



August 2019

Groton Water Department Manganese Mitigation for Whitney Pond Wells Alternatives Analysis and Compliance Plan



Prepared for:

Groton Water Department
Town Hall
173 Main Street
Groton, MA 01450

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1 Introduction

1.1 Background

The Town of Groton (Town) was issued a letter from the Massachusetts Department of Environmental Protection (MassDEP) on February 25, 2019 indicating that manganese test results in Whitney Well #1 and Whitney Well #2 finish water exceed MassDEP's Office of Research and Standards Guidance Level for manganese. Because of these test results, MassDEP requires that a draft compliance plan be submitted by September 1, 2019 to reduce the level of manganese to a level "reliably and consistently" below the 0.30 mg/L Health Advisory Level (HAL) at the entry point to the distribution system and "preferably" below the 0.05 mg/L Secondary Maximum Contaminant Level (SMCL). A final plan is due by February 1, 2020. See **Appendix A** for a copy of the letter.

1.2 Project Objective and Scope of Work

The objective of this work was to perform an analysis of potential manganese mitigation alternatives, select the most favorable alternative, then prepare a manganese compliance plan (i.e., "corrective action plan") in accordance with MassDEP requirements. The most favorable alternative would ideally have the capacity to replace or exceed the approved maximum daily withdrawal of the Whitney Pond Wells (0.576 mgd) while cost effectively providing treated water below the SMCL.

The following tasks were performed to meet the project objective:

- Developed seven (7) potential manganese mitigation alternatives;
- Prepared a decision matrix to enable scoring of each alternative;
- Further analyzed top two (2) alternatives as selected by the Groton board of Water Commissioners, including development of conceptual site layout and refined cost estimates for one (1) alternative;
- Prepared Manganese Compliance Plan with recommended alternative, as selected by the Groton Water Commissioners based upon the information provided through the alternatives analysis.

The remaining sections of this report describe each task in detail and recommended next steps.

1.3 Manganese Information

Manganese is a naturally-occurring mineral found in soil, groundwater, and surface water. It is considered a toxic trace element, a naturally occurring metal that is essential for humans to survive, while also toxic when concentrations in the body are too high. It is naturally prevalent throughout the United States with higher concentrations in the Northeast. A focus on manganese in drinking water for both human health and nuisance effects has led to efforts to reduce manganese through treatment.

Human Health Impacts

Though humans need some level of manganese in their diet, excessive concentrations of manganese have been shown to cause neurological impacts. Studies showed links between cognitive processes and manganese exposure from various routes, including drinking water, and exposure limits related to age and gender. These studies found that excessive manganese in children's diet from various sources was linked to learning disabilities while recognizing that manganese is present in formula, cereals, vegetables, fruits as well as some drinking waters.

Infants and children younger than 12 months old are potentially most susceptible to excess manganese exposure because of their developing neurological and gastrointestinal systems. Infants appear to absorb more manganese than older age children and adults, but excrete less.

Other Impacts

Manganese has long been known to cause nuisance and aesthetic issues in drinking water, including staining laundry and water use fixtures, causing metallic or vinyl taste, clogging water and well filters, and causing objectionable color. As water interacts with the manganese in the soil, the manganese reduces to a soluble form. When exposed to the air, manganese oxide precipitates out of the water, causing the aesthetic issues.

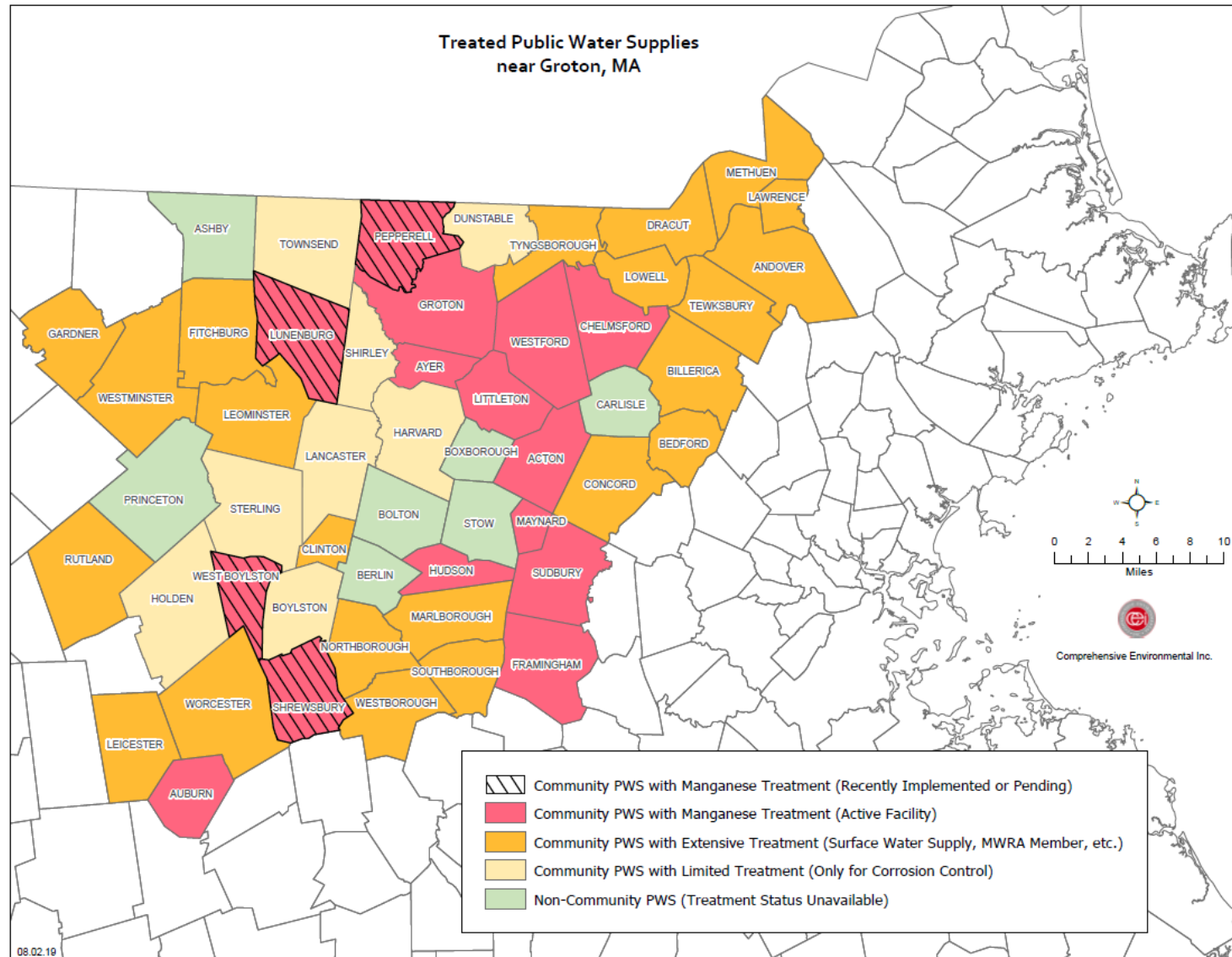
Manganese deposition can cause serious problems to public and private water suppliers. When dissolved manganese is in pipes it has a tendency to precipitate at a slow but continuous rate. Manganese precipitate builds up and eventually causes blockages in pipes and orifices. Taste problems and discoloration of drinking water increases as a result of this process. Wells are also susceptible. Manganese can clog well screens resulting in slower rates of withdrawal.

Treatment Technologies

Historically, three categories of treatment technologies have been used to handle manganese in drinking water: chemical addition, aeration, and filtration. Filtration with GreensandPlus media has been shown to be a cost effective method of manganese-removal, and is presently used by the Groton Water Department to treat its Baddacook Pond well.

Manganese in Surrounding Communities

Public Water Suppliers in communities surrounding Groton are increasingly required to implement extensive treatment for various constituents above and beyond chemical addition for corrosion control. Of the 50 Massachusetts Communities closest to Groton, just eight have limited treatment for corrosion control (similar to the existing situation for the Whitney Wells), 24 have extensive treatment (e.g., surface water supply), and 10 have an active or pending manganese treatment facility (see **Figure 1-1**).

**Figure 1-1. Treated Public Water Supplies near Groton, MA**

2 Initial Alternatives Analysis

An alternatives analysis was performed to identify, score, and select potential alternatives for mitigation of manganese in the Whitney Pond Wells. Refer to **Appendix B** for maps depicting each proposed alternative.

2.2 Alternative Identification

Seven (7) potential alternatives for mitigation of manganese at the Whitney Pond Wells were developed including use of new sources as a replacement for the Whitney Pond Wells, treatment, and wholesale water purchase. All alternatives with the exception of treatment for Whitney Pond Wells were initially developed under a previous Water Management Act Grant (BRP-2016-06)¹. Refer to findings from the previous grant for more detailed descriptions and backup information for developed alternatives.

Alternative 1: Develop Shattuck Road Wells

This alternative would involve constructing pumping facilities at the Shattuck Road Wells and installing water transmission main to the existing Baddacook Pond Water Filtration Plant for treatment (see **Figure B-1**). The Whitney Pond Wells would be taken offline.

The permitted but yet to be constructed Shattuck Road Wells were installed and tested in 2006 and are located to the south of Martin Ponds Road in the Merrimack River Basin. These wells are permitted for a combined maximum daily withdrawal of 0.324 mgd which is less than the approved 0.576 mgd maximum daily withdrawal for the Whitney Pond Wells. Initial water quality testing results indicated that the wells will require corrosion control and iron and manganese removal.

This alternative would include the following work:

- Construct one or two permanent wells with associated pumping facilities.
- Re-use the existing 8-inch water main as the raw water transmission main from Shattuck Wells to the Baddacook Pond Water Filtration Plant.
- Install approximately 4,000 feet of 12-inch diameter water main through an existing GWD easement from the Baddacook Pond Water Filtration Plant to Schoolhouse Road.
- Treat for corrosion control and iron and manganese removal at the existing Baddacook Pond Water Filtration Plant. The existing Plant appears to have adequate capacity to treat the additional water from the Shattuck Wells.

Proposed work would be performed near or within wetland areas and within an Area of Critical Environmental Concern. Expected permits include completion of a Notice of Intent (NOI) to the Town and State including the Massachusetts Natural Heritage and Endangered Species Program (NHESP), and a 401 Water Quality Certification. Additional permit requirements may include construction monitoring by a NHESP authorized biologist and intensive upland wildlife habitat restoration.

The Shattuck Road Wells are located in the same sub-basin as GWD's existing wells (subbasin 13063) which has a biological category (BC) of 5 and an August flow alteration of 43.2% causing it to be listed as a Groundwater Withdrawal Category (GWC) of 4. Any increased groundwater withdrawals of 0.183 mgd or more from this subbasin would cause the GWC to change to GWC 5. The BC will not change due to an increased withdrawal since it is already in the highest impacted classification of BC 5. Mitigation will be

¹ Comprehensive Environmental (2016): Alternative Source Study and Mitigation Planning, SWMI WMA Grant BRP-2016-06, completed 2016 June 30.

required if GWD exceeds baseline; however, use of these wells would not necessarily increase the total withdrawal from this basin since selection of this alternative would completely replace the Whitney Wells.

