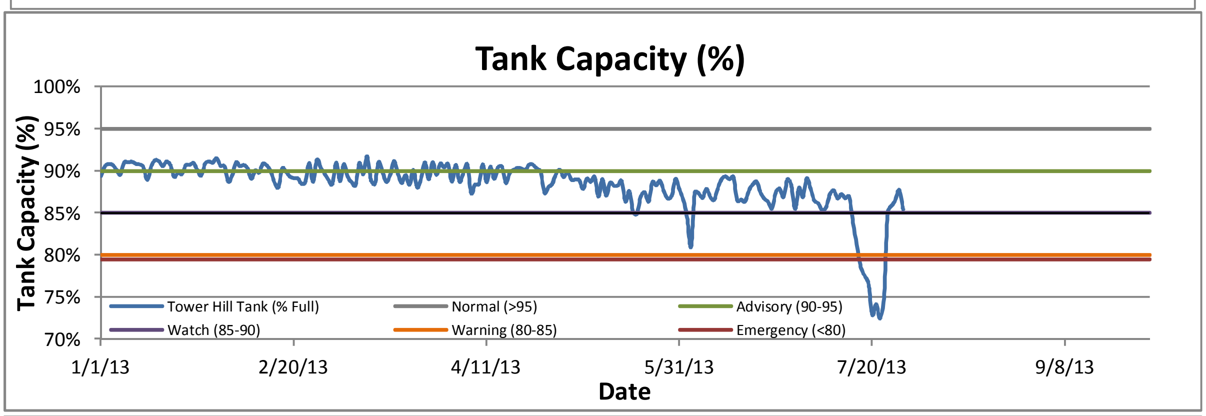


FIGURE 2-6
2013 HISTORICAL WATER RESTRICTION TRIGGERS







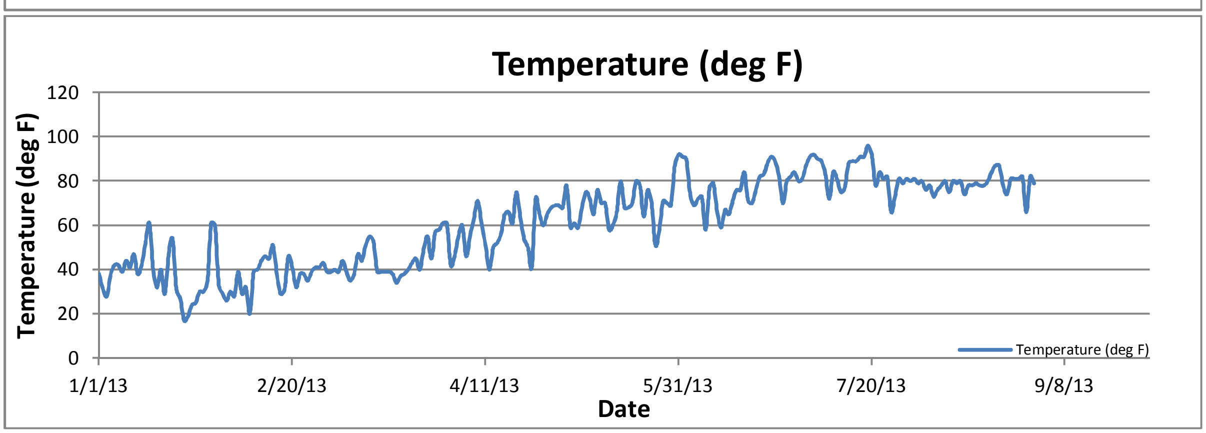


TABLE 2-9
RECOMMENDED WATER RESTRICTION TRIGGERS

TRIGGER	MONITORING INDICATOR	RATIONALE
PRIMARY	Total Water Demand	Indicator of stressed system
	Town Storage Tank Elevation	Limits ability of Town to provide water in Emergency
	Andover Drought Status	Majority of North Reading water supply / represents a composite of several indices
	Andover Water Use**	Manage volumes to less than IBTA Allowances
SECONDARY	Ipswich River Flowrate	Town is an net importer of water into basin
	State Drought Watch	Not as sensitive as other indices
	State Precipitation Index	Not as sensitive as other indices
	Sequential Days Over 90 Degrees**	Indicator of increase in Outdoor Watering

Note: ** A recommended change from the current water restriction triggers in place.

Section 3

WRIGHT-PIERCE
Engineering a Better Environment™

SECTION 3

DROUGHT RESPONSE PLAN

3.1 DROUGHT INDICATORS

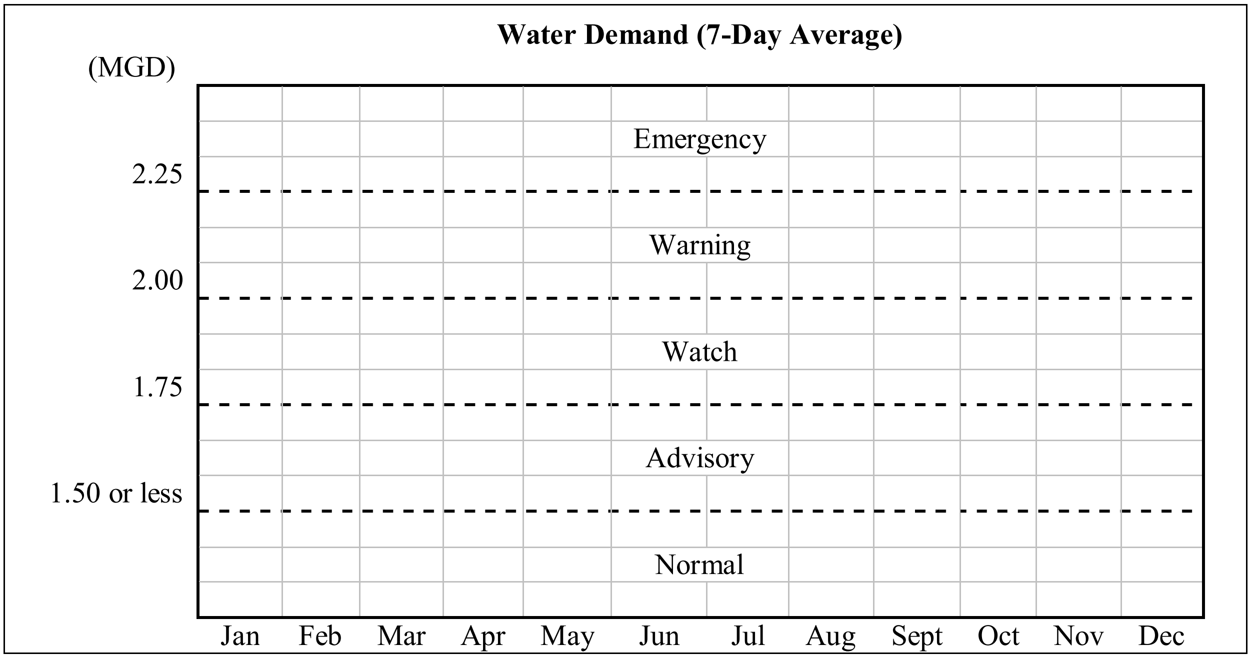
As the water demand increases, the flow rates and the storage tank levels decrease which, in turn, increases the severity of consumption restrictions within the Town. Conservative indicators are set on numerical values for the drought/demand indicator points in order to prevent a failure of the Town water system and limit the need to introduce elevated restrictions. The greatest demand is during the summer when the weather is warmer and when evapo-transpiration is highest resulting in reduced water available for groundwater recharge and runoff to rivers and streams. Simultaneously, excess amount of water is being utilized for outdoor water use such as watering lawns. The water consumption in the summer season generally increases by 30-50% as compared to the winter season. It is mandatory that consumption be limited during this season or any other time of reduced or limited supply such as an instance of severe fire usage or major water break.

Establishment of the drought indicators is one of the key steps in the DMP. The indicators, discussed in Section 2 are set by guidelines in the form of stages or phases that indicate the severity of the drought. Once an indicator threshold is hit, the new stage goes into immediate action in order for the Town to control water demand to an amount that the Town can reasonably supply during the stressed period. The Primary drought indicators recommended for North Reading are water demand, Andover water use, storage capacity, and Andover Drought Phase. The other indices should be considered especially under circumstances of widespread publicized drought concerns. North Reading should review the key indices for indications of areas of concern under those circumstances.

3.1.1 Water Demand

North Reading's water demand is critical when establishing the DMP.
Figures 3-1 and 3-2 illustrates the water demand for the whole year relative to the Town's two water sources.

FIGURE 3-1
DROUGHT INDICATOR: TOTAL WATER DEMAND (SEVEN-DAY AVERAGE)



These measures are in place to sustain the long-term use of the Town well supplies and limit the chance of exceedences of the authorized water use allowed by the Town's Water Registration. These levels will determine the drought stage that would need to go into effect. For example, if the water demand increases above 1.50 MGD, then the Advisory Stage will take immediate effect. What each stage consists of can be found in Section 3.2 Drought Stage Assignment. The goal is to remain in the Normal Stage of 1.50 or less MGD average seven day water demand.

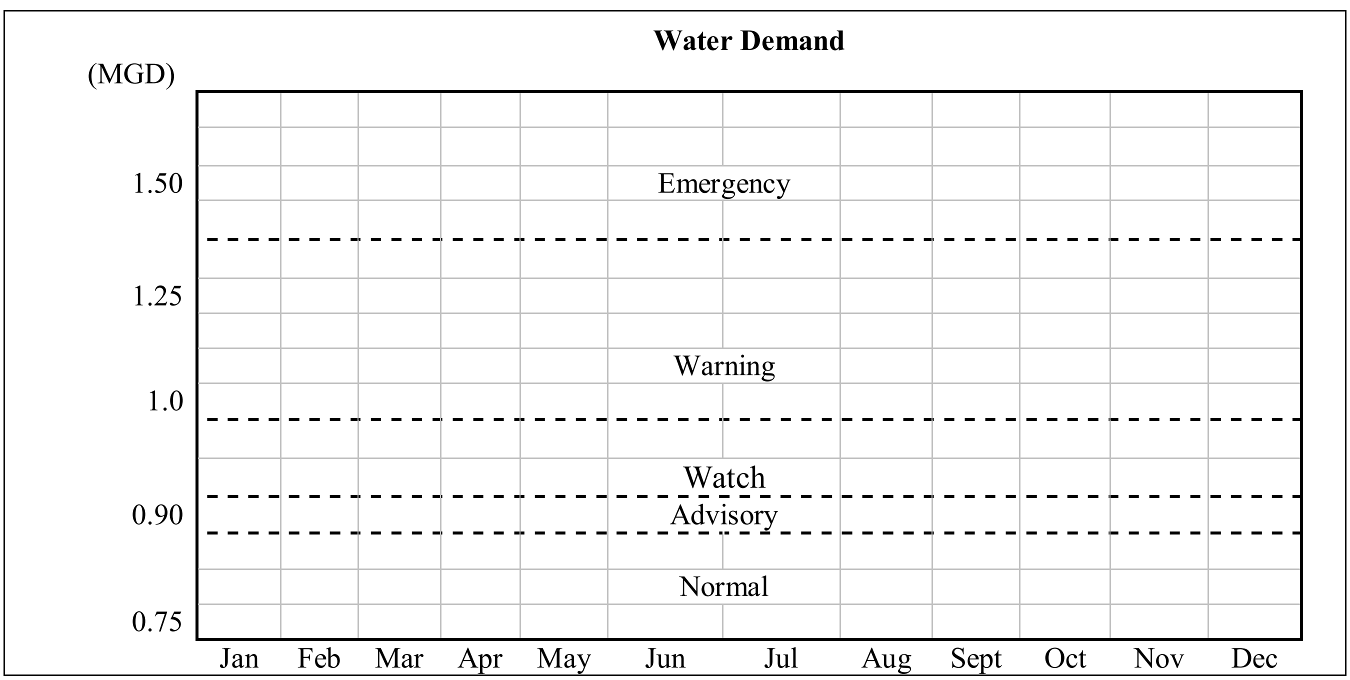
Another recommendation to the existing Drought Management Plan and Secondary Triggers is depicted in the following Table 3-1:

TABLE 3-1
RECOMMENDED RANGE FOR ANDOVER WATER USE

TRIGGER	ANDOVER WATER USE (MGD)
Normal	< 0.90
Advisory	0.9 – 0.95
Watch	0.95 – 1.0
Warning	1.0 – 1.25
Emergency	>1.25

By adjusting the ranges of the water purchased from Andover, The Town maintains the amount of water below the existing IBTA permit limit of maximum withdrawal of 1.5 MGD. This would also assist the Town with maximizing the withdrawal from their local sources up to 0.96 MGD. If yield from local sources are not sufficient to accommodate the increasing demands, water restrictions will be enforced earlier to help reduce water usage within permitted limits.

FIGURE 3-2
DROUGHT INDICATOR: ANDOVER WATER USE

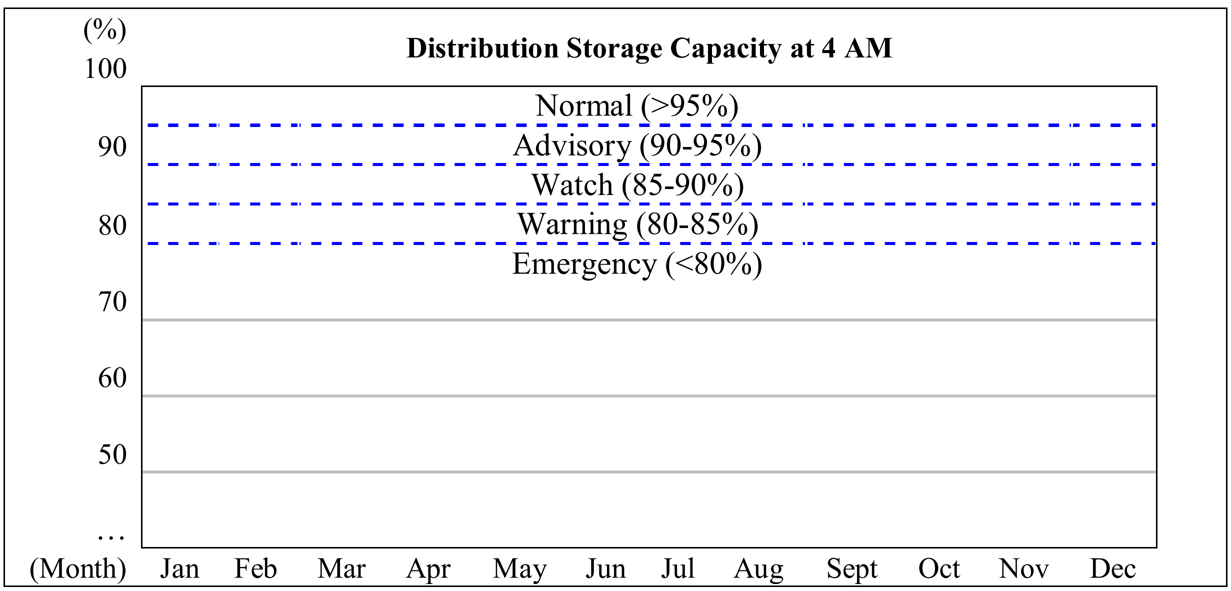


These measures are required to reduce the chance that the IBTA permit is exceeded. These levels will determine the drought stage that would need to go into effect. For example, if the water demand increases above 0.90 MGD, then the Advisory Stage will take immediate effect. What each stage consists of can be found in Section 3.2 Drought Stage Assignment. The goal is to remain in the Normal Stage of 0.90 or less MGD.

3.1.2 Storage Tank Levels

The storage capacity in the water storage tanks is a crucial drought indicator. Figure 3-3 shows the numerical levels to trigger each stage. Once a capacity percentage is hit, the stage will initiate immediately.

FIGURE 3-3
DROUGHT INDICATOR: DISTRIBUTION STORAGE CAPACITY AT 4 AM



This capacity analysis is for the whole year with snap shots taken at 4:00 a.m.. The goal is to remain in the Normal Stage at a distribution storage capacity of greater than 95%.

3.1.3 Andover Drought Status

The Town purchases a majority of its water from their neighboring Town of Andover; therefore any drought phases Andover decides to uphold would be adapted to the Town. North Reading is directly impacted by any drought related issues Andover experiences. Andover's designated phases are listed below in Table 3-2. To understand this drought system, the trigger levels are indicated below.

TABLE 3-2
DROUGHT INDICATOR: ANDOVER DROUGHT TRIGGER LEVELS

DROUGHT PHASE	LABEL	RESPONSE ACTION
Phase I	Watch	Voluntary Conservation *Target Largest Users*
Phase II	Warning	Voluntary Conservation of all users. Mandatory conservation for targeted largest users.
Phase III	Emergency	Mandatory restrictions with by-law in effect.
Phase IV	Critical	Maximum mandatory restriction.

It should be noted that Andover's drought phases differ from Massachusetts and North Reading's drought stages which are consistent. Andover has four drought phases, each indicating a response plan. The first trigger level which is called Phase I "Watch" has the response plan of contacting the system's 25 largest water users and asking those users to conserve their water usage. North Reading is the Andover water system's largest user. The largest water users list is consistently updated every year. Once Phase II is triggered, there is a mandatory restriction on these 25 largest users and all public users are asked to voluntary conserve water. This may be publicized and communicated to the public through radio, television, newspaper, printed flyers, bill stuffers, and etc. Once Phase III triggers are hit, the Town of Andover Water Use Restriction/Bylaw is put into effect and places limitations on municipal water. Maximum response is mandatory once Phase IV Critical Phase is initiated. Restrictions and measures are at the highest and are enforced on all municipal water use. The emergency public agency actions begin at this time. North Reading will monitor all drought activities and phases that Andover experiences to guide the Town's own drought plan.

3.1.4 Summary

Table 3-3 below is a summary table for the four primary drought triggers stated earlier that will be monitored by the Town on a predetermined basis in order to determine the drought stage and corresponding conservation measures to be implemented to achieve the water use reduction goals established by the Town. Table 3-4 below is a summary table for the four secondary drought triggers that will also be monitored by the Town.

TABLE 3-3
PRIMARY DROUGHT INDICATORS FOR EACH DESIGNATED STAGE

		Total Water Demand (7-Day Average) (MGD)	Tower Hill Storage Tank Capacity at 4 AM	Andover Drought Phase	Andover Water Use*
Stage 0	Normal	< 1.5	> 95%	Normal	< 0.90
Stage I	Advisory	1.5 - 1.75	90 - 95%	Watch	0.90 – 0.95
Stage II	Watch	1.75 - 2.0	85 - 90%	Warning	0.95 – 1.0
Stage III	Warning	2.0 - 2.25	80 - 85%	Emergency	1.0 – 1.25
Stage IV	Emergency	> 2.25	< 80%	Critical	> 1.25

*** Recommended Change as discussed in Section 2.**

TABLE 3-4
SECONDARY DROUGHT INDICATORS FOR EACH DESIGNATED STAGE

		7 Day Ipswich River Flow @ South Middleton (cfs)	MA DCR Drought Status	MA DCR 3 Month Precipitation Deficit (in)	Sequential Days > 90 degrees*
Stage 0	Normal	> 29.8	Normal	< 0.5	na
Stage I	Advisory	29.8	Advisory	0.5 – 1.5	2
Stage II	Watch	18.7 – 29.8	Watch	1.5 – 2.5	3
Stage III	Warning	15.1 – 18.7	Warning	2.5 – 3.0	4
Stage IV	Emergency	< 15.1	Emergency	> 3.0	5

*** Recommended Change as discussed in Section 2.**

The Town monitors the levels of all their systems, water treatment and storage facilities/tanks/interconnections, on a routine basis which helps initiate triggers for each drought stage. If and when the water falls below a certain level as indicated in this plan, there will be new drought stage with each passing trigger. The severity corresponds to the stage of the drought status.

Various conditions and phases were analyzed to correspond with priority levels. All indicators and triggers were carefully established to provide the most efficient drought plan.

3.2 DROUGHT STAGE ASSIGNMENT

Various conditions and restrictions were analyzed to correspond with each priority level to achieve the most efficient results. The existing assignment for each drought condition stage is shown in Table 3-5.

The five stages (Stage 0 through IV) provide designated mandatory restrictions for the whole Town of North Reading. Each of the drought stages will trigger certain restrictions which range from minimal or extreme. Stage 0 is the normal condition and the most minimal of the stages, whereas Stage IV is the most extreme condition that bans outdoor water use altogether, along with other designated restrictions.

Observation periods vary depending on the month of the year and the drought stage the Town is currently in. The recommended observation frequency increases during the summer months due to the increased likelihood of higher demand that is normally associated with this season, therefore it is important that the data be monitored more frequently. As the Drought Stage changes the frequency of observation also changes. Tables 3-6 and Table 3-7 indicate the frequencies.

TABLE 3-5
NORTH READING EXISTING WATER USE RESTRICTIONS

Town of North Reading Water Use Restrictions		
Drought Condition		**Restrictions**
Stage 0	Normal	Winter (October 1 - April 30) = No Restrictions.
Stage 0	Normal	▪ Summer (May 1 - September 30) = Voluntary Water Conservation.*
		▪ Outdoor water use on ODD and EVEN days between 7 PM and 7 AM.
		▪ Residents with ODD numbered addresses may water lawns on ODD numbered days.
		▪ Residents with EVEN numbered addresses may water lawns on EVEN numbered days.
Stage I	Advisory	▪ Mandatory Water Conservation.
		▪ **Lawn watering restricted to two (2) times per week per Precinct between 7 PM and 7 AM** as follows: Precinct 1: Monday & Thursday Precinct 2 & 3: Tuesday & Friday Precinct 4: Wednesday & Saturday
Stage II	Watch	▪ Mandatory Water Conservation.
		▪ **Lawn watering restricted to one (1) time per week per Precinct between 7 PM and 10 PM** as follows: Precinct 1: Monday Precinct 2 & 3: Wednesday Precinct 4: Friday
Stage III	Warning	▪ Mandatory Water Conservation.
		▪ **Outdoor water use restricted to hand held hose or water can with person in attendance between 7 PM and 10 PM** for irrigation of shrubs, flowers, and gardens only.
		▪ The following are prohibited: -Lawn watering; swimming pool filling; washing of cars, trucks, boats, buildings; and cleaning of driveways.
Stage IV	Emergency	▪ Mandatory Water Conservation.
		▪ **No outdoor water use.**
		▪ Water use restricted to normal bathing, cooking, laundry and sanitary use, or to meet the core function of a business or maintenance of livestock.

*** Recommended Change as discussed in Section 3.2.1.**

TABLE 3-6
OBSERVATION FREQUENCY THROUGHOUT THE YEAR

DATE	OBSERVATION FREQUENCY
January - April	Monthly
May- September	Weekly
October - December	Monthly

TABLE 3-7
OBSERVATION FREQUENCY FOR EACH STAGE

DROUGHT PHASE	PHASE TITLE	FREQUENCY
Stage 0	Normal	Monthly
Stage I	Advisory	Weekly
Stage II	Watch	Daily
Stage III	Warning	Hourly
Stage IV	Emergency	Hourly

This plan will be able to implement any drought measures already in effect and reduce the occurrences of any water shortages.

3.2.1 Recommendations to the Existing Water Use Restrictions

A review of the existing Water Use Restrictions and the Primary and Secondary triggers was performed. As previously noted in Section 2 and as shown in Tables 3-3 and 3-4, Wright-Pierce recommends changes to the primary and secondary triggers including Andover Water Use becoming a Primary Trigger and Sequential Days Over 90 Degrees becoming a Secondary Trigger. When reviewing the performance of the existing Water Use Restrictions and management of the water system through a drought event (based on historical data and the available water supply from the Town's local sources and the interconnection with Andover), Wright-Pierce recommends the Town change "Voluntary Water Conservation" in the Summer from May 1 through September 30, during Stage 0 (Normal) Drought Condition to **"Mandatory Water Conservation"** during that said period. This would establish a mind-set with the residents on how to use water for non-essential uses so they create habit that conforms to the conservation measures needed to manage water use during the summer. This would also help keep the water use demand within the withdrawal permits for its local sources and the existing IBTA for the Andover interconnection.

3.3 DROUGHT PLAN IMPLEMENTATION

Optimization of water use and drought management can be initiated upon being vigilant, controlling consumption, having effective public awareness, and monitoring data consistently. North Reading has established a set a stages to monitor and implement water restrictions to maintain control of the water demand along with a safety factor in order to maintain adequate water for fire protection. Water shortages may vary in degree and duration, and the Town of North Reading must be prepared for the minimum to most extreme conditions. The summer season historically experiences the most extreme water demand and drought conditions within each year. The increased temperature creates dry weather that increases the risk for fire danger and simultaneously the fire supply demand needs to be maintained for protection.

The drought plan consists of keeping a consistent monitoring of important drought indicators, as discussed in Section 3.1, then using those indicators and a set list of restrictions for each, as discussed in Section 3.2. If all steps are taken effectively and efficiently, then water shortages may not occur during drought-like conditions.

In order for the most successful implementation of the DMP, communication to the public is a critical factor along with teaching users to preserve water. For example, North Reading teaches users on their Town website how to efficiently water one's lawn. To learn more about this method and others, visit North Reading's home page at www.northreadingma.gov/Pages/NReadingMA_Water/waterright.

Water conservation techniques can be found at the following resource http://www.mass.gov/dep/water/resources/watercon.htm#conserve

Additionally the website http://www.mass.gov/dcr/watersupply/rainfall/index.htm contains useful information on monthly precipitation, composite and water conditions, precipitation trends, dry periods, high or low river flow conditions, and groundwater levels.

3.4 ADDITIONAL MEASURES

Once the drought plan is implemented, restrictions must be held otherwise additional measures may need to take place. These additional measures may include:

- Ticketing/Issuing violation notices for unauthorized water use
- House to house verbal/written warnings from police department or DPW department
- Recording water meters to ensure proper water use
- Fines and penalties
- Reverse 911 calls from Town
- Termination of water supply

It is strongly encouraged for all users to adhere to the drought management plan. All restrictions will be enforced.

3.5 COMMUNICATION

The restrictions set for each drought stage, as indicated previously in Section 3.2, need to be effectively communicated within the Town to ensure that an adequate water supply would be available for all residents and businesses. Communication is important in three phases: North Reading's residents, inter-Town, and public awareness/education.

