TATA & HOWARD

October 15, 2021

Mr. Robert Gallo, P.E., Vice President
New England Service Company
37 Northwest Drive
Plainville, CT 06062

Subject: Discoloration Assessment
FINAL Flushing and Tank Evaluation
T&H No. 6959

Dear Mr. Gallo:

In accordance with our agreement, Tata & Howard is pleased to present you with this letter report for the flushing, tank evaluation, and sustainability portion of the Colonial Water Company, Dover, Massachusetts (MA) Discoloration Assessment project for the New England Service Company who currently own the Colonial Water Company water system. This evaluation focuses on the feasibility of a system-wide unidirectional flushing program, an assessment of required storage and possible locations for a new atmospheric water storage tank, and potential interconnections with surrounding water systems. Additionally, the evaluation includes a review of the existing Knollwood Drive Station and the potential to utilize the source as the distribution system's main supply or as a supplemental supply for the main service area. The water quality at each of the supply sources was reanalyzed with the most recent laboratory results for both iron and manganese.

1 Existing System and Water Quality

1.1 Background

A Water Quality Evaluation was prepared by Tata & Howard and submitted to the Colonial Water Company in September 2021. The Water Quality Evaluation focused on the existing water quality of the Colonial Water Company water system, specifically related to the levels of manganese in the wells and distribution system. Three options for manganese removal/sequestration were reviewed and evaluated; sequestration with a blended orthophosphate, GreensandPlus™ filtration, and biological removal.

The Colonial Water Company Dover water system is supplied from seven active groundwater sources contained within three well sites; Francis Street, Draper Road, and Knollwood Drive. The Francis Street Wells consist of Well A, Well B, and Well C. The

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Draper Road Wells consist of Well No. 1 and Well No. 2. The Knollwood Drive Wells consist of Well 1 and Well 2. The Colonial Water Company also owns and operates two additional ground water sources, the Chickering Drive Wells. These two wells provide water to a separate area of the Town of Dover, and they are not connected to the Dover water system discussed in this report. The active groundwater sources currently have varying levels of treatment at each treatment plant, including:

- Francis Street Station – This site is the largest source and treats Francis Street Well A, Well B, and Well C with potassium hydroxide for corrosion control and sodium hypochlorite for disinfection with the Massachusetts Department of Environmental Protection (MassDEP) approved 4-log inactivation of viruses.
- Draper Road Station – This site is the smallest source and treats Draper Road Wells No. 1 and 2 with potassium hydroxide for corrosion control and sodium hypochlorite for disinfection.
- Knollwood Drive Station – This site treats Knollwood Drive Wells with potassium hydroxide for corrosion control.
- Chickering Drive Station – This site treats Chickering Drive Wells with potassium hydroxide for corrosion control. The Chickering Drive Wells provide water to a small portion of the distribution system. It is completely isolated from the main water distribution system and is therefore a separate service area.

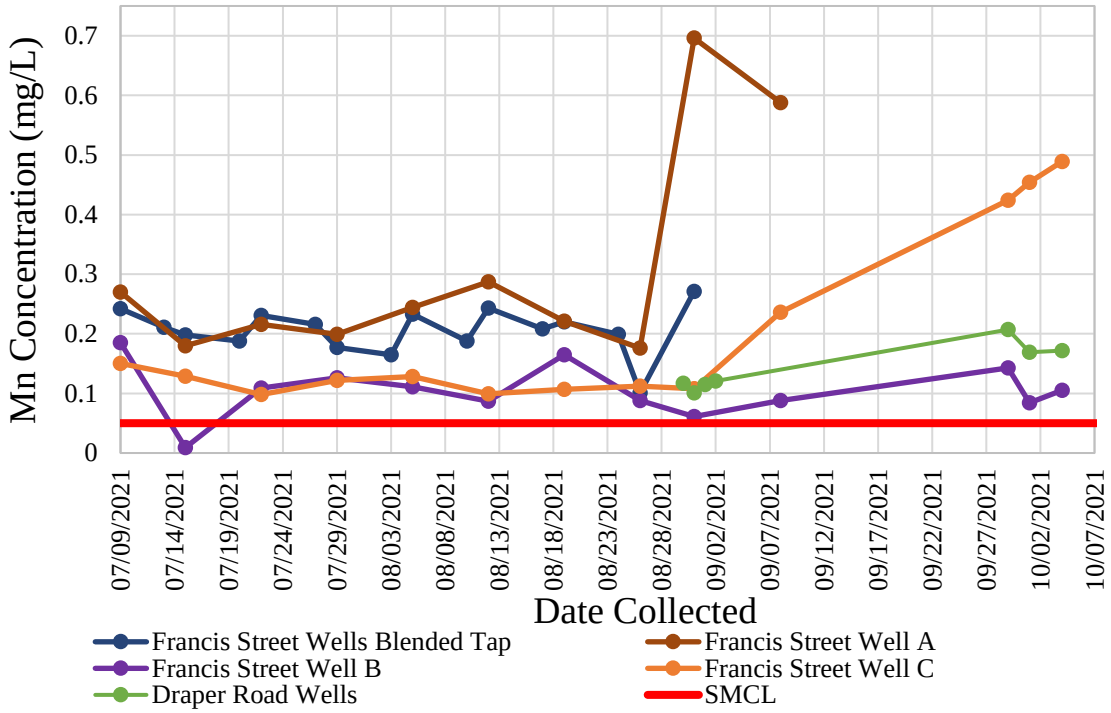
As discussed in the Water Quality Evaluation report prepared by Tata & Howard, there are elevated manganese levels present in the Francis Street Wells and Draper Road Wells. The majority of the samples for Knollwood Drive are nondetectable for manganese with only one sample indicating a concentration slightly above the laboratory detection limit. Manganese is nondetectable in the Chickering Drive Wells. MassDEP requires manganese levels at the point of entry for any source or group of sources to be consistently and reliably below 0.30 mg/L, which is interpreted as the annual average being less than 0.21 mg/L and no samples exceeding 0.3 mg/L.

Since the completion of the Water Quality Evaluation report dated September 14, 2021, samples were collected to determine iron levels in Francis Street Wells B and C, Knollwood Wells 1 and 2, and Draper Road Well No. 2. Francis Street Well A and Draper Road Well No. 1 were not sampled because they are currently shut down for reasons further discussed in this letter. There were several samples with elevated levels of iron greater than the SMCL of 0.3 mg/L as discussed below.

1.2 Manganese

Refer to the following **Figure No. 1** which is a graph of total manganese concentrations for all Colonial Water Company sources. Chickering Drive and Knollwood Drive Wells are not included since the manganese concentrations are mostly nondetectable in these sources.

Figure No. 1
Total Manganese Concentrations



Based on laboratory results, at the Francis Street Wells' current sampling location, total manganese concentrations were below the SMCL from November 2019 through May 2021. Then, in June 2021, the total manganese in the blended sample increased to 0.237 mg/L. Since then, sampling has been conducted on each of the Francis Street Wells individually. In general, the results indicate that manganese levels in all three Francis Street wells have significantly increased.

Refer to the following **Figure No. 2**, **Figure No. 3**, and **Figure No. 4** graphs of total versus dissolved manganese at each of the Francis Street wells. Beginning on September 8, 2021, each well was analyzed individually for both total manganese and dissolved manganese. This additional sampling was conducted to determine if sequestration is a treatment option. For sequestration to be successful, a majority of the manganese must be in the dissolved form.

Figure No. 2
Francis Street Well A
Total vs. Dissolved Manganese

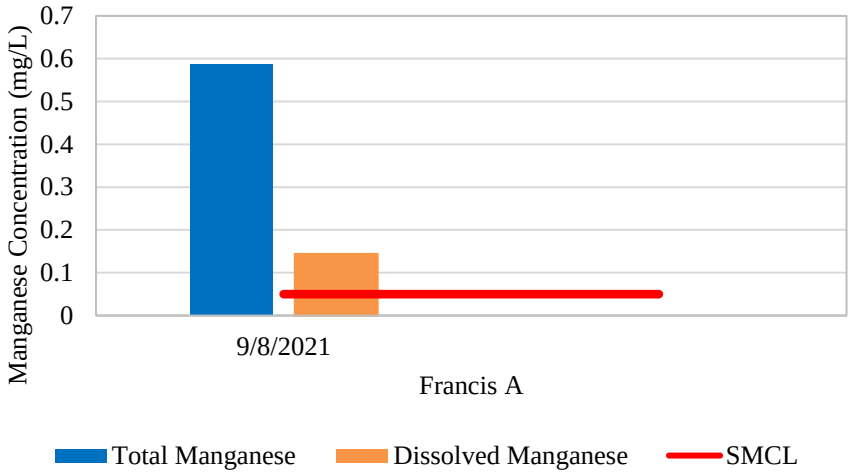


Figure No. 3
Francis Street Well B
Total vs. Dissolved Manganese

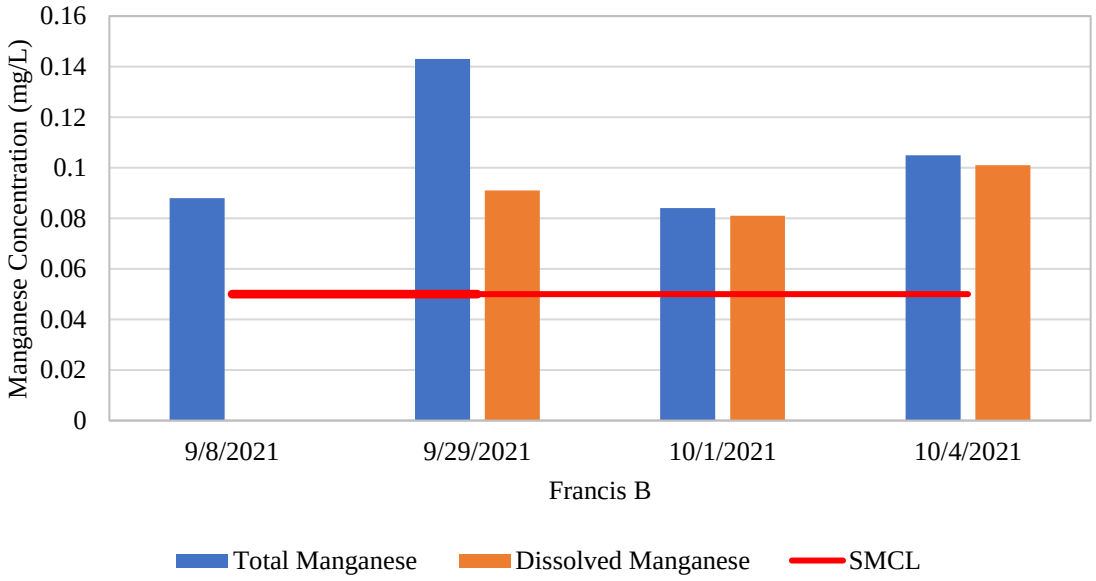


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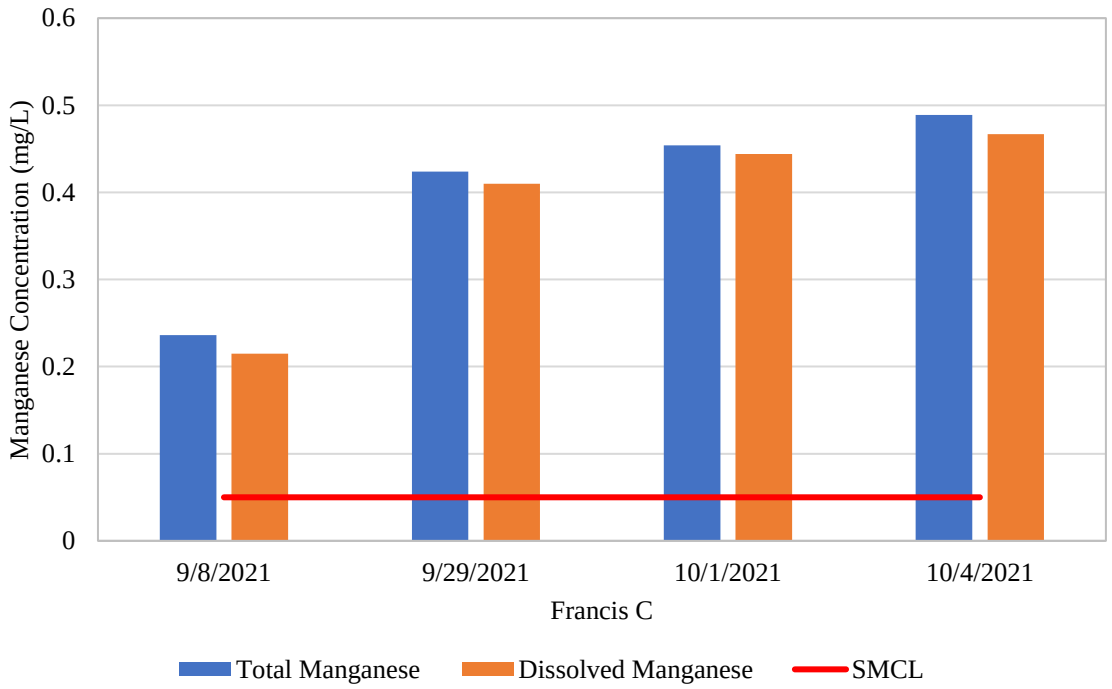
Figure No. 4
Francis Street Well C
Total vs. Dissolved Manganese



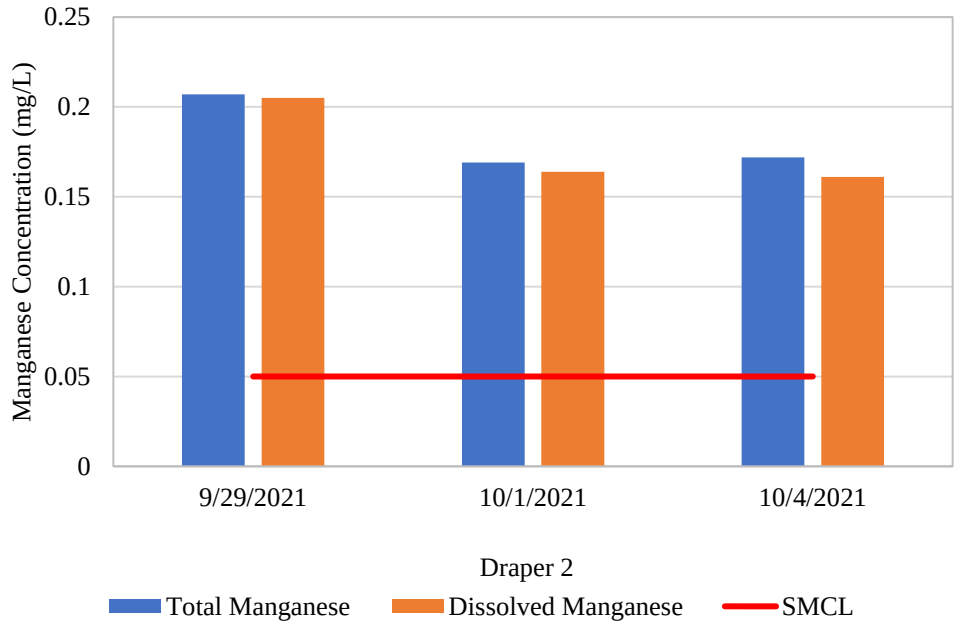
The majority of the manganese in Francis Street's Well A is in the oxidized form. Therefore, sequestration is not an option for this source. Well A is the largest producing well at the Francis Street Station. In September 2021, the Colonial Water Company shut down Well A as a result of the elevated total manganese concentrations. The majority of the manganese in Francis Street's Wells B and C is in the dissolved, however, as a result of the extent of the elevated levels of total manganese (as high as 0.489 mg/L in Well C), sequestration is not an option.

The Francis Street Wells were recently redeveloped. Before redevelopment, Francis Street Well A had a specific capacity of 25 gallons per minute per foot of water column (gpm/ft) at 180 gallons per minute (gpm). After redevelopment, the specific capacity was 26.4 gpm/ft at 203 gpm. Before redevelopment, Francis Street Well B had a specific capacity of 9.7 gpm/ft at 130 gpm. After redevelopment, the specific capacity was 11.42 gpm/ft at 128 gpm. Before redevelopment, Francis Street Well C had a specific capacity of 26.78 gpm/ft at 150 gpm. After redevelopment, the specific capacity was 31.3 gpm/ft at 150 gpm.

Refer to the following **Figure No. 5**, which contains total and dissolved manganese concentrations of Draper Road's Well 2. Draper Road's Well 1 was not sampled because it is not currently in operation due to an e-coli contamination event. The majority of the

manganese in Draper Road's Well 2 is in the dissolved form, however, sequestering is not feasible at the Draper Road Station due to elevated iron levels. Refer to Section 1.3 for a discussion about iron in the well.

Figure No. 5
Draper Road Well No. 2
Total vs. Dissolved Manganese



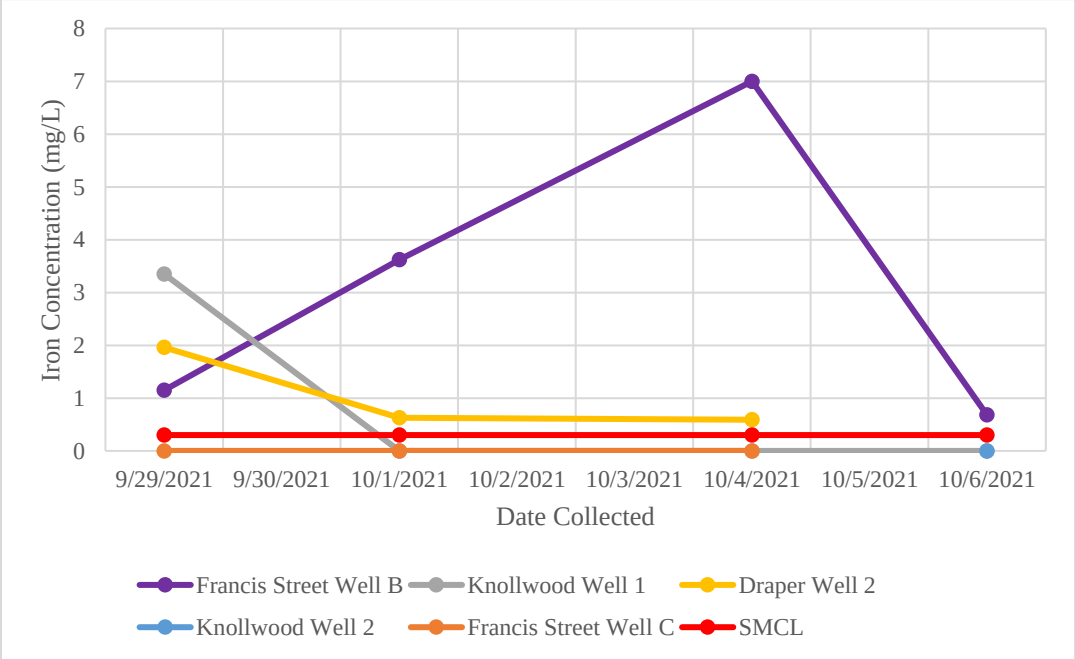
Manganese levels at the Knollwood Station Well 1 were nondetectable in samples collected from September 29, 2021 to October 6, 2021. For Knollwood Station Well 2, a sample collected on September 29, 2021 indicated a total manganese concentration of 0.007 mg/L and a dissolved manganese concentration of 0.006 mg/L. A sample collected on October 6, 2021 indicated that manganese was nondetectable in Well 2.

1.3 Iron

Iron levels in the Colonial Water Company's sources were analyzed with the exception of the Chickering Drive Wells. Refer to **Figure No. 6**, which contains the iron levels, per recent sampling. As previously mentioned, the SMCL for iron is 0.3 mg/L. The levels were nondetectable in both Knollwood Station Wells 1 and 2, as well as in Francis Street's Well C. However, the iron level in Francis Street's Well B was 1.15 mg/L on September 29, 2021. Then, the next two samples, collected on October 1, 2021 and October 4, 2021 were 3.62 mg/L and 7.00 mg/L, respectively. An additional sample, collected on October 6, 2021, indicated an iron concentration of 0.68 mg/L in Francis Street's Well B.

On September 29, 2021, iron in Knollwood Drive's Well 1 was 3.35 mg/L. However, samples collected on October 2, October 4, and October 6, 2021 indicated nondetectable levels of iron. The 3.34 mg/L results may be an outlier or attributable to sampling technique. One sample was collected for Knollwood Drive's Well 2 on October 6, 2021 which indicated a nondetectable level of iron. Iron concentrations at Draper Road's Well 2 ranged from 0.59 mg/L to 1.96 mg/L.

Figure No. 6
Iron



1.4 Water Quality Summary

The following is a summary of the iron and manganese analysis for each of the Colonial Water Company's sources analyzed.

Francis Street Station

Well A

In the recent past, total manganese in the Francis Street Station's blended tap was below the SMCL of 0.05 mg/L. However, a blended sample collected on June 30, 2021 was 0.237 mg/L for total manganese. Since then, the total manganese in the raw water has been consistently trending upward and remained above the SMCL in all three of the Francis Street Station's wells. When the total manganese levels

reached 0.696 mg/L in a raw water sample from Well A, the Colonial Water Company shut the well down in September of 2021. Prior to doing so, a sample was analyzed for total and dissolved manganese. Refer to **Figure No. 2**. The sample indicated that the majority of the manganese is oxidized. Since most of the manganese is already oxidized, and the total manganese was 0.588 mg/L on September 08, 2021, sequestration is not a viable option for Well A. This conclusion is based on one sample where total versus dissolved manganese was analyzed. Additional sampling would be important before making a definitive conclusion about treatment for Well A. To utilize this well in the future, treatment by filtration is recommended. Sampling for iron levels in Well A did not take place because the well is shut down. The majority of the historical analytical data indicates iron was nondetectable to 0.02 mg/L in blended finished water samples from the Francis Street Station.

Well B

With the exception of the sample taken on September 08, 2021, samples from Well B indicated that the majority of the manganese is dissolved. Refer to **Figure No. 3**. However, the total manganese levels remain significantly above the SMCL of 0.05 mg/L. The highest total manganese level was 0.185 mg/L on July 09, 2021 for Well B. Based on this information, sequestration may have been a viable option for treatment of Well B. However, it has recently been determined that iron levels in Well B are significantly above the SMCL of 0.3 mg/L as shown in **Figure No. 6**. A sample from September 29, 2021 contained 1.15 mg/L of iron. On October 1, 2021, the iron level was 3.62 mg/L. The next sample on October 4, 2021 had 7.00 mg/L of iron. The last follow-up sample on October 6, 2021 contained 0.68 mg/L of iron. In general, iron levels above 1.0 mg/L are difficult to sequester. Therefore, while the manganese levels in Well B are acceptable for sequestering, the iron levels are not. To utilize this well in the future, treatment by filtration is recommended. This well is the smallest of the three Francis Street wells. While Well A is offline due to water quality, Wells B is operating in lead, and Well C is operating in lag configuration in an effort to reduce the impacts of the water quality of the two wells on the finished water, particularly in regards to manganese levels.

Well C

Manganese levels in Well C have been indicating a steep upward trend, as can be seen in **Figure No. 1**. Between August 31, 2021 and October 4, 2021, the manganese levels went from 0.108 mg/L to 0.489 mg/L. This is significantly above the SMCL of 0.05 mg/L. Refer to **Figure No. 4**. The majority of the manganese in Well C is dissolved. However, based on the magnitude of the manganese concentrations in this well, sequestration would not be an option. Iron

levels at Well C were nondetectable. To utilize this well in the future, treatment by filtration is recommended.

Draper Road Station

Wells No. 1 and No. 2

Draper Road's Well No. 1 was not sampled because it is not currently in operation due to an e-coli contamination event. As shown in **Figure No. 5**, the majority of the manganese in Well No. 2 is in the dissolved form.

Iron levels in the Draper Road Well No. 2 are above the SMCL. Samples collected in September and October of 2021 had a maximum of 1.96 mg/L of iron and a minimum of 0.59 mg/L of iron. Refer to **Figure No. 6**. Based on the high levels of manganese and iron in the well, sequestering would likely not be effective. Therefore, filtration would be the best option for this source. Since the source is only permitted for 0.078 million gallons per day (mgd), abandonment should be considered as filtration would be cost prohibitive.

Knollwood Drive Station

Wells 1 and 2

Manganese levels in the Knollwood Well 1 were nondetectable, while levels in Well 2 were well below the SMCL. Manganese levels at the Knollwood Well 1 were nondetectable in samples collected from September 29, 2021 to October 6, 2021. For Knollwood Well 2, a sample collected on September 29, 2021 indicated a total manganese concentration of 0.007 mg/L and a dissolved manganese concentration of 0.006 mg/L.

The iron level on September 29, 2021 was 3.35 mg/L for Well 1 as shown in **Figure No. 6**. All three follow-up samples, collected on October 1, 2021, October 4, 2021, and October 6, 2021, had nondetectable levels of iron in Well 1. Well 1was inspected on September 24, 2021 as discussed later in this letter. Then, the well was redeveloped on October 5, 2021. During redevelopment, the well pumped heavy iron deposits. The elevated level of iron in the September 29, 2021 sample may be a result of disturbing iron deposits during the inspection of Well 1. As previously mentioned, the iron level in Well 1 was nondetectable on October 6, 2021 which was one day after redevelopment of the well. A sample collected on October 6, 2021 indicated that iron was nondetectable in Well 2.

In the Water Quality Evaluation report prepared by Tata & Howard, it was recommended that the Colonial Water Company perform a feasibility study that focuses on the possibility

of further utilizing the Knollwood Drive source where there are currently no manganese issues.

2 Water System Demands and Well Pumping Capacity

Annual Statistical Reports (ASRs) for the Colonial Water Company, Dover distribution system were provided for 2017 through 2020. The reported net finished water that entered the distribution system includes the Chickering Drive Well. Because of this, the Individual Groundwater Source Statistics Tables were used to calculate the average day demand (ADD) for the Colonial Water Company distribution system without the Chickering Drive Well. The reported maximum day demand (MDD) for the system does include the Chickering Drive Well totals as this is the only MDD reported in the ASR. The ADD ranged from 0.138 million gallons per day (mgd) to 0.152 mgd and the MDD ranged from 0.194 mgd to 0.368 mgd. The highest ADD and MDD occurred in 2020. The historical ADD and MDD are presented in **Table No. 1**. It should be noted that with the Chickering Drive Well demands, the ADD ranged from 0.141 mgd to 0.156 mgd.

Table No. 1
Colonial Water Company, Dover Demand Summary

Year	ADD (mgd)	MDD (mgd)	Peaking Factor (MDD/ADD)
2017	0.143	0.358	2.51
2018	0.145	0.368	2.53
2019	0.138	0.194	1.41
2020	0.152	0.368	2.42

Peak hour demand is the maximum total quantity of water supplied in a single hour over a one-year period, typically expressed in mgd. These demands are typically met by distribution water storage facilities. Because the Colonial Water Company distribution system does not have any atmospheric water storage tanks in the system, the peak hour needs to be supplied from the wells and the existing hydropneumatic tanks located at the Francis Street and Draper Road Stations.

Pumping records for every few minutes from July 2020 were reviewed to estimate peak hour demands. Based on reviewing the pumping records, the peak usage occurs between 3:00 AM and 4:00 AM. This is due to automatic irrigation systems. The pumping rates from Francis Street Wells A, B, and C were approximately 450 gpm, Draper Road Wells were approximately 50 gpm, and the Knollwood Drive Wells were approximately 25 gpm. This gives an estimated peak hour pumped from supplies of 525 gpm. It should be noted that during peak demands, pressures in the system drop. This suggests that the peak hour demand is actually higher and cannot be met by the current supply sources.

The water distribution system has permitted sources in two different basins. The Francis Street and Draper Road Wells are in the Boston Harbor Basin, and the Knollwood Drive Wells and Chickering Drive Well are located within the Charles River Basin. According to the most recent Charles River Water Management Act (WMA) Permit, dated December 2010, Colonial Water Company may take the annual average system-wide withdrawal volumes from its sources in either basin in the manner that best meets operational needs, as long as the combined system-wide withdrawals do not exceed the volumes outlined in the permit. The total daily average withdrawal volume for all Colonial Water Company's sources is 0.13 mgd for the period of March 1, 2019 to February 29, 2024. **Table No. 2** shows the maximum approved pumping rates from each source. The approved pumping rates for the Francis Street Wells is from the February 2018 Francis Street Well C final approval.

Table No. 2
Supply Summary

Name of Supply	Basin	Approved Maximum Withdrawal Volume (mgd)
Knollwood Drive Wells	Charles River	0.432
Francis Drive Well A	Boston Harbor	0.31*
Francis Drive Well B	Boston Harbor	0.16*
Francis Drive Well C	Boston Harbor	0.23*
Draper Road Well No. 1	Boston Harbor	0.039
Draper Road Well No. 2	Boston Harbor	0.039

*The Francis Street Wells have a combined approved daily volume of 0.47 mgd. The approved maximum withdrawal for Francis Street Well C is based on the reported design capacity of the well pump (159 gpm at 282 feet).

It should be noted that based on the permitted daily pumping rate of 0.13 mgd, the Colonial Water Company has exceeded the permit capacity every year between 2017 and 2020. To increase the permit capacity, Colonial Water Company would need to apply for an increase to their WMA Permit Withdrawal volume. For MassDEP to consider providing additional capacity, Colonial Water Company would need to comply with performance standards for unaccounted for water of 10 percent and residential per capita usage of 65 gallons per capita day (gpcd). Based on the 2017 through 2020 ASRs, the Colonial Water Company's unaccounted for water has ranged from 12 to 13 percent, and the residential water usage has ranged from 65 to 73 gpcd, with the exception of 2019 when the residential usage was below 70 gpcd. If conservation measures were to be implemented and adhered to, then Colonial Water Company may be able to decrease water usage to the approved permitted withdrawal volumes.

Colonial Water Company is in the process of being acquired by Aquarion Water Company of Massachusetts (AWC-MA) and AWC-MA expects to assume oversight of the system starting in late 2021. AWC-MA's sister company, Aquarion Water Company of

Connecticut (AWC-CT), has successfully been running water conservation programs in CT since 2017. In systems that show similar water usage patterns as Dover, AWC-CT has been able to reduce seasonal usage by 11%. AWC-MA plans to implement a similar program in Dover for the Summer of 2022.

3 Knollwood Drive Wells

3.1 Knollwood Drive Wells

Due to the water quality concerns at the Francis Street Wells, this letter report will consider the option of utilizing the Knollwood Wells to maximize the approved pumping capacity and supply the Main Service Area. The authorized maximum daily withdrawal for the Knollwood Drive Wells is 0.432 mgd or 300 gpm. Because the Knollwood Drive Wells currently serve a small service area, the wells produce much less than the authorized maximum daily withdrawal. Based on 2019 production totals for the Colonial Water Company's Dover distribution system, the Knollwood Drive Wells produced a total of approximately 9.5 million gallons in a year. Based on the total 2019 production data, the Knollwood Drive Wells produced approximately 19 percent of the total system supply. Based on the 2019 production totals, the Francis Street Wells produced the highest volume of source water of approximately 30.0 million gallons, or approximately 60 percent of the total system supply.

There are two wells at the Knollwood Drive Station, one 8-inch (Well 1) and one 6-inch (Well 2). In September 2021, the 6-inch well was inspected and pumped, and the well was able to produce 40 gpm at 140 pounds per square inch (psi), and 60 gpm at 100 psi. Based on the inspection, the well was very encrusted. Therefore, the well was redeveloped in October 2021. Before redevelopment, the specific capacity was 20.43 gpm/ft at 94 gpm. After development, the specific capacity was 27.49 gpm/ft at 102 gpm. The 8-inch well (Well 1) was also inspected and redeveloped in October 2021. Before redevelopment, the specific capacity was 11.69 gpm/ft at 76 gpm. After development, the specific capacity was 12.98 gpm/ft at 85 gpm.

Based on most recent MDD of 0.368 mgd, and the authorized maximum daily withdrawal volume for the Knollwood Drive Wells of 0.432 mgd, the Knollwood Drive Wells would be able to supply the system's MDD if the Francis Street Wells and Draper Road Wells were offline. The Knollwood wells would likely not be able to provide the peak hour demand. Also, without an atmospheric water storage tank, the peak hour demand has to come from the wells and hydropneumatics tanks, where the tanks provide little storage. The Knollwood Drive Wells have two small bladder tanks and no hydropneumatics tanks, therefore, the peak hour demands cannot be met from these wells. Also, it is unknown at this time if the Knollwood Drive Wells would be able to produce a combined 300 gpm after redevelopment and the chemical feed system will need to be evaluated for potential upgrades to account for the additional flow. Further pumping tests need to be performed to determine the potential long-term capacity of the wells. Based on the system ADD and

the WMA Permit conditions in the Charles River Basin, the Knollwood Drive Wells cannot be used to supply the entire current ADD of the Dover system on their own. Based on the WMA Permit, the total system ADD cannot be supplied by the Frances Street and Draper Road Wells either. The Colonial Water System, with the cooperation of its customers and the community, will need to implement conservation measures and take steps to reduce the unaccounted for water to be in compliance with the permit or to be able to request more water through a WMA Permit amendment.

3.2 Knollwood Drive Station Chemical Feed Facilities

The potassium hydroxide (KOH) equipment at the Knollwood Drive Station is designed for a flow of 125 gpm at a dosage of 100 gallons per million gallons treated. To increase the usage of the Knollwood Drive Station's wells above 125 gpm, an additional KOH bulk tank will be required. A larger day tank and metering pumps would also be required. The station was designed to accommodate future installation of chlorine disinfection. The chlorine facilities are also designed for a flow of 125 gpm at a dosage of 2 mg/L. An inspection of the pump station will be required to determine if the chemical upgrades needed to treat flows greater than 125 gpm will fit into the existing station.

3.3 Knollwood Service Area

The Knollwood Drive Wells currently service the Knollwood Service Area, or downtown area of Dover. The Knollwood Service Area has a general hydraulic gradeline of approximately 320 feet above mean sea level (MSL). Compared to the general hydraulic gradeline of the Main Service Area of approximately 450 feet above MSL, the Knollwood Drive Service Area is the lower service area. There is an existing pressure reducing valve (PRV) between the Knollwood Service Area and the Main Service Area on Centre Street that can allow for flows from the Main Service Area to the Knollwood Service Area. The PRV is set to open when pressures in the Knollwood Service Area drop to approximately 55 psi at the PRV. A water distribution system map indicating the different service areas is included in Appendix A.

As discussed, the Knollwood Drive Wells currently serve the Knollwood Service Area only. Three options were considered to provide water from the Knollwood Drive Wells into the Main Service Area.

Option 1 – Dedicated Line

If the Knollwood Drive Wells were utilized to serve the Main Service Area as well, the Knollwood Drive pump station would need to be connected to the Main Service Area with a dedicated water main from the pump station to the Main Service Area. Also, the well pumps will need to be evaluated to determine if they would be able to supply water to the higher hydraulic gradeline of the Main Service Area. With the increased flow and head, the required submersible pumps may not fit in the existing wells. If the larger pumps cannot fit in the existing wells, a larger replacement well will be difficult to permit based

on the existing Zone I radius. A feasibility analysis will be required to determine if the pumps will fit and if not, whether a replacement well in the same location as the existing wells is an option. Otherwise, the capacity that can be obtained will need to be determined without installing a larger diameter well. Under this scenario, the Knollwood Service Area would be served through the PRV instead of directly from the wells. Approximately 2,400 linear feet of 8-inch diameter water main would be needed to connect the Knollwood Wells to the Main Service Area at the PRV location. A map showing the dedicated line is included in Appendix B.

Option 2 – Eliminate Centre Street PRV

Alternatively, the existing PRV on Centre Street could be removed, ultimately eliminating the Knollwood Service Area. Currently, the Knollwood Service Area also serves a portion of the Town of Dover through a master meter on Centre Street. Elevations in the Colonial Water Center portion of the Knollwood Service Area range from approximately 145 feet above MSL to 182 feet above MSL at street level. This area has existing static pressures between 60 psi and 75 psi. Elevations in the Town of Dover range from approximately 115 feet above MSL to 162 feet above MSL. This area has existing static pressures between 68 psi and 90 psi. If the PRV were eliminated, and this area is served by the Main Service Area, static pressures in the Colonial Water Company portion of the Knollwood Service Area could increase to between 115 psi and 130 psi. Static pressures in the Town of Dover could increase to between 125 psi and 145 psi.

An upper limiting pressure of 120 psi is generally recommended, as older fittings in the system are generally rated at 125 to 150 psi. Pressure above this level can result in increased water use from fixtures and also increased leakage throughout the distribution system. The MassDEP published Guidelines for Public Water Systems recommends that pressure reducing devices be utilized on mains or on individual services lines when static pressures exceed 100 psi. Also, plumbing code states that water heaters in homes can be affected when pressures exceed 80 psi. Based on these guidelines, it is recommended that the Centre Street PRV remain in service to provide acceptable pressures to the Knollwood Service Area.

Option 3 – Expand Knollwood Service Area

A third option is to eliminate the Centre Street PRV and expand the Knollwood Service area by constructing a new PRV on Walpole Street south of Bretton Road. According to Colonial Water Company staff, there is an abandoned meter pit along Bretton Road near Picardy Lane that could be used for the PRV. Ground elevations in the expanded service area range from 171 feet above MSL near the PRV and 240 along Bretton Road. The higher elevations could experience pressures near 35 psi based on the operating gradeline in the Knollwood Service Area. Some adjustments to the well operation could allow for a small increase in pressures in the Knollwood Service Area to provide increased static pressures along Bretton Road.

The condition of the meter pit would need to be evaluated. This option will allow for more of the system to be supplied from the Knollwood Drive Wells. The total amount of customers served would need to be evaluated to determine if demands can be met with the current chemical feed facility capacity. Also, if upgrades can be made to the chemical feed facility and pumps to maximize the water available from the Knollwood Drive Wells, a Colonial Water Company owned abandoned well site on Picardy Lane could be used for a booster pump station to pump water from the Knollwood Service Area to the Main Service Area. This would eliminate the need for the dedicated water main from the well site to the existing PRV.

A more detailed analysis is recommended to determine the feasibility of utilizing the Knollwood Drive Wells to serve a larger area. Additional water quality analyses including nitrates and sodium are recommended. It should be noted that once the Knollwood Drive Wells pump at a higher rate, the water quality of the sources could potentially change. A map showing the proposed PRV location as well as the proposed expanded service area boundary is included in Appendix C.

4 System Flushing

4.1 Unidirectional Flushing Program

A program to reduce customer complaints not only includes methods to improve water quality at the source of supply, but also includes routine maintenance procedures such as distribution system flushing. Precipitated iron and manganese, as well as other products of corrosion, accumulate in water mains over time, particularly in dead end mains. Periods of high demand, such as during a fire, will re-suspend these deposits and carry them to the customers' taps. The result may be a series of complaints about discolored water and stained laundry.