Alternative 2: Develop Unkety Brook Wells

This alternative would involve constructing pumping facilities at the Unkety Brook Wells, construction of a new corrosion control facility for treatment, and installation of water transmission main (see **Figure B-2**). The Whitney Pond Wells would be taken offline.

The permitted but yet to be constructed Unkety Brook Wells were installed and tested in 2004. They are located on the southeastern side of Chicopee Row in the Nashua River Basin. These wells are permitted for a combined maximum daily withdrawal of 0.300 mgd which is less than the approved 0.576 mgd maximum daily withdrawal for the Whitney Wells. Initial water quality testing results indicated that the wells will require corrosion control treatment and may potential require future iron and manganese removal once wells are routinely pumped (i.e., the geology of the aquifer includes areas with high iron and manganese in the groundwater), although current levels of iron and manganese are below the SMCL.

This alternative would include the following work:

- Construct two permanent wells with associated pumping facilities.
- Install approximately 1,500 feet of 6-inch water main through existing GWD easements.
- Construct corrosion control facility on a private parcel adjacent to Chicopee Row with room to expand for potential future iron and manganese removal.
- Install approximately 7,800 linear feet of 12-inch water main along Chicopee Row to the intersection of Marlins Pond Road and Hollis Road.

Proposed work is close to wetland areas and could require dewatering during construction. There are also two culverted stream crossings that will require special construction methods. A majority of the route is also located with an ACEC. Expected permits include completion of an NOI to the Town and State including the NHESP program. Additional permit requirements may include construction monitoring by a NHESP authorized biologist and intensive upland wildlife habitat restoration.

The Unkety Brook Wells are located in the Nashua Basin (subbasin 11068) which has a BC of 3 and an August flow alteration of 10% making it a GWC 3. This subbasin has a Cold Water Fishery (CFR). Any increased groundwater withdrawals of 0.155 mgd or more from this subbasin could cause the GWC to change. Additionally, an increased withdrawal of 0.0397 mgd or more will cause the BC to change. The authorized withdrawal from the Unkety Brook Wells is 0.3 mgd, which is greater than the two thresholds that will cause both a GWC and BC change to more impacted category. Further, the GWD does not have any current withdrawals in the Nashua Basin, so all withdrawal from the Unkety Brook Wells would require mitigation to offset the withdrawals.

Alternative 3A: Develop Additional Well at Whitney Pond

This alternative would involve testing, permitting, installation, and construction of a third well at Whitney Pond (see **Figure B-3**).

This alternative would supplement current withdrawals from Whitney Pond Wells #1 and #2 and is not expected to result in increased withdrawals and subsequent mitigation requirements. The purpose of the new well would be to reduce the extent of groundwater drawdown associated with each well since the entire permitted withdrawal would be spread over three wells instead of two. The reduced drawdown and combination of three wells may result in iron and manganese levels that are potentially decreased from the blended wells prior to entering the distribution system. Raw water quality testing and location of a new

potential third well has not yet been performed. While this alternative has the potential to temporarily decrease iron and manganese levels, it is likely that levels will increase over time from continued pumping, ultimately requiring treatment for manganese removal at some future date.

Alternative 3B: Treat Whitney Pond Wells at New Treatment Facility

This alternative would involve construction of a new iron and manganese treatment facility at the Whitney Pond Wells (see **Figure B-3**). The facility would be connected to the existing distribution system.

This alternative is not expected to result in increased withdrawals and subsequent mitigation requirements. This alternative would enable GWD to maintain current supply capacity and retains the option for development of additional sources (e.g., Shattuck) in the future if demands increase.

Alternative 3C: Treat Whitney Pond Wells at Existing Baddacook Water Filtration Plant

This alternative would involve construction of a raw water transmission main from the Whitney Pond Wells to the Baddacook Pond Water Filtration Plant and expansion of the Plant's capacity to accommodate treatment of raw water from the Whitney Pond Wells (see **Figure B-3**).

This alternative is not expected to result in increased withdrawals and subsequent mitigation requirements. This alternative will enable GWD to maintain current supply capacity and leaves the option for development of additional sources (e.g., Shattuck) in the future if demands increase. This alternative would include the following work:

- Install approximately 6,800 feet of 8-in raw water distribution main.
- Install approximately 4,100 feet of 12-inch finished water distribution main.
- Convert approximately 5,500 feet of 12-inch and 1,600 feet of 8-inch water distribution main into finished and raw water distribution main, respectively.
- Expand Baddacook Pond Water Filtration Plan to accommodate Whitney Pond Wells.

Proposed work would be performed near or within wetland areas and within an Area of Critical Environmental Concern. There are also two culverted stream crossings that would require special construction methods. Expected permits include completion of a Notice of Intent (NOI) to the Town and State including the Massachusetts Natural Heritage and Endangered Species Program (NHESP), and a 401 Water Quality Certification. Additional permit requirements may include construction monitoring by a NHESP authorized biologist and intensive upland wildlife habitat restoration.

Alternative 4A: Purchase Town Forest Well Water from West Groton Water District

This alternative would involve wholesale purchase of water from the West Groton Water District's (District) Town Forest Well source (see **Figure B-4**). The Whitney Wells would be taken offline.

The District installed a gravel packed well within the Town Forest on Town-owned land. The Town agreed to allow the District to install the well provided that the water be shared with GWD. The Town Forest Well is located in the Nashua River Basin in the southwestern corner of Town to the west of Shirley Road. Raw water from the Town Forest Well has low and/or non-detectable levels of iron and manganese and is currently treated only for corrosion control. It is possible that increased pumping rates associated with water purchase could lead to an increase in iron and manganese levels. The District has indicated that GWD will be responsible for treatment costs if iron and manganese levels increase as a result of increased pumping.

This alternative would include the following work:

- Install approximately 5,200 feet of 8-inch water main from Long Hill Road to Farmers Row to connect to GWDs existing distribution system.
- Purchase approximately 0.35 mgd of water from the District for an annual cost of \$683,000 per year to accommodate historical demand from the Whitney Pond Wells². For the purposes of this evaluation, the rate is assumed to be the District's current lowest tier customer rate of \$4.00 per hundred cubic feet, although a discounted rate may be negotiable. Note that approval would be sought for purchase of at least 0.576 mgd to account for the approved maximum daily withdrawal of the Whitney Pond Wells.

The proposed water main installation work would be performed near wetlands and will require crossing of the Nashua River. It is expected that special construction methods will be required for the crossing. Expected permits include completion of a NOI to the Town and State.

The District's current total average daily permit withdrawal is 0.27 mgd. The Town Forest Well has a permitted maximum day withdrawal of 0.85 mgd. In 2015, approximately 70% of the District's demands were supplied by the Town Forest Well. Pumpage for 2015 from the Town Forest Well was approximately 0.138 mgd average day. The District's total average day demand was 0.201 mgd and maximum day demand was 0.571 mgd. It is therefore assumed that approximately 0.45 mgd (or less)³ would be available to GWD which is less than the approved 0.576 mgd maximum withdrawal for the Whitney Wells. It is also likely that the District will need to mitigate for this additional withdrawal above their 0.27 mgd baseline and that mitigation costs would likely be passed to GWD.

The Town Forest Well is located in the Nashua Basin (subbasin 11034) which is a BC of 4 and has an August flow alteration of 12.5% making it a GWC 3. This subbasin has a CFR. Any increased groundwater withdrawals of 1.53 mgd or more from this subbasin could cause the GWC to change. Additionally, an increased withdrawal of 2.98 mgd or more will cause the BC to change. The permitted withdrawal from this well is less than the trigger levels to cause a category change.

Alternative 4B: Install New Treatment Facility at Town Forest Well

This alternative alternate is identical to Alternative 4A, but would involve connection to the Groton Water District's (District) Town Forest Well source and construction of a new "Town owned" corrosion control facility and dedicated finish water main rather than wholesale purchase (see **Figure B-4**).

This alternative would include the following work:

- Install approximately 6,300 feet of 8-inch water distribution main cross country to Shirley Road.
- Construct booster pump station and Town owned corrosion control facility at Shirley Road.
- Install approximately 3,400 feet of 8-inch water distribution main from Shirley Road to Joy Lane.

The proposed water main construction would cross through wetland areas, will cross the Nashua River, and is located within an ACEC. Expected permits include completion of an NOI to the Town and State and the NHESP. Additional potential permit requirements include construction monitoring by a NHESP authorized biologist and intensive upland wildlife habitat restoration.

² GWD average daily demand is approximately 0.45 mgd. The Whitney Pond Wells have historically supplied approximately 75% of GWDs average daily demands (0.45 mgd · 75% = 0.35 mgd).

³ Assumed Potential Water Available to GWD = 0.85 – (70%·0.571) = 0.45 mgd

2.3 Alternative Scoring

A decision matrix was developed to enable relative scoring of each alternative. The decision matrix includes the following weighted factors:

- Supply/demand balance: Will the selected alternative meet existing and future supply needs?
- Manganese reduction efficacy: Will the selected alternative provide a long-term reduction in manganese and iron levels?
- Order-of-Magnitude cost: Are capital costs and long-term operation and maintenance costs reasonable?
- Permitting considerations: What extent of permitting will be required for approval of the proposed alternative?

Refer to **Appendix C** for the completed decision matrix. Composite alternative scores were calculated as a weighted average of each factor's score and assigned weight. Alternative 3B resulted in the highest score while Alternative 2 resulted in the lowest score.

2.4 Alternative Selection

The completed decision matrix was presented to the Groton Water Commissioners at a public meeting on July 23, 2019. The Commissioners voted unanimously for Alternative 3B at the meeting. The below provides rationale for this selection.

- **Alternative 1:** Alternative 1 (Shattuck Road Wells) has the potential to provide iron and manganese treatment for a moderate cost. This alternative was not selected as it will be unable to maintain existing supply capacity provided by the Whitney Pond Wells.
- **Alternative 2:** Alternative 2 (Unkety Brook Wells) was the lowest scored alternative. This alternative was not selected as it is unable to maintain existing supply capacity provided by the Whitney Pond Wells, may require future additional treatment of iron and manganese, is expensive, and will potentially require extensive WMA permitting and associated mitigation measures.
- **Alternative 3A:** Alternative 3A (Whitney Pond Wells – New Source) is the lowest cost alternative. This alternative was not selected because it will likely only provide a temporary reduction in iron and manganese levels before they increase over time with pumping, ultimately requiring the same type of treatment for iron and manganese removal as noted for Alternatives 3B and 3C.
- **Alternative 3B:** Alternative 3B (Whitney Pond Wells – New Treatment) scored the second highest and will provide a long-term reduction in iron and manganese levels while maintaining current supply capacity. This option was not selected because it is expected to be more expensive than Alternative 3C from a capital and long-term operational perspective and may require hiring a new operator due to the logistics of operating and maintaining two major treatment facilities.
- **Alternative 3C (Recommended):** Alternative 3C (Whitney Pond Wells – Expanded Baddacook Treatment) is the recommended alternative. This alternative will provide a long-term reduction in iron and manganese levels while maintaining current supply capacity. This alternative is moderately expensive, but offers attractive long-term operational and maintenance benefits (reduced costs and ease of operations) relative to comparable alternatives (i.e., Alternative 3B, Alternative 4B) with no WMA permitting. This alternative will also allow GWD to maintain current capacity while retaining the option for development and treatment of additional sources (i.e., Shattuck Road Wells) at the expanded Baddacook Pond Water Filtration Plant should future demands increase.