3.5.1 North Reading Communication

Communication within the Town is an essential process. Water storage tank levels must be monitored by operators and reported back to the Water Superintendent if the levels become comparable to the drought plan trigger levels. If a trigger level is reached, the Water Superintendent will contact the DPW Director to notify them of the drought stage. The DPW will need to alert all staff and ensure that the public is informed. North Reading utilizes their homepage website to provide as an additional communication measure.

3.5.2 Inter-Town Communication

The communication between North Reading and Andover includes the Town Administrators, DPW Directors, and Water Superintendents communicating with their counterparts. Once parties are informed, the Town can respond appropriately.

3.5.3 Public Awareness and Education

Communicating and teaching the community is a vital role in the management and planning phases. Having the public aware of the dire circumstances that may occur during drought conditions can help to efficiently conserve and optimize water supply. North Reading uses multiple techniques in order to inform and teach the public such as:

- Online resources
  - Environmental Protection Agency (EPA): http://www.epa.gov/
  - U.S. Geological Survey (USGS): http://ma.water.usgs.gov/drought/
  - The Official Website of the Massachusetts Department of Environmental Protection (MassDEP): http://www.mass.gov/dep/
  - The Official Website of the Commonwealth of Massachusetts: http://www.mass.gov/portal/
  - North Reading Home Page: http://northreadingma.gov/Pages/index
  - National Drought Mitigation Center: http://www.drought.unl.edu/
  - Massachusetts Emergency Management Agency (MEMA): www.mass.gov/mema.
- Written/Digital Communication
  - Newspaper and flyers
  - Public notices and signboards strategically placed
  - Television
  - Telephone (calling and texting) (Reverse 911)
  - Mail
  - Email

Techniques (whether new or old) are always sought after, to efficiently improve the communication and awareness within the Town.

The Town also utilizes CODE RED, a system to keep residents informed in the event of emergency situation or critical community alerts. This system can also be used to notify the residents when water restrictions are in place and enforced. The Town should encourage residents to sign up for notifications through this source.

Section 4

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SECTION 4

WATER USE REDUCTION MEASURES

4.1 REDUCTION STRATEGIES

North Reading has a water restriction bylaw, Section 191-6, in place to enforce measures needed to mitigate a drought condition through reduction in water use. Refer to Appendix B for the current Town of North Reading By Law for Restriction on Water Use. The goal of the bylaw is to reduce non-essential water use during a drought condition and maintaining a sufficient water supply for essential uses as well as fire protection. Drought restriction strategies will help reduce the water usage specifically in the summer period, May 1 to September 30, by controlling non-essential water uses and by planning and managing the criteria to determine and control non-essential water use early within a drought condition, gives the Town an opportunity to prolong the use of their sources when they become most critical. The town may also declare water restriction any season if it is deemed necessary to conserve the water supply during an emergency or critical failure of the water system infrastructure. It is important to note that reduction in water use in general, regardless of the drought status, is needed to maintain the water usage below the IBTA with Andover and withdrawal from local sources located within the Ipswich River Watershed within registered permitted volumes.

The strategies currently taken by the Town in regard to water restrictions have been reviewed in addition to new measures to help decrease consumption.

4.1.1 Pricing Rates

Water use during the summer months can double from the average water use for the remaining year and is attributed to outdoor water use. When reviewing goals and tools associated with drought management planning, a reduction in non-essential water use during the summer period is critical. Encouraging residents to reduce water usage during the summer, through education and standards practice is essential for a viable program. However an incentive, such as financial savings, or discouragement, through higher water rates, is needed sometimes to see results that will mitigate water shortages. One approach to manage a sustainable water system is an increasing block rate structure for water billing. The Town of North Reading currently employs a three-tiered increasing block water rate structure as follows:

TABLE 4-1
NORTH READING'S CURRENT (FY 14)
INCREASING BLOCK WATER RATE STRUCTURE

TIER	WATER QUANTITY (GALLONS/QUARTER)	RATE ($/1,000 GALLONS)
First	< 10,000	$7.30
Second	10,001 - 22,500	$10.70
Third	> 22,500	$14.60

Another way to control non-essential outdoor water usage from doubling during the summer period is to meter all irrigation systems connected to the Town's water distribution system and charge a third tier rate for this non-essential use and/or a flat rate applied annually for a plumbed irrigation system.

4.1.2 Underground Sprinkler Systems

The Town's current bylaws include requirements of outdoor irrigation systems which give the Town knowledge and some control of irrigation systems connected to the public water supply. Some of the measures the Town has in place include the following:

- Registration for all outdoor irrigation systems with the Town of North Reading, DPW
- Installation of a Rain Sensing Device
- Installation of a Backflow Preventer
- Annual Inspections

Some additional measures the Town can take to reduce the usage of nonessential water include the following:

- Metering the irrigation systems separately and applying a higher rate for the use of potable water for a non-essential use.

- Educating and encouraging outdoor watering by hand held hoses between the hours of 4:00 a.m. and 6:00 a.m. when evaporation is the lowest would help mitigate a drought condition and further stress on the public water supply system.
- Banning plumbed outdoor irrigation systems connected to the public water supply.

Ultimately it is up to the Town what water conservation measures to consider, adopt and manage in regards to drought and water management.

4.1.3 Water Reduction Devices

The following are low cost devices that can be installed and retrofitted to existing fixtures that conserve on water during normal essential water uses providing a more sustainable system. The residents can be encouraged to purchase these items or the Town can consider providing them for free, with potential funding through State grants and programs, to help reduce the water demand and manage water use through a drought condition.

- Low flow showerheads (2.0 gpm)
- Faucet aerators (1.5 gpm)

Other considerations include educating the residents to look for and correct leaking fixtures that can be responsible for a large amount of household water use. According to DEP research, 8% or more of all household water use is due to leaks in the piping and fixtures within a home. Some measures for residents to consider include the following:

- Inspecting fixtures and piping (visible) for leakage or signs of leakage such as staining in ceilings and floors.
- Test for leaking toilets by adding dye to the tank and after a few minutes; look for any dye in the bowl.
- Residential water audits (to be discussed further in the following section).

4.1.4 Residential Water Audits

Residential Water Audits free of charge should be offered upon request to all residents and required for the largest 25% users of the system. Reducing water usage to the residential population, which is responsible for the most water usage as discussed in Section 2, should be a priority for the Town.

Through the audit the consumer becomes more aware of the water usage in relation to others, how much they are spending in non-essential water uses such as outdoor water use, detecting leaks within their "system" or house plumbing and appliances, and verifying whether their systems in place are water efficient and how installing "low flow" appliances/fixtures can save them money each year. It also is an opportunity to educate the public how important water conservation especially during a drought condition and how the Water Restriction in place works and enforced in Town.

4.2 PROJECTED WATER USE

Projected water use needs to be evaluated and considered when planning and managing a sustainable water system. The projected water demands are determined by assessing population growth, growth patterns in a community, and historical water-use trends. A Water Master Plan is currently being prepared for the Town of North Reading that will project water demands to year 2033. In summary, the water demands for North Reading are projected to increase based on population growth and non-residential demand even when accounting for increased conservation measures. With an increase in water demands, additional stress is placed on a system if a lack of water supply is available especially during a drought event or emergency situation.

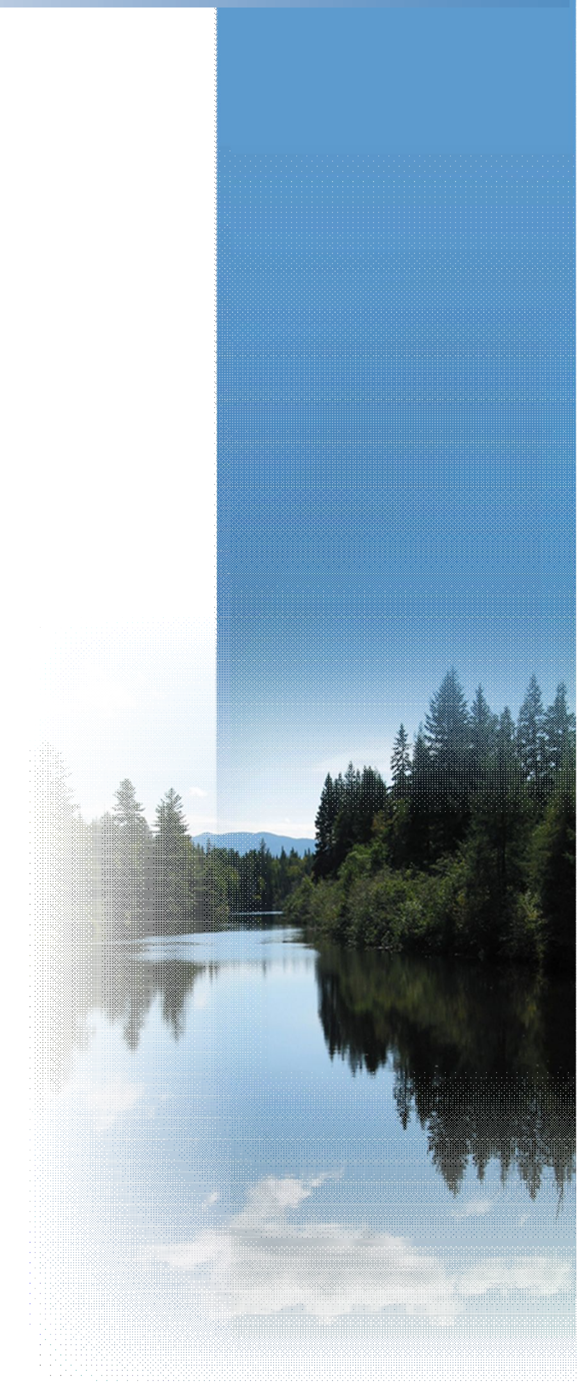
4.2.1 Supplemental Water Sources

To provide a sustainable water system for North Reading, the Town should always be considering redundancy when it comes to supply and meeting water demands of the community. The Town of North Reading currently purchases a significant portion its water supply from the Town of

Andover through two existing interconnections. The Town also maintains two emergency interconnections with the Town of Wilmington. The remaining water supply is produced from a series of Town-owned wells located in the Ipswich River basin.

North Reading is currently considering an alternative supply with the Massachusetts Water Resources Authority (MWRA) water system through an interconnection to the neighboring Town of Reading. The MWRA began developing a plan to address the lack of redundancy to this area and is currently designing a redundant pipeline that will service Reading and North Reading if they choose to pursue this connection.

APPENDIX A



Water Restriction Triggers

Trigger		Water Use Reduction Goal (%)	PRIMARY				SECONDARY			
			Average 7 Day Total Water Demand (MGD)	Tower Hill Storage Tank Capacity @ 4 AM (%)	Andover Drought Stage	Andover Water Use (MGD)	7 Day USGS Ipswich River Flow @South Middleton (CFS)	MA DCR Drought Status	MA DCR 3 Month Precipitation Deficit (In.)	Sequential Days > 90 degrees
Stage										
0	Normal	0	<1.5	>95	Normal	< 0.90	>29.8	Normal	<0.5	NA
I	Advisory	10-15	1.5-1.75	90-95	Watch	0.9-0.95	29.8	Advisory	0.5-1.5	2
II	Watch	15-25	1.75-2.0	85-90	Warning	0.95-1.0	18.7-29.8	Watch	1.5-2.5	3
III	Warning	25-40	2.0-2.25	80-85	Emergency	1.0-1.25	15.1-18.7	Warning	2.5-3.0	4
IV	Emergency	40+	>2.25	<80	Critical	>1.25	<15.1	Emergency	>3.0	5

Primary Trigger Monitoring Frequency

January-April	Monthly
May-September	Weekly
October-December	Monthly

Revised: November 12, 2013

Water Restriction Triggers

Internal Procedures

November 12, 2013

PRIMARY

These triggers have a direct correlation to North Reading Water Use Restrictions. Historically, North Reading has restricted water use days/weeks before Andover. By its water supply contract, North Reading must not have its water restrictions less than the current Andover's Drought Stage.

Average 7 Day Total Water Demand – Manually calculated by Water Superintendent based on totalizer/meter readings at 3 NR locations and the Andover Connections.

Tower Hill Water Storage at 4 AM – Manually calculated by Water Superintendent based on actual water tank level readings.

Andover Drought Stage – As noted on Andover website and/or Andover Water Department notifications to North Reading

Andover Water Use – Manually calculated by Water Superintendent based on Andover meters.

SECONDARY

These triggers are general in nature and provide regional trends.

7 Day USGS Ipswich River Flow at South Middleton Gage – Found on USGS website for this station.

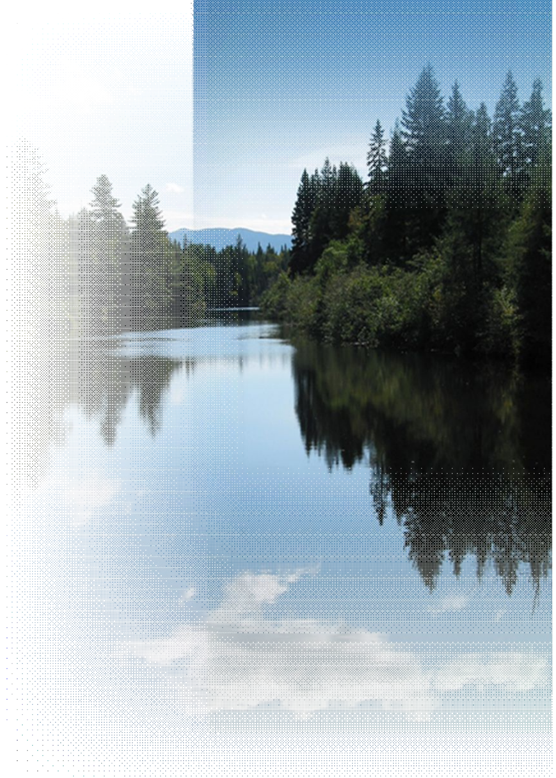
MA DCR Drought Status – Found online at MA DCR website.

MA DCR Precipitation Deficit – Found online at MA DCR website.

Sequential Days > 90 degrees – From a variety of weather reports – TV, internet, weather services, etc.

Town of North Reading Water Use Restrictions		
Drought Condition		**Restrictions**
Stage 0	Normal	Winter (October 1 - April 30) = No Restrictions.
Stage 0	Normal	▪ Summer (May 1 - September 30) = Mandatory Water Conservation.
		▪ Outdoor water use on ODD and EVEN days between 7 PM and 7 AM.
		▪ Residents with ODD numbered addresses may water lawns on ODD numbered days.
		▪ Residents with EVEN numbered addresses may water lawns on EVEN numbered days.
Stage I	Advisory	▪ Mandatory Water Conservation.
		▪ **Lawn watering restricted to two (2) times per week per Precinct between 7 PM and 7 AM** as follows: Precinct 1: Monday & Thursday Precinct 2 & 3: Tuesday & Friday Precinct 4: Wednesday & Saturday
Stage II	Watch	▪ Mandatory Water Conservation.
		▪ **Lawn watering restricted to one (1) time per week per Precinct between 7 PM and 10 PM** as follows: Precinct 1: Monday Precinct 2 & 3: Wednesday Precinct 4: Friday
Stage III	Warning	▪ Mandatory Water Conservation.
		▪ **Outdoor water use restricted to hand held hose or water can with person in attendance between 7 PM and 10 PM** for irrigation of shrubs, flowers, and gardens only.
		▪ The following are prohibited: -Lawn watering; swimming pool filling; washing of cars, trucks, boats, buildings; and cleaning of driveways.
Stage IV	Emergency	▪ Mandatory Water Conservation.
		▪ **No outdoor water use.**
		▪ Water use restricted to normal bathing, cooking, laundry and sanitary use, or to meet the core function of a business or maintenance of livestock.

APPENDIX B



By Law Section 191-6: Restrictions on Water Use

A. Authority.

By Law 191-6 Water Use Rules & Regulations authorizes the Board of Selectmen to adopt, and periodically amend, rules and regulations relating to the procedures and administration of Chapter 191, Article II after public notice and a public hearing.

B. Restrictions on Water Use

(1). A declaration of a State of Water Supply Conservation shall include one or more of the restrictions, conditions, or requirements found in the table titled "Town of North Reading Water Use Restrictions" to limit the use of water as necessary to provide an adequate supply of water for domestic and fire fighting use.

(2). The Board of Selectmen may require additional water use limitations above those found in B.(1). in case of emergencies such as disasters or critical infrastructure failure.

C. Normal Conditions

(1). The Normal condition in the table titled "Town of North Reading Water Use Restrictions" shall be in effect year round, unless there is a declaration of a State of Water Supply Conservation.

(2). During the winter period (October 1 to April 30) there are no water restrictions.

(3). During the summer period (May 1 to September 30) outdoor water use is on an Odd and Even day schedule from 7 PM to 7 AM. Residents with Odd numbered addresses may water lawns on Odd numbered days. Residents with Even numbered addresses may water lawns on Even numbered days.

D. Outdoor Irrigations Systems

(1). Outdoor water use is a significant source of consumption for North Reading public water supply system. Lawn irrigation systems are a high percent of this water use. Established lawns only need 1 inch of water per week. Overwatering actually creates a weak grass plant with shallow roots that cannot tolerate drought or pests. The use of rain gauges and/or soil moisture sensors are recommended to assist homeowners to minimize water use.

(2). In order to prevent excessive outside water use, all outdoor irrigation systems connected to the Town of North Reading public water supply shall be equipped with a rain sensing device, approved by the North Reading Department of Public Works, so that watering will be automatically prevented during rain storms.

(3). All irrigation systems connected to the public water supply shall also have a backflow prevention device, approved by the Plumbing Inspector, to prevent the introduction of contaminants into the public water supply. Each device shall be installed in accordance with Massachusetts General Law and the manufacturer's instructions. Each device shall be tested upon its installation and annually thereafter in accordance with Massachusetts General Law.

(4). All outdoor irrigations systems not connected to the Town of North Reading public water supply should also be equipped with a rain sensing device so that watering will be automatically prevented during rain storms. This benefits the customer as it reduces pump energy use & cost; and reduces withdrawals from the Ipswich River basin. A backflow prevention device should also be installed to protect the health and safety of residents using the non public water supply.

(5). Annually, the owners of all outdoor irrigations systems connected to the public water supply shall inspect their system and make repairs or adjustments as necessary in order to reduce water use. Broken pipes or leaks shall repaired; damaged or tilted sprinkler heads shall be repaired or adjusted; and any other source of water waste shall be corrected. Rain gauges and backflow prevention devices shall be checked to ensure good working condition. The same annual inspection and repair is recommended for irrigation systems not connected to the public water supply.

(6). All outdoor irrigations systems, whether connected to the public water supply or not, shall be registered with the Department of Public Works.

(7) All outdoor irrigations systems not connected to the Town of North Reading public water supply shall have a sign at the property front indicating “private well water”. The standard sign shall be the type manufactured for the DPW & will be sold to residents at cost.

E. Exemptions.

Persons seeking an exemption from the requirements of section 191-6 are required to make application to the Town of North Reading Department of Public Works in Town Hall.

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H

APPENDIX H
Wetland Reports

Caron Environmental Consulting
978-874-5469
Wetlands • Forestry • Permitting • Habitat Studies

October 23, 2019

Mr. Robert Williamson
Wright-Pierce
75 Washington Ave: Suite 202
Portland, ME 04101

Re: Wetland Delineation
303 Main Street/North Reading

Dear Mr. Williamson:

As requested, we have delineated the wetlands on the above-referenced site. The delineation was conducted on October 22, 2019. The delineation was based on observations of the soils, the plant communities and hydrology.

The edge of a Bordering Vegetated Wetland was delineated with blue flagging labeled A1 to A16. The wetland is wooded. The immediately adjacent uplands are commercially developed areas.

Species which were observed to be dominant primarily in the wetlands include Winterberry, Skunk Cabbage, Arrowwood, Sensitive Fern and sedges. Several species are common in both the wetlands and uplands including Red Maple, Pepperbush and Poison Ivy. Species abundant primarily in the uplands include Black Locust, Norway Maple, Black Oak, European Buckthorn, Multiflora Rose, Bittersweet, Japanese Knotweed, Goldenrods, Fox Grape and Gill-over-the-Ground. The attached Delineation Data Forms provide greater detail on the vegetation, soil conditions and hydrological indicators.

The MassGIS Online Viewer does not show any Estimated/Priority Habitat Areas or Certified Vernal Pools on the site.

There is a 100-year flood zone mapped on part of the property. Your office will need to determine its extent based on elevation or graphically, as appropriate.

There is a storm water basin on the site that contains a mix of upland and wetland species. It is our understanding that this stormwater management feature was constructed after 1996. Accordingly, per 310 CMR 10.02(2)c it is not a jurisdictional area.

The delineation was based on features visually apparent at the time. As you are aware the interpretation of the boundaries of wetlands can vary depending on many factors including the time of year, growth phase of vegetation, groundwater levels, soil conditions, weather, and political factors. As a result, no delineation can be considered definitive until it has been reviewed and verified by all of the relevant approving authorities.

If you have any questions in regards to this matter, please feel free to contact us.

Very truly yours,
CARON ENVIRONMENTAL CONSULTING
By;

Charles E. Caron

247 Bragg Hill Road • Westminster, MA 01473
Fax 978-874-1790 • Email: caronenv@aol.com

DEP Bordering Vegetated Wetland (310 CMR 10.55) Delineation Field Data Form

Applicant: Town of North Reading Prepared by: Caron Environmental Consulting Project location: 303 Main Street/North Reading DEP File #: __________

Check all that apply:

- ☐ Vegetation alone presumed adequate to delineate BVW boundary: fill out Section I only
- ☑ Vegetation and other indicators of hydrology used to delineate BVW boundary: fill out Sections I and II
- ☐ Method other that dominance test used (attach additional information)

Section I. Vegetation Observation Plot Number: A8-W Transect Number: A8 Date of Delineation: 10/22/2019

A. Sample Layer and Plant Species (by common/scientific name)	**B. Percent Cover (or basal area)**	**C. Percent Dominance**	**D. Dominant Plant (yes or no)**	**E. Wetland Indicator Category***
Herbs & Seedlings				
Skunk Cabbage/*Symplocarpus foetidus*	10.5	41	Yes	OBL*
Poison Ivy/*Toxicodendron radicans*	3.0	11	Yes	FAC*
Jewelweed/*Impatiens capensis*	3.0	11	Yes	FACW*
Grass spp.	3.0	11	Yes	-----
Swamp Dewberry/*Rubus hispidus*	3.0	11	Yes	FACW*
Multiflora Rose/*Rosa multiflora*	3.0	11	Yes	FACU
Shrubs				
Sweet Pepperbush/*Clethra alnifolia*	38.0	74	Yes	FAC*
Arrowwood/*Viburnum dentatum*	10.5	20	Yes	FAC*
European Buckthorn/*Frangula alnus*	3.0	6	No	FAC*
Saplings				
Red Maple/*Acer rubrum*	38.0	93	Yes	FAC*
Gray Birch/*Betula populifolia*	3.0	7	No	FAC*
Trees				
Red Maple	0.800	100	Yes	FAC*

* Use an asterisk to mark wetland indicator plants

Vegetation conclusion:

Number of dominant wetland indicator plants: 8 **Number of dominant non-wetland indicator plants:** 1

Is the number of dominant wetland indicator plants equal to or greater than the number of dominant non-wetland indicator plants? Yes

If vegetation alone is presumed adequate to delineate the BVW boundary, submit this form with the Request for Determination of Applicability or Notice of Intent. MA DEP; 3/95

Section II. Indicators of Hydrology <u>Plot A8-W</u>

Hydric Soil Interpretation

1. Soil Survey

Is there a published soil survey for this site? ☑ Yes ☐ No

Title/date: Soil Survey of Middlesex County, Massachusetts

Map number: Online map

Soil type mapped: Hinckley Loamy Sand

Hydric soil inclusions:

Are field observations consistent with soil survey? ☐ Yes ☑ No

Remarks:

2. Soil Description

Horizon	Depth (inches)	Matrix Color	Mottles Color
O	0”-24”+	10 YR 2/1	

Remarks:

Other:

Conclusion: Is soil hydric: ☑ Yes ☐ No

Other Indicators of Hydrology: (check all that apply and describe)

- ☑ Site inundated:
- ☐ Depth to free water in observation hole:
- ☑ Depth to soil saturation in observation hole: to surface
- ☐ Water marks:
- ☐ Drift lines:
- ☐ Sediment deposits:
- ☐ Drainage patterns in BVW:
- ☐ Oxidized rhizospheres:
- ☐ Water-stained leaves:
- ☐ Recorded data (stream, lake, or tidal gauge; Aerial photo; other):
- ☑ Other: Sulfidic Odor

Vegetation and Hydrology Conclusion

	Yes	No
Number of wetland indicator plants >/= number of non-wetland indicator plants	☑	☐
Wetland hydrology present:		
Hydric soil present	☑	☐
Other indicators of hydrology present	☑	☐
Sample location is in a BVW	☑	☐

Submit this form with the Request for Determination of Applicability or Notice of Intent.

DEP Bordering Vegetated Wetland (310 CMR 10.55) Delineation Field Data Form

Applicant: Town of North Reading Prepared by: Caron Environmental Consulting Project location: 303 Main Street/North Reading DEP File #: __________

Check all that apply:

- ☐ Vegetation alone presumed adequate to delineate BVW boundary: fill out Section I only
- ☑ Vegetation and other indicators of hydrology used to delineate BVW boundary: fill out Sections I and II
- ☐ Method other that dominance test used (attach additional information)

Section I. Vegetation Observation Plot Number: A8-U Transect Number: A8 Date of Delineation: 10/22/2019

A. Sample Layer and Plant Species (by common/scientific name)	**B. Percent Cover (or basal area)**	**C. Percent Dominance**	**D. Dominant Plant (yes or no)**	**E. Wetland Indicator Category***
<u>Herbs & Seedlings</u>				
Bittersweet/*Celastrus orbiculatus*	3.0	33	Yes	UPL
Poison Ivy	3.0	33	Yes	FAC*
Norway Maple/*Acer platanoides*	3.0	33	Yes	UPL
<u>Shrubs</u>				
Multiflora Rose	38.0	74	Yes	FACU
European Buckthorn	10.5	20	Yes	FAC*
Common Buckthorn/*Rhamnus cathartica*	3.0	6	No	FAC*
<u>Saplings</u>				
Black Locust/*Robinia pseudoacacia*	3.0	100	No	FACU
<u>Woody Vines</u>				
Bittersweet	38.0	100	Yes	UPL
<u>Trees</u>				
Red Maple	0.267	100	Yes	FAC*

* Use an asterisk to mark wetland indicator plants

Vegetation conclusion:

Number of dominant wetland indicator plants: 3 **Number of dominant non-wetland indicator plants:** 4

Is the number of dominant wetland indicator plants equal to or greater than the number of dominant non-wetland indicator plants? No

If vegetation alone is presumed adequate to delineate the BVW boundary, submit this form with the Request for Determination of Applicability or Notice of Intent.