Periodic flushing of the distribution system can help remove these deposits. However, the flushing program must remove the accumulated deposits from the water mains to be effective. Inadequate flushing will stir up and move the deposits from one area to another and may result in more serious complaints. To physically remove or "flush" the deposits from the water main, the velocity of the water must be relatively high.

A flushing program should be carried out during periods of low demand and suitable weather. The flushing crew must be adequately prepared for the work and have a complete set of valve maps. In addition, adequate valves must be available to isolate sections of the distribution system and prevent re-suspended deposits from traveling to areas of the system previously flushed and cleaned. A secondary benefit associated with a flushing program is the improvement of the carrying capacity of the water mains. The removal of deposits, scale, and encrustation will allow more water to flow through the pipes in the distribution system.

A unidirectional flushing plan includes a list of valves to be opened, followed by a list of valves to be closed, then the plan will identify the hydrants to be opened. The program should be designed to flush from a supply or water storage tank, if available, to system extremities. It should be noted that for the Colonial Water Company's Dover system, to obtain adequate flow and velocity while flushing unidirectionally, the Francis Street Wells will need to be operated at maximum capacity. Due to the existing water quality concerns at this site, additional iron and manganese will be introduced to the system that could adhere to the pipe walls in the distribution system.

MassDEP published Guidelines for Public Water Systems recommends utilizing a minimum velocity of at least 2.5 feet per second (ft/s) to remove deposits. The American Water Works Association recommends a minimum velocity of at least 3.0 ft/s. To obtain these velocities, different flow rates will be needed based on the water main diameter. Water mains in the system range from 4-inch to 12-inch. The only 12-inch diameter water main is located in the Town of Dover. The needed flow to achieve 2.5 ft/s or 3.0 ft/s are included in **Table No. 3**. The program should be designed to maintain a minimum system pressure of 20 psi.

The feasibility of flushing the system using a unidirectional flushing program was considered under two scenarios. The first was using the Francis Street and Draper Road Wells. This assumes that the wells are treated for the removal of iron and manganese prior to flushing. The second was utilizing just the Knollwood Drive Wells to flush the Main Service Area. This would require the construction of the previously discussed dedicated water main from the Knollwood Drive Wells to the Centre Street PRV. This would also require the upgrades to the Knollwood Drive chemical feed system.

Table No. 3
Colonial Water Company, Dover Demand Summary

Diameter (in)	Flow for 2.5 ft/s (gal/min)	Flow for 3.0 ft/s (gal/min)
12	880	1,060
8	390	470
6	220	270
4	100	120

Based on pumping records provided by the Colonial Water Company, when in operation, the three Francis Street Wells can produce approximately 450 gpm, and the Draper Road Wells can produce approximately 50 gpm. Flushing would need to be completed during periods of low demand, typically at night in early spring or fall outside of the time period that automatic sprinklers would be in operation. Based on operations at the Francis Street Wells, and the hydraulic model, it will be difficult to obtain flow rates above 390 gpm from

hydrants. System demand conditions would need to be ideal to maintain 20 psi in the distribution system and the velocity would only be 2.5 ft/s in 8-inch mains.

If pump capacity and chemical feed facility capacity is addressed, the potential maximum pump rate from the Knollwood Drive Wells is 300 gpm. At this rate, utilizing this well alone would only provide an acceptable flushing velocity in 4-inch or 6-inch diameter water mains. Most of the water mains in the system are 8-inch diameter, so the Knollwood Drive Wells would not be able to be utilized to adequately flush the system. Also, to flush unidirectionally with enough velocity, the Knollwood Drive Wells would not be able to be utilized to provide enough velocity from one direction in the water mains north of the Francis Street Wells.

Development of the unidirectional flushing plan can be completed using the hydraulic model to plan out what valves and hydrants are to be operated to minimize the impact to the customers and to develop sequences that provide adequate flow, velocity, and pressures. Any area that cannot meet recommended velocities or pressures will be flagged. The engineering cost to develop the plan is about $7,000. Implementation of the plan would require two to three staff to open valves and hydrants and to monitor pressures in the system. Flushing should take place at night to limit disruption to customers and to maximize the available flow from the wells. Depending on the hours available for flushing each night and the window of optimal weather conditions in the early spring and late fall, it could take multiple weeks to flush the entire system. Also, based on the number of water quality complaints and knowledge of the source water, there is likely a significant amount of residual iron and manganese on the pipes in the system. It will take a considerable amount of water and time to adequately flush the pipes. Also, at the low available flow rates and on the low end of recommended flushing velocities, the program may not be effective in flushing the pipes.

4.2 Alternative Flushing Methods

As an alternative to a unidirectional flushing program, the Colonial Water Company should consider alternate methods of flushing. Some alternative methods, such as the NO-DES™ method, use a trailer mounted pumping, filtering, and re-chlorinating system which circulates water within a section of the water distribution system using two hydrants; drawing the water from the system through one hydrant and re-introducing the water into the system through another hydrant. This method circulates water at prescribed velocities and passes the water through a series of filters that remove intentionally stirred up sediment and particulate matter, including any accumulated biofilm. The primary advantage of this flushing approach for the Dover system is that it will provide for higher flushing velocities than those that can be currently achieved.

The Colonial Water Company should also investigate the option of ice-pigging which can remove the sediment and tuberculation on the pipe walls.

Alternative flushing methods could provide significant benefit for the Company's Dover system; however, should the flushing be completed prior to installing treatment to remove the iron and manganese from the source water, additional accumulations of iron and manganese will occur in the distribution system over time, which will require additional flushing to remove.

5 Water Storage Tank Evaluation

5.1 Recommended Water Storage Volume

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

Typically, there are three components that must be considered when evaluating storage requirements. These components include equalization, fire flow requirements, and emergency storage. The three components of the storage evaluation were calculated under current and future demand conditions. Equalization storage provides water from the tanks during peak hourly demands in the system. Typically, this quantity is a percentage of the maximum day demands. The percentages can range from fifteen to twenty-five percent, with fifteen percent used for a large system, twenty percent for a medium sized system and twenty-five percent used for a small system. A system is considered small if it has less than 3,300 customers, while a system is considered large if it has more than 50,000 customers. The Colonial Water Company Dover system is considered small. As a result, twenty five percent of maximum day demand was used for equalization storage calculations.

Currently, the Colonial Water Company system does not have any storage and does not have fire protection capabilities from the existing water supplies. If the system were to provide fire protection in the storage tank, a volume recommended for fire protection needs to be estimated. The recommended fire flow in any community is established by the Insurance Service Office (ISO). The ISO determines a theoretical flow rate needed to combat a major fire at a specific location; taking into account the building structure, floor area, the building contents, and the availability of fire suppression systems. The fire flow storage component is based on the basic fire flow requirement multiplied by the required duration of flow. The 2012 Water Storage Tank and Supply Evaluation and Hydraulic Model project utilized the 2008 ISO published Guide for Determination of Needed Fire Flow to estimate needed fire flows in the water distribution system for residential and non-residential buildings. The guide uses factors such as building size, material, location, and contents. Based on a review of the system, the 2021 project estimated a basic needed fire

flow for the system of 2,500 gpm for two hours, which requires a volume of 0.30 million gallons (mg).

The emergency storage component is typically equivalent to one ADD. However, if there is emergency power available at the sources or emergency connections with surrounding communities capable of supplying at least an ADD, the emergency storage component can be waived. Based on information provided by system operators, emergency power is available at the Frances Street and Draper Road well sites. These wells can produce the ADD, therefore the emergency component can be waived.

Recommended Storage Volume

1. Equalization
   - Small sized system = 25-percent of the Maximum Day Demand
   - Maximum Day Demand = 0.368 mgd
   - Equalization = 0.25 x 0.368 = 0.092 mg

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

3. Emergency Storage: Waived

The total recommended storage volume for equalization only is approximately 0.1 mg. The total recommended storage needed to provide equalization and fire protection is 0.39 mg.

When considering sizing of a water storage tank, the requirements regarding system redundancy pursuant to 310 CMR 22.21(3)(a) were reviewed. "Any person who obtains Department approval for a community public water system that relies entirely upon groundwater sources shall provide additional wells, wellfield or springs and pumping equipment, or the equivalent, capable of producing the same volumes and quality of water as the system's primary well, wellfield, or spring at all times, or shall provide the storage capacity equivalent to the demand of at least two average days if approved by Department, unless an interconnection with another public water system has been provided which can adequately provide the quantity and quality of water needed." Based on the existing permitted pumping rates, the system can produce an ADD from the Francis Street Wells or the Knollwood Drive Wells. This assumes that improvements are made to connect the Knollwood Service Area to the Main Service Area through either dedicated water main from the wells to the Centre Street PRV or relocating the PRV and constructing a booster pumping system on Picardy Lane. If Colonial Water Company were not able to provide an ADD out of any of these combinations of wells, the required storage of two times the ADD would be approximately 0.30 mg. Colonial Water Company would need to consider the larger tank volume with equalization and fire protection to provide at least 0.30 mg.

Overflow Elevation

As previously discussed, street level elevations in the Knollwood area of the distribution system, including the area served in the Town of Dover, range from 115 feet above MSL to 182 feet above MSL. Street level elevations in the Main Service Area range from 170 feet above MSL to 342 feet above MSL. It should be noted that during the time of the 2012 project, the street elevations in the Main Service Area ranged from 170 to 323 feet above MSL. The only area with street elevations higher than 323 feet above MSL are within the new development on Dancer Farm Drive.

The MassDEP published Guidelines for Public Water Systems recommends a normal working pressure in the distribution system be between 60 and 80 psi and not less than 35 psi. An upper limiting pressure of 120 psi is generally recommended, as older fittings in the system are generally rated at 125 psi to 150 psi. Pressure above this level can result in increased water use from fixtures and also increased leakage throughout the distribution system. The MassDEP published Guidelines for Public Water Systems recommends that pressure reducing devices be utilized on mains or on individual services lines when static pressures exceed 100 psi. Also, plumbing code states that water heaters in homes can be affected when pressures exceed 80 psi.

The existing hydraulic model was used to review static pressures in the distribution system under existing operating conditions and with a proposed water storage tank at several locations. To maintain a pressure of 45 psi at the original high elevation of 323 feet above MSL, the previous tank studies recommended a tank overflow elevation of 427 feet above MSL for an atmospheric tank. The static pressures at the high elevation would be approximately 45 psi when the tank is full. Under existing conditions, areas in the Main Service Area between Bretton Road and the Centre Street PRV can experience static pressures between 100 and 120 psi. Static pressures in this area are not expected to increase with an overflow elevation of 427 feet above MSL.

To maintain 45 psi at Dancer Farm Drive, the recommended overflow elevation of the tank would be approximately 446 feet above MSL. This would result in similar static pressures as under existing conditions in the Main Service Area between Bretton Road and the Centre Street Tank. Because only one area of the system is above a street elevation of 323 feet above MSL, we recommend still considering the overflow elevation of 427 feet. Depending on the water level operating range in the tank and well status, static pressure on Dancer Farm Drive could range from approximately 32 psi to 45 psi. The existing static pressure at this location is approximately 45 psi.

A minimum pressure of 20 psi should be maintained at the highest served customer under MDD conditions with a coincident fire flow. To maintain 20 psi on Dancer Farm Drive, water levels in an atmospheric tank could be able to drop to 388 feet above MSL and still be usable volume.

5.2 Potential Storage Tank Locations

The four potential tank locations considered in this evaluation are at Picardy Lane, Tower Drive, Francis Street, and Draper Road. At this time, the sites were not evaluated for constructability and potential concerns with land acquisition or easements. Once a feasible option was identified, further analysis would be needed to discuss the volume options related to equalization only or equalization and fire protection and potential costs. A map showing the potential tank sites is included in Appendix D.

Picardy Lane

The Picardy Lane site is at the location of the Picardy Pump House which previously housed wells. It has a ground elevation of approximately 221 feet. There is land on Picardy Lane owned by the Colonial Water Company. Because most of the Main Service Area is above this elevation, the water storage tank would need to supply the Main Service Area through an elevated tank or through pumped storage. To achieve the necessary overflow elevation of 427 feet, an elevated tank would be constructed at a height of approximately 206 feet. Elevated water storage tanks this tall exist, but are rare, would be very expensive to construct, and a tank of this height would also be obtrusive to the neighborhood.

The booster pump station would be sized to meet ADD, MDD, and peak hour demands. Additional high capacity pumps could be utilized to provide fire protection if the tank was sized for fire protection. The existing well building on this site could be utilized to house the pumps. There would be minimal site work required to connect the tank and pump station to the system. It should be noted that the tank would need to be filled from the system. The piping would need to be configured to allow the booster pump station to be offline while the tank is filling. While the tank is filling, system demands would need to be met from the wells. A more detailed analysis of existing system demands would need to be considered to determine the operations of the system to fill the tank during periods of lower demand to not stress the wells and to allow the pump station to be online during peak demands. A new generator would be needed at the site to provide emergency power.

Tower Drive

There is an existing easement on Tower Drive. The ground elevation at this site is approximately 415 feet above MSL. Tower Drive is currently served by the Cedar Road Booster Pump Station. A new water main would be required from the tank along an existing easement to Cedar Hill Road. If the existing easement is still available, this would require approximately 800 linear feet of new water main to connect the tank to the system. It is believed the existing well pumps can be utilized to fill the tank and the hydropneumatic tanks could be removed or abandoned.

Due to the ground elevation of 415 feet, the entire tank would be usable. A tank constructed to an overflow of 427 feet above MSL would only need to be 12 feet high. The site is currently heavily wooded, and clearing would be required to construct the tank. Also, a visual inspection of the area indicated that there is a significant amount of ledge.

Significant costs associated with blasting for construction of the tank and installation of the water main to Cedar Hill Road would need to be considered. Also, the Tower Drive site is located on an easement from an abutting resident, which may impact construction. The status and original provisions set forth in the easement agreement are unknown. Further analysis would be needed to evaluate if a tank is feasible at the site.

Francis Street

Construction of a water storage tank at the Francis Street Station was considered. The ground elevation at the site is approximately 247 feet above MSL. To achieve the necessary overflow elevation of 427 feet, the tank would be constructed at a height of approximately 180 feet. A composite elevated tank could be constructed, however due to costs and constructability this is likely not feasible.

An alternative option at the Francis Street Station would be pump storage. Water would be pumped from the system into the proposed tank. Based on a review of the layout of the existing Francis Street Station, it has been assumed that the existing building cannot be used to house the proposed pumps. A new building would need to be constructed. Also, depending on where the tank is constructed, approximately 300 feet of water main would be needed to connect the tank to the pump station and to the system. The existing generator at Francis Street Station should be upgraded to supply emergency power to the well pumps and tank booster pumps during a power outage.

It should be noted that the tank would need to be filled from the system. The piping would need to be configured to allow the booster pump station to be offline while the tank is filling. While the tank is filling, system demands would need to be met from the wells. A more detailed analysis of existing system demands would need to be considered to determine the operations of the system to fill the tank during periods of lower demand to not stress the wells and to allow the pump station to be online during peak demands.

Based on a discussion earlier in this letter, water treatment will be needed to utilize the Francis Street Wells. Site constraints may limit the availability to construct a water storage tank with booster pumping capability and a water treatment facility at this site. Colonial Water Company does own some adjacent property, but the wetlands in the area will make construction difficult if not impossible. If a treatment plant is constructed, Colonial Water Company could consider the storage options for equalization only and construct a 100,000-gallon clearwell with the treatment plant that could be utilized to help meet peak demands.

Draper Road

Construction of a water storage tank at the Draper Road Station was considered. The ground elevation at the site is approximately 225 feet above MSL. To achieve the necessary overflow elevation of 427 feet, the tank would be constructed at a height of approximately 202 feet. This is not feasible from a construction and cost standpoint. Also, a water storage tank of this height would be obtrusive to the neighborhood.

An alternative option at the Draper Road site would be pumped storage. Based on the existing station layout, there may not be adequate space to provide the needed pumping equipment within the station. A separate pump station would be required. There have been discussions about possibly abandoning these wells due to the low permitted volume and poor water quality. If the wells were abandoned, that existing well pumping station could be reconfigured to house the pumping equipment. The existing generator would need to be evaluated to determine if it is sized correctly for any changes to the pumping configuration at the site. This property is larger than the Francis Street site, however, the Tubwreck Brook runs through the northern portion of the property and wetlands cover approximately half of the available land. Also, depending on where the tank is constructed, approximately 500 feet of water main would be needed to connect the tank to the pump station and to the system.

It should be noted that the tank would need to be filled from the system. The piping would need to be configured to allow the booster pump station to be offline while the tank is filling. While the tank is filling, system demands would need to be met from the wells. A more detailed analysis of existing system demands would need to be considered to determine the operations of the system to fill the tank during periods of lower demand to not stress the wells and to allow the pump station to be online during peak demands.

6 System Resiliency

A preliminary assessment was completed on potential interconnections with neighboring public water systems. Colonial Water Company identified potential interconnections with Walpole and Medfield. Colonial Water Company has initiated communication with the public water systems to discuss the feasibility of an interconnection and to obtain information on water main locations in proximity to Town lines and information on operating hydraulic gradelines to determine needed infrastructure at the interconnection, for example, meter pits, hydrant to hydrant connections, pressure reducing valves, or booster pumps. Additional information on water main size and material in the Medfield or Walpole water systems in the vicinity of the potential interconnection would need to be evaluated for available carrying capacity. Initial conversations with both Medfield and Walpole indicated that a formal request for an interconnection to the Board of Selectmen or Board of Water and Sewer Commissioners, respectively, would be required for further exploration of the feasibility of the interconnection. The Company plans to continue those conversations more formally and to understand options and feasibility of both a bi-directional emergency interconnection to meet redundancy requirements and whether additional long-term supply to accommodate peak demands is a possibility.

The Colonial Water Company Dover system has pipe near the Medfield town line at three locations, Hartford Street, County Street, and Pine Street. There is an existing 6-inch diameter cement lined cast iron main on County Street that extends to the Town line. It has been assumed that infrastructure improvements to the Colonial Water Company system will not be required for an interconnection. The existing 8-inch diameter cement lined cast

iron water main on Saddle Ridge Road crosses Hartford Street approximately 600 feet from the Town line. Six hundred linear feet of 8-inch diameter ductile iron water main would be needed to extend the Dover system to the Medfield Town line. The existing 8-inch diameter cement lined cast iron water main on Hales Hollow extends to Pine Street. Approximately 1,900 linear feet of ductile iron water main would be needed to extend the Dover system on Pine Street to the Medfield Town line.

The Colonial Water Company Dover system has pipe near the Walpole town line on County Street. Approximately 1,900 linear feet of new 8-inch diameter ductile iron water main would be needed to extend the existing 8-inch diameter cement lined cast iron water main on County Street to the Walpole Town line.

7 Recommendations and Conclusions

Based on the information presented in this letter report, the Colonial Water Company has multiple options to consider to improve the water quality within the water system. Some of the options can be completed within a relatively short timeframe, while other options can take multiple years to implement. A recommendations plan has been developed that addresses the issues on an immediate, short-term, and long-term schedule. It has been assumed that the immediate options can be completed in 2021, short-term options in 2022 and the long-term options could take three or more years to complete.

Immediate

Alternative flushing methods should be investigated as an immediate action item, such as NO-DES™ or ice pigging, since its currently difficult to achieve adequate scouring velocities; particularly given existing well capacities. . Further investigation on available methods, implementation timelines, and costs would need to be completed.