- **Alternative 4A:** Alternative 4A has the potential to supplement a majority of lost capacity from the Whitney Pond Wells. This option was not selected because the purchase of water from the District on a long-term basis will be extremely expensive and the increased withdrawals from the Nashua basin will be challenging to permit. This option also carries the additional risk that GWD may need to ultimately implement treatment if iron and manganese levels are elevated from additional pumping of the Town Forest Well.
- **Alternative 4B:** Alternative 4B has the potential to supplement a majority of lost capacity from the Whitney Pond Wells. This option was not selected because it is expensive, will be challenging to permit, and carries the additional risk that GWD may need to implement treatment if iron and manganese levels are elevated from additional pumping of the Town Forest Well.

3 Detailed Information for Selected Alternative

Alternative 3C (Whitney Pond Wells – Expanded Treatment at Baddacook) was selected by the Water Commissioners for inclusion in the MassDEP required Manganese Compliance Plan. The following sections include more detailed information for this selected alternative, including a preliminary site and facility layout and cost estimate.

3.1 Preliminary Site Plan and Facility Layout

Comprehensive Environmental (CEI) met GWD at the Baddacook Pond Water Filtration Plant (Plant) on July 17, 2019 to evaluate the feasibility of expanding the Plant to treat the Whitney Pond Wells (i.e., Alternative 3C). A preliminary site plan and facility layout for prepared following the site visit (see **Appendix D**).

Conceptual Site Plan

It was determined during the site visit that the preferred location for future expansion would be to install an addition approximately 45 feet long by 30 feet wide onto the northwest side of the existing building. This location would adjoin with the prior facility expansion completed circa 2005 and would enable matching of the existing roofline to minimize potential building construction costs. Expansion of the Plant would also require a new backwash water settling tank, expanded lagoons, larger propane tank and generator, new exterior piping, and other components. Refer to **Appendix D-1** for a conceptual site plan of the potential expansion.

Conceptual Facility Expansion Layout

A conceptual facility expansion layout was prepared based on discussions with GWD operators during the July 17, 2019 site visit and by performing preliminary sizing calculations for chemical storage and filtration (**See Appendix D-2**). The proposed facility expansion layout includes a pair of horizontal filters identical to the existing filters, a bulk storage area for potassium hydroxide, a bulk storage area for sodium hypochlorite, a combined chemical feed area with chemical metering pumps and day tanks for both chemicals, and a finish water metering pit. The proposed layout will also include a new control panel configured to control all four filters.

It is expected that raw water from the Whitney Pond Wells and Baddacook Pond Well will be chemically treated using separate day tanks in the chemical feed area, but will be routed to a common header across all four filters which will allow for operational flexibility. A common backwash header will also be utilized. The firm capacity of the expanded treatment facility would be approximately 1,300 gpm which is equivalent to the approximate maximum pumping capacity of Baddacook Pond Well (250 gpm), Shattuck Well Number 1 (286 gpm), and Whitney Well #1 (750 gpm). The design media loading rate to meet firm capacity would

be 4.3 gpm/sf (1,300 gpm divided by 3 filters with 100 square feet of media surface each). This filter loading rating is conservative and could potentially be operated at 7 gpm/sf or higher pending successful pilot testing. The manufacturer of GreenSand Plus indicates that the media can handle loading rates of up to 12 gpm/sf. Preliminary chemical storage sizing has been performed based on expected potassium hydroxide and sodium hypochlorite dosages from previous raw water quality data and anticipated design flows.

3.2 Cost Estimate

An order-of-magnitude cost estimate was developed for Alternative 3C (the selected alternative). The American Association of Cost Engineers has defined levels of accuracy that are commonly used by professional cost estimators. Three categories of accuracy include: (1) order-of- magnitude, (2) budget, and (3) definitive estimates. The estimates of comparative cost presented in this report are considered order-of-magnitude, and were developed with limited engineering detail for comparison purposes.

The cost estimate is based on July 2019 construction costs scaled forward to reflect June 2022 construction costs (assuming 3% inflation per year). Cost must be re-evaluated prior to appropriating funds. Actual project costs may vary from this preliminary estimate as a result of additional engineering detail and other cost-related variables. **Table 3-1** presents the order-of-magnitude capital costs for components of the proposed water main installation and treatment facility expansion. Supplemental costs are provided by **Table 3-2** that break down potential construction costs associated with expansion of the Plant.

Table 3-1. Order of Magnitude Cost Estimate for Alternative 3C

Item	Unit of Measure	Est. Quantity	Unit Cost	Total
Water Main				
Engineering for WM (design, bid, field)	LS	1	\$ 225,000	\$ 225,000
Environmental Permitting	LS	1	\$ 80,000	\$ 80,000
Install 12-inch DI Water Main	LF	4100	\$ 160	\$ 656,000
Install 8-inch DI water Main	LF	6800	\$ 150	\$ 1,020,000
Bridge Crossings	EA	3	\$ 25,000	\$ 75,000
<i>Subtotal</i>				\$ 2,060,000
<i>15% Contingency</i>				\$ 310,000
<i>Total</i>				\$ 2,370,000
Water Main Total with 3% inflation (2019-2022)				\$ 2,670,000
Treatment				
Pilot Testing	LS	1	\$ 50,000	\$ 50,000
Engineering Design ¹	LS	1	\$ 250,000	\$ 250,000
OPM Design Phase	LS	1	\$ 70,000	\$ 70,000
Engineering Bid / Construction Phase	LS	1	\$ 200,000	\$ 200,000
Engineering Field - Resident Services	LS	1	\$ 190,000	\$ 190,000
OPM Construction Phase	LS	1	\$ 70,000	\$ 70,000
Materials Testing	LS	1	\$ 20,000	\$ 20,000
Electrical Services Cost	LS	1	\$ 10,000	\$ 10,000
Construction of the Project ²	LS	1	\$ 2,900,000	\$ 2,900,000
<i>Subtotal</i>				\$ 3,760,000
<i>15% Contingency</i>				\$ 560,000
<i>Total</i>				\$ 4,320,000
Sub-Total with 3% inflation (2019-2022)				\$ 4,860,000
Complete Project Total:				\$ 7,530,000

¹Assumes permitting for water main and treatment performed concurrently.

²See Table below for supplemental construction cost breakdown for treatment plant expansion.

Table 3-2. Supplemental Order-of-Magnitude Construction Cost for Baddacook Expansion

Item	Unit of Measure	Est. Qty.	Unit Cost	Total
Mobilization / Demobilization	LS	1	\$ 125,000	\$ 125,000
Site Work (Exterior Piping, Lagoons, Clearing, Grading, Footings, Etc.)	LS	1	\$ 700,000	\$ 700,000
Building Construction (Masonry, Roofing, Painting, HVAC, Plumbing, Etc.)	LS	1	\$ 800,000	\$ 800,000
Backwash Settling Tank	LS	1	\$ 250,000	\$ 250,000
Filtration System (Tanks, Piping, Equipment, Etc.)	LS	1	\$ 500,000	\$ 500,000
Chemical Feed System (Equipment, Tanks, Piping)	LS	1	\$ 150,000	\$ 150,000
Electrical (Lights, Raceways, Equip. Connections, Generator, Etc.)	LS	1	\$ 275,000	\$ 275,000
Instrumentation and Controls	LS	1	\$ 100,000	\$ 100,000
Treatment Construction Cost Estimate:				\$ 2,900,000

4 Manganese Compliance Plan

A Manganese Compliance Plan (i.e., Corrective Action Plan) has been developed based on findings from the alternative analysis. Refer to **Appendix E** for the MassDEP Corrective Action Plan (CAP) to reduce manganese at the Whitney Pond Wells to a level reliably and consistently below 0.30 mg/L (and likely below the SMCL of 0.05 mg/L). The CAP includes a detailed milestone-based schedule.

5 Summary and Next Steps

The Town was issued a letter from MassDEP on February 25, 2019 indicating that manganese test results in Whitney Well #1 and Whitney Well #2 finish water exceed MassDEP's Office of Research and Standards Guidance Level for manganese. The objective of this project was to perform an analysis of potential manganese mitigation alternatives, assist the GWD with selecting the most favorable alternative, then prepare a manganese compliance plan in accordance with MassDEP requirements.

An analysis of potential manganese mitigation alternatives was performed including use of new sources, treatment, and wholesale water purchase from another PWD. Alternatives were evaluated and scored based on a multi-factor decision matrix. The completed decision matrix was presented to the Groton Water Commissioners at a public meeting on July 23, 2019 where the Commissioners voted unanimously in favor of treating the Whitney Pond Wells at the existing Baddacook Pond Water Filtration Plant. The selected alternative would involve construction of a raw water transmission main to the Baddacook Pond Water Filtration Plant and expansion of the Plant's capacity to accommodate treatment of raw water from the Whitney Pond Wells for an approximate capital cost of \$7.5 million dollars.

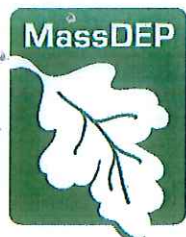
A proposed manganese compliance plan was prepared summarizing the alternative analysis, the Town's preferred alternative, and a proposed compliance schedule.

Recommended next steps for GWD include:

1. Gain approval from Commissioners and Town Selectmen on proposed compliance plan.
2. Submit draft manganese compliance plan to MassDEP before September 1, 2019.
3. Meet with MassDEP to discuss the draft manganese compliance plan.
4. Make adjustments to the plan if needed, and submit final plan before February 1, 2020.
5. Proceed with milestone-based activities from the finalized plan (i.e., pilot testing, obtain funding, perform design, perform construction).
6. Perform periodic re-evaluation of water supply system to make determination if implementation of additional alternatives would be appropriate depending on capacity of sources / demand projections – e.g., connect Shattuck Road Wells to Baddacook Pond Water Filtration Plant.