Section II. Indicators of Hydrology Plot A8-U

Hydric Soil Interpretation

1. Soil Survey

Is there a published soil survey for this site? ☑ Yes ☐ No

Title/date: Soil Survey of Middlesex County, Massachusetts

Map number: Online map

Soil type mapped: Hinckley Fine Sandy Loam

Hydric soil inclusions:

Are field observations consistent with soil survey? ☐ Yes ☑ No

Remarks:

2. Soil Description

Horizon	Depth (inches)	Matrix Color	Mottles Color
A	0"-24"+	10 YR 4/3	None

Remarks: The A horizon was comprised of old fill.

Other:

Conclusion: Is soil hydric: ☐ Yes ☑ No

Other Indicators of Hydrology: (check all that apply and describe)

- ☐ Site inundated:
- ☐ Depth to free water in observation hole:
- ☐ Depth to soil saturation in observation hole:
- ☐ Water marks:
- ☐ Drift lines:
- ☐ Sediment deposits:
- ☐ Drainage patterns in BVW:
- ☐ Oxidized rhizospheres:
- ☐ Water-stained leaves:
- ☐ Recorded data (stream, lake, or tidal gauge; Aerial photo; other):
- ☐ Other:

Vegetation and Hydrology Conclusion

	Yes	No
Number of wetland indicator plants >/= number of non-wetland indicator plants	☐	☑
Wetland hydrology present:		
Hydric soil present	☐	☑
Other indicators of hydrology present	☐	☑
Sample location is in a BVW	☐	☑

Submit this form with the Request for Determination of Applicability or Notice of Intent.


Wetland at Plot A8-W


Upland at Plot A8-U


Soil at Plot A8-W


Soil at Plot A8-U

Caron Environmental Consulting
978-874-5469
Wetlands • Forestry • Permitting • Habitat Studies

March 6, 2019

Mr. Robert Williamson
Wright-Pierce
75 Washington Ave: Suite 202
Portland, ME 04101

Re: Wetland Delineation
Central Street/North Reading

Dear Mr. Williamson:

As requested, we have delineated the wetlands on the above-referenced site. The delineation was conducted on December 10, 2018. The delineation was based on observations of the soils, the plant communities and hydrology.

The edges of Bordering Vegetated Wetlands were delineated with blue flagging labeled L1 to L43, M1 to M13 and N1 to N14. The L and M-series wetlands are marsh-like with a wooded fringe, though the north end of the M-series becomes wooded. The N-series wetland is wooded. The majority of the upland is wooded but also contains a well field, pump building and a driveway.

There was puddling in the northwest corner of the site. This area should not be subject to regulation as the puddling appears to be due to the recent excessive rain and past disturbance. It is not Isolated Land Subject to Flooding as the capacity is clearly less than ¼ acre foot and the average depth of water observed was less than 1". The area does not appear to be a vegetated wetland as it is dominated by upland species such as White Pine and Scarlet Oak and the soil has a Bw-horizon with a color of 10 YR 5/6.

Species which were observed to be dominant primarily in the wetlands include Phragmites, Cattails, Tussock Sedge, Speckled Alder, Sensitive Fern, Winterberry, Sphagnum Moss and Royal Fern. Several species are common in both the wetlands and uplands including Red Maple, European Buckthorn, Highbush Blueberry, Bittersweet, Fox Grape and Sweet Pepperbush. Species abundant primarily in the uplands include Scarlet Oak, White Oak, Princess Pine, White Pine, Black Cherry and Hayscented Fern. The attached Delineation Data Forms provide greater detail on the vegetation, soil conditions and hydrological indicators.

The MassGIS Online Viewer does not show any Estimated/Priority Habitat Areas or Certified Vernal Pools on the site. The Online Viewer shows a large portion of the site to be within the 100-year Flood Zone. Your office will need to determine its extent either based on elevation or graphically, as appropriate.

247 Bragg Hill Road • Westminster, MA 01473
Fax 978-874-1790 • Email: caronenv@aol.com

The delineation was based on features visually apparent at the time. As you are aware the interpretation of the boundaries of wetlands can vary depending on many factors including the time of year, growth phase of vegetation, groundwater levels, soil conditions, weather, and political factors. As a result, no delineation can be considered definitive until it has been reviewed and verified by all of the relevant approving authorities.

If you have any questions in regards to this matter, please feel free to contact us.

Very truly yours,
CARON ENVIRONMENTAL CONSULTING
By;

Charles E. Caron

DEP Bordering Vegetated Wetland (310 CMR 10.55) Delineation Field Data Form

Applicant: Town of North Reading Prepared by: Caron Environmental Consulting Project location: Central Street/North Reading DEP File #: ___________

Check all that apply:

- ☐ Vegetation alone presumed adequate to delineate BVW boundary: fill out Section I only
- ☑ Vegetation and other indicators of hydrology used to delineate BVW boundary: fill out Sections I and II
- ☐ Method other that dominance test used (attach additional information)

Section I. Vegetation Observation Plot Number: L39-W Transect Number: L39 Date of Delineation: 12/10/2018

A. Sample Layer and Plant Species (by common/scientific name)	**B. Percent Cover (or basal area)**	**C. Percent Dominance**	**D. Dominant Plant (yes or no)**	**E. Wetland Indicator Category***
Herbs & Seedlings				
Sheep Laurel/*Kalmia angustifolia*	3	33	Yes	FAC*
White Pine/*Pinus strobus*	3	33	Yes	FACU
Highbush Blueberry/*Vaccinium corybosum*	3	33	Yes	FACW*
Shrubs				
European Buckthorn/*Fragula alnus*	63.0	82	Yes	FAC*
Highbush Blueberry	10.5	14	No	FACW*
White Pine	3.0	4	No	FACU
Saplings				
White Pine	20.5	100	Yes	FACU
Trees				
Red Maple/*Acer rubrum*	8.666	95	Yes	FAC*
White Pine	0.463	5	No	FACU

* Use an asterisk to mark wetland indicator plants

Vegetation conclusion:

Number of dominant wetland indicator plants: 4 **Number of dominant non-wetland indicator plants:** 2

Is the number of dominant wetland indicator plants equal to or greater than the number of dominant non-wetland indicator plants? Yes

If vegetation alone is presumed adequate to delineate the BVW boundary, submit this form with the Request for Determination of Applicability or Notice of Intent.

Section II. Indicators of Hydrology   Plot L39-W

Hydric Soil Interpretation

1. Soil Survey

Is there a published soil survey for this site? ☑ Yes ☐ No

Title/date: Soil Survey for Middlesex County, Massachusetts

Map number: Online map

Soil type mapped: Freetown Muck

Hydric soil inclusions:

Are field observations consistent with soil survey? ☐ Yes ☑ No

Remarks:

2. Soil Description

Horizon	Depth (inches)	Matrix Color	Mottles Color
A	0"-6"	10 YR 2/1	None
Bw	6"-22"+	10 YR 5/3	10 YR 6/2 7.5 YR 4/6

Remarks: Soil is sand.

Other:

Conclusion: Is soil hydric: ☑ Yes ☐ No

Other Indicators of Hydrology: (check all that apply and describe)

- ☐ Site inundated:
- ☐ Depth to free water in observation hole:
- ☑ Depth to soil saturation in observation hole: at 10"
- ☐ Water marks:
- ☐ Drift lines:
- ☐ Sediment deposits:
- ☐ Drainage patterns in BVW:
- ☐ Oxidized rhizospheres:
- ☐ Water-stained leaves:
- ☐ Recorded data (stream, lake, or tidal gauge; Aerial photo; other):
- ☑ Other: Sulphidic odor

Vegetation and Hydrology Conclusion

	Yes	No
Number of wetland indicator plants >/= number of non-wetland indicator plants	☑	☐
Wetland hydrology present:		
Hydric soil present	☑	☐
Other indicators of hydrology present	☑	☐
Sample location is in a BVW	☑	☐

Submit this form with the Request for Determination of Applicability or Notice of Intent.

DEP Bordering Vegetated Wetland (310 CMR 10.55) Delineation Field Data Form

Applicant: Town of North Reading Prepared by: Caron Environmental Consulting Project location: Central Street/North Reading DEP File #: ___________

Check all that apply:

- ☐ Vegetation alone presumed adequate to delineate BVW boundary: fill out Section I only
- ☑ Vegetation and other indicators of hydrology used to delineate BVW boundary: fill out Sections I and II
- ☐ Method other that dominance test used (attach additional information)

Section I. Vegetation Observation Plot Number: L39-U Transect Number: L39 Date of Delineation: 12/10/2018

A. Sample Layer and Plant Species (by common/scientific name)	**B. Percent Cover (or basal area)**	**C. Percent Dominance**	**D. Dominant Plant (yes or no)**	**E. Wetland Indicator Category***
Herbs & Seedlings				
White Pine	3	25	Yes	FACU
Highbush Blueberry	3	25	Yes	FACW*
Lowbush Blueberry/*Vaccinium angustifolium*	3	25	Yes	FACU
European Buckthorn	3	25	Yes	FAC*
Shrubs				
White Pine	10.5	100	Yes	FACU
Saplings				
White Pine	20.5	66	Yes	FACU
Red Maple	10.5	34	Yes	FAC*
Woody Vines				
Bittersweet/*Celastrus orbiculates*	10.5	100	Yes	FACU
Trees				
White Pine	1.901	54	Yes	FACU
Black Cherry/*Prunus serotina*	0.894	25	Yes	FACU
Scarlet Oak/*Quercus coccinea*	0.385	11	No	UPL
White Oak/*Quercus alba*	0.367	10	No	FACU

* Use an asterisk to mark wetland indicator plants

Vegetation conclusion:

Number of dominant wetland indicator plants: 3 **Number of dominant non-wetland indicator plants:** 7

Is the number of dominant wetland indicator plants equal to or greater than the number of dominant non-wetland indicator plants? No

If vegetation alone is presumed adequate to delineate the BVW boundary, submit this form with the Request for Determination of Applicability or Notice of Intent.

Section II. Indicators of Hydrology Plot L39-U

Hydric Soil Interpretation

1. Soil Survey

Is there a published soil survey for this site? ☑ Yes ☐ No

Title/date: Soil Survey for Middlesex County, Massachusetts

Map number: Online map

Soil type mapped: Udorthents, sandy

Hydric soil inclusions:

Are field observations consistent with soil survey? ☑ Yes ☐ No

Remarks:

2. Soil Description

Horizon	Depth (inches)	Matrix Color	Mottles Color
A	0"-7"	10 YR 3/3	None
Bw	7"-24"+	10 YR 5/4	None

Remarks: A horizon - Disturbed

Other:

Conclusion: Is soil hydric: ☐ Yes ☑ No

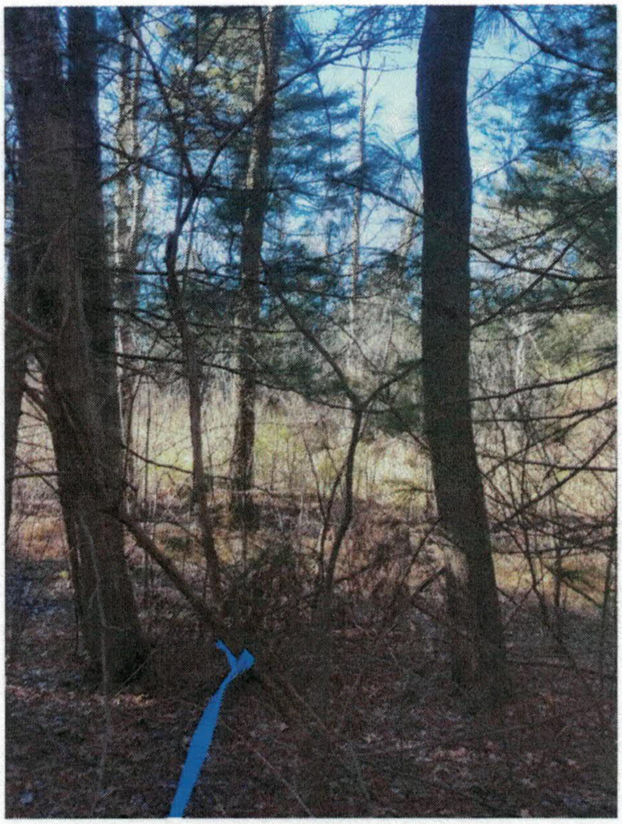
Other Indicators of Hydrology: (check all that apply and describe)

- ☐ Site inundated:
- ☐ Depth to free water in observation hole:
- ☐ Depth to soil saturation in observation hole:
- ☐ Water marks:
- ☐ Drift lines:
- ☐ Sediment deposits:
- ☐ Drainage patterns in BVW:
- ☐ Oxidized rhizospheres:
- ☐ Water-stained leaves:
- ☐ Recorded data (stream, lake, or tidal gauge; Aerial photo; other):
- ☐ Other:

Vegetation and Hydrology Conclusion

	Yes	No
Number of wetland indicator plants >/= number of non-wetland indicator plants	☐	☑
Wetland hydrology present:		
Hydric soil present	☐	☑
Other indicators of hydrology present	☐	☑
Sample location is in a BVW	☐	☑

Submit this form with the Request for Determination of Applicability or Notice of Intent.



Wetland at Plot L39-W

Upland at Plot L39-U

Soil at Plot L39-W

Soil at Plot L39-U

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APPENDIX I
Project Notification Form

JP
RECEIVED
DEC 13 2019
MASS. HIST. COMM
RC. 67459

950 CMR: OFFICE OF THE SECRETARY OF THE COMMONWEALTH

APPENDIX A
MASSACHUSETTS HISTORICAL COMMISSION
220 MORRISSEY BOULEVARD
BOSTON, MASS. 02125
617-727-8470, FAX: 617-727-5128

PROJECT NOTIFICATION FORM

Project Name: **North Reading Chlorine Injection Facilities (CIF)**

Location / Address: **Central Street and Main Street (See Attached Figure)**

City / Town: **North Reading**

Project Proponent

Name: **Mark Clark, Utilities Superintendent, North Reading DPW**

Address: **235 North Street**

City/Town/Zip/Telephone: **North Reading, MA 01864**

Agency license or funding for the project (list all licenses, permits, approvals, grants or other entitlements being sought from state and federal agencies).

Agency Name	Type of License or funding (specify)
MEPA	*Final Environmental Impact Report (FEIR)*
MassDEP	*BRP WS-29 and 32*
WRC	*Inter-Basin Transfer Act*

Project Description (narrative):

The Town of North Reading intends to receive it's drinking water from the Town of Andover. This requires that two CIFs to be constructed to boost chlorine residuals in water entering the North Reading water distribution system from Andover. The two proposed CIFs are proposed at locations on Central Street and Main Street (See attached figure).

Does the project include demolition? If so, specify nature of demolition and describe the building(s) which are proposed for demolition.

The project includes the demolition of the existing pump station at the Central Street property. All existing equipment will be removed from the facility and the building will be demolished, backfilled, and returned to grade.

Does the project include rehabilitation of any existing buildings? If so, specify nature of rehabilitation and describe the building(s) which are proposed for rehabilitation.

N/A

Does the project include new construction? If so, describe (attach plans and elevations if necessary).

Two new CIFs are proposed on properties located along Main Street and Central Street. The CIFs will boost chlorine levels of water entering the North Reading water distribution system from the Town of Andover.

After review of MHC files and the materials you submitted, it has been determined that this project is unlikely to affect significant historic or archaeological resources.

Rc. 67459

12/23/19

Jonathan K. Patton
Archaeologist/Preservation Planner
Massachusetts Historical Commission

APPENDIX A (continued)

To the best of your knowledge, are any historic or archaeological properties known to exist within the project's area of potential impact? If so, specify.

No. Also, both properties are currently occupied and built upon.

What is the total acreage of the project area?

Woodland	10.5 acres	Productive Resources:	
Wetland	3.4 acres	Agriculture	acres
Floodplain	10.4* acres	Forestry	acres
Open space	acres	Mining/Extraction	acres
Developed	2.3 acres	Total Project Acreage	16.2 acres

What is the acreage of the proposed new construction? 0.9** acres

**Floodplain overlaps other land categories, this measurement is seperate.*
***All new construction is proposed in previously developed land areas.*

What is the present land use of the project area?

- The Central Street property is currently owned and used by the North Reading Department of Public Works. Construction will be limited to previously developed areas of the property. A portion of the project will be located in an existing floodplain.
- The Main Street property is a privately owned commercial space available. Construction will be limited to developed commercial and developed open space portions of the property.

Please attach a copy of the section of the USGS quadrangle map which clearly marks the project location.

Attached

This Project Notification Form has been submitted to the MHC in compliance with 950 CMR 71.00.

Signature of Person submitting this form: [signature] Date: 12/9/19

Name: **Collin Stuart**

Address: **230 Commerce Way, Suite 302**

City/Town/Zip: **Portsmouth, NH 03801**

Telephone: **603 - 570 - 7123**

REGULATORY AUTHORITY

950 CMR 71.00: M.G.L. c. 9, §§ 26-27C as amended by St. 1988, c. 254.

J

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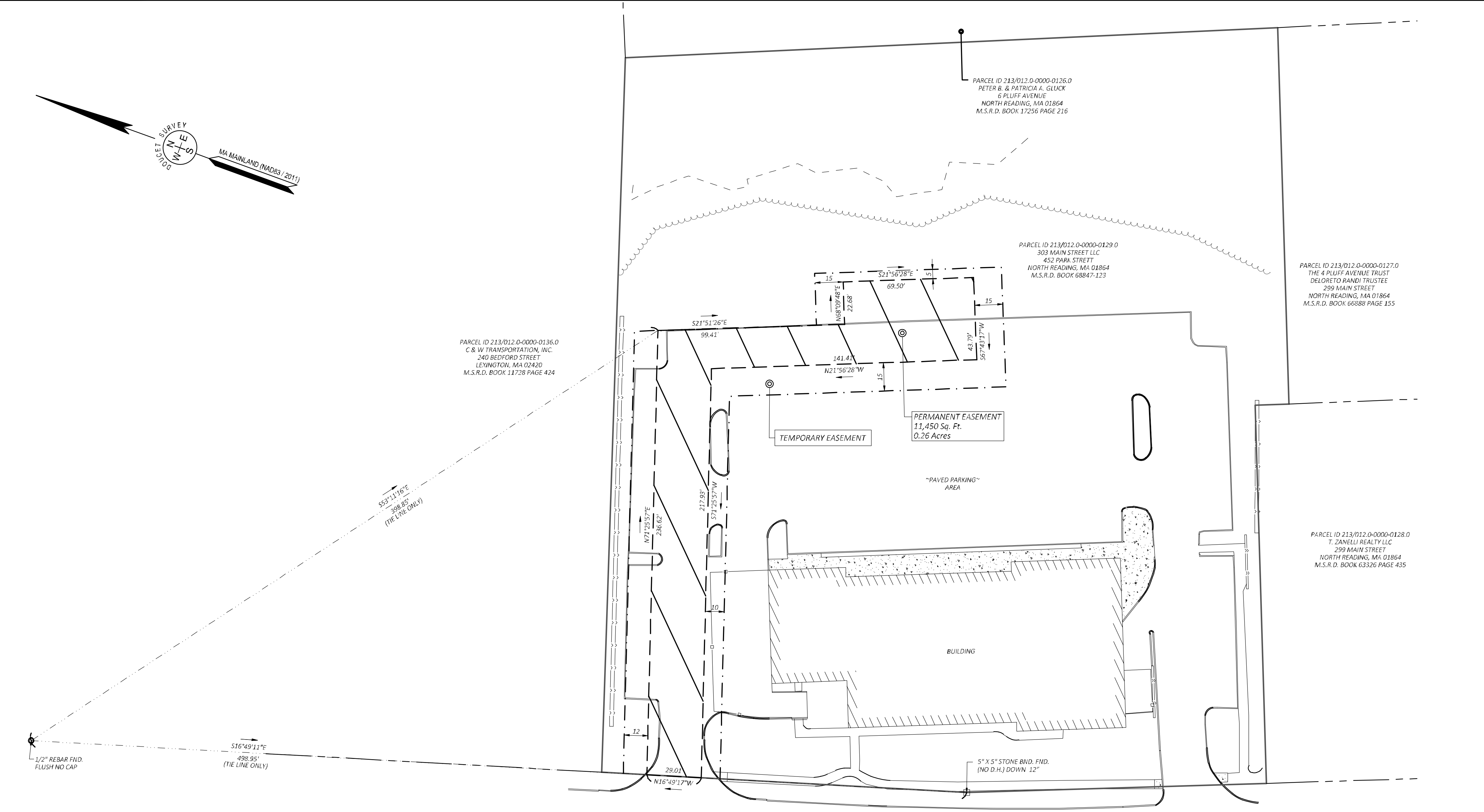
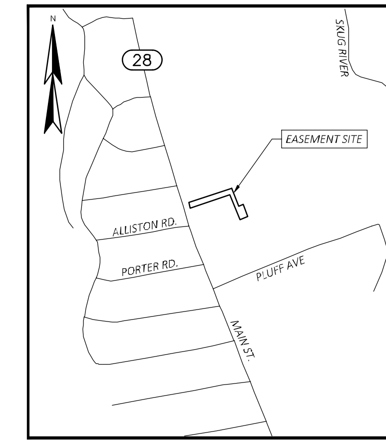
APPENDIX J
Easement Plan





LOCATION MAP (n.t.s.)

LEGEND

EXISTING

- LOT LINE (PER REFERENCE PLAN)
- APPROX. ABUTTER LOT LINE
- PROPOSED PERMANENT EASEMENT LINE
- PROPOSED TEMPORARY EASEMENT LINE
- CURBING
- BUILDING
- STOCKADE FENCE
- RETAINING WALL
- TREE LINE
- EDGE OF WETLANDS
- BOUND
- CONCRETE
- BND. FND. — BOUND FOUND

30 0 30 60
SCALE: 1 INCH = 30 FT.

EASEMENT PLAN

LAND OF
303 MAIN STREET LLC
OF
303 MAIN STREET
NORTH READING, MASSACHUSETTS

NO.	DATE	DESCRIPTION	BY

DRAWN BY:	E.D.P.	DATE	JANUARY 2020
CHECKED BY:	S.V.M.	DRAWING NO.	6289A
JOB NO.	6289	SHEET	1 OF 1

NOTES:

1. REFERENCE: TAX MAP 12, LOT 129
303 MAIN STREET
NORTH READING, MA
D.S. PROJECT NO. 6289

2. OWNER OF RECORD: 303 MAIN STREET LLC
452 PARK STREET
NORTH READING, MA 01864
M.C.R.D. BOOK 68847 PAGE 123

3. FIELD SURVEY PERFORMED BY D.J.B. & J.H.H. DURING DECEMBER 2019 USING A TRIMBLE S7 TOTAL STATION AND A TRIMBLE R8/R10 SURVEY GRADE GPS WITH A TRIMBLE TSC3 DATA COLLECTOR. TRAVERSE ADJUSTMENT BASED ON LEAST SQUARE ANALYSIS.

4. JURISDICTIONAL WETLANDS DELINEATED BY CARON ENVIRONMENTAL ENGINEERING DURING MONTH YEAR IN ACCORDING TO THE:
   - US ARMY CORPS OF ENGINEERS WETLANDS DELINEATION MANUAL, TECHNICAL REPORT Y-87-1 (JANUARY, 1987).
   - INTERIM REGIONAL SUPPLEMENT TO THE CORPS OF ENGINEERS WETLAND DELINEATION MANUAL: NORTHCENTRAL AND NORTHEAST REGION (OCTOBER 2009).
   - NATIONAL LIST OF PLANT SPECIES THAT OCCUR IN WETLANDS: NORTHEAST (REGION 1). U.S. FISH AND WILDLIFE SERVICE (MAY 1988).
   - CODE OF ADMINISTRATIVE RULES. WETLANDS BOARD, STATE OF NEW HAMPSHIRE (CURRENT).

6. HORIZONTAL DATUM BASED ON NAD83(2011) MASSACHUSETTS STATE PLANE MAINLAND COORDINATE ZONE (2001) DERIVED FROM REDUNDANT GPS OBSERVATION UTILIZING THE KEYNET GPS VRS NETWORK.

7. VERTICAL DATUM IS BASED ON APPROXIMATE NAVD88(GEOID12A) (±.2') DERIVED FROM REDUNDANT GPS OBSERVATIONS UTILIZING THE KEYNET GPS VRS NETWORK.

REFERENCE PLANS:

1. "PLAN OF LAND #303 MAIN STREET IN NORTH READING, MA" DATED JANUARY 30, 2017 BY WILLIAMS & SPARAGES.

I CERTIFY THAT THIS PLAN WAS PREPARED IN ACCORDANCE WITH THE PROCEDURAL AND TECHNICAL STANDARDS FOR THE PRACTICE OF LAND SURVEYING IN THE COMMONWEALTH OF MASSACHUSETTS.

I CERTIFY THAT THE PREPARATION OF THIS PLAN CONFORMS WITH THE RULES AND REGULATIONS OF THE REGISTRY OF DEEDS.