A feasibility study for utilizing the Knollwood Drive Station to service all or a portion of the Main Service Area should be completed because the sources have the best water quality in the system. This would allow the Colonial Water Company to use less water from the Francis Street Station to meet demands. There is an abandoned meter pit located on Bretton Road near Picardy Lane. The study should investigate the possibility of replacing the abandoned meter pit with a PRV which could expand the Knollwood Drive Station's service area. Then, the Picardy Pump House could possibly be used as a booster pump station to provide water to the Main Service Area.

The well pump sizes and capacities will need to be evaluated to determine available flows from the wells. The Knollwood Drive Station has a KOH chemical feed system that is sized for 125 gpm. Flows above this will require upgrades to the KOH chemical feed system. In addition, chlorination would need to be constructed at the well site. The feasibility study should include a review of existing infrastructure, and a cost/benefit analysis is needed to determine if this option is financially sound taking site limitations and upgrades into account.

Further investigation of potential interconnection options should be pursued as an immediate action. This includes formally reaching out to Town officials in Medfield and Walpole to discuss interconnection option. Infrastructure needs, such as water mains, pump systems, meter pits, etc., should also be considered.

Short-term

Upon completion of the Knollwood Service Area feasibility study, Colonial Water Company should begin to implement the recommended improvements to provide more water from the Knollwood Drive Wells to the Main Service Area. The extent of these infrastructure improvements is not known at this time but could include, chemical feed upgrades, pump upgrades, water mains, a new PRV, and a new booster pump station.

Another short-term action is to conduct a feasibility analysis of constructing a water treatment facility at the Francis Street Station. Sequestering is not an option at the Station given the elevated levels of iron and manganese as well as the speciation of the manganese. Therefore, either biological removal or GreensandPlus™ filtration should be further analyzed. The feasibility study should consider treatment options, construction costs, land requirements, permitting implications related to wetlands which surround the station, and residuals management given there are no public sewers in the area to use as a discharge location. The feasibility analysis should also develop an implementation schedule to evaluate the length of time for piloting, design, permitting, and construction.

Long-Term

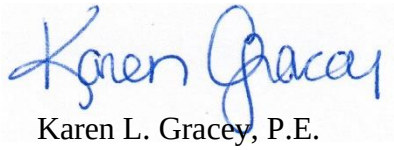
Treatment at the Francis Street Station is a long-term solution to the water quality concerns. It could take three years or more to design, permit, and construct a treatment facility.

Another long-term system improvement would be utilizing storage for meeting peak flows. The ability of having storage for equalization and meeting peak demands will impact the size of the treatment plant. The Picardy Lane Tank option is the most ideal location based on available land, land ownership, and location. Further analysis is needed to consider the final tank volume (equalization only or equalization and fire protection) and costs associated with the tank and upgrading the well station to a booster pump station. This site is also being considered for a booster pump to serve the Main Service Area from the Knollwood Service Area. This same pump could be used to pump out of a storage tank at this location.

At this time, we wish to express our appreciation to the Colonial Water Company for their participation in this evaluation and for their help in collecting information and data. We appreciate the opportunity to assist the Colonial Water Company on this important project. Should you have any questions or require additional information please do not hesitate to contact our office.

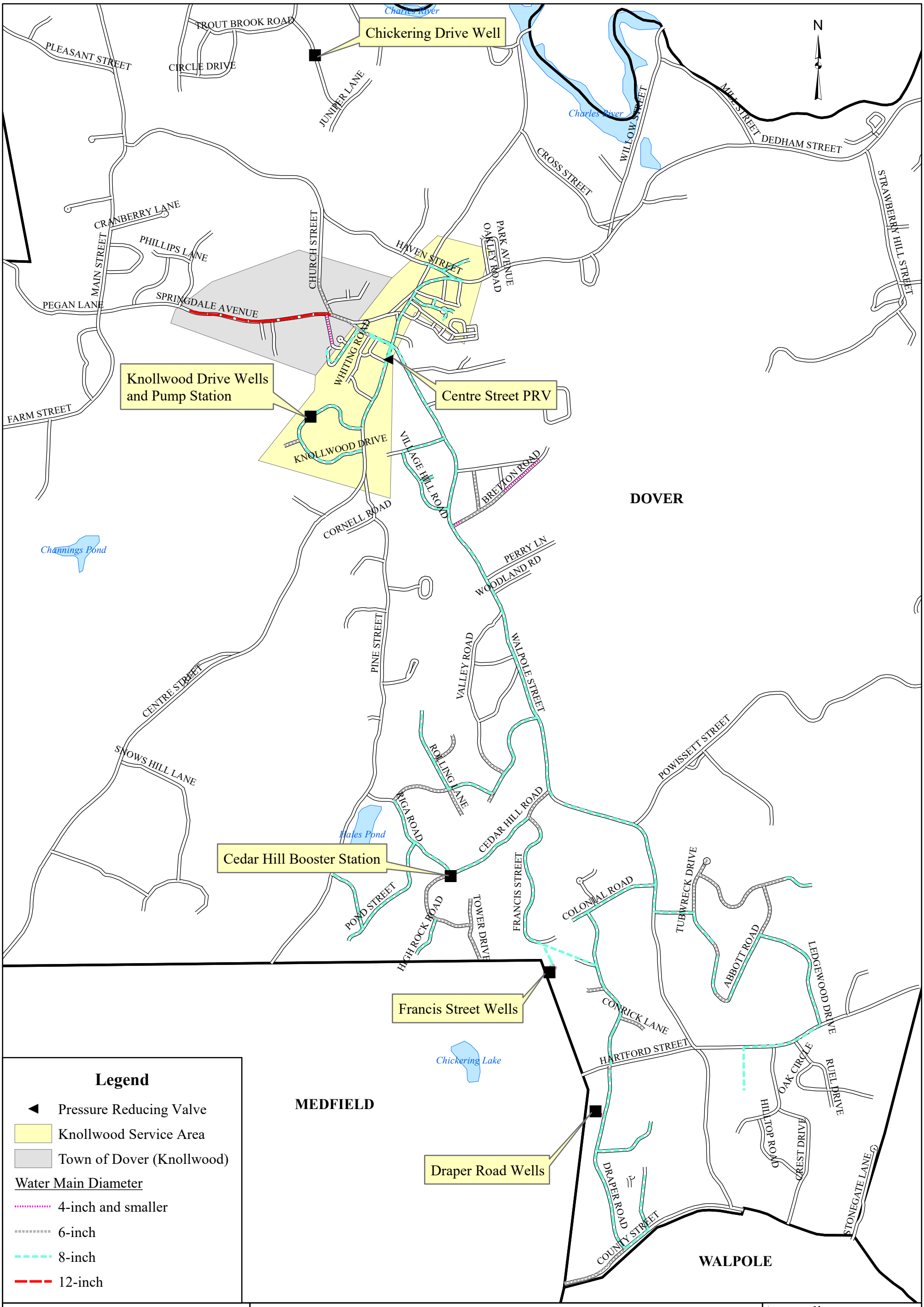
Sincerely,

TATA & HOWARD, INC.



Karen L. Gracey, P.E.
Co-President

Attachments



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Date: October 2021

Approximate Scale: 1" = 1,500'

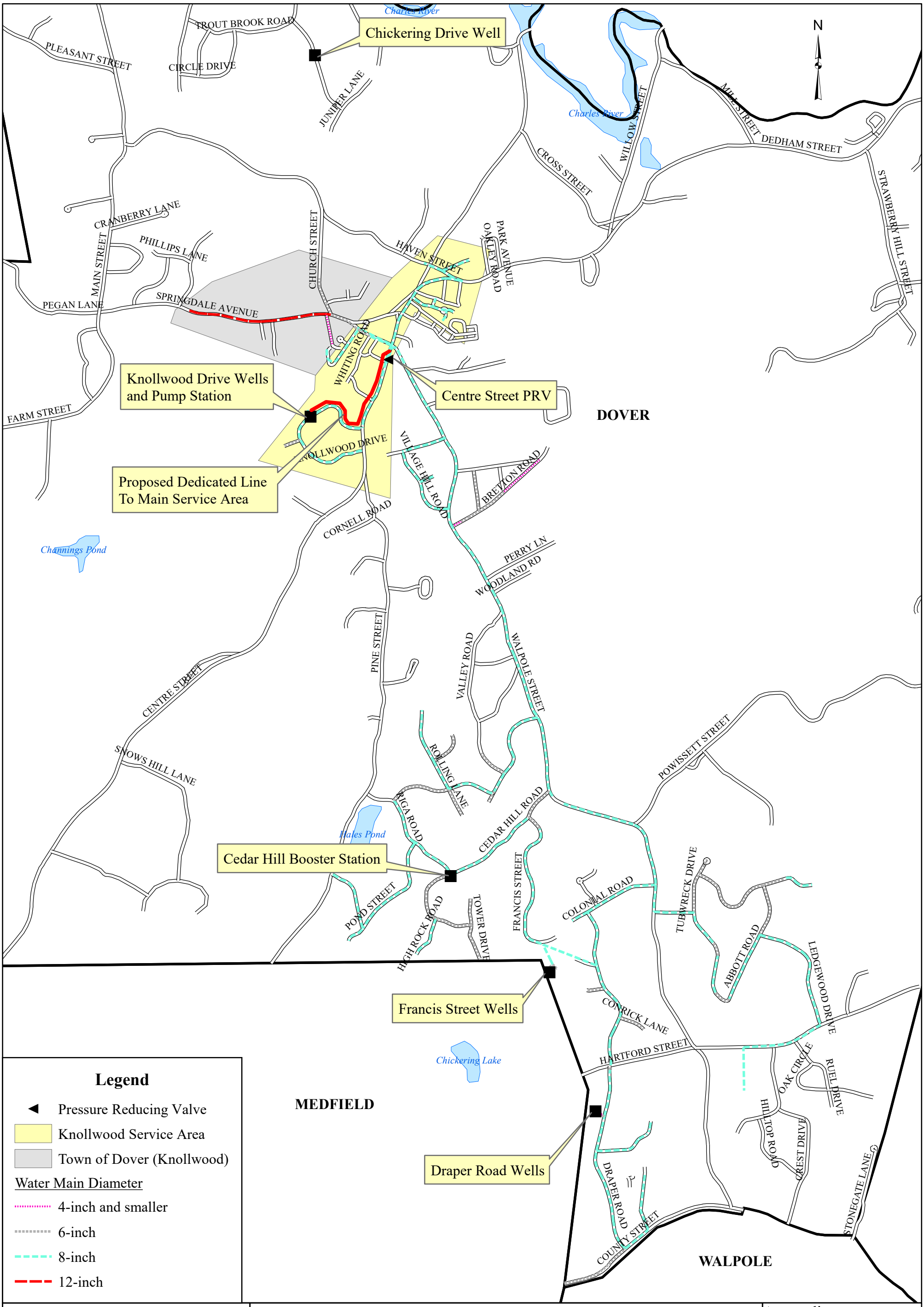
Water Distribution System

Colonial Water Company

Dover, Massachusetts

Appendix

A



Legend

- Pressure Reducing Valve
- Knollwood Service Area
- Town of Dover (Knollwood)

Water Main Diameter

- 4-inch and smaller
- 6-inch
- 8-inch
- 12-inch

TATA & HOWARD

Date: October 2021

Approximate Scale: 1" = 1,500'

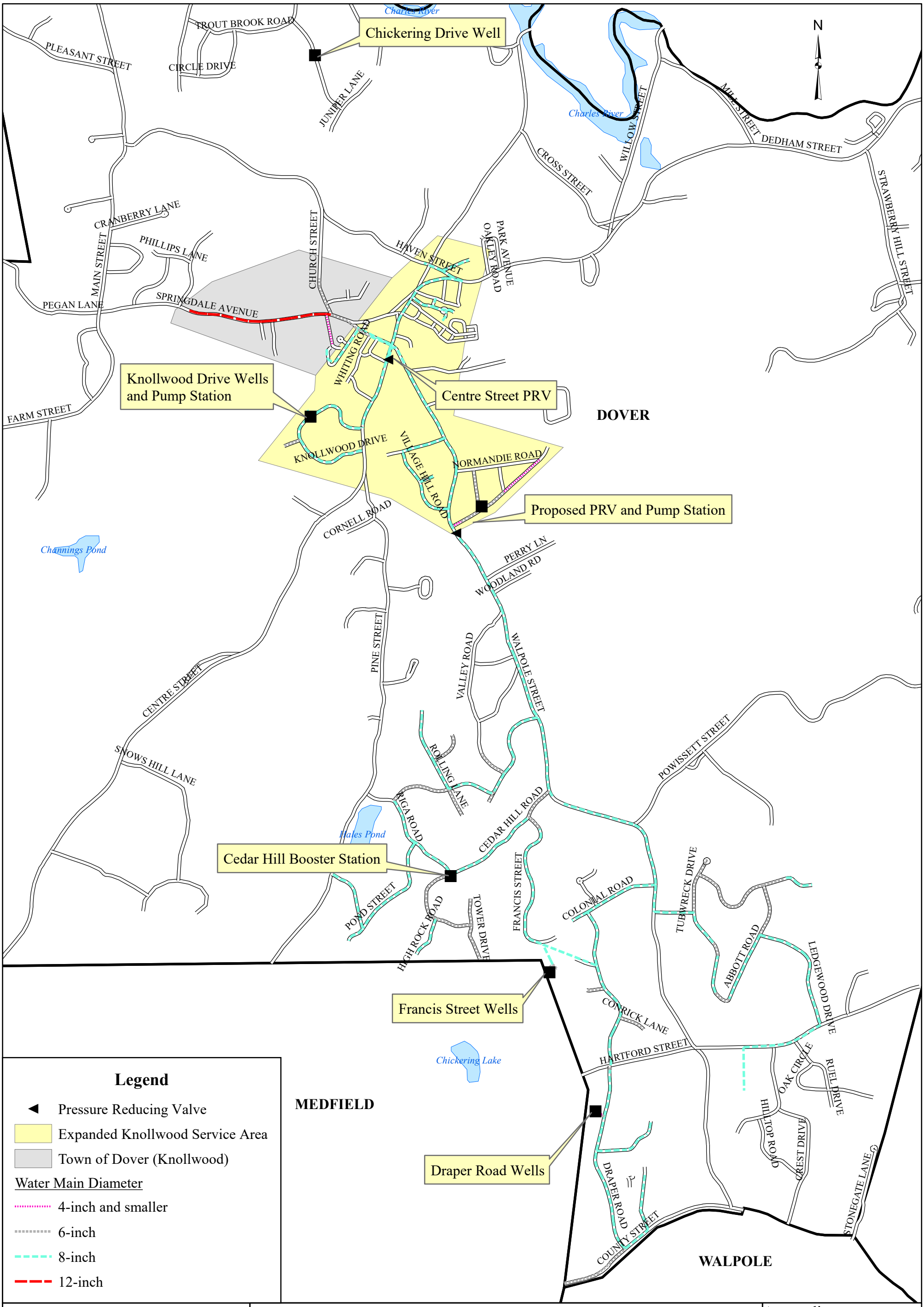
Proposed Water Main to Connect
Knollwood Street Wells to Main Service Area

Colonial Water Company

Dover, Massachusetts

Appendix

B



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Date: October 2021

Approximate Scale: 1" = 1,500'

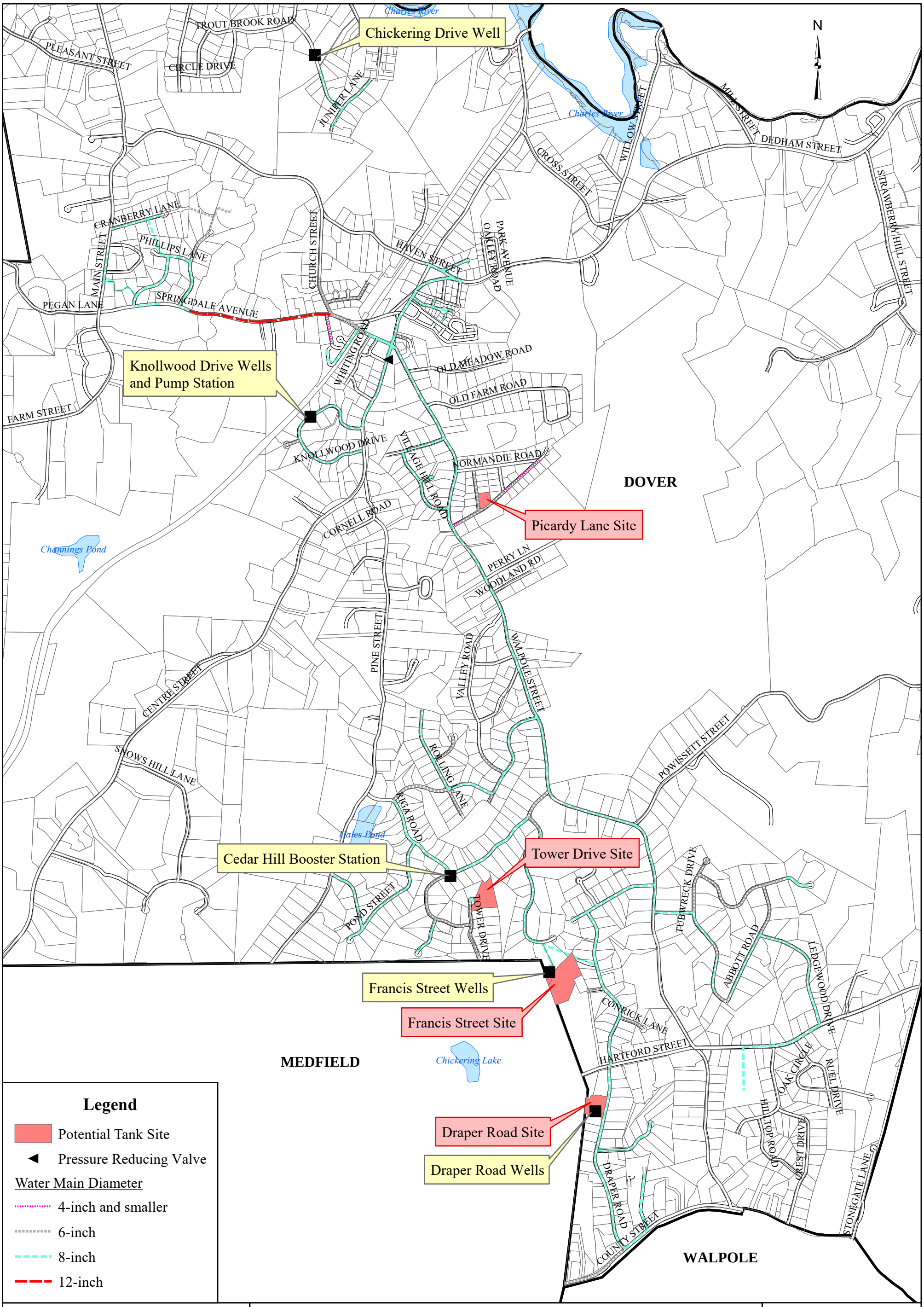
Potential Expanded Knollwood Service Area

Colonial Water Company

Dover, Massachusetts

Appendix

C



Legend

- Potential Tank Site
- Pressure Reducing Valve

Water Main Diameter

- 4-inch and smaller
- 6-inch
- 8-inch
- 12-inch

TATA & HOWARD

Date: October 2021

Approximate Scale: 1" = 1,500'

Potential Water Storage Tank Locations

Colonial Water Company

Dover, Massachusetts

Appendix

D