Appendix A

Copy of MassDEP Letter



Commonwealth of Massachusetts
Executive Office of Energy & Environmental Affairs

Department of Environmental Protection

Central Regional Office • 8 New Bond Street, Worcester MA 01606 • 508-792-7650

Charles D. Baker
Governor

Karyn E. Polito
Lieutenant Governor

Matthew A. Beaton
Secretary

Martin Suuberg
Commissioner

February 25, 2019

Groton Water & Sewer Department
173 Main Street
Groton, MA 01450

PWS Town: GROTON
PWS Name: Groton Water Department
PWSID#: 2115000
Program: Water Quality - Manganese

Attn: Thomas Orcutt, Water Superintendent

Re: Manganese Results Greater than 0.30 mg/L

Dear Public Water Supplier,

The Massachusetts Department of Environmental Protection (MassDEP) is in receipt of your latest manganese results. Your test results confirm that the manganese level in your finished water is greater than 0.30 mg/L, MassDEP's Office of Research and Standards Guidance Level (ORSGL) for manganese. MassDEP recommends that people drink water with manganese levels less than 0.30 mg/L over a lifetime and also recommends that people limit their consumption of water with levels over 1.0 mg/L, primarily to decrease the possibility of adverse neurological effects. ***Infants up to one year of age should not be given water with manganese over 0.30 mg/L, nor should formula for infants be made with that water for more than a total of 10 days throughout the year.***

See MassDEP's website for more information about manganese in drinking water

<https://www.mass.gov/lists/contaminants-in-drinking-water#manganese->

PWSID	PWS NAME	CLASS	WATER TYPE	LOC CODE	LOC NAME	COLLECTED	CHEMICAL NAME	RESULT	UOM
2115000	GROTON WATER DEPARTMENT	COM	F	04G	WHITNEY WTF WELL #2 (TREATED)	30-Jan-19	MANGANESE	0.364	MG/L
2115000	GROTON WATER DEPARTMENT	COM	F	04G	WHITNEY WTF WELL #2 (TREATED)	26-Dec-18	MANGANESE	0.439	MG/L
2115000	GROTON WATER DEPARTMENT	COM	F	04G	WHITNEY WTF WELL #2 (TREATED)	01-Oct-18	MANGANESE	0.446	MG/L
2115000	GROTON WATER DEPARTMENT	COM	F	04G	WHITNEY WTF WELL #2 (TREATED)	19-Jul-18	MANGANESE	0.278	MG/L
2115000	GROTON WATER DEPARTMENT	COM	F	04G	WHITNEY WTF WELL #2 (TREATED)	11-Apr-18	MANGANESE	0.23	MG/L
2115000	GROTON WATER DEPARTMENT	COM	F	04G	WHITNEY WTF WELL #2 (TREATED)	16-Jan-18	MANGANESE	0.265	MG/L

PWSID	PWS NAME	CLASS	WATER TYPE	LOC CODE	LOC NAME	COLLECTED	CHEMICAL NAME	RESULT	UOM
2115000	GROTON WATER DEPARTMENT	COM	F	03G	WHITNEY WTF WELL #1 (TREATED)	30-Jan-19	MANGANESE	0.31	MG/L
2115000	GROTON WATER DEPARTMENT	COM	F	03G	WHITNEY WTF WELL #1 (TREATED)	26-Dec-18	MANGANESE	0.214	MG/L
2115000	GROTON WATER DEPARTMENT	COM	F	03G	WHITNEY WTF WELL #1 (TREATED)	01-Oct-18	MANGANESE	0.325	MG/L
2115000	GROTON WATER DEPARTMENT	COM	F	03G	WHITNEY WTF WELL #1 (TREATED)	10-Jul-18	MANGANESE	0.167	MG/L
2115000	GROTON WATER DEPARTMENT	COM	F	03G	WHITNEY WTF WELL #1 (TREATED)	08-May-18	MANGANESE	0	MG/L
2115000	GROTON WATER DEPARTMENT	COM	F	03G	WHITNEY WTF WELL #1 (TREATED)	22-Jan-18	MANGANESE	0.202	MG/L

MassDEP is requiring you to take the following actions:

1. The manganese health advisory information was already provided to your customers in your latest CCR, therefore no general public notice is required but **you must notify new customers and new billing units of these results** in accordance with 310 CMR 22.03(8) and 310 CMR 22.16 (1) (a) 3 e and 310 CMR 22.15(3) (b) until MassDEP determines that the level is reliably and consistently below 0.30 mg/L. **You must also continue to follow any and all directions from MassDEP regarding public notification requirements.** You may use the attached public advisory to inform your new customers and new billing units about the potential health concerns of exposure to elevated concentrations of manganese in drinking water to certain sub-populations, or you can provide them with a copy of your most recent CCR. If you choose to use a different notice or add any system specific information to the attached public advisory you must receive written approval from your MassDEP regional office. **You must include your procedure for notifying new customers and new billing units in your plan submission** (see number 3 below).
2. **For Community systems: Continue to report manganese results in your annual Consumer Confidence Report (CCR) and include specific language** in accordance with 310 CMR 22.16A (8) (a), 310 CMR 22.16A (8) (f), 310 CMR 22.16A (23) until your results are below 0.05 mg/L. For specific language and instructions please see: "Manganese Reporting in Consumer Confidence Reports" at <https://www.mass.gov/service-details/manganese-reporting-in-consumer-confidence-reports>
3. **Submit a proposed compliance plan to reduce the level of manganese** at the location(s) specified to a level reliably and consistently below 0.30 mg/L (preferably below the SMCL of 0.05 mg/L) **by September 1, 2019** and a Final Plan **by February 1, 2020** in accordance with 310 CMR 22.03(8) and 310 CMR 22.03(14)(a).

Attached is a template form for you can use to complete and return to MassDEP with the details of your plan. The plan must indicate how you plan to bring the levels below 0.30 mg/L, preferably reliably and consistently below 0.30 mg/L at the entry point to the distribution system. We encourage you to consult with your regional MassDEP DWP representative for compliance assistance in developing a plan to manage and address the manganese levels in your system.

4. **Continue ongoing water quality monitoring** and data submittals according to your system's sampling schedule pursuant to 310 CMR 22.03(2), 310 CMR 22.03(10), 310 CMR 22.07D, and 310 CMR 22.03(8).

Thank you for your efforts and commitment to provide a safe drinking water supply for your consumers. Please contact your regional drinking water technical assistance provider Paula Caron [Paula.Caron@mass.gov] or 508-767-2719, if you would like to discuss this information.

Sincerely,



Robert A. Bostwick
Drinking Water Section Chief
MassDEP Central Regional Office

Attachments: Manganese Fact Sheet
 Manganese Compliance Action Plan (CAP) Form
 Manganese CCR Reporting Required Health Language

cc:

Local Board of Health

Mark Haddad, Town Manager, 173 Main St., Groton, MA 01450

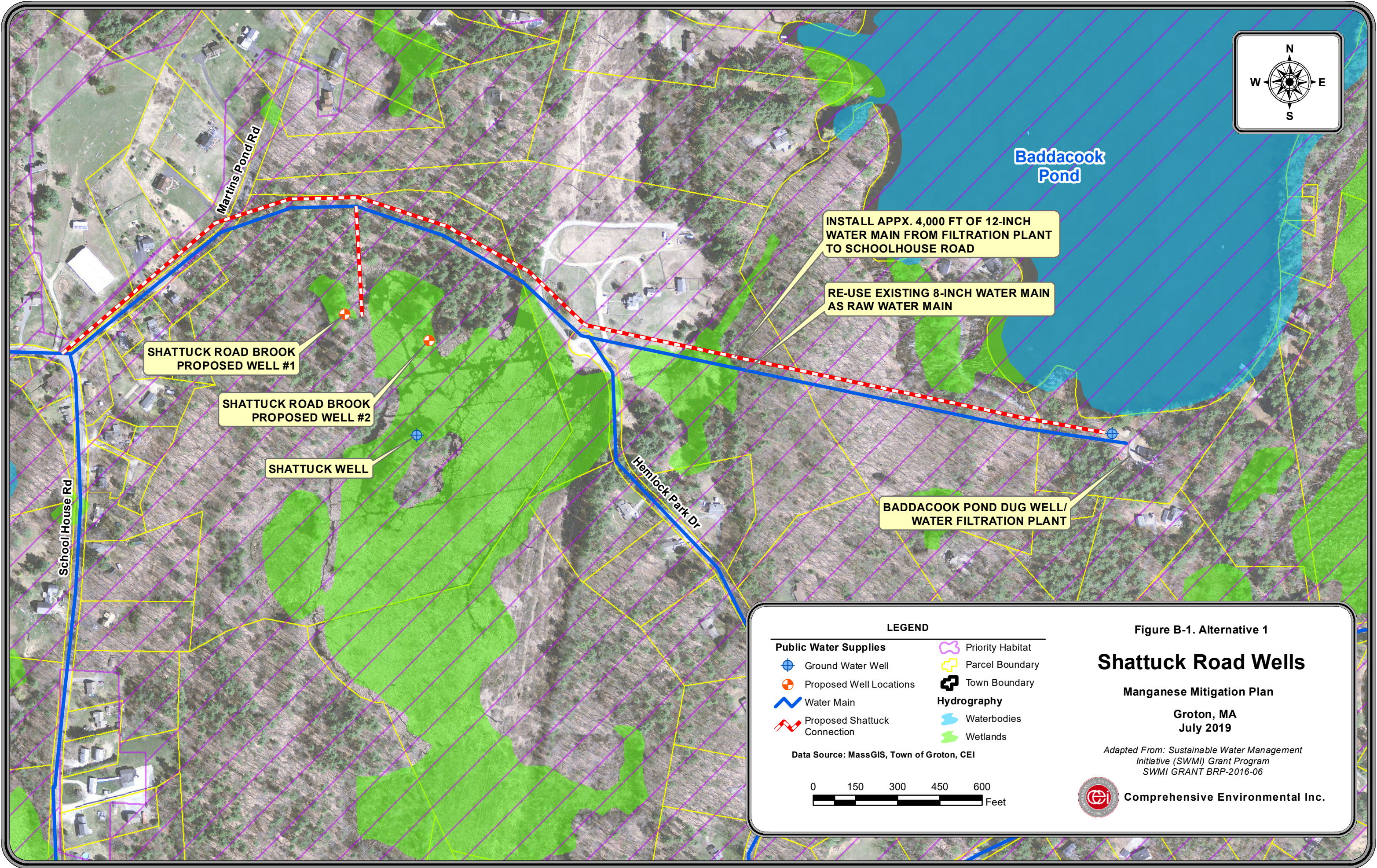
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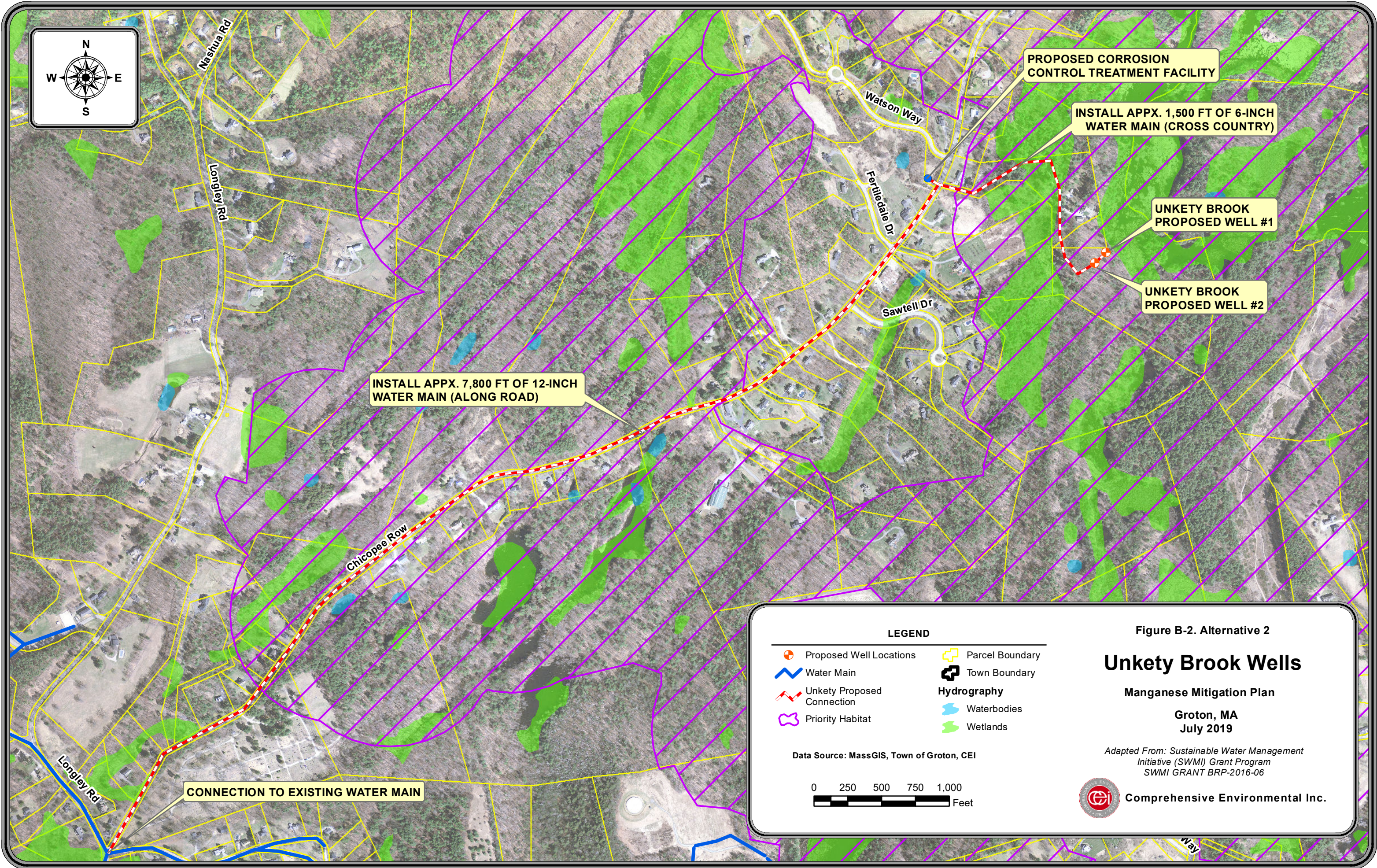
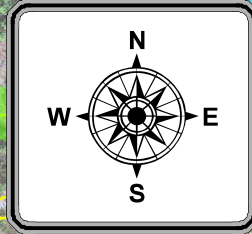
DWP Scanned Document Archive (pdf)

File Name: Groton-2115000-WQ-Manganese Notification-2019-02-25

Appendix B

Potential Alternatives (Figures)





LEGEND

- | | |
|----------------------------|--------------------|
| Proposed Well Locations | Parcel Boundary |
| Water Main | Town Boundary |
| Unkety Proposed Connection | Hydrography |
| Priority Habitat | Waterbodies |
| | Wetlands |

Data Source: MassGIS, Town of Groton, CEI

0 250 500 750 1,000
Feet

Figure B-2. Alternative 2

Unkety Brook Wells

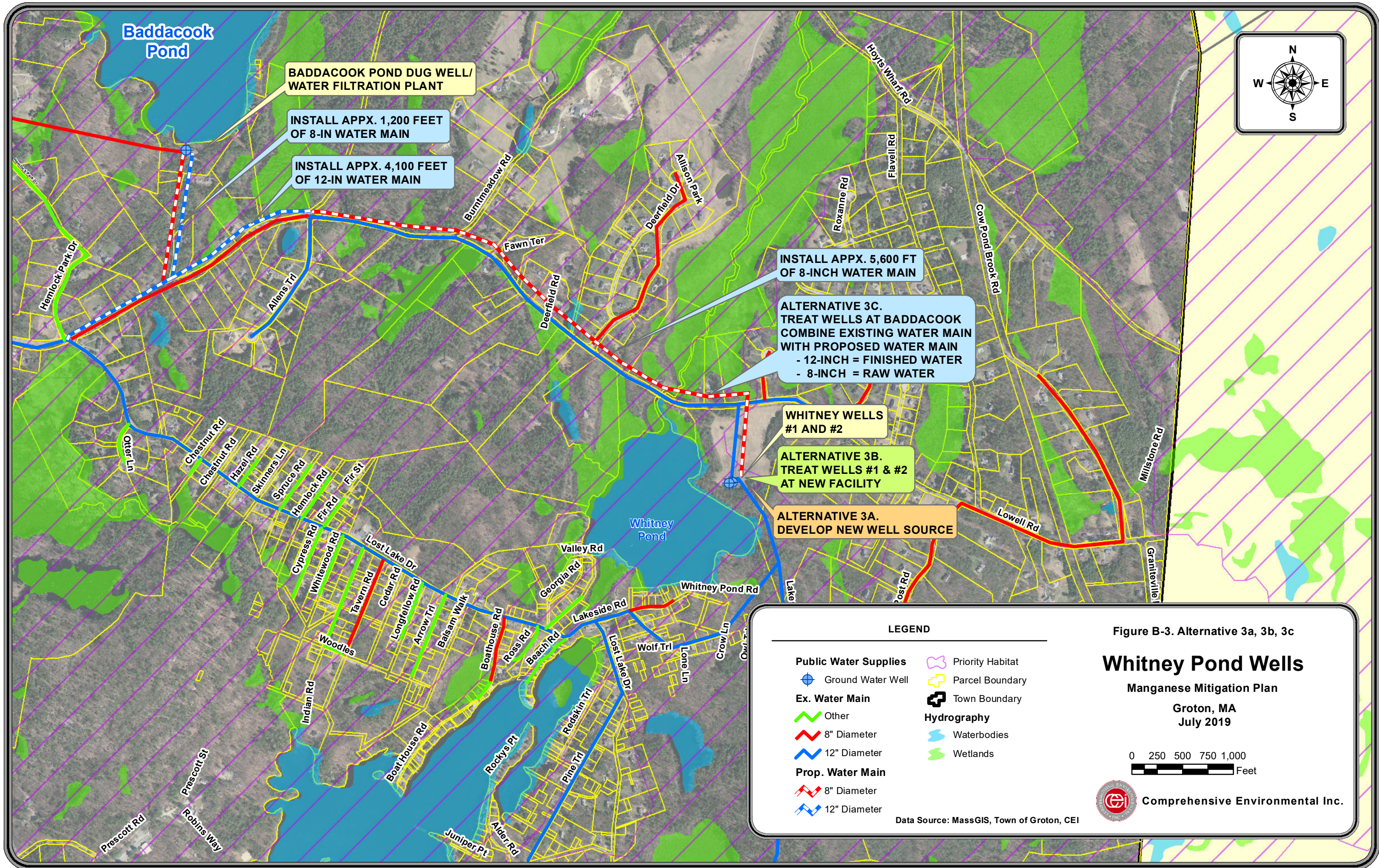
Manganese Mitigation Plan

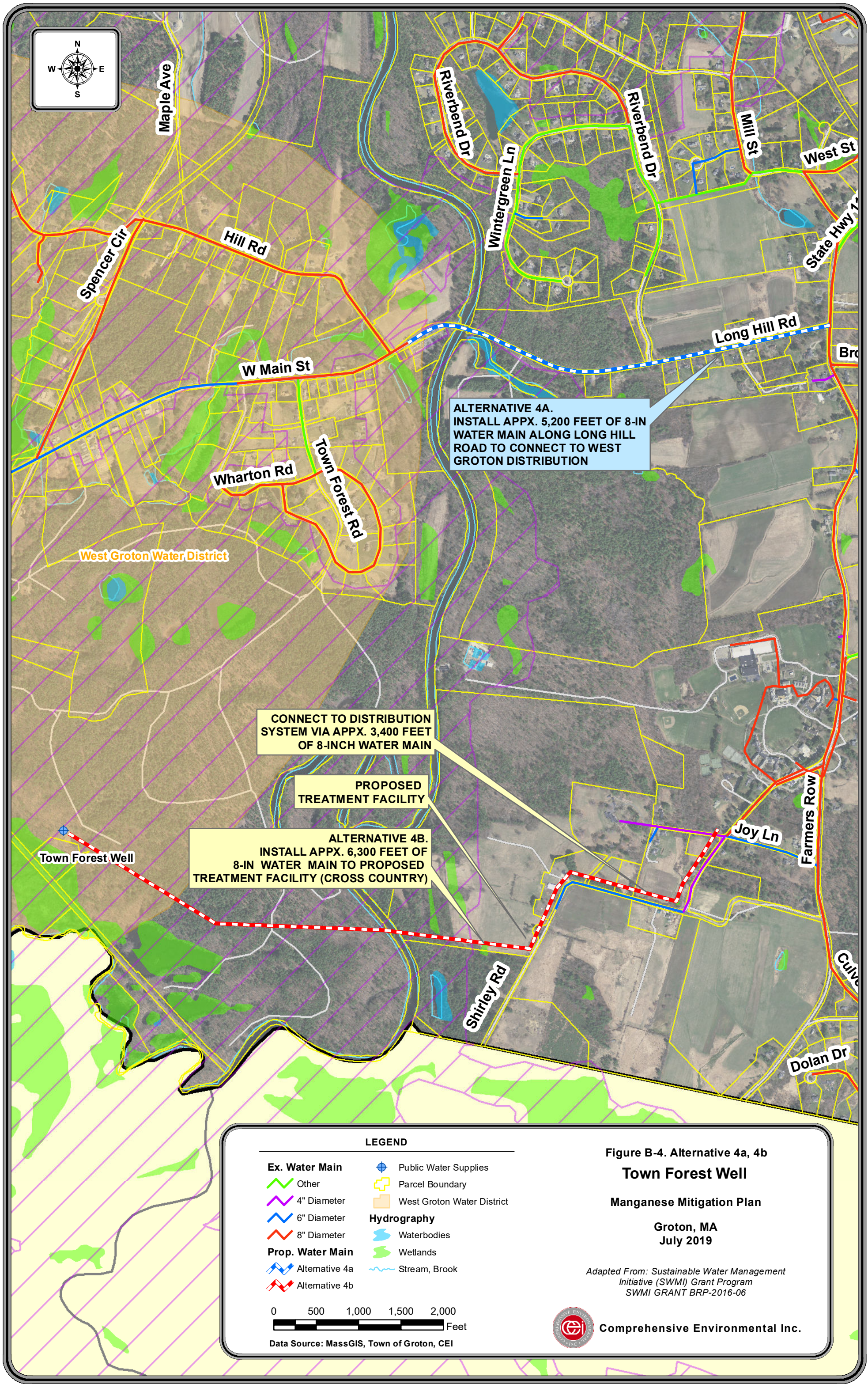
Groton, MA
July 2019

Adapted From: Sustainable Water Management
Initiative (SWMI) Grant Program
SWMI GRANT BRP-2016-06



Comprehensive Environmental Inc.





Appendix C

Completed Decision Matrix

Decision Matrix

0=Poor, 1 = Fair, 2 = Good, 3 = Excellent		Alternative 1	Alternative 2	Alternative 3A	Alternative 3B	Alternative 3C	Alternative 4A	Alternative 4B
Factor	Weight	Shattuck Road Wells: Develop Source Merrimack Basin	Unkety Brook Wells: Develop Source Nashua Basin	Whitney Pond Well #3: Develop Additional Source Merrimack Basin	Whitney Pond Wells #1, #2: New Treatment Facility Merrimack Basin	Whitney Pond Wells #1, #2: Treat at Baddacook WTP Merrimack Basin	Town Forest Well: Purchase from District Nashua Basin	Town Forest Well: New Treatment Facility Nasuhua Basin
		- Construct Wells / Pumping - Install Water Main - Connect to Baddacook WTP	- Construct Wells / Pumping - Install Water Main - Construct Treatment Facility	- Obtain Approval - Construct Well / Pumping - Connect to Distribution	- Construct Treatment Facility - Connect to Distribution	- Install Water Main - Connect to Baddacook WTP - Expand Baddacook WTP	- Connect to Distribution - Install Meter Vault	- Install Water Main - Construct Pump Station - Construct Treatment Facility
Supply/Demand Balance								
Whitney Wells Online	NA	No <i>(could be pumped in rotation)</i>	No	Yes	Yes	Yes	No	No
Approved Maximum Daily Withdrawawal (mgd)	NA	0.324	0.300	NA	0.576	0.576	0.850	0.850
Maintain Supply Capacity (no loss)	20%	1	1	3	3	3	2	2
Efficacy in Reduction of Manganese Levels								
Conceptual Fe/Mn Treatment Plan		Plan to treat at Baddacook WTP	Corrosion control (present) Mn treatment possible (future)	No Fe or Mn Treatment	Plan to treat at New Whitney WTP	Plan to treat at expanded Baddacook WTP	Plan to treat at existing District Facility	Coorosion control (present) Mn treatment possible (future)
Reduce Mn Levels below 0.3 mg/L MassDEP Health Advisory Level	20%	3	2	1	3	3	3	3
Reduce Mn Levels below 0.05 mg/L SMCL (DEP treatment goal)	5%	3	3	0	3	3	3	3
Temporary Fix (minimal benefit) vs Long Term Solution (high benefit)	10%	2	2	1	3	3	2	2
Project Costs								
Estimated Capital Costs (2022)	NA	\$3,850,000	\$7,740,000	\$1,000,000	\$7,600,000	\$2,600,000 (WM only) \$4,900,000 (WTP only) \$7,500,000 (combined)	\$2,810,000	\$5,850,000
Annual Debt Service on Construction Cost ³	NA	\$235,000	\$474,000	\$61,000	\$465,000	\$460,000	\$172,000	\$358,000
Annual O&M Cost Increase (2022)	NA	\$90,000	\$90,000	Minimal Increase	\$180,000	\$100,000	\$683,000	\$90,000
Estimated Total Costs (20 years)	NA	\$6,500,000	\$11,280,000	\$1,220,000	\$12,900,000	\$11,200,000	\$17,100,000	\$8,960,000
Estimated Total Costs (30 years)	NA	\$7,400,000	\$12,180,000	\$1,220,000	\$14,700,000	\$12,200,000	\$23,930,000	\$9,860,000
Project capital costs	20%	2	1	3	1	1	3	2
Operation and maintenance costs	10%	2	2	3	1	2	0	2
Cost to Implement WMA Mitigation	5%	3	1	3	3	3	1	1
WMA Permitting								
Ease of WMA Permitting and Extent of WMA Permitting Requirements	10%	2	0	2	2	2	1	1
Relative Score	100%	2.1	1.4	2.2	2.3	2.4	2.1	2.1

Notes:

1. Alternatives 1, 2, 4A, 4B developed under prior SWMI Grant (BRP-2016-06).
2. Cost estimates are for planning purposes only (i.e., order-of-magnitude) and have been adjusted for potential inflation from 2019 to 2022 assuming 3% annual inflation.
3. Annual Debt Service Cost accounts for 2% SRF Loan (20 yr) Equal Principal Loan on Total Project Costs including Engineering, Construction and Contingency
4. Water Purchase Costs from Groton Water District (i.e., O&M) for Option 4A assumed as follows:

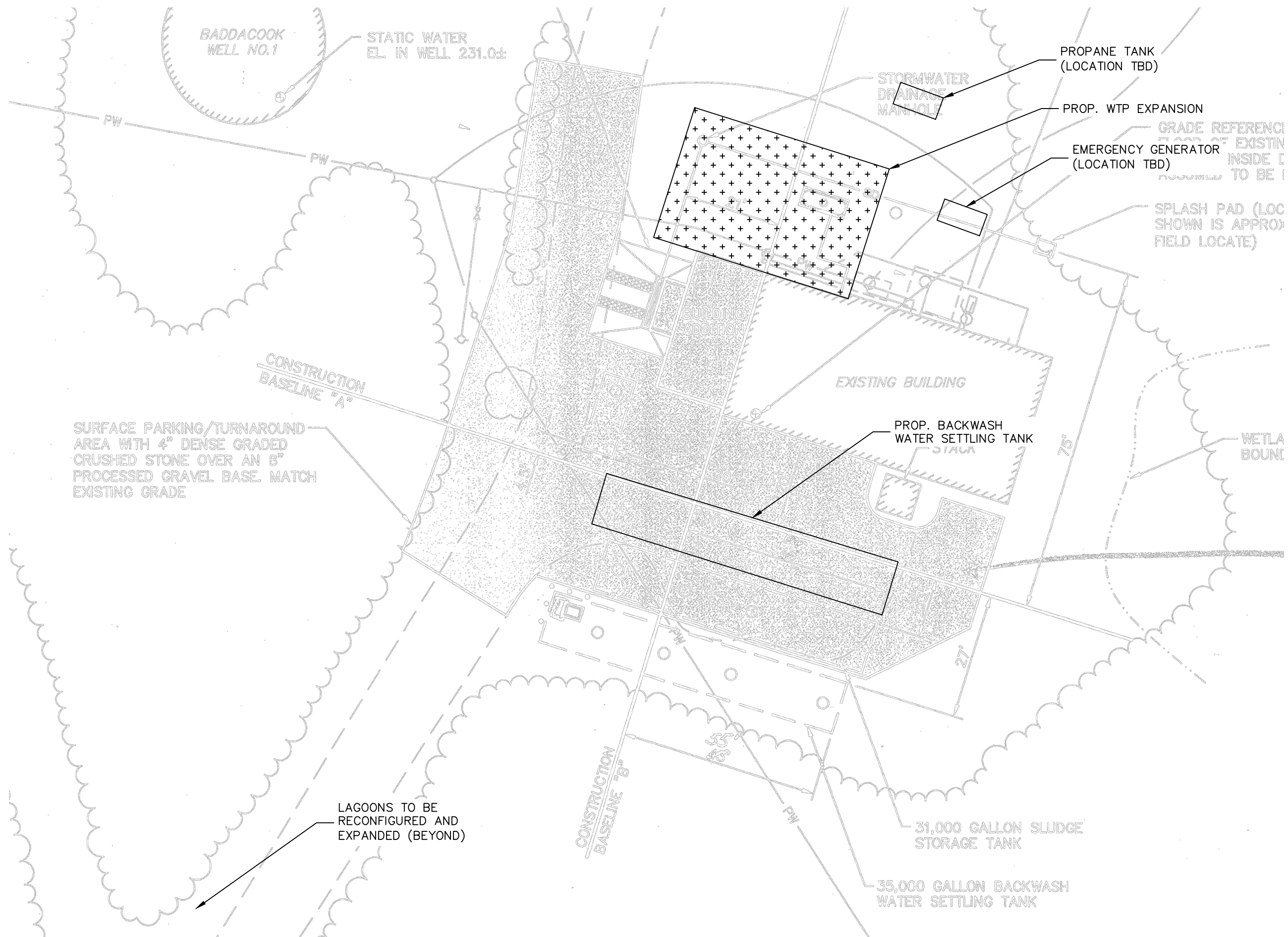
- Groton Water Department Average Daily Demand Is Appx. 0.45 mgd (2018 SWMI Grant)

- Assume Whitney Wells supply appx. 75% of Average Daily Demand (0.35 mgd)

- Assume 0.35 mgd purchased from Groton Water District at rate of \$4.00 per hcf
5. O&M cost for Alternative 3B (New Treatmetn Facility) assumes \$80,000 to potentially hire new operator
6. Approved maximum daily withdrawal of Town Forest Well is 0.850 mgd; Existing maximum daily demand of Town Forest Well is appx. 0.40 mgd assuming 70% of Groton Water District's demands are supplied by the well.

Appendix D

Conceptual Site Plan / Layout *(Selected Alternative)*



General Notes

1. BASE INFORMATION FROM RECORD DRAWINGS ENTITLED "CONTRACT NO. 4 WATER FILTRATION PLANT", DATED APRIL 2005.

No.	Revision/Issue	Date

COMPREHENSIVE ENVIRONMENTAL
INCORPORATED



CONCEPTUAL
SITE PLAN

TOWN OF GROTON
WATER DEPARTMENT

Project No.: 239-13 JULY 2019	Sheet C-1
Drawn By: DR Checked By: MO Scale: AS SHOWN	

EX. 6" HDPE ALIGNMENT
RAW WATER FROM
BADACOOK WELL TO WTP

PROP. EXPANSION
FOOTPRINT

BULK STORAGE AREA
WITH CONTAINMENT
(POTASSIUM HYDROXIDE)

METER PIT
(FINISH WATER)

CONTROL PANEL
(ALL 4 FILTERS)

EX. PAVEMENT

BULK STORAGE AREA
WITH CONTAINMENT
(SODIUM HYPOCHLORITE)

PRELIMINARY FACILITY SIZING

DESIGN FLOW	
POTENTIAL FLOW FROM BADDACOOK / SHATTUCK WELLS (GPM)	550
POTENTIAL FLOW FROM WHITNEY WELLS (GPM)	750
FACILITY DESIGN FLOW (GPM):	
1,300	
NOTES:	
1. ASSUMES MAX PUMPING OF BADDACOOK (250 GPM) & SHATTUCK (286 GPM)	
2. REGISTERED / AUTHORIZED MAXIMUM DAY WITHDRAWAL:	
- BADDACOOK: 0.217 MGD (150 GPM)	
- SHATTUCK: 0.324 MGD (225 GPM)	
- WHITNEY: 0.576 MGD (400 GPM)	

FILTER CAPACITY		
SCENARIO	LOADING RATE	
	4 GPM/ SF	7 GPM/ SF
WTP MAX. CAPACITY WITH FOUR (4) FILTERS ONLINE (GPM)	1,600	2,800
WTP MAX. CAPACITY WITH THREE (3) FILTERS ONLINE (GPM)	1,200	2,100
WTP MAX. CAPACITY WITH TWO (2) FILTERS ONLINE (GPM)	800	1,400
NOTES:		
1. ASSUMES EACH FILTER HAS APPX. MEDIA SURFACE AREA OF 100 SF (2, 50 SF CELLS)		

DAY TANKS AND
CHEMICAL FEED AREA
(KOH & NaOCL)

General Notes

1. BASE INFORMATION FROM RECORD
DRAWINGS ENTITLED "CONTRACT NO. 4
WATER FILTRATION PLANT", DATED APRIL
2005.

No.	Revision/Issue	Date

COMPREHENSIVE ENVIRONMENTAL
INCORPORATED



41 MAIN STREET
BOLTON, MA 01740

CONCEPTUAL
EXPANSION
LAYOUT

TOWN OF GROTON
WATER DEPARTMENT

Project No.: 239-13 JULY 2019	Sheet C-2
Drawn By: DR Checked By: MO Soiler: AS SHOWN	

Appendix E

Preliminary Corrective Action Plan



COMPREHENSIVE
ENVIRONMENTAL
INCORPORATED

41 Main Street
Bolton, MA 01740
www.ceiengineers.com

August 15, 2019

MassDEP, Drinking Water Program
Attn: Paula Caron
8 New Bond Street
Worcester, MA 01606

RE: Proposed Manganese Compliance Plan

Dear Ms. Caron:

On behalf of the Town of Groton Water Department (Town), Comprehensive Environmental Inc. (CEI) is submitting a proposed manganese compliance plan in accordance with a letter issued by MassDEP on February 25, 2019. The letter indicates that manganese test results in Whitney Well #1 and Whitney Well #2 finish water exceeded MassDEP's Office of Research and Standards Guidance Level for manganese and that a draft compliance plan (i.e., corrective action plan) must be submitted by September 1, 2019 to reduce the level of manganese to a level "reliably and consistently" below the 0.30 mg/L Health Advisory Level (HAL) at the entry point to the distribution system and "preferably" below the 0.05 mg/L Secondary Maximum Contaminant Level (SMCL).

Refer to the attached Corrective Action Plan (CAP) for the Town's proposed strategy to address elevated manganese levels at the Whitney Pond Wells. Please contact me should have any questions at 508-281-5177 (mohl@ceiengineers.com).

Sincerely,

COMPREHENSIVE ENVIRONMENTAL INC.

Michael P. Ohi, P.E.¹
Principal, Project Manager
¹Licensed in Massachusetts

Attachments: Proposed Manganese Corrective Action Plan and Accompanying Figures

Copies to: Thomas Orcutt, Groton Water Department

RESPONSE REQUIRED

Corrective Action Plan (CAP) for addressing manganese levels above the ORSG Level of 0.30 mg/L

CAP Response Due Date: September 1, 2019

PWS ID#: 2115000

PWS Name: Groton Water Department

Instructions: Please complete, sign, date and return this document by the CAP response due date listed about to: **MassDEP, Drinking Water Program, 8 New Bond St., Worcester, MA 01606**

This plan will provide the basis for further documentation of your actions to address manganese levels over the ORSG Level.

In addition to the required notification of public health officials and consumers, a long term corrective action plan must be submitted to MassDEP. When developing a plan, you must consider and include discussion of the following areas and any actions you plan to take to reduce your manganese levels reliably and consistently below 0.30 mg/L:

- ✓ Education and notification to inform sensitive sub-populations;
- ✓ Monitoring additional parameters. It is generally recommended that you routinely monitor and gather enough information to assess levels in affected sources that may account for fluctuations in concentrations above the SMCL, including pumping rates, blending patterns, periodic/seasonal use, and variations in seasonal water quality;
- ✓ Monitoring in the distribution system;
- ✓ Optimization of existing treatment processes (greensand, ion exchange, softeners etc);
- ✓ Managing the use of the source(s) with elevated manganese levels;
- ✓ Use of another source, (please note: new sources must reduce levels below 0.05 mg/L);
- ✓ Blending the source(s) with elevated manganese levels with other source(s);
- ✓ Connection to another PWS with manganese level reliable and consistently below 0.30 mg/L;
- ✓ Treatment options to remove elevated manganese levels including Point-of-Use (POU) or Point-of-Entry (POE) for clearly separate distribution systems. (Please note: sequestration treatment is not an acceptable option because it masks but does not remove manganese); and
- ✓ Other options.

Long-Term Plan

Check one: Preliminary ☒ Final ☐

Please identify if the following items have been included in your Long-Term Corrective Action Plan (CAP):			
Possible Corrective Action Plan Topics	In the CAP		
Education and notification to inform the sensitive sub population.	Yes	No	N/A
Monitoring additional parameters. It is generally recommended that you routinely monitor and gather enough information to assess levels in affected sources that may account for fluctuations in concentrations above the SMCL, including pumping rates, blending patterns, periodic/seasonal use, and variations in seasonal water quality.	Yes	No	N/A
Monitoring in the distribution system.	Yes	No	N/A
Optimization of existing treatment processes (greensand, ion exchange, softeners etc).	Yes	No	N/A
Managing the use of the source(s) with elevated manganese levels.	Yes	No	N/A
Use of another source, (please note: new sources must reduce levels below 0.5 mg/L)	Yes	No	N/A
Blending the source(s) with elevated manganese levels with other source(s).	Yes	No	N/A
Connection to another public Water Supply with Manganese level reliably and consistently below 0.30 mg/L.	Yes	No	N/A
Treatment options to remove elevated manganese levels. (Sequestration treatment is not an acceptable option because it masks but does not remove manganese).	Yes	No	N/A
Other Options.	Yes	No	N/A

Long-Term Narrative:

In the long-term, my system plans to undertake the following action to address the issue

[Please include a description of the plans you intend to take below, or attach additional pages as necessary]

Alternatives Analysis:

An analysis of potential manganese mitigation alternatives was performed. The most favorable alternative would have the capacity to replace or exceed the approved maximum daily withdrawal of the Whitney Pond Wells (0.576 mgd) while cost effectively providing treated water below the HAL and SMCL. An array of alternatives was considered including use of new sources, treatment, and wholesale water purchase from another PWD. Alternatives were evaluated and scored based on a multi-factor decision matrix that included the following general factors:

- Supply/demand balance: Will the selected alternative meet existing and future supply needs?
- Manganese reduction efficacy: Will the selected alternative provide a long-term reduction in manganese and iron levels?
- Order-of-Magnitude cost: Are capital costs and long-term operation and maintenance costs reasonable?
- Permitting considerations: What extent of permitting will be required for approval of the proposed alternative?

Alternative Selection:

The completed decision matrix was presented to the Groton Water Commissioners at a public meeting on July 23, 2019 where the Commissioners voted unanimously in favor of treating the Whitney Pond Wells at the existing Baddacook Pond Water Filtration Plant (Plant). The selected alternative would involve construction of a raw water transmission main to the Plant and expansion of the Plant's capacity to accommodate treatment of raw water from the Whitney Pond Wells.

This alternative will enable GWD to maintain current supply capacity and retains the option for development of additional sources in the future if demands increase. This alternative would include the following work (**Figure 1**):

- Install approximately 6,800 feet of 8-inch raw water distribution main.

- Install approximately 4,100 feet of 12-inch finished water distribution main.
- Convert approximately 5,500 feet of 12-inch and 1,600 feet of 8-inch water distribution main into finished and raw water distribution main, respectively.
- Expand Baddacook Pond Water Filtration Plant to accommodate Whitney Pond Wells.

It is expected that expansion of the Plant to accommodate the Whitney Pond Wells will result in a long-term reduction of Manganese levels below the HAL and SMCL.

Conceptual Facility Expansion Layout:

The Plant currently utilizes Greensand Plus media filtration to treat the Baddacook Pond Well. The plant would be expanded to include two (2) horizontal filters with Greensand Plus media identical to the existing filters, a bulk storage area for potassium hydroxide, a bulk storage area for sodium hypochlorite, a combined chemical feed area with day tanks for both chemicals, and a finish water metering pit. The proposed layout would also include a new control panel configured to control all four filters.

It is expected that raw water from the Whitney Pond Wells and Baddacook Pond Well will be chemically treated using separate metering pumps and day tanks in the chemical feed area, but will be routed to a common header across all four filters which will allow for operational flexibility. A common backwash header will also be utilized. The firm capacity of the expanded treatment facility would be approximately 1,300 gpm which is equivalent to the approximate maximum pumping capacity of Baddacook Pond Well (250 gpm), Shattuck Well #1 (286 gpm), and the Whitney Pond Wells (750 gpm). Shattuck Well #1 will not be treated at this time, but the Plant expansion will retain the ability to route the Shattuck Well #1 water to the Plant for treatment, at a future time. The design media loading rate to meet firm capacity would be 4.3 gpm/sf (1,300 gpm divided by 3 filters with 100 square feet of media surface each). This filter loading rating is conservative and could potentially be operated at 7 gpm/sf or higher pending successful pilot testing. The manufacturer of GreenSand Plus indicates that the media can handle loading rates of up to 12 gpm/sf.

See **Figure 2** and **Figure 3** for a conceptual site plan and facility layout, including preliminary facility sizing calculations.

Additional CAP Actions:

- The Town will continue to provide manganese health advisory information in annual Consumer Confidence Reports, including notification of new customers and billing units.
- The Town will continue ongoing water quality monitoring and data submittals.

Planned action and date of completion: <i>[Please include a timeline for the actions outlined above]</i>	
Action	To be completed by date:
See Figure 4 for a proposed milestone-based schedule.	

I certify under the penalty of law that I am the person authorized to fill out this form and the information contained herein is true, accurate and complete to the best of my knowledge and belief.

Name: Tom Orcutt

Title: Superintendent

Signature:

Date: August 15, 2019

Phone: (978) 448-1122

Email: torcutt@townofgroton.org

Corrective Action Plan (CAP) for addressing manganese levels above the ORSG Level of 0.30 mg/L

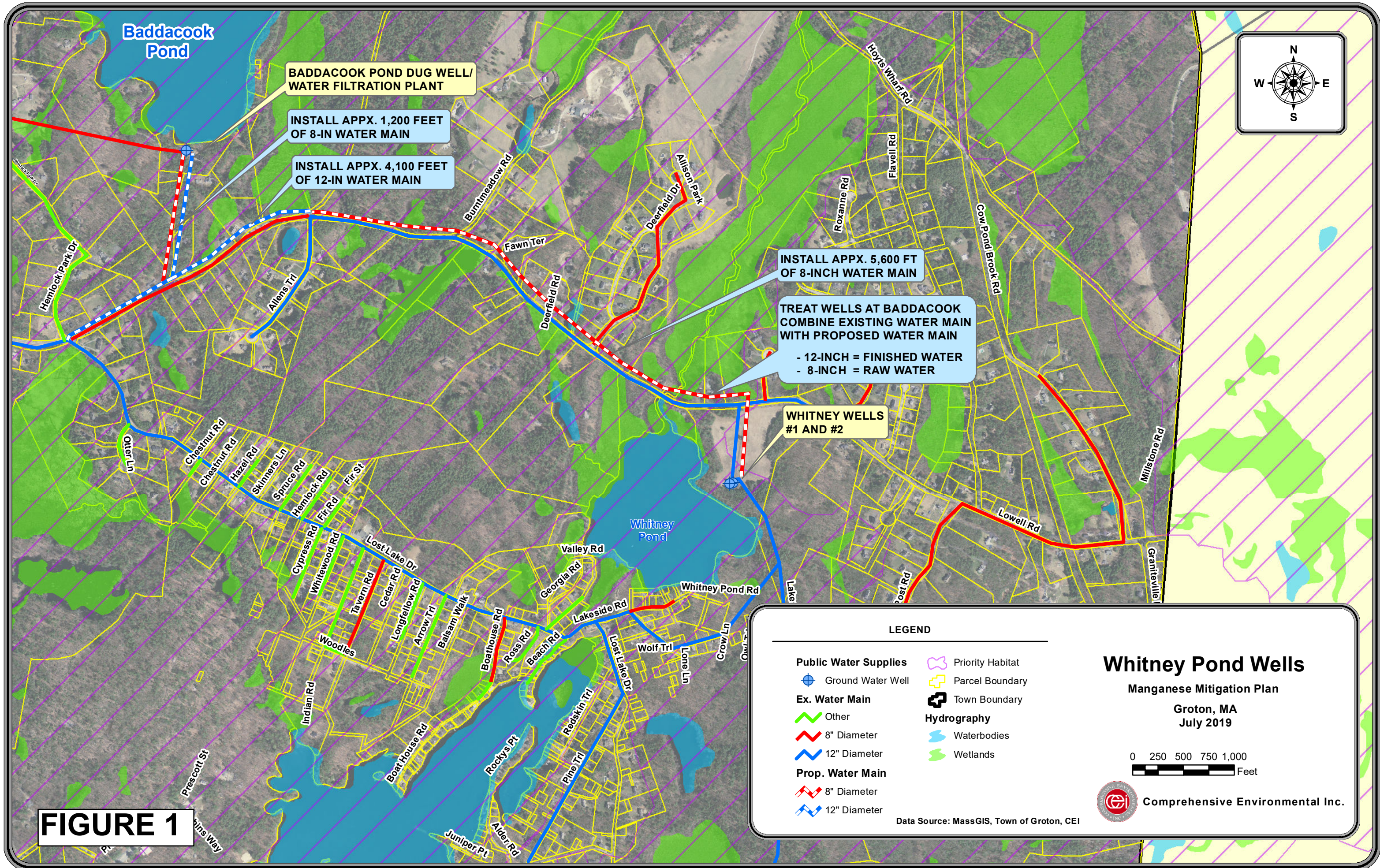
Technical Assistance Requested: *(Please fill in your contact information if requesting assistance)*

PWS ID#: 2115000	PWS Name: Groton Water Department	
Contact Name: Tom Orcutt	Phone: (978) 448-1122	Email: torcutt@townofgroton.org

- ☒ I would like to schedule a meeting with a MassDEP staff person to discuss my system's plans.
- ☐ I would like to receive a visit from a technical assistance (TA) provider to discuss my system's plans.

FIGURES

- **Figure 1:** Conceptual water main layout of selected alternative.
- **Figure 2:** Conceptual site plan of selective alternative.
- **Figure 3:** Conceptual facility layout of selected alternative
- **Figure 4:** Proposed milestone-based schedule



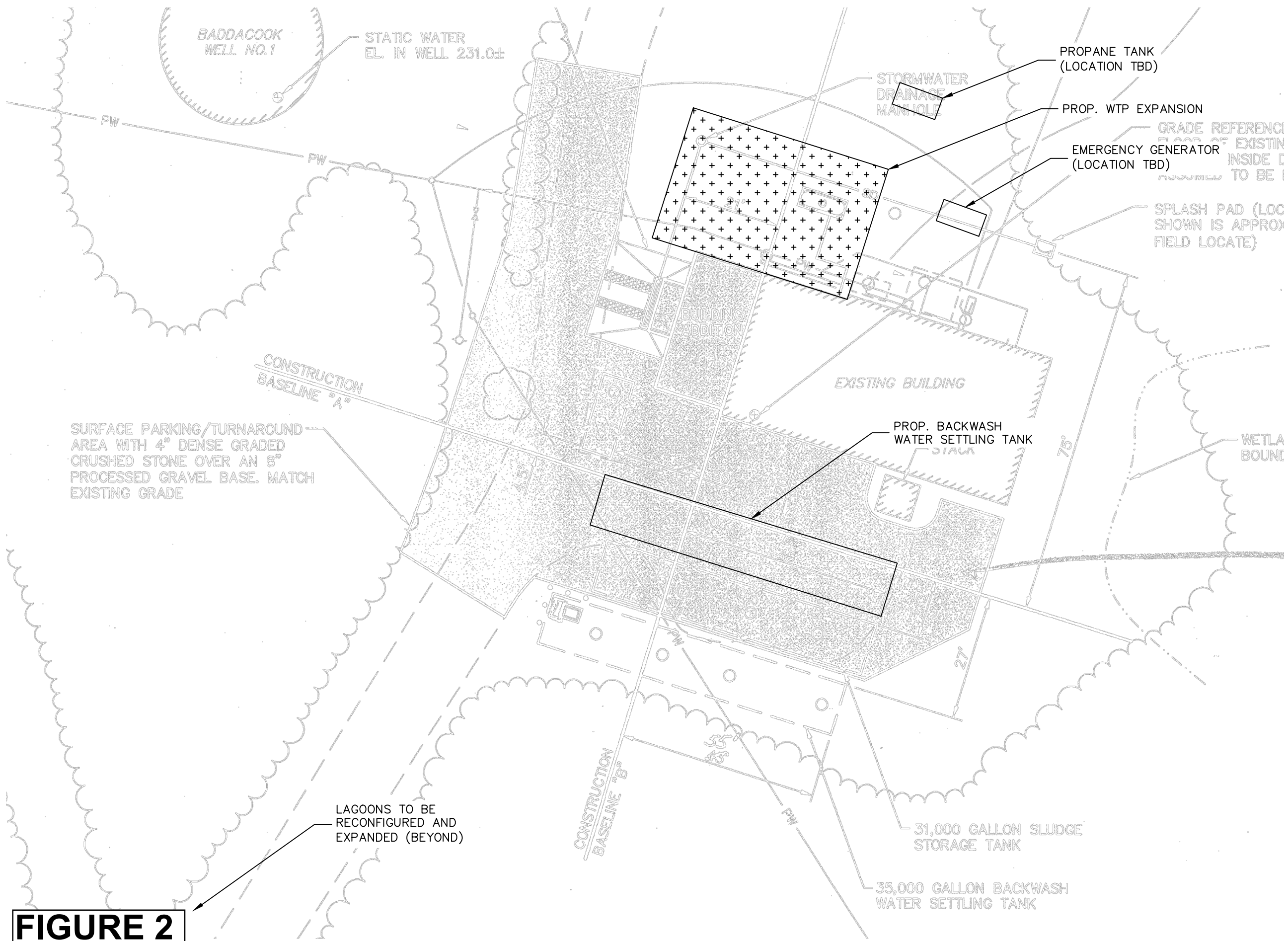


FIGURE 2

General Notes

1. BASE INFORMATION FROM RECORD DRAWINGS ENTITLED "CONTRACT NO. 4 WATER FILTRATION PLANT", DATED APRIL 2005.

No.	Revision/Issue	Date

COMPREHENSIVE ENVIRONMENTAL INCORPORATED

41 MAIN STREET
BOLTON, MA 01740

CONCEPTUAL SITE PLAN

TOWN OF GROTON
WATER DEPARTMENT

Project No.: 239-13 JULY 2019	Sheet C-1
Drawn By: DR	
Checked By: MO	
Scale: AS SHOWN	

EX. 6" HDPE ALIGNMENT
RAW WATER FROM
BADACOOK WELL TO WTP

PROP. EXPANSION
FOOTPRINT

BULK STORAGE AREA
WITH CONTAINMENT
(POTASSIUM HYDROXIDE)

METER PIT
(FINISH WATER)

CONTROL PANEL
(ALL 4 FILTERS)

EX. PAVEMENT

PRELIMINARY FACILITY SIZING

DESIGN FLOW	
POTENTIAL FLOW FROM BADDACOOK / SHATTUCK WELLS (GPM)	550
POTENTIAL FLOW FROM WHITNEY WELLS (GPM)	750
FACILITY DESIGN FLOW (GPM):	1,300
NOTES:	
1. ASSUMES MAX PUMPING OF BADDACOOK (250 GPM) & SHATTUCK (286 GPM)	
2. REGISTERED / AUTHORIZED MAXIMUM DAY WITHDRAWAL:	
- BADDACOOK: 0.217 MGD (150 GPM)	
- SHATTUCK: 0.324 MGD (225 GPM)	
- WHITNEY: 0.576 MGD (400 GPM)	

FILTER CAPACITY		
SCENARIO	LOADING RATE	
	4 GPM/ SF	7 GPM/ SF
WTP MAX. CAPACITY WITH FOUR (4) FILTERS ONLINE (GPM)	1,600	2,800
WTP MAX. CAPACITY WITH THREE (3) FILTERS ONLINE (GPM)	1,200	2,100
WTP MAX. CAPACITY WITH TWO (2) FILTERS ONLINE (GPM)	800	1,400
NOTES:		
1. ASSUMES EACH FILTER HAS APPX. MEDIA SURFACE AREA OF 100 SF (2, 50 SF CELLS)		

DAY TANKS AND
CHEMICAL FEED AREA
(KOH & NaOCL)

FIGURE 3

General Notes

1. BASE INFORMATION FROM RECORD DRAWINGS ENTITLED "CONTRACT NO. 4 WATER FILTRATION PLANT", DATED APRIL 2005.

No.	Revision/Issue	Date

COMPREHENSIVE ENVIRONMENTAL
INCORPORATED



41 MAIN STREET
BOLTON, MA 01740

CONCEPTUAL
EXPANSION
LAYOUT

TOWN OF GROTON
WATER DEPARTMENT

Project No.: 239-13 JULY 2019	Sheet C-2
Drawn By: DR Checked By: MO Soiler: AS SHOWN	

June 25, 2019

[illegible]

FIGURE 4