WILLIAM J. DOUCET P.L.S. #45709 **DATE**

DOUCET SURVEY LLC
Serving Your Professional Surveying & Mapping Needs
102 Kent Place, Newmarket, NH 03857 (603) 659-6560
2 Commerce Drive (Suite 202) Bedford, NH 03110 (603) 614-4060
10 Storer Street (Riverview Suite) Kennebunk, ME (207) 502-7005
http://www.doucetsurvey.com

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K

APPENDIX K
Emission Reduction Information

Technical Bulletin

Diesel Particulate Filter Operation and Maintenance

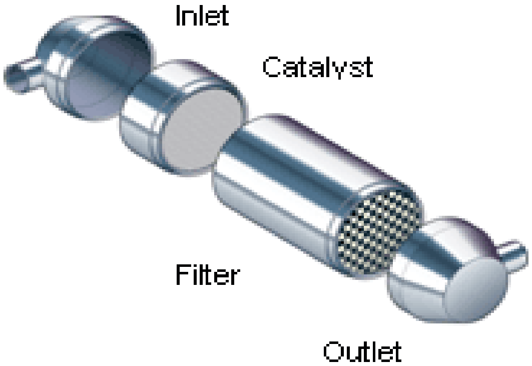
National Clean Diesel Campaign

www.epa.gov/cleandiesel

This bulletin is intended to provide general guidance. Diesel Particulate Filter (DPF) manufacturers and product suppliers should provide more detailed device-specific information and training to vehicle service technicians on proper retrofit product maintenance procedures for a specific product. DPFs are currently installed on all new on-highway engines in the United States, and DPFs may also be installed on most vehicles as a retrofit device.

DPF Operation

DPFs work by physically trapping and removing particulate matter (PM) from the engine's exhaust. The DPF can accumulate and combust PM within the filter element to achieve greater than 85 percent reductions in PM emissions. The combustion of PM in a filter occurs during regeneration. During normal operation a DPF will cause fluctuations in exhaust backpressure as PM is accumulated. Consequently, a DPF is used in conjunction with an exhaust backpressure monitoring system.



Diesel Particulate Filter (DPF)

Backpressure Monitoring

As a DPF collects PM, the passage of exhaust gas through the pores of the filter element may be progressively blocked, causing an increase in exhaust backpressure. Collected PM is combusted and reduced to ash during filter regeneration, effectively unblocking the pores of the filer element and decreasing exhaust backpressure.

Normal filter operation will include fluctuations in exhaust backpressure; however, over time the accumulation of ash will gradually continue to increase backpressure. Long term buildup of ash is remedied by periodic filter cleaning.

Engine manufacturers place limits on the exhaust backpressures for their engines; therefore, an exhaust backpressure monitoring and operator notification system must be installed with every DPF. If exhaust backpressure exceeds certain thresholds, the operator is notified that maintenance is needed. It is important that all vehicle/ equipment operators and fleet service technicians are properly trained to recognize and respond to high backpressure alert signals. Backpressure monitoring systems should be periodically inspected for proper operation.

Filter Regeneration

Regeneration occurs when the filter element reaches the temperature required for the combustion of the accumulated PM, converting it primarily to ash, gaseous carbon dioxide (CO2) and water (H2O).

"Passive" regeneration occurs when the exhaust gas temperatures are high enough to initiate combustion of the accumulated PM in the DPF, without added fuel, heat or driver action. "Active" regeneration may require driver action and/or other sources of fuel or heat to raise the DPF temperature sufficiently to combust accumulated PM. Active regeneration can be accomplished either during normal vehicle operation or during a controlled event while the vehicle is stationary. During operation, active regeneration may use extra fuel to raise the DPF temperature to combust accumulated PM. An active system that requires the vehicle to remain stationary dictates the time required every shift or every day that the vehicle must be out of service. The frequency of regeneration is determined by the engine's duty cycle, PM emission rate, filter technology, and other factors. When using an active filter, it is particularly important to follow the manufacturer's instructions for regeneration.

EPA-420-F-10-027
May 2010

DPF Maintenance

In addition to PM, the filter also traps noncombustible materials resulting primarily from lubrication oil and fuel additives (ash). Cleaning of ash from retrofit DPFs is typically required every 6 to 12 months. An engine emitting excessive PM or experiencing inadequate regeneration will cause a DPF to require more frequent cleaning. Diagnostics should be performed to identify the cause for more frequent cleaning intervals. It is important to avoid excessive PM and ash accumulation in a DPF, so proper maintenance and cleaning instructions should be followed closely. A backpressure monitoring system should always be used with a DPF and periodic inspection of the monitoring system should be performed to confirm proper operation.

In general, cleaning requires heating the filter and using compressed air combined with a vacuum system to blow the ash from the filter and capture it in a sealed container. Cleaning requires manually removing the DPF from the vehicle and placing it in a cleaning station designed for this purpose. Highly automated cleaning stations are becoming available, allowing fleet service technicians to perform cleaning on-site. Professional filter cleaning services are also available. Costs for cleaning stations or professional cleaning services should be considered when purchasing DPFs.

If equipment down time during cleaning is a concern, fleets may consider buying extra filters to have in stock at the time of cleaning. The filter must be reinstalled in the correct flow direction to maintain proper operation. Removal of the DPF for filter cleaning and reinstallation is typically performed by fleet service technicians.

It is important that all vehicle/equipment operators and fleet service technicians are properly trained on filter cleaning procedures.

Documentation should remain with the vehicle and/or in fleet records which lists installation and vehicle information such as mileage, opacity readings, date, device model number, DPF serial number, installer, etc. Records should also be maintained to document when service is performed and when the DPF is cleaned. If a fleet moves a DPF between different vehicles, records should be carefully monitored to identify if a particular vehicle or device appears to require different service intervals than another.

Engine Maintenance

It is important to properly maintain vehicles and monitor fuel and lubrication oil consumption. A bad fuel injector or increase in oil consumption may be masked by a DPF. The DPF may be damaged by a poorly maintained engine. When a DPF is removed for cleaning, it may be useful to check the opacity of the vehicle to determine if a potential engine problem exists. Maintaining service records is advisable to track potential concerns or changes in operation.

Technical Bulletin

Diesel Particulate Filter Installation

National Clean Diesel Campaign
www.epa.gov/cleandiesel

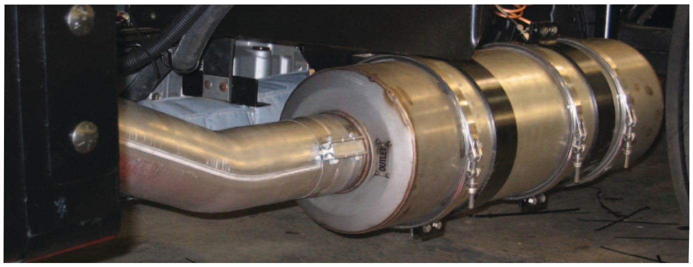
Pre-Installation

Prior to installing any retrofit device, it is important to perform a thorough engine inspection and review maintenance records to ensure proper engine operation. Vehicles with excessive fuel or lubrication oil consumption should be repaired prior to installing retrofit technologies. Excessive blowby emissions can be a sign of engine wear and further inspection of the engine may be necessary. Opacity testing with a smoke meter may also be useful to confirm proper engine operation. Prior to installing a retrofit, the exhaust system integrity should also be confirmed.

Technology Selection

To select the best Diesel Particulate Filter (DPF) for a specific vehicle it is necessary to identify:

- Vehicle Type: Highway or Nonroad
- Vehicle Class: School Bus, Class 8A Tractor, Ferry, Locomotive, Forklift, etc
- Vehicle Specifications: Manufacturer, Model, Model Year
- Engine Specifications: Manufacturer, Model, Model Year, Displacement, Horsepower, Engine Location on Vehicle, Turbo-charger, Exhaust Gas Recirculation (EGR)
- EPA Engine Family Name: Can be found on the engine's emission label and contains 12 or 13 characters such as TCP7.2RZBDBRB or 3NVXHO466ANA
- Annual Miles Traveled (Highway) or Annual Hours of Operation (Nonroad)
- Engine-out PM emission levels
- Engine duty cycle and the resultant exhaust temperatures.
- Any unique vehicle, equipment or engine operation that may create unusual conditions on the exhaust system or DPF. Conditions such as high vibration or shock loading may warrant special consideration in DPF selection and/or mounting.



Diesel Particulate Filter (DPF) installed on municipal truck

The United States Environmental Protection Agency (EPA) and the California Air Resources Board (CARB) maintain lists of verified diesel retrofit technologies that define the specific applications and engine operating criteria that must be met to successfully apply a particular retrofit technology (www.epa.gov/otaq/retrofit/verif-list.htm). When installed as described on the verified technologies list and within the verified scope of coverage, a device is expected to achieve the verified performance and durability.

Exhaust Temperature Data Logging

The exhaust temperature profile is one of the main factors in determining whether a passive or active DPF system is acceptable for a specific vehicle or piece of equipment. The required minimum exhaust temperatures for regeneration of passive DPF systems depend on the filter design and often range from 210°C for 40 percent of the time to 260°C for 30 percent of the time. Active DPF systems rely on an additional heat source for filter regeneration. Therefore, active DPFs are not as dependent as passive DPFs are on the engine duty cycle and the resultant exhaust temperatures typically encountered in normal operation.

Exhaust temperature data logging must be performed on each vehicle. The filter manufacturer or an authorized representative must perform the data logging and analysis of results. If varying vehicle routes or sporadic work loads are used, or significant changes in ambient temperatures are expected, data logging under a variety of conditions may be necessary to accurately document the duty cycle and the resultant exhaust temperatures. Exhaust pipe insulation may be used to retain heat. If insulation is used, data logging should be performed with insulation installed. When data logging, temperature measurements must be recorded at the installation location for the DPF. Fleets should maintain data logging records for all vehicles in case they are needed for later reference.

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Installation

Installation may be performed by the retrofit supplier, or the retrofit supplier may provide training to fleet personnel to perform installation.

In some applications, the DPF matches the dimensions of the conventional muffler and can be installed as a muffler replacement. In other cases the space available for DPF installation on the vehicle or equipment is very restricted and the DPF configuration must be custom-designed. Safety, visibility, and vibration may also need to be addressed by a custom installation. The time required for DPF installation will vary depending on the situation and can range from two to twelve hours or more for an active system. Special equipment or a regeneration station may be necessary for some active systems.

Since a DPF typically weighs more and may be larger than the muffler, stronger clamps and brackets are required in place of those used with the original muffler. Failure to utilize appropriate hardware and follow mounting instructions can result in a failure of support brackets and damage to the equipment or vehicle. To facilitate removal of the DPF for cleaning, quick-release clamps are often used at the filter element.

Passive DPF systems impose strict requirements on exhaust temperatures and must be mounted within a set distance from the exhaust manifold, as specified by the manufacturer. Exhaust pipe insulation may be used to retain heat. Active systems may have more flexibility in their installation location.

Documentation should remain with the vehicle and/or in fleet records which lists installation and vehicle information such as mileage, opacity readings, date, device model number, DPF serial number, installer, etc. Records should also be maintained to document when service is performed and when the DPF is cleaned. If a fleet moves a DPF between different vehicles, records should be carefully monitored to identify if a particular vehicle or device appears to require different service intervals than another.

Backpressure Monitoring

An exhaust backpressure monitoring and operator notification system must be installed with every DPF. The driver notification system must be installed where it is readily visible by the driver during normal vehicle/equipment operation. In some cases an additional notification system may be installed in the engine compartment to alert maintenance technicians of service needs. If exhaust backpressure exceeds certain thresholds, the operator is notified that maintenance is needed. It is important that all vehicle/equipment operators and fleet service technicians are properly trained to recognize and respond to backpressure warning signals as well as understand whether or not the warning signal is continuously displayed or only during certain operating conditions. It is also important that the backpressure monitoring system be periodically inspected to confirm proper operation.

Technical Bulletin

Diesel Particulate Filter General Information

National Clean Diesel Campaign

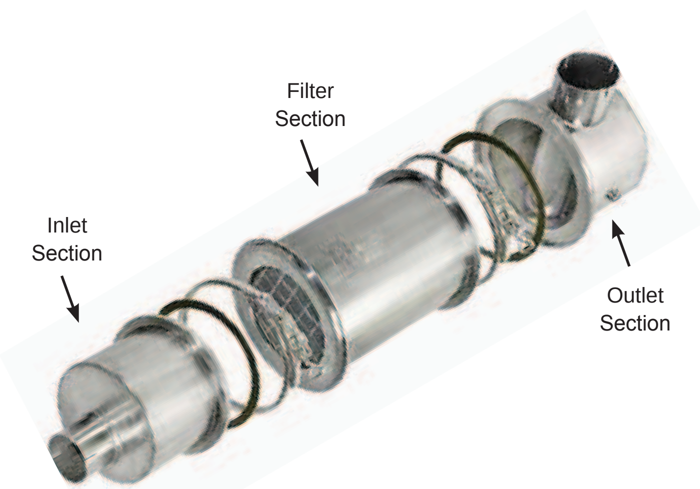
www.epa.gov/cleandiesel

Technical Overview

Diesel Particulate Filters, also known as DPFs, are exhaust aftertreatment devices that significantly reduce emissions from diesel fueled vehicles and equipment. DPFs typically use a porous ceramic or cordierite substrate or metallic filter, to physically trap particulate matter (PM) and remove it from the exhaust stream.

After it is trapped by the DPF, collected PM is reduced to ash during filter regeneration. Regeneration occurs when the filter element reaches the temperature required for combustion of the PM. "Passive" regeneration occurs when the exhaust gas temperatures are high enough to initiate combustion of the accumulated PM in the DPF, without added fuel, heat or driver action. "Active" regeneration may require driver action and/or other sources of fuel or heat to raise the DPF temperature sufficiently to combust accumulated PM. The frequency of regeneration is determined by the engine's duty cycle, PM emission rate, filter technology and other factors. When using an active filter, it is particularly important to follow the manufacturer's instructions for regeneration.

In addition to regeneration, the filter must be periodically cleaned to remove noncombustible materials and ash. It is important to avoid excessive PM and ash accumulation in a DPF, so proper maintenance and cleaning instructions should be followed closely. Cleaning of DPFs is typically required every 6 to 12 months. The cleaning process involves manually removing the filter element from the vehicle and placing it in a cleaning station designed for this purpose. An engine emitting excessive PM or inadequate filter regeneration will cause a DPF to require more frequent cleaning. Diagnostics should be performed to identify the cause for more frequent cleaning intervals. A backpressure monitoring system should always be used with a DPF and periodic inspection of the monitoring system should be performed to confirm proper operation.



Diesel Particulate Filter

Emissions Reduction

The United States Environmental Protection Agency (EPA) and the California Air Resources Board (CARB) evaluate the emission reduction performance of DPFs and identify engine operating criteria and conditions that must exist for DPFs to achieve those reductions.

DPFs verified by EPA and CARB are typically effective at reducing emissions of PM by 85 to 90 percent or more. EPA's Verified Technology List also shows that certain DPFs reduce emissions of hydrocarbons and CO by 70 to 90 percent. DPFs generally do not reduce oxides of nitrogen (NOx) emissions. DPFs can be combined with crankcase ventilation systems for additional emission reductions.

EPA is aware of concerns that catalyzed DPFs may increase the nitrogen dioxide (NO2) fraction of total NOx emissions. Some DPFs generate NO2 as a means to help filter regeneration at lower temperatures. The NO2 produced by a DPF is dependent on the catalyst formulation. EPA and CARB have established a limit on increases in NO2 emissions from diesel retrofit devices and all DPFs on the lists of verified products comply with this limit.

Application

Verified DPFs are available for nonroad and highway heavy-duty diesel engines including those on buses, trucks, construction equipment, auxiliary power units and stationary generators.

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Each DPF is verified for use with specific engines and/or with specific configurations over a range of model years. In addition to vehicle and engine specifications, the intended application should be evaluated for exhaust temperature, duty cycle, fuel sulfur levels, lubrication oil consumption and engine-out PM emission levels. Exhaust temperature data logging should be performed with each installation over a range of vehicle duty cycles and, if possible, over a range of ambient temperatures. A copy of results and analysis from data logging should be retained by the fleet for each installation. EPA and CARB's lists of verified diesel retrofit technologies define the specific engine operating criteria required to successfully apply a particular retrofit technology: www. epa.gov/otaq/retrofit/verif-list.htm.

Fuel

DPFs are verified for use with Ultra Low Sulfur Diesel fuel (ULSD), which contains up to 15 parts per million sulfur. Fuel additives should not be used unless explicitly approved by the DPF manufacturer.

Cost

DPFs generally cost between $5,000 to $15,000 or more, including installation, depending on engine size, filter technology and installation requirements. Active DPF systems are more expensive than passive DPF systems and can cost up to $50,000 for a large piece of nonroad equipment. Vehicle inspection, data logging and backpressure monitoring systems are required with each installation and these costs are typically included in the cost of the DPF. Because a DPF is likely to be heavier than a muffler, it is likely that special mounting is necessary. Costs for cleaning stations or cleaning services should also be considered when purchasing DPFs.

Longevity

When properly installed and maintained, DPFs should remain effective for the life of the vehicle, generally five to ten years or 10,000 or more hours of operation. Engine problems with fuel control or oil consumption may quickly deteriorate the performance of a DPF. Consequently, regular engine maintenance is essential to DPF performance.

Warranty coverage is typically part of the commercial contract negotiated between the product suppliers and their customers. Such warranties typically cover defects in materials or workmanship for a specified period defined in years, miles and/or operating hours.

As part of their verification program, CARB has established detailed warranty periods for CARB-verified retrofit technologies as shown in the following table.

California Air Resources Board Warranty Period

Vehicle Category	Warranty Period
GVWR > 33,000 lbs. hp > 250 hp and miles/ year > 100,000 Vehicle miles < 300k	Two years; unlimited mileage
GVWR > 33,000 lbs. hp > 250	Five years or 150,000 miles
GVWR 19,500 to 33,000 lbs.	Five years or 100,000 miles
GVWR < 19,000 lbs.	Five years or 60,000 miles

Technical Bulletin

Diesel Oxidation Catalyst Installation, Operation, and Maintenance

National Clean Diesel Campaign

www.epa.gov/cleandiesel

Pre-Installation

Prior to installing any retrofit device, it is important to perform a thorough engine inspection and review maintenance records to ensure proper engine operation. Vehicles with excessive fuel or lubrication oil consumption should be repaired prior to installing retrofit technologies. Excessive blowby emissions can be a sign of engine wear and further inspection of the engine may be necessary. Prior to installing a retrofit, the exhaust system integrity should also be confirmed.

Technology Selection

To select the best Diesel Oxidation Catalyst (DOC) for a specific vehicle, it is necessary to identify:

- Vehicle Type: Highway or Nonroad
- Vehicle Class: School Bus, Class 8A Tractor, Ferry, Locomotive, Forklift, etc
- Vehicle Specifications: Manufacturer, Model, Model Year
- Engine Specifications: Manufacturer, Model, Model Year, Displacement, Horsepower, Engine Location on Vehicle, Turbo-charge, Exhaust Gas Recirculation (EGR)
- EPA Engine Family Name: Can be found on the engine's emission label and contains 12 or 13 characters such as TCP7.2RZBDBRB or 3NVXHO466ANA

Diesel Oxidation Catalyst (DOC) on Track Dozer

- Annual Miles Traveled (Highway) or Annual Hours of Operation (Nonroad)
- Engine-out PM emission levels
- Any unique vehicle, equipment or engine operation that may create unusual conditions on the exhaust system or DOC. Conditions such as high vibration or shock loading may warrant special consideration in DOC selection and/or mounting.

The United States Environmental Protection Agency (EPA) and the California Air Resources Board (CARB) maintain lists of verified diesel retrofit technologies that define the specific applications and engine operating criteria that must be met to successfully apply a particular retrofit technology (www.epa.gov/otaq/retrofit/verif-list.htm). When installed as described on the verified technologies list and within the verified scope of coverage, a device is expected to achieve the verified performance and durability.

Exhaust Temperature Data Logging

To achieve verified levels of emissions reductions DOCs typically require a minimum exhaust gas temperature of 150°C. This temperature requirement is met in normal operation with most duty cycles. Data logging is not typically necessary to evaluate acceptable exhaust gas temperatures prior to DOC installation.

Installation

Installation may be performed by the retrofit supplier, or the retrofit supplier may provide training to fleet personnel to perform installation.

In most applications, the DOC may be configured to match the dimensions of the conventional muffler and can be installed as a muffler replacement. In other cases the space available for DOC installation on the vehicle or equipment is very restricted and the DOC configuration must be custom-designed. Safety, visibility, and vibration issues may also need to be addressed by a custom

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installation. The time required for DOC installation will vary depending on the situation and is generally one to three hours.

Since a DOC typically weighs more and may be larger than the muffler, stronger clamps and brackets are required in place of those used with the original muffler. Failure to utilize appropriate hardware and follow mounting instructions can result in a failure of support brackets and damage to the equipment or vehicle.

The DOC must be mounted within a set distance of the exhaust manifold, as specified by the manufacturer. While not normally necessary, exhaust pipe insulation may be used to retain heat when the DOC is mounted a long distance from the turbo charger.

Documentation should remain with the vehicle and/or in fleet records which lists installation and vehicle information such as mileage, date, device model number, installer, etc.

Operation and Maintenance

Once properly installed, DOCs require little maintenance. DOC manufacturers and product suppliers should provide vehicle service technicians with training on proper retrofit maintenance procedures. Periodic inspection and tightening of mounting hardware is typically appropriate.

Plugging is very rare, but it can occur in older, high-emitting or poorly maintained vehicles and/or if an engine has a mechanical failure. Long duration idling should also be avoided. If a DOC is overwhelmed with unburned fuel or lubricants (ash) it may need to be cleaned and the manufacturer’s instructions should be followed.

It is important to properly maintain vehicles and monitor fuel and lubrication oil consumption. A bad fuel injector or increased oil consumption may be masked by a DOC. The DOC may be damaged by excessive fuel or oil consumption or a poorly maintained engine.

Technical Bulletin

Diesel Oxidation Catalyst General Information

National Clean Diesel Campaign

www.epa.gov/cleandiesel

Technical Overview

Diesel Oxidation Catalysts, also known as DOCs, are exhaust aftertreatment devices that reduce emissions from diesel fueled vehicles and equipment. Engine manufacturers have used DOCs in different in-use applications for many years, and DOCs are widely used as a retrofit technology because of their simplicity and limited maintenance requirements. DOCs generally consist of a precious metal coated flow-through honeycomb structure contained in a stainless steel housing. As hot diesel exhaust flows through the honeycomb structure, the precious metal coating causes a catalytic reaction that breaks down pollutants into less harmful components.

Diesel Oxidation Catalyst (DOC)

Emissions Reduction

The United States Environmental Protection Agency (EPA) and the California Air Resources Board (CARB) evaluate the emission reduction performance of DOCs and identify engine operating criteria and conditions that must exist for DOCs to achieve those reductions.

DOCs verified by EPA and CARB are typically effective at reducing emissions of particulate matter (PM) by 20 to 40 percent. EPA's Verified Technology List also shows that DOCs may reduce hydrocarbons by 40 to 75 percent and carbon monoxide by 10 to 60 percent. The PM removed by DOCs is largely the soluble organic fraction that comes from unburned fuel and oil. DOCs generally have little impact on elemental carbon and oxides of nitrogen (NOx) emissions. DOCs have also been verified in combination with crankcase ventilation systems for additional emissions reduction.

EPA is aware of concerns that DOCs may increase the nitrogen dioxide (NO2) fraction of total NOx emissions. The NO2 produced by a DOC is dependent on the catalyst formulation. EPA and CARB have established a limit on increases in NO2 emissions from diesel retrofit devices and all DOCs on the lists of verified products comply with this limit.

Application

Verified DOCs are available for nonroad and highway heavy-duty diesel engines including those on buses, school buses, trucks, mining equipment, construction equipment, cargo handling equipment, marine vessels, auxiliary power units and stationary generators.

Each DOC is verified for use with specific engines and/or with specific configurations over a range of model years. In addition to vehicle and engine specifications, the intended application should be evaluated for exhaust temperature, fuel sulfur levels and lubrication oil consumption. EPA and CARB's lists of verified diesel retrofit technologies define the specific engine operating criteria required to successfully apply a particular retrofit technology: www.epa.gov/otaq/retrofit/verif-list.htm.

Fuel

DOCs perform best with Ultra Low Sulfur Diesel fuel (ULSD), and some DOCs are verified for use with Low Sulfur Diesel (LSD). ULSD, which contains up to 15 parts per million sulfur, is required for highway vehicles and will begin to be phased in for the nonroad sector beginning in 2010.

EPA is aware of concerns that DOCs may release some ultrafine particulates. Such concerns are associated with high sulfur levels in diesel fuel and the potential for sulfur

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to accumulate in the DOC and then be released as sulfate particles. This characteristic may also be associated with the precious metal loading and vehicle operation. When used with ULSD EPA does not believe DOCs increase ultrafine PM. Although nonroad diesel fuel will not be required to meet ULSD sulfur levels until 2010, nonroad equipment equipped with DOCs should preferably be fueled with ULSD.

Cost

DOCs generally cost between $600 to $2,000 or more, including installation, depending on engine size, installation requirements or other unique needs. Because a DOC is likely to be heavier than a muffler, it is likely that special mounting is necessary.

Longevity

When properly installed and maintained, DOCs should remain effective for the life of the vehicle, generally five to ten years or 10,000 or more hours of operation. Engine problems with fuel control or oil consumption may quickly deteriorate the performance of a DOC. Consequently, regular engine maintenance is essential to DOC performance.

Warranty coverage is typically part of the commercial contract negotiated between the product suppliers and their customers. Such warranties typically cover defects in materials or workmanship for a specified period defined in years, miles and/or operating hours.

As part of their verification program, CARB has established detailed warranty periods for CARB-verified retrofit technologies as shown in the following table.

California Air Resources Board Warranty Period

Vehicle Category	Warranty Period
GVWR > 33,000 lbs. hp > 250 hp and miles/year > 100,000 Vehicle miles < 300k	Two years; unlimited mileage
GVWR > 33,000 lbs. hp > 250	Five years or 150,000 miles
GVWR 19,500 to 33,000 lbs.	Five years or 100,000 miles
GVWR < 19,000 lbs.	Five years or 60,000 miles

Refuse Truck with Diesel Oxidation Catalyst (DOC)

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