REPORT
Pare Project No. 08176.18

WATER SYSTEM STORAGE TANK EVALUATION

Southborough, Massachusetts

PREPARED FOR:

Town of Southborough
Department of Public Works
85 Cordaville Road
Southborough, MA

PREPARED BY:

Pare Corporation
8 Blackstone Valley Place
Lincoln, RI 02865

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PARE
CORPORATION

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SECTION 1 – INTRODUCTION

As requested, Pare Corporation (Pare) has performed an evaluation of a new water storage tank in the Town of Southborough's High Service Area (HSA). It has been previously identified that Southborough has an insufficient amount of storage for fire protection and emergency conditions. This situation will be particularly acute in the future when new development occurs and the Town approaches its full build-out potential. This deficiency was identified in a report prepared by H2O Engineering in early 2007, and confirmed by Pare in our original tank siting analysis performed later that same year, and reaffirmed in the Town's 2009 Water System Master Plan. This evaluation builds upon and is a continuation of the previous system studies listed above. While the need for additional storage has been an issue for many years, it has become even more critical with the prospect of the proposed Park Central development, which will bring the Town closer to full build-out. The Park Central development could significantly increase system demand, and includes certain land areas that are too high to be served by the existing system storage tanks. In addition, the owner of Park Central expressed a willingness to provide the Town with a parcel for a new water storage tank. As a result, the Town thought it was a good opportunity to reinvigorate the evaluation and design of new system storage and evaluate whether or not the Park Central property is the best location for that storage.

The following sections include the methodology for Pare's study, the findings of our evaluation, and our conclusions based on those findings.

SECTION 2 – BACKGROUND

2.1 System Overview

The Town of Southborough (Town) owns and operates a water distribution system that serves a population of approximately 9,350 people. While the Town is primarily residential in nature, some dense commercial development exists along the Boston Worcester Turnpike (Rt. 9). Of the Town's current population, approximately 93 percent is connected to the distribution system. Over the last 3 years, system-wide consumption averaged approximately 1 million gallons per day (MGD) and increased to approximately 2.8 MGD in the summer. The Town's current sole source of supply is the Massachusetts Water Resource Authority (MWRA) via 2 connections to the Hultman Aqueduct, 1 connection to the Metrowest Water Supply Tunnel, and 1 direct connection to the John J. Carroll Water Treatment Plant. Existing customers are served by 3 water storage tanks, 2 pump stations, and 86 miles of transmission and distribution piping.

The system is operated as 2 distinct pressure zones, referred to as the High Service Area (HSA) and the Low Service Area (LSA). The boundary between the HSA and LSA runs generally north-south along Rt. 85 from the Marlborough town line to I-90. From I-90, the boundary runs roughly east-west from Rt. 85 to the Westborough town line. The eastern half of Town and locations south of I-90 are in the LSA. The remaining area north of I-90 and west of Rt. 85 is in the HSA (refer to Sheet 1 of 12 in Appendix A). The Town of Southborough's water system has 4 pressure-reducing valves (PRVs) designed to transfer water from the HSA to the LSA during times of peak water demand.

The LSA encompasses approximately 55 percent of the overall Town by area, and 60 percent of the population. The LSA operates at a hydraulic grade line (HGL) of approximately 493 feet mean sea level (MSL) and is served by the Hosmer Pump Station and the Oak Hill and Clear Hill storage tanks.

The HSA encompasses approximately 45 percent of the overall Town by area, and 40 percent of the population. The HSA operates at an HGL of approximately 515 feet MSL and is served by the Boland Pump Station and the Tara Road storage tank.

The Town of Southborough's water distribution system is made up of approximately 86 miles of water main, ranging in size from 6-inches to 12-inches in diameter.

The Town of Southborough has 3 water storage tanks, the Tara Road Tank (Fiddler's Green), the Oak Hill Tank, and the Clear Hill (Overlook) Tank. The Tara Road Tank is located in the HSA, while the Oak Hill Tank and the Clear Hill Tank are both located in the LSA. The following table describes the 3 water storage tanks.

TABLE 1: Southborough System Storage Tanks

	Tara Road (Fiddler's Green)	Clear Hill	Oak Hill
Nominal Size	1.300 MG	0.460 MG	0.275 MG
Diameter	67 ft	40 ft	25 ft
Base Elevation	467 ft	451 ft	418 ft
Overflow Elevation	515.0 ft	493.3 ft	492.7 ft
Operating Range	503.0 to 510.0 ft	482.0 to 488.0 ft	482.0 to 488.0 ft
Style	Standpipe	Standpipe	Standpipe
Year Built	1960	1930	1930
Location	Tara Road	Overlook Drive	Oak Hill Road

2.2 High Service Area System History

It is Pare's understanding, based on our review of past studies of the system, that the Southborough system was originally designed to serve areas of Town that have a ground surface elevation below 400 feet MSL. Originally, the system was designed and operated as 1 pressure gradient (i.e., no separate pressure zones) with an HGL of approximately 493 feet MSL, which is the overflow of the Oak Hill and Clear Hill tanks (in the Low Service Area). The Tara Road tank was built in 1960, and has an overflow of 515 feet MSL (in the High Service Area). However, until 1988, the Tara Road tank was only ever filled to an elevation of approximately 493 feet MSL, which kept the entire system at 1 pressure gradient, or 1 pressure zone. The HSA was established in 1988, which effectively divided the Town into 2 pressure zones. The HSA raised the HGL of the western half of Town to 515 feet MSL, raising pressure by approximately 10 pound per square inch (psi), which was done to better serve areas that experienced low pressures due to higher ground surface elevations.

2.3 System Pressure

The Massachusetts Department of Environmental Protection Guidelines for Public Water System state that the normal working pressure in the distribution system should be approximately 60 – 80 psi and not less than 35 psi, and that all service connections shall have a minimum residual water pressure at street level of at least 20 psi under all design conditions of flow. Sheet 1 of 12 in Appendix A illustrates system pressures during a maximum day condition. When the Tara Road tank is full, customers above elevation 434 will experience pressures below 35 psi. These customers are generally located in the area immediately surrounding the Tara Road tank site.

2.4 System Storage

The distribution system currently has 1.30 MG of storage capacity in the HSA. The effective volume of storage, or usable storage, is defined by the American Water Works Association (AWWA) as the volume of water stored above an elevation that would provide a minimum allowable pressure under peak hour or maximum day demands during normal operating conditions. For this evaluation, effective storage was considered the volume of water above an elevation that would provide a minimum pressure of 20 psi to the highest customer.

Pare took the elevation of the highest service connection at the street level and added 46 feet (i.e., 20 psi x 2.31) to establish the minimum effective water level in the Tara Road tank. In the HSA, the highest service connection is approximately 450 feet MSL. Based on this service connection, the lowest water elevation in the Tara Road tank that can provide all customers with 20 psi is approximately 496 feet MSL. Therefore, the total effective storage volume in the HSA is about 0.50 MG (out of a total of 1.30 MG). The water stored in the tank below elevation 496 feet MSL (0.80 MG) would be considered ineffective, or unusable. This means that only the top 19 feet (38 percent) of the Tara Road tank is considered usable – if the water level falls below this level, customers will start to experience unacceptably low pressure (i.e., below 20 psi).

As stated in previous reports on system storage, there is no set requirement for how much storage a system must have to operate; it is typically considered prudent to size storage for normal use (equalization), fire flow events, and emergency conditions. Each system, depending on its size and the adequacy of its supply pumps, will determine how much storage is necessary to satisfy these requirements. For this evaluation, Pare calculated the required storage for the HSA as described below. Please note that as a planning tool, Pare utilized projected demand information

for a scenario in the future when the Town is built out to its maximum density based on current zoning. This was done to make sure that future storage is sized appropriately for current and future system demand.

Equalization storage: Equalization storage is the amount of water required to meet demands in excess of the production capability. Currently, Southborough's production capacity is greater than the system's maximum day demand. Therefore, the amount of storage required for normal use should be at least enough to meet demands above maximum day demand up to peak hour demands (which is generally the system's highest short-term demand scenario). Based on the water use patterns in the system, which were last evaluated as part of the 2009 Master Plan and AWWA's standards for water storage, the volume of equalization storage required to meet peak hour demands is approximately 15 percent of maximum day demand. The build-out maximum day demand in the HSA is projected to be approximately 1.8 million gallons (MG), and therefore equalization storage should be approximately 270,000 gallons (1,800,000 gallons x 0.15).

The proposed Park Central Development is projected to have a maximum day demand of approximately 285,000 gpd. As stated in the paragraph above, equalization storage should be approximately 15 percent of maximum day demand. Therefore, the amount of additional equalization storage that Southborough should have to accommodate Park Central is approximately 43,000 gallons (285,000 x 0.15). While this is a relatively small increase in overall system storage, it is an indication that the stress on system storage is increasing and will further increase in the future.

Fire storage: The quantity of distribution system storage necessary for fire protection is based on the fire flow requirements established by the Insurance Services Office (ISO). The required fire storage volume is determined by multiplying the required flow duration (in minutes) by the maximum fire flow (in gallon per minute) in the service area. Based on ISO's report dated March 1990, the highest required fire flow in the HSA is near the Trottier School and is 3,000 gpm. As referenced in AWWA M31 Distribution System Requirements for Fire Protection, the required flow duration for a required fire flow of 3,000 gpm is 3 hours (180 minutes), which results in a required storage volume in the HSA of 540,000 gallons.

Emergency Storage: Finally, a system should have adequate emergency storage to prevent serious disruptions in service in the event of a water main break or other emergency situation. In this

case, Pare assumed 20 percent of an average day would be adequate for emergency volume to initiate emergency response. Therefore, the recommended emergency storage in the HSA is approximately 160,000 gallons. In the event that all effective storage was depleted, the Town would have to rely on the ineffective storage, which may result in system pressure dropping below 20 psi for some customers.

As defined above, the total effective volume of storage recommended in the HSA is the sum of the required equalization storage, fire storage, and emergency storage, which is approximately 970,000 gallons (270,000 + 540,000 + 160,000). The total deficit in recommended effective storage is approximately 0.47 MG (0.97 – 0.50). That is to say, to achieve the total volume of effective storage recommended in the HSA, the Town would have to add approximately 0.47 MG of effective storage.

2.5 System Available Fire Flow

The available fire flow in a water system is defined as the maximum amount of flow available at a hydrant while maintaining a minimum residual pressure of 20 psi in the system. Pare utilized the Town of Southborough's computerized hydraulic model developed as part of the 2009 Master Plan to estimate the available fire flow. Refer to Sheet 2 of 12 in Appendix A for system-wide available fire flows.

The 2009 Master Plan identified certain areas of Town that had deficient fire flow ratings, which is to say these areas of Town did not have as much available fire flow as required by ISO. The required fire flows that were identified as deficient in the 2009 Master Plan are identified in Table 2.

TABLE 2: Fire Flow Analysis (High Service Area)

	Location	Needed Fire Flow based on ISO Requirements	Available Fire Flow	
			Based on ISO's Flow Tests	**Based on Computer Modeling**
1.	Neary School (near Trottier School)	3,000 gpm	1,900 gpm	2,300 gpm
2.	Mary E. Finn School	2,250 gpm	1,500 gpm	2,400 gpm
3.	Highland Street @ Parkerville Road	1,500 gpm	1,200 gpm	2,360 gpm

The Southborough DPW has completed multiple distribution system improvements since the 2009 Master Plan, which include the following:

- Upgrades to the Boland Pumping Station to increase water supply to the HSA;
- Upgrades to the 4 system PRVs to move water from the HSA to the LSA;
- Water main upgrades on Parkerville Road to address the fire flow deficiency at the Finn School;
- Supervisory control and data acquisition (SCADA) system upgrades to improve real-time system operation and response to system emergencies; and
- Water main upgrades at 2 locations on Rt. 9 to improve dependability of system piping.

As in the 2009 Master Plan and previous studies completed, the recommendation for additional storage in the HSA and improved fire flow to the Trottier School area is still an outstanding concern.

SECTION 3 – METHODOLOGY

In 2007, a tank siting analysis was completed in which 25 potential tank sites were evaluated. Only 6 of those 25 sites had adequate ground surface elevations where pumping would not be required. At the time, 3 of those 6 sites were considered cost-effective sites for a new tank. Those 3 sites included the existing Tara Road tank site, the Town-owned parcel located off of Deerfoot Road (Fairview Hill), and the Flatly property (now part of the proposed Park Central development). When evaluating new tank alternatives as part of this study, Pare only considered those 3 tank sites.

Pare, in conjunction with the Town and the Public Works Planning Board, developed and evaluated 5 options for a new HSA tank. Each option was evaluated for its ability to address the system's most critical needs (i.e., increase effective storage and increase available fire flow). Pare utilized the Town's computerized hydraulic model to evaluate each option and its impact on system pressure and available fire flow.

Each option was also evaluated against other important criteria, such as their impact on system pressure, their potential impact on water quality, and their impact on system redundancy. Redundancy is important because it allows one tank to come out of service for maintenance and repairs without significant disruptions to water service. Pressure is a complex criterion because, as is the case in Southborough, it can be difficult to increase areas with low pressure without over-pressurizing areas with high pressure. Water quality comes into consideration when evaluating overall storage volume. Too much water in storage can lead to an increase in system water age, and ultimately poor water quality.

Finally, for each option, Pare developed an opinion of probable construction cost, and estimated how much each option would cost in terms of the dollars spent for each gallon of effective (usable) storage gained.

Please note that Pare utilized readily and publically available mapping information when evaluating tank sizes and locations. In some cases, elevation information utilized by Pare for this study is only accurate to within ±5 feet. As such, the tank sizes described below should be considered preliminary and may change based on actual ground surface elevations established during the final design of the tank.

Option 1: Replace the existing 1.3 MG Tara Road tank with a larger 2.5 MG tank; while maintaining the existing HGL of 515 feet MSL in the HSA. This new tank could be sited on the existing Tara Road tank site, or could be built on the nearby Park Central property. It is noted that the most advantageous site within the Park Central property (i.e., the site with the highest ground surface elevation) is actually in Westborough, on the Southborough line. The site is bounded by the Park Central development on one side and by I-495 on the other.

Option 1A: Keep the existing Tara Road tank in service and build a second tank in the HSA on the Fairview Hill site. The new tank would be 1.5 MG and have an overflow elevation of 515 feet MSL, the same as the existing Tara Road tank.

Option 1B: Keep the existing Tara Road tank in service and build a second tank in the HSA on the Fairview Hill site. The new tank would be 1.5 MG and have an overflow elevation of 515 feet MSL, the same as the existing Tara Road tank. This option would also include a new water main connecting Fairview Drive and Deerfoot Road.

Option 2: Replace the existing Tara Road tank with a taller tank that would increase pressure in the HSA by approximately 17 psi. This new taller tank would have an overflow elevation of approximately 555 feet MSL and would be approximately 1.3 MG. Because of the increase in system pressure, certain areas of the HSA would have to be moved into the LSA to avoid over-pressurizing those customers. As a result, the demand in the HSA would go down, resulting in the need for slightly less effective storage, approximately 0.86 MG.

Option 3: Build a new taller tank on the Park Central property (on the same Westborough parcel identified in Option 1). This tank would be approximately 0.75 MG and would have an overflow elevation of approximately 590 feet MSL. This new tank would be the basis for a new pressure zone in the system, referred to as the Extra High Service Area (EHSA). Under this option, the Tara Road tank would remain in service, but certain areas of the HSA would be converted to the new EHSA and served from the new taller tank. This option would require the installation of a new booster pump station to move water from the HSA to the EHSA.

SECTION 4 – RESULTS/DISCUSSIONS

4.1 Advantages/Disadvantages Discussion

The following section summarizes the relative advantages and disadvantages of each option based on their relative impact to effective storage volume, system pressures, available fire flow, and system redundancy. Pare's opinion of probable construction cost for each option is provided as well. Please note that all of the costs presented below are in 2016 dollars. These costs will need to be adjusted prior to tank construction to reflect appropriate cost escalation.

Option 1 (2.5 MG Replacement Tank at Tara Road)

- Advantages
  - This option would increase the overall storage volume in the HSA, and specifically would add an additional 0.5 MG of effective storage, which would result in the recommended total effective storage volume of 0.97 MG.
- Disadvantages
  - This option would not result in an increase in pressure in areas that have relatively low pressure (refer to Sheet 3 of 12 in Appendix A).
  - This option would not improve fire flow in the HSA (refer to Sheet 4 of 12 in Appendix A).
  - This option would add an additional 0.78 MG of ineffective storage in the HSA, which could create water quality issues.
  - This option will not provide for any new redundancy in storage.
- Pare's opinion of probable construction cost for this option is **$4.4 M.**

Option 1A (New 1.5 MG Tank at Fairview Hill)

- Advantages
  - This option would increase the overall storage volume in the HSA, and specifically would add an additional 0.48 MG of effective storage, resulting in a total of 0.98 MG of effective storage.
  - This option would improve fire flow to some areas of the HSA (refer to Sheet 6 of 12 in Appendix A), particularly in the area of the Trottier School.
  - This option would create significant redundancy in HSA storage.

- Disadvantages
  - This option would not increase pressure in the HSA; however, some customers may experience more stable pressure than they experience currently (refer to Sheet 5 of 12 in Appendix A).
  - This option would create an additional 1 MG of ineffective storage.
- Pare's opinion of probable construction costs for this option is **$3.9 M.**

Option 1B (New 1.5 MG Tank at Fairview Hill with New Connection to Deerfoot Road)

- Advantages
  - This option would increase the overall storage volume in the HSA, and would specifically add 0.48 MG of effective storage, increasing the effective storage to 0.98 MG.
  - This option would improve fire flow to some areas of the HSA (Refer to Sheet 8 of 12 in Appendix A), particularly the area around the Trottier School. This option would also improve fire flows above and beyond the improvements realized as part of Option 1A.
  - This option would create significant redundancy in storage.
- Disadvantages
  - This option would not increase pressure in the HSA; however, some customers may experience more stable pressure (Refer to Sheet 7 of 12 in Appendix A).
  - This option would add an additional 1 MG of ineffective storage to the HSA.
  - This option is more costly than Option 1A.
- Pare's opinion of probable construction cost for this option is **$4.8 M.**

Option 2 (1.3 MG Replacement Ground Storage Tank at Tara Road)

- Advantages
  - This results in adequate equalization and fire storage as recommended above.
  - This option would increase pressure to areas in the HSA that currently experience relatively low pressure, providing everybody a minimum of 35 psi during normal operating conditions (refer to Sheet 4 of 12 in Appendix A).
  - This option would increase fire flow in the HSA (refer to Sheet 10 of 12 in Appendix A).
  - Effective storage volume would increase from 38% of overall storage to 67%.

- Disadvantages
  - This option would increase pressure too much for some customers that already get high pressure (refer to Sheet 9 of 12 in Appendix A).
  - To mitigate excessively high pressures, this option would necessitate a modification to the zone boundary between the HSA and the LSA. This option would require relocating the 4 existing PRV zone valves, which adds cost to this option. Even with the relocation of the PRVs, some areas would experience pressure in excess of 120 psi.
  - As a result of the zone boundary modification, this option would increase the size of the LSA, which would add demand on the Hosmer Pump Station.
  - While fire flow would be improved in some areas of the HSA, the area around the Trottier School would still have less than 3,000 gpm of available fire flow.
  - This option would do nothing to improve system redundancy in the HSA.
- Pare's opinion of probable construction cost for this option is **$5.0 M.**

Option 3 (New 0.75 MG Elevated Tank at Park Central)

- Advantages
  - This option results in adequate equalization and fire storage by sharing water from the EHSA to the HSA.
  - Customers in the HSA that experience pressure less than 35 psi during normal operating periods would be transferred to the EHSA, and as a result would experience an increase in pressure of approximately 32 psi (refer to Sheet 11 of 12 in Appendix A).
  - This option would increase fire flow in the HSA (refer to Sheet 12 of 12 in Appendix A).
  - This option would expand the water system capacity to serve future development at higher elevations around the Park Central development.
  - The effective storage volume in the existing Tara Road tank would increase from 38% of overall storage to 70%.
  - Because the proposed tank site is bounded by I-495 to one side and the proposed Park Central development to the other, there are currently no residents within Southborough that would be direct abutters to the tank.
- Disadvantages
  - This option would require a new booster pump station near Tara Road tank,

which would add cost to the project.

- This would require new PRVs along the EHSA/HSA boundary.
- This option would do little to improve system redundancy in the HSA.
- Because the proposed tank site in the Park Central property is actually located in Westborough, the tank would needed to go through the Westborough site plan development project.

- Pare's opinion of probable construction costs for this option is **$6.2 M.**

The following table summarizes the each option relative to Pare's evaluation criteria.

TABLE 3 – TANK OPTION SUMMARY TABLE

Tank Option	Cost	Cost/gallon (usable)	Pressure	Fire Flow	Unusable Storage	Promotes System Redundancy
1	$4.4M	$8.00/gal	No Change	No Change	1.95 MG	No
1A	$3.9M	$15.00/gal	No Change	Modest Improvement	1.14 MG	Yes
1B	$4.8M	$18.46/gal	No Change	Significant Improvement	1.14 MG	Yes
2	$5.0M	$7.25/gal	Increase (18 psi)	Modest Improvement	0.51 MG	No
3	$6.2M	$4.77/gal	Increase (32 psi)	Modest Improvement	0.07 MG	No

4.2 Option Screening

To screen out the least desirable options, Pare prepared a simple comparison table of each option and the 6 evaluation criteria discussed above, which include:

- Cost;
- Cost per gallon (effective or usable);
- Impact to pressure;
- Impact to available fire flow;
- Water quality (ineffective or unusable storage); and
- Whether or not the option promotes redundancy.

Each option was rated on a scale of 1 to 5, with 5 being the most advantageous and 1 being the least advantageous. Each criteria was assigned a weight based on its relative importance to the overall importance – the weighting is on a percentage basis with all 6 criteria adding up to 100 percent. Each option's score (1 through 5) was multiplied by the weighted criteria to come up with a weighted total. The highest weighted total represents the most advantageous option, while the lowest weighted total represents the least advantageous option.

Please note that a variation of this screening process is presented in Section 5 of this report, with updated screening tables provided as Appendix B.

As a starting point, Pare weighted each criteria with equal value (16.7 percent), as if each criteria has the same level of importance in the decision making process. That is to say, the *total cost* of a particular option is weighted the same as the impact it would have on *fire flow* or *pressure*. It is unlikely that each of these criteria are equally important, but this represents the first trial of the screening process.

TABLE 4 – EQUAL WEIGHTED SCREENING

Tank Option	Cost	Cost/gallon (usable)	Pressure	Fire Flow	Unusable Storage	Promotes Redundancy	Weighted Total
Weighted Percentage	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	
1	4	3	1	1	3	1	2.2
1A	5	4	2	4	1.5	5	3.6
1B	3	2	3	5	1.5	5	3.3
2	2	1	4	2	4.5	1	2.4
3	1	5	5	3	4.5	1	3.3

When all the criteria are weighted equally, Option 1A, the new tank on the Fairview site, appears to be the most advantageous. It is notable that Option 3, the option that creates a new pressure zone, has a similar weighted score

For comparison, Pare varied the weighting criteria to reflect the significance of each criterion as Pare perceives them, based on our past experience with other similar tank projects. For this example, Pare increased the value of the *cost* and *available fire flow*, which tend to carry significant weight in these types of projects. Pare reduced slightly the *cost per gallon* and the impact on *system redundancy*, which are both important factors, but less so than *total cost* and *fire flow*. Finally, Pare reduced weight of *pressure impacts* and *unusable storage*, which in this case seem to be relatively minor concerns.

TABLE 5 – WEIGHTED SCREENING (1ST VARIATION)

Tank Option	Cost	Cost/gallon (usable)	Pressure	Fire Flow	Unusable Storage	Promotes Redundancy	Weighted Total
Weighted Percentage	25%	15%	10%	25%	10%	15%	
1	4	3	1	1	3	1	2.3
1A	5	4	2	4	1.5	5	4.0
1B	3	2	3	5	1.5	5	3.5
2	2	1	4	2	4.5	1	2.2
3	1	5	5	3	4.5	1	2.9

When the weighting of each criterion was changed to reflect a somewhat more typical weighting scheme, the new tank on the Fairview site appears to be the most advantageous option.

Based on feedback received during Public Works Planning Board meetings, Pare varied the weighting of the evaluation criteria to reflect different concerns of the Board. For example, the Board thought that *total cost* and *fire flow* were the most important criteria, but the *cost per gallon of usable storage* was a somewhat arbitrary criterion and therefore not necessarily worth considering. The Board also thought that *volume of unusable storage* was a relatively insignificant criterion given that none of the options result in excessive amounts of unusable storage. Based on this feedback, 2 additional screening variations were generated. The first

variation increases the weight of *total cost* and reduces the weight given to *cost per gallon of usable storage*. The second increases the weight of *total cost* and *fire flow*, and reduces the weight of *unusable storage* and *cost per gallon of usable storage*.

TABLE 6 – WEIGHTED SCREENING (2ND VARIATION)

Tank Option	Cost	Cost/gallon (usable)	Pressure	Fire Flow	Unusable Storage	Promotes Redundancy	Weighted Total
Weighted Percentage	40%	0%	10%	25%	10%	15%	
1	4	3	1	1	3	1	2.3
1A	5	4	2	4	1.5	5	4.0
1B	3	2	3	5	1.5	5	3.5
2	2	1	4	2	4.5	1	2.2
3	1	5	5	3	4.5	1	2.9

TABLE 7 – WEIGHTED SCREENING (3RD VARIATION)

Tank Option	Cost	Cost/gallon (usable)	Pressure	Fire Flow	Unusable Storage	Promotes Redundancy	Weighted Total
Weighted Percentage	40%	0%	10%	35%	0%	15%	
1	4	3	1	1	3	1	2.2
1A	5	4	2	4	1.5	5	4.4
1B	3	2	3	5	1.5	5	4.0
2	2	1	4	2	4.5	1	2.1
3	1	5	5	3	4.5	1	2.1

For both these variations, the new tank on the Fairview site appears to be the most advantageous option.

Finally, Pare generated a screening variation that removed cost considerations from the screening evaluation entirely, to see if any option stands out as clear leader if cost were not an issue. For this variation, weight of the *total cost* and *cost per usable gallon* was distributed over the other criteria.

TABLE 8 – WEIGHTED SCREENING (4th VARIATION)

Tank Option	Cost	Cost/gallon (usable)	Pressure	Fire Flow	Unusable Storage	Promotes Redundancy	Weighted Total
Weighted Percentage	0%	0%	25%	40%	10%	25%	
1	4	3	1	1	3	1	1.2
1A	5	4	2	4	1.5	5	3.5
1B	3	2	3	5	1.5	5	4.2
2	2	1	4	2	4.5	1	2.5
3	1	5	5	3	4.5	1	3.2

When cost considerations are eliminated from the decision making process, the Fairview site appears to be the most advantageous; however, the option with the new water main between Fairview and Deerfoot appears to be more advantageous than the option without.

SECTION 5 – PUBLIC PARTICIPATION

An important part of this evaluation process was to collect public input on the tank siting options and incorporate public feedback into the evaluation process. The two mechanisms used for gathering public input were presentations at Public Works Planning Board Meetings and a separate public meeting, open to all Southborough residents, but specifically for neighbors of the Tara Road and Fairview Road sites.

5.1 Public Works Planning Board Meetings

The process for evaluating the various tank sites was a collaborative process between the Southborough Public Works Department, the Public Works Planning Board (PWPB), and Pare. Pare presented the findings of our preliminary evaluation at PWPB meeting on September 27, 2016. A copy of the September 27th presentation, sign-in sheet, and meeting minutes are attached.

Pare incorporated comments from the September 27th meeting into the report, and presented an updated version of the report at a PWPB meeting on November 7, 2016. A copy of the November 7th presentation, sign-in sheet, and meeting minutes are attached. The updated presentation follows the same format as the original presentation; however, the new information is presented in italicized, underlined text.

5.2 December 13, 2016 Public Meeting

On December 13, 2016, the Department of Public Works, the PWPB, and the Pare presented the preliminary findings of the tank siting evaluation at a public meeting at the Southborough Senior Center. While all PWPB meetings are open to the public, this one was organized specifically to disseminate the information in the preliminary evaluation to residents and property owners near the proposed tank sites. The meeting was attended by approximately 30 people and lasted approximately 2 hours.

The most common concern raised by residents was the impact the tank would have on their quality of life and the value of their homes. The question of quality of life is entirely subjective and cannot be answered in an engineering evaluation such as this. The question of property

values is one that would require an in depth real estate valuation of the nearby properties and other comparable properties near similar size water storage tanks. The scope of this type of valuation is beyond the typical scope of a preliminary engineering evaluation.

Other questions arose during the meeting are summarized below. To the degree these questions can be answered through engineering analysis or Pare's relevant engineering experience, Pare addressed certain questions in the summary below.

1. COMMENT – One resident asked if wetland storage or storage in a natural waterbody (fire ponds) could be utilized to reduce the volume of storage needed for fire protection. PARE'S RESPONSE – This type of storage utilizes a dry hydrant connected to a waterbody, such as a pond or lake. It is Pare's opinion that this type of storage is impractical when other reliable sources of water are available, as is the case in most of Southborough. This type of storage is used in rural areas where no other means of fire protection is available. While this type of storage is effective in rural areas, it can be inefficient and unreliable. It adds response time for the Fire Department (driving to the dry hydrant and then the fire); it could adversely impact sensitive environmental receptors; and could contaminate the potable water system if the Fire Department ever connected their equipment to the Town's potable water system after utilizing the dry hydrant. Most importantly, the Town already has a robust and effective fire protection system in the existing distribution system. The most cost-effective means of improving fire protection in Town is to improve the existing distribution system. If the Fire Department needs to target specific areas or structures where the existing distribution system is weak or there is no access to the distribution system, a dry hydrant system may be a feasible way to improve fire protection in that one area, but it is Pare's opinion that it is not a feasible alternative to increasing distribution storage volume.
2. COMMENT – One resident commented that there is no public water on Deerfoot Road.
3. COMMENT – One resident commented that the costs presented in this report are not accurate because they do not include the cost of property value mitigation or the cost of law suits that the Town may need to defend if the tank project goes forward on the Fairview site.
4. COMMENT – Another resident indicated they would seek damages if the tank was constructed on the Fairview site.
5. COMMENT – One resident suggested that Pare reconsider the screening process using a

scaling approach that better reflects the differences between the costs. For example, in Pare's screening system each option cost was ranked 1 through 5, highest to lowest. In that scenario, the lowest cost ($3.9M) option was weighted 5 times higher than the highest cost ($6.2M), even if the highest cost option was less than 2 times higher than the lowest. This resident felt that Pare's screening system unreasonably skewed the weighting system toward lower cost options. PARE'S RESPONSE – Pare re-ran the screening exercise with the same weighting factors previously, but scaled any criterion that has to do with costs to reflect the relative differences between each option. A copy of the revised screening table is attached. With the original screening process, Options 1A and 1B consistently rose to the top. With this revised screening approach, Options 1A and 1B also rose to the top, with the exception of one option. When all the criteria are weighted equally, Option 3 (a new taller tank with a new Extra High Service Area) rose to the top. It should be noted that this revised screening process is not more or less appropriate than Pare's original screening method; it's just a variation on the screening process. There are a number of ways to screen the tank options. What is important to note is that under most of the variations Pare reviewed, Options 1A and 1B rose to the top, suggesting they may be the most advantageous options for the Town.

6. COMMENT – One resident requested that examples of various tank styles be added to the report. PARE's RESPONSE – A portfolio of different style tanks have been added to Appendix C.

Copies of the Public Works Planning Board agendas, meeting minutes, and the presentations from the September 27, 2016 meeting, the November 7, 2016 meeting, and the December 13, 2016 meeting are attached as Appendix D.

An additional public meeting was held on March 13, 2017 to further discuss the tank siting analysis. At that meeting, a member of the public provided feedback on the December 13, 2016 version of the report. A copy their feedback is attached at the end of Appendix D.

QUESTION: If storage is the primary objective, why is usable storage not used as an evaluation criteria and weighted accordingly?

RESPONSE: All the options were designed to provide the same amount of usable storage; approximately 500,000 gallons, and by that measure all the options provide the same benefit to

the system. The volume of usable storage targeted for this assessment (500,000 gallons) was carefully determined based on engineering assessments of existing and future needs, therefore every option must provide at least 500,000 gallons of new usable storage. However, it is not necessarily a benefit to the system if any one of these options provides more than 500,000 gallons. Any additional storage above 500,000 gallons could be viewed as unnecessary. One option (Option 3) provides additional usable storage because it "unlocks" usable storage in the existing Tara tank by converting some of Tara's unusable storage into usable storage. The real benefit of Option No.3 is not that it provides more usable storage, but that it reduces the amount of unusable storage in the system by converting it to usable. While usable storage is not a screening criteria, unusable storage is a screening criteria used in the tables in Section 4, and therefore, it is Pare's opinion that the usable/unusable storage balance of all the options has been addressed.

QUESTION: What quantifiable data supports the "significant improvement" rating of Fairview Hill option 1B vs the "modest improvement" rating of the Park Central option 3?

RESPONSE: Pare's evaluation of fire flow was based on computer modeling of fire flow for each option, which provides quantifiable fire flow data throughout the water system. Option 1B was rated as significant because it provides an improvement in fire flow over the greatest area of the system, and specifically an increase in available fire flow around the Trottier School. Option 3 improves fire flow primarily in the new EHSA and does not provide any improvement in the area around the Trottier School. Because the area around the Trottier School is the area targeted for fire flow improvement and because Option 1B provide the most significant increase in fire flow to the area around the Trottier School, Option 1B was rated higher than Option 3.

QUESTION: The report states that the Park Central development includes certain land that is too high to be served by the existing storage tanks. How was this factored into the overall evaluation of the options, particularly Option 3?

RESPONSE: Option No.3 is the only option that directly addresses the higher elevations in the Park Central development. If another option is selected, it would be the responsibility of the developer to ensure adequate pressure and fire flow in the development, either through the use of booster pumps, or the construction of a storage tank for the development.

QUESTION: At the December meeting there was discussion that the creation of an EHSA provides better pressure and fire flow to meet the development potential of the EHSA. How is this factored into the evaluation of the options, particularly the Park Central Option 3?

REPONSE: All the screening scenarios include criteria for pressure and fire flow. The impact Option 3 has on pressure and fire flow was considered when the rankings were assigned to each option.

QUESTION: Why is the cost evaluation a simple comparison of total cost vs consideration of what is achieved with each option, i.e. what you get for the dollars spent?

RESPONSE: A description of what is achieved with each option is provided in Section 4, along with the cost of each option. In terms of "what you get" for the dollars spent, the benefits of each option are laid out in Section 4, but how they get weighed relative to each other is a subjective evaluation. The question is, is it worth paying for a more expensive option if that options improves fire flow, or pressure, or system redundancy? What should be the dollar value assigned to each of those criteria? While it is impossible to put an exact dollar figure to each criteria, or even to have a firm consensus on which criteria is the most important, the screening tables in Section 4 lay out a number of ways they could be considered. While not a perfect system, the screening tables outline a means of identifying the options that provide the most significant benefit to the Town.

QUESTION: Why isn't the "efficiency" of the capital investment as measured by cost/usable gallon given more consideration?

RESPONSE: Cost per usable gallon is a useful metric in identifying the capital efficiency of each option, but it only has limited value in this assessment. There are two reasons why cost per usable gallon is not given greater considered herein.

- 1 – Four of the 5 options provide the same usable storage, and the fifth option provides more. Therefore, a comparison of all 5 options is not a true "apples to apples" comparison. The usable storage volumes would need to be adjusted, along with the

project costs, to provide a true "apples to apples" comparison.

- 2. – Ultimately the cost per usable gallon is not going to figure into the final decision on where to site a new storage tank in any significant way. As long as the final selection provides a meaningful improvement in usuable storage, fire flow, and system redundancy; the only cost factor that will matter is the total project cost, which is the most meaningful way to measure the financial burden on rate payers.

QUESTION: Has potential cost mitigation from developer(s) been factored into the cost assessment?

RESPONSE: No developer mitigation has been factored into this evaluation, with one exception. It was assumed that the Town would be given the parcel of land in Park Central at no cost. If the Town needs to purchase the land, that cost would need to be factored into Options No.1, No.2, and No.3.

QUESTION: Has litigation risk and liability for residential property value impact been factored into the cost assessment?

RESPONSE: No, litigation risk and liability for residential property value impact have not been factored into the cost assessment.

QUESTION: Explain why the Park Central Option 3 does not promote some level of redundancy when operationally there is the ability to share water between the HSA and EHSA?

RESPONSE: Option No.3 does not promote the same level of redundancy as Options 1A and 1B because it is more difficult to move water between service areas than to have two tanks in the same service area. In addition, Option No.3 requires a new pump station, which adds an additional weak point in the system (an additional mechanical system that can break down). Therefore, the benefit of being able to share water between the EHSA and HSA is largely offset by the added vulnerability of having to pump the water into the EHSA.

QUESTION: The additional screens presented in Appendix B attempt to use a scale but does not apply a scale to all criteria. Why isn't a scale applied to all the evaluation criteria?

RESPONSE: A scale could be added to all the evaluation criteria, but it was only requested to be added to certain criteria, such as cost and unusable storage. It is important to note that the screening tables presented herein could be modified in almost an unlimited number of ways. The 10 scenarios that are presented in Section 4 and Appendix B, represent a reasonable number of screening scenarios that present a diverse weighting of the most common and reasonable screening criteria.

QUESTION: Why is there inconsistency in the Pare ratings when the criteria are evaluated the same between options? (see pg. 14, Table 4)

RESPONSE: Pare's understanding of this question is that certain options were ranked the same on a scale of 1 to 5 for certain criteria, but not for the redundancy criterion. For example, Option 1A and 1B were both assigned a value of 5 under redundancy, while the other three options were each assigned a valve of 1. Under other criteria, if two options tied for first place, they were give the average score of 4.5 ([4 +5)/2]), rather than both being assigned a value of 5. Pare applied this same mechanism to the redundancy criteria and screened each scenario. The results are provided in Appendix B.

SECTION 6 – CONCLUSIONS

Based on the comparisons presented above, feedback provided by the Public Works Planning Board, and the evaluation work completed by Pare and other engineering firms previous to Pare, it is the opinion of Pare that Options 1A and 1B (a new tank located at the Fairview Hill site) achieve the primary objectives of this project – increasing usable storage and improving fire protection, while doing so at the lowest cost of all the options reviewed. Options 1A and 1B are also the only two options that truly create redundancy in system storage.

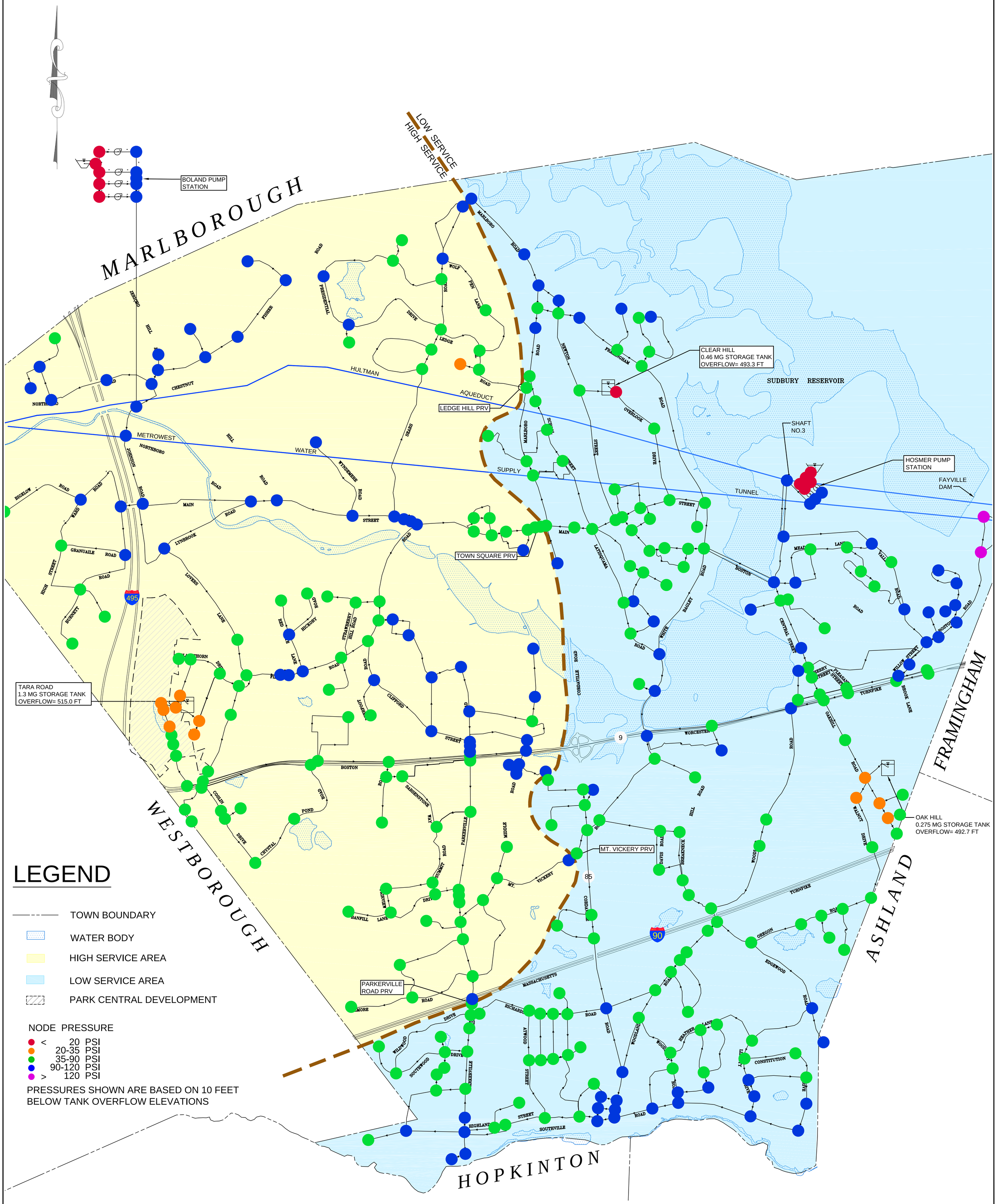
It is important to note that the screening process used as part of this project is relatively subjective and could vary significantly based on how each criteria is weighted. However, of the fifteen (15) screening variations presented (five presented above and the additional ten presented in Appendix B), twelve (12) indicate that Options 1A and 1B are the most advantageous options, and therefore there seems to be compelling evidence that Option 1A, and to a lesser degree Option 1B, provide the most balance relative to cost and technical concerns.

From the public meetings that have been held to-date, it is clear that there is significant apprehension from residents around the Fairview site, specifically about the impact that this project would have on their quality of life or the value of their property. Quality of life and property values are not the type of technical or cost considerations that would be captured in an engineering study such as this. Nevertheless, they are important considerations that should be considered when siting a new water storage tank. It is recommended that a visioning study be prepared that includes a visual model of the tank site that helps residents visualize what a new tank might look like. This model could be constructed from drone photography and 3D modeling, which would let neighbors see how the proposed tank would look from their property. This visioning study could also include a shadow assessment to demonstrate to homeowners how tank's shadow might travel across their property. It is recommended that the visualization study be the next step in the tank siting process. In addition, the Town could consult with a real estate professional regarding the impact the new tank would have on nearby property values. In the future when the Town ultimately makes the decision on where to build a new water storage tank, the Town should consider the technical aspects of the project presented herein, as well as the non-technical aspects such as quality of life and possible property value impacts.

Pare would be pleased to meet with the Town again to review the findings of this report and discuss the next steps in this tank siting process.

APPENDIX A

System Pressure and Available Fire Flow Drawings



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TOWN OF SOUTHBOROUGH
WATER SYSTEM MASTER PLAN

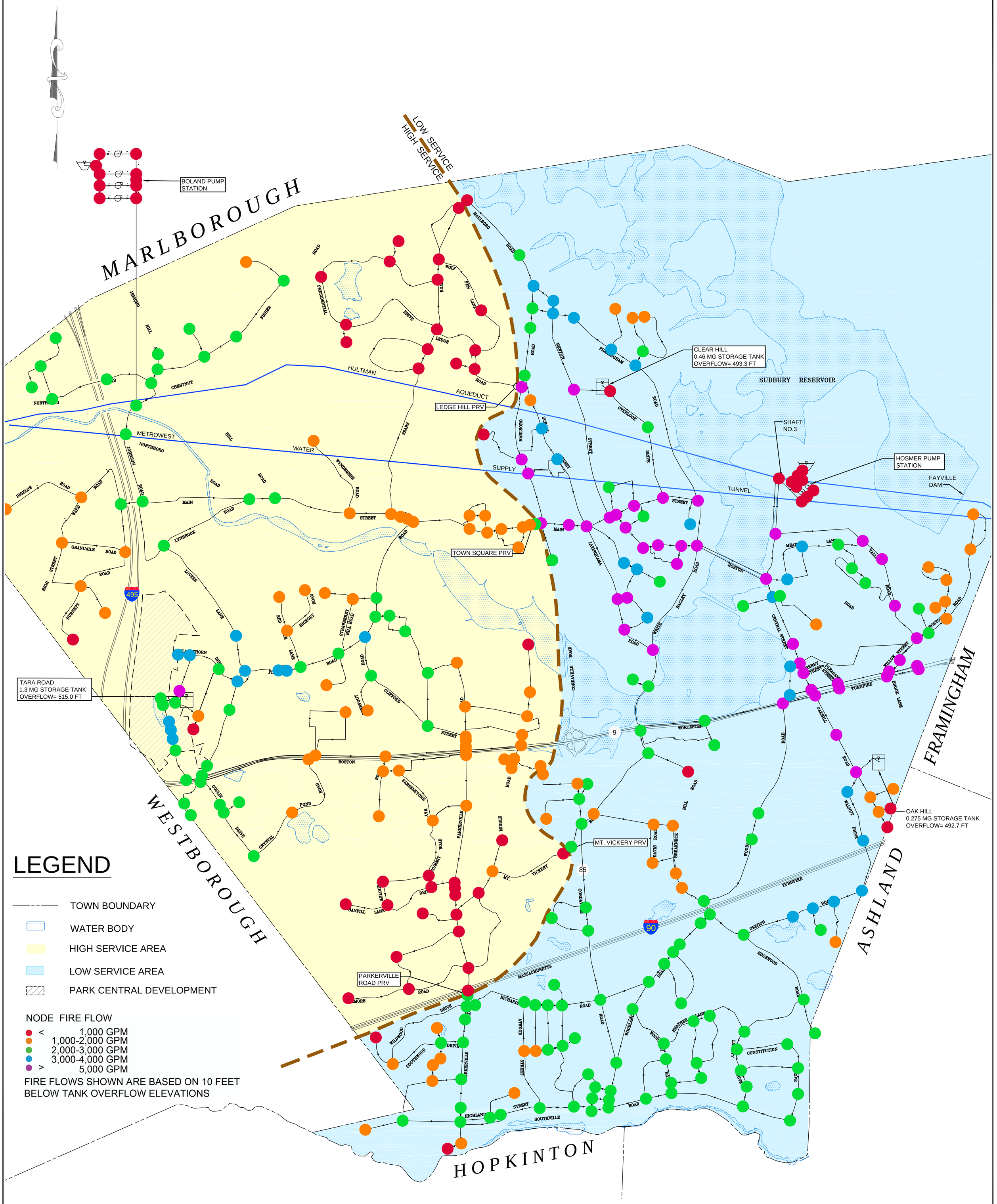
SOUTHBOROUGH, MASSACHUSETTS

REVISIONS:	
PROJECT NO.:	08176.15
DATE:	NOVEMBER 2016
SCALE:	1"=800'
DESIGNED BY:	SPD
CHECKED BY:	LMG
DRAWN BY:	AKL
APPROVED BY:	TPT

DRAWING TITLE: MDD PRESSURE EX. CONDITIONS

DRAWING NO.:

SHEET NO. 1 OF 12



LEGEND

- TOWN BOUNDARY
- WATER BODY
- HIGH SERVICE AREA
- LOW SERVICE AREA
- PARK CENTRAL DEVELOPMENT

NODE FIRE FLOW

- < 1,000 GPM
- 1,000-2,000 GPM
- 2,000-3,000 GPM
- 3,000-4,000 GPM
- > 5,000 GPM

FIRE FLOWS SHOWN ARE BASED ON 10 FEET BELOW TANK OVERFLOW ELEVATIONS

Graphic Scale 1"=800'

800' 400' 0 800' 1600' 3200'

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DRAWING TITLE: FIRE FLOW EX. CONDITIONS

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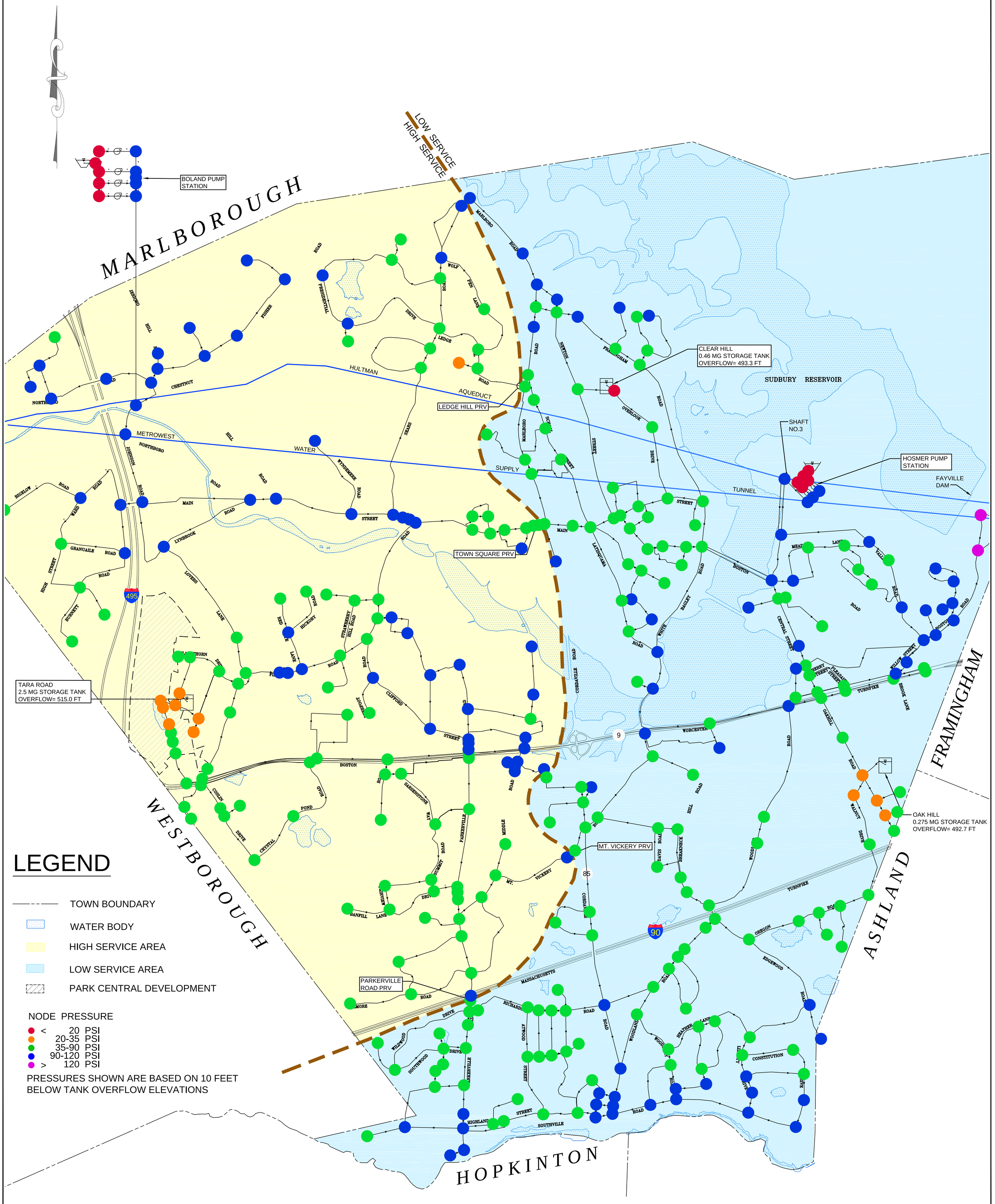
SHEET NO. 2 OF 12



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DRAWING TITLE: MDD PRESSURE OPTION 1

DRAWING NO.:

SHEET NO. 3 OF 12

BOLAND PUMP STATION

LOW SERVICE
HIGH SERVICE

MARLBOROUGH

HULTMAN AQUEDUCT

METROWEST WATER SUPPLY TUNNEL

LEDGE HILL PRV

TOWN SQUARE PRV

CLEAR HILL
0.46 MG STORAGE TANK
OVERFLOW= 493.3 FT

SUDBURY RESERVOIR

SHAFT NO.3

HOSMER PUMP STATION

FAYVILLE DAM

TARA ROAD
2.5 MG STORAGE TANK
OVERFLOW= 515.0 FT

MT. VICKERY PRV

PARKERVILLE ROAD PRV

OAK HILL
0.275 MG STORAGE TANK
OVERFLOW= 492.7 FT

WESTBOROUGH

FRAMINGHAM

ASHLAND

HOPKINTON

LEGEND

- TOWN BOUNDARY
- WATER BODY
- HIGH SERVICE AREA
- LOW SERVICE AREA
- PARK CENTRAL DEVELOPMENT

NODE FIRE FLOW

- < 1,000 GPM
- 1,000-2,000 GPM
- 2,000-3,000 GPM
- 3,000-4,000 GPM
- > 5,000 GPM

FIRE FLOWS SHOWN ARE BASED ON 10 FEET BELOW TANK OVERFLOW ELEVATIONS

Graphic Scale 1"=800'

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DRAWN BY:	AKL
APPROVED BY:	TPT

DRAWING TITLE: FIRE FLOW OPTION 1

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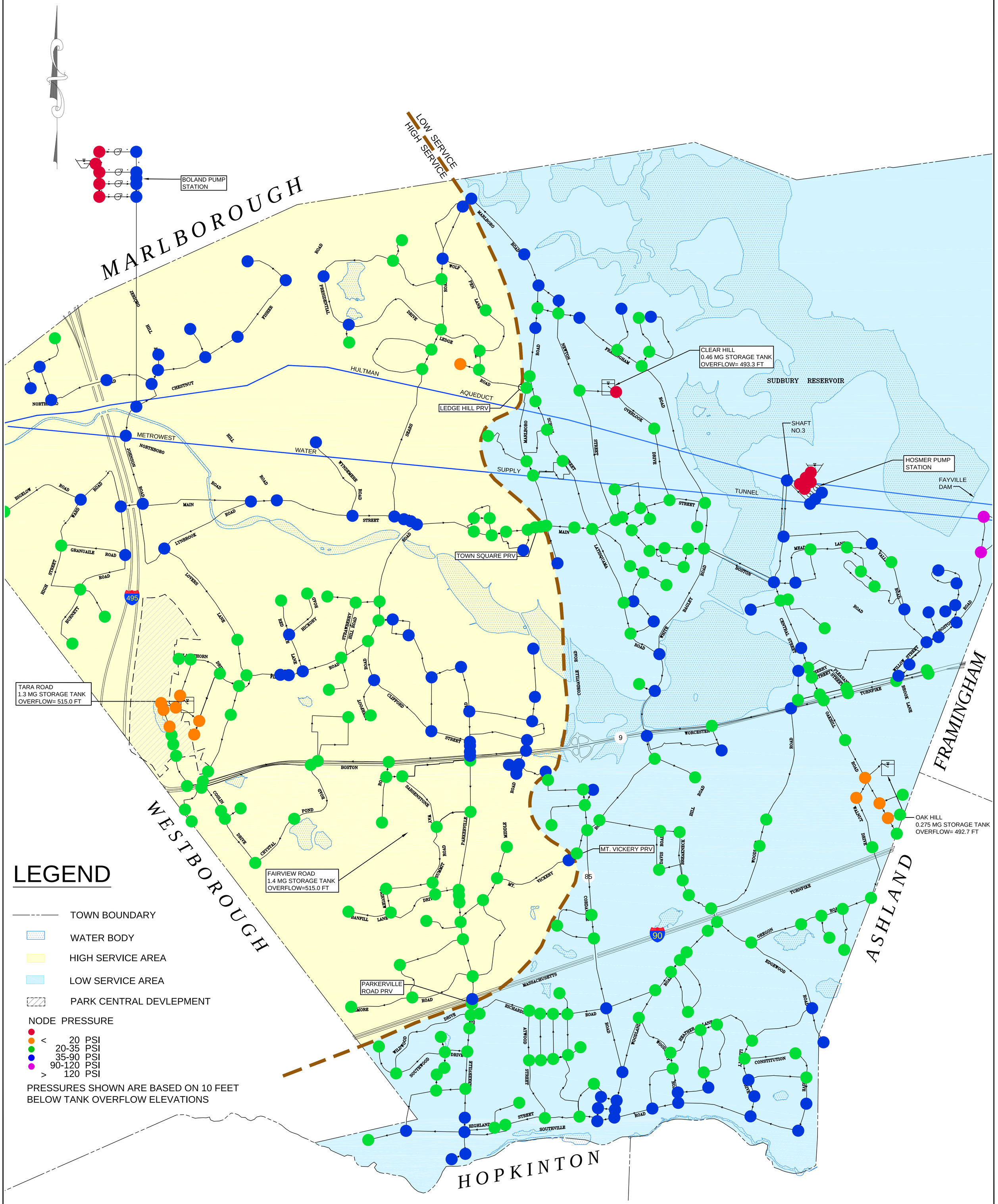

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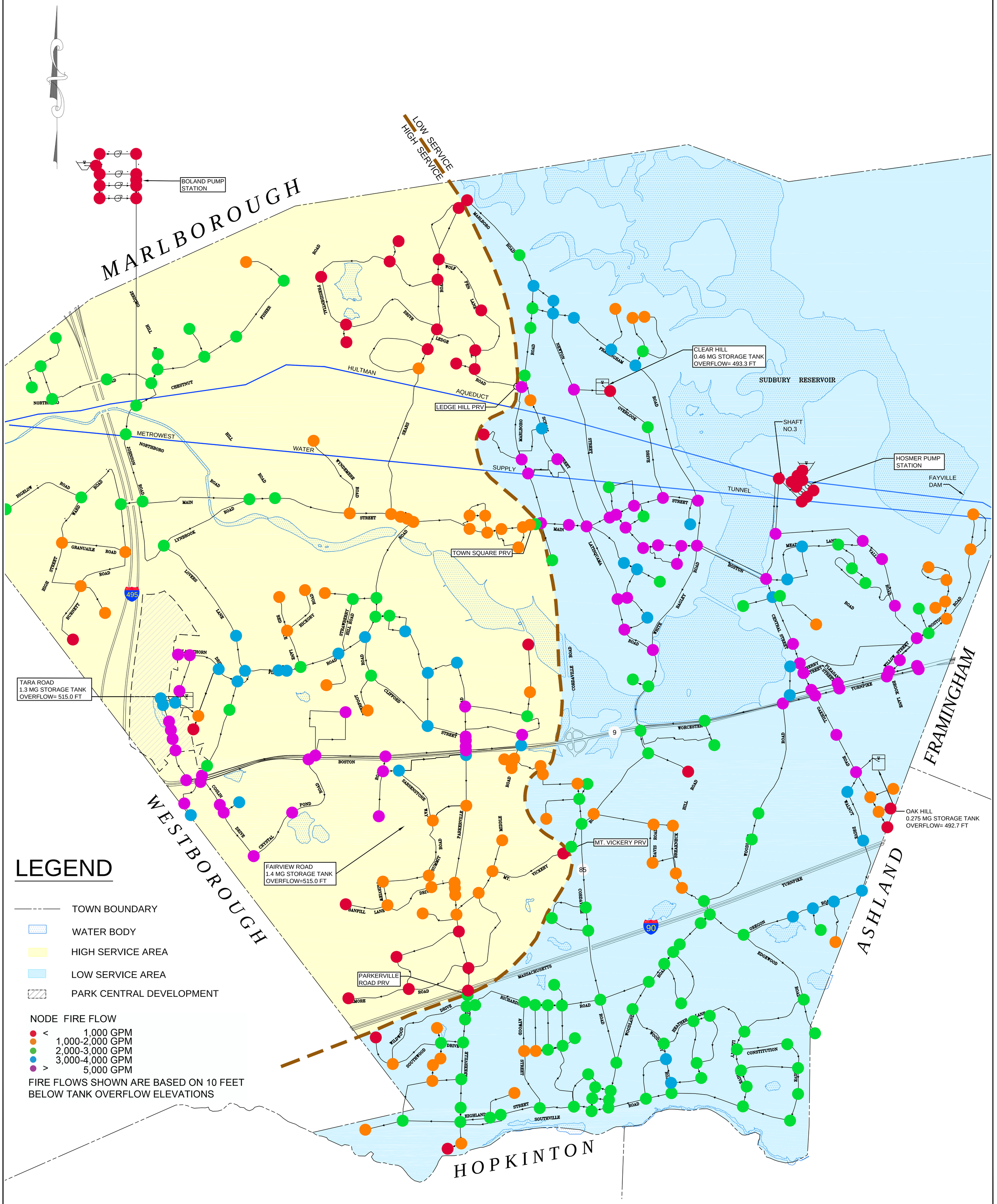

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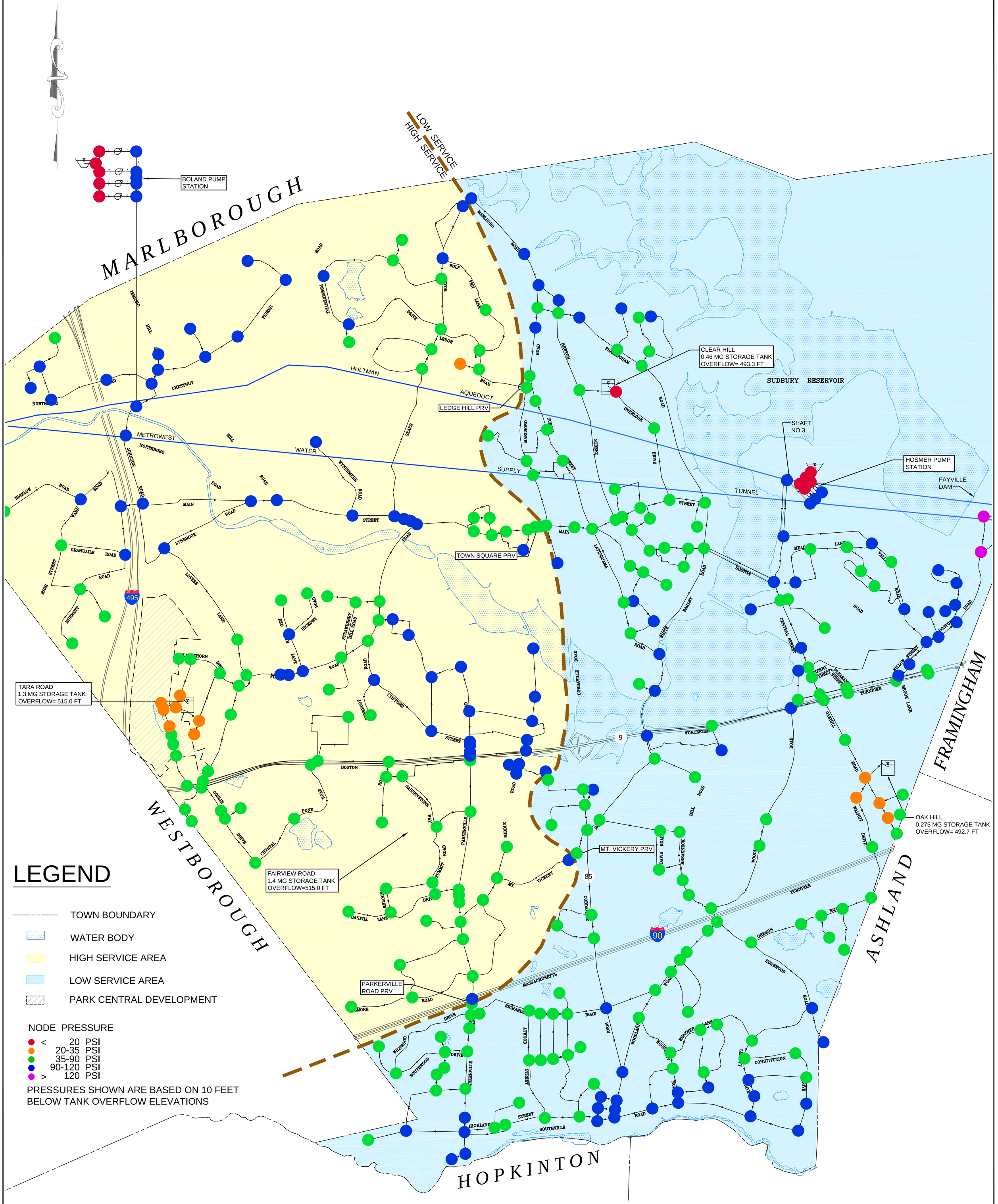
SHEET NO. 6 OF 12



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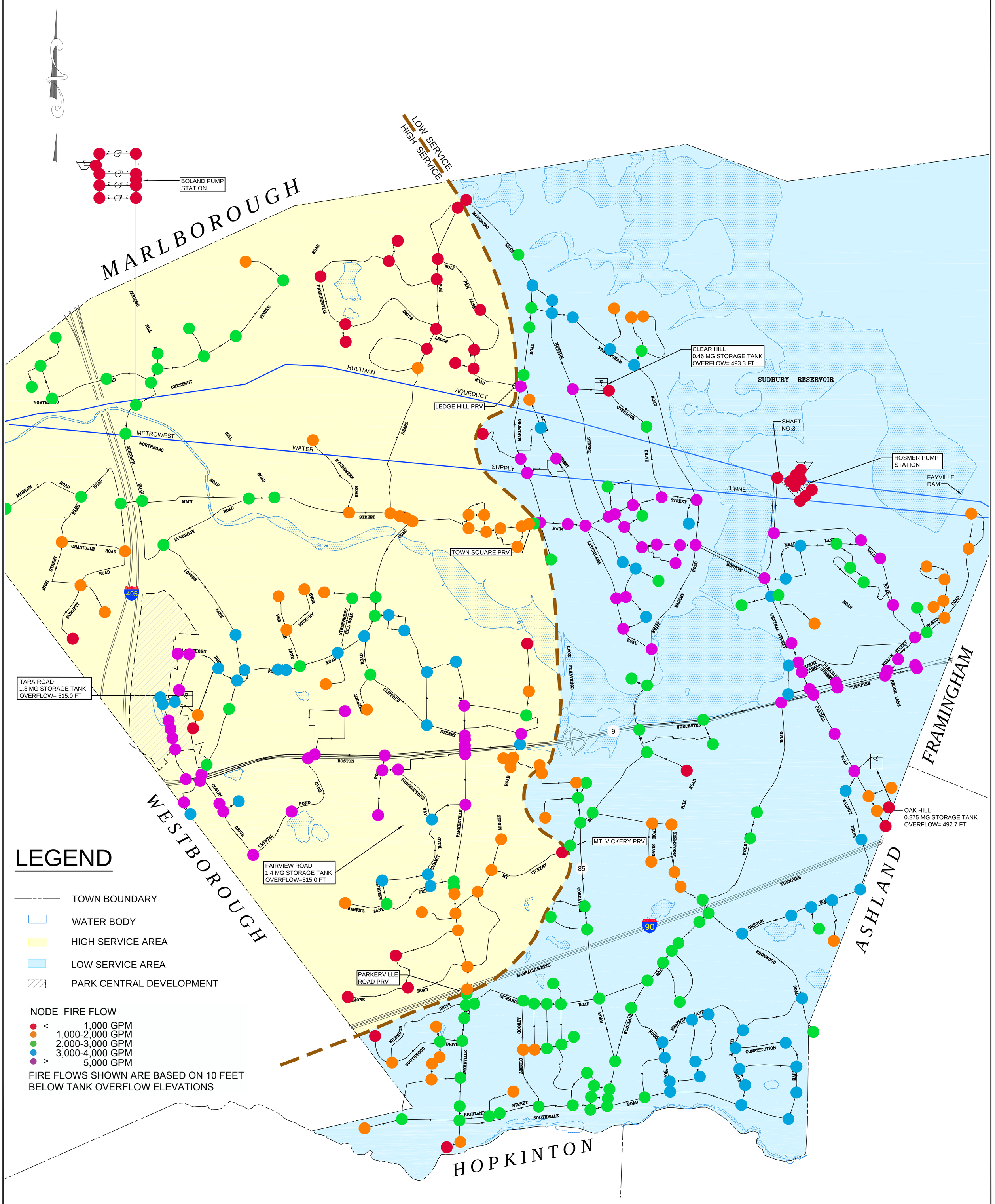
DRAWN BY:	AKL
APPROVED BY:	TPT

DRAWING TITLE: MDD PRESSURE OPTION 1B

DRAWING NO.:

SHEET NO. 7 OF 12



LEGEND

- TOWN BOUNDARY
- WATER BODY
- HIGH SERVICE AREA
- LOW SERVICE AREA
- PARK CENTRAL DEVELOPMENT

NODE FIRE FLOW

- < 1,000 GPM
- 1,000-2,000 GPM
- 2,000-3,000 GPM
- 3,000-4,000 GPM
- > 5,000 GPM

FIRE FLOWS SHOWN ARE BASED ON 10 FEET BELOW TANK OVERFLOW ELEVATIONS

Graphic Scale 1"=800'

800' 400' 0 800' 1600' 3200'

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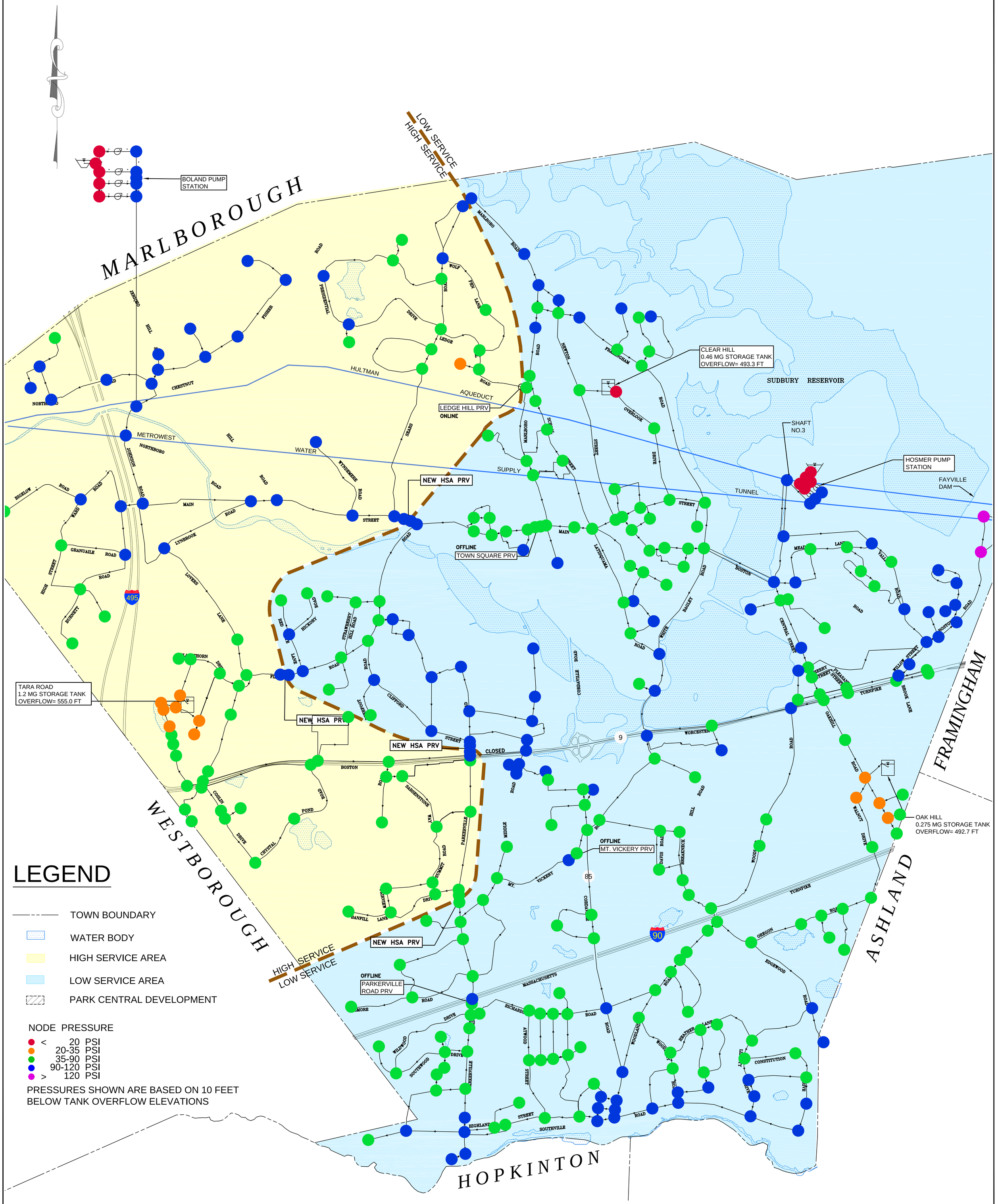
DRAWING TITLE: FIRE FLOW OPTION 1B

DRAWING NO.:

SHEET NO. 8 OF 12



LEGEND

- TOWN BOUNDARY
- WATER BODY
- HIGH SERVICE AREA
- LOW SERVICE AREA
- PARK CENTRAL DEVELOPMENT

NODE PRESSURE

- < 20 PSI
- 20-35 PSI
- 35-90 PSI
- 90-120 PSI
- > 120 PSI

PRESSURES SHOWN ARE BASED ON 10 FEET BELOW TANK OVERFLOW ELEVATIONS

Graphic Scale 1"=800'

800' 400' 0 800' 1600' 3200'

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WATER SYSTEM MASTER PLAN

SOUTHBOROUGH, MASSACHUSETTS

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DRAWN BY:	AKL
APPROVED BY:	TPT

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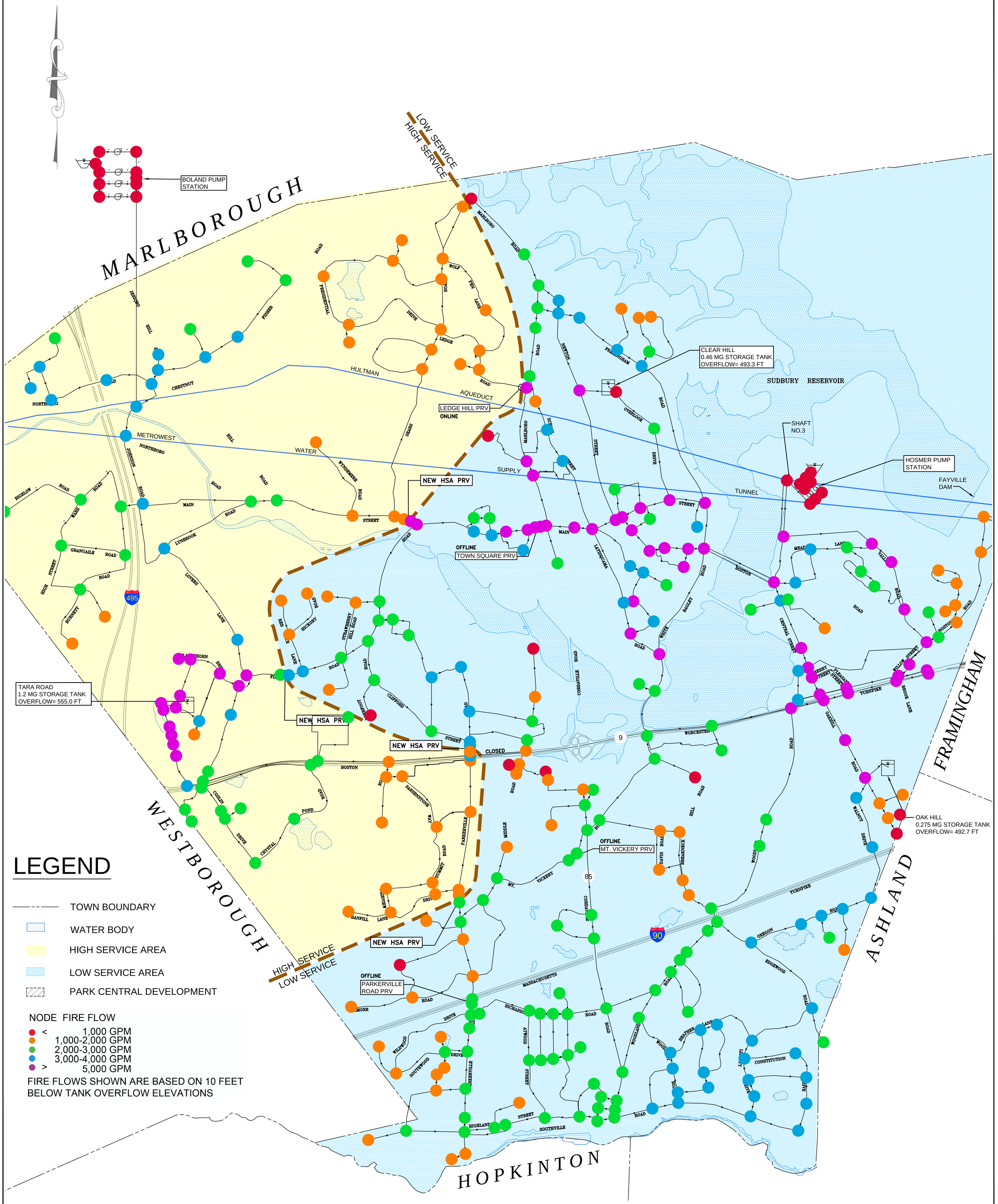
SHEET NO. 9 OF 12



LEGEND

- TOWN BOUNDARY
- WATER BODY
- HIGH SERVICE AREA
- LOW SERVICE AREA
- PARK CENTRAL DEVELOPMENT

NODE FIRE FLOW

- < 1,000 GPM
- 1,000-2,000 GPM
- 2,000-3,000 GPM
- 3,000-4,000 GPM
- > 5,000 GPM

FIRE FLOWS SHOWN ARE BASED ON 10 FEET BELOW TANK OVERFLOW ELEVATIONS

Graphic Scale 1"=800'

800' 400' 0 800' 1600' 3200'

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TOWN OF SOUTHBOROUGH
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SOUTHBOROUGH, MASSACHUSETTS

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DESIGNED BY:	SPD
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DRAWN BY:	AKL
APPROVED BY:	TPT

DRAWING TITLE: FIRE FLOW OPTION 2

DRAWING NO.:

SHEET NO. 10 OF 12

BOLAND PUMP STATION

LOW SERVICE
HIGH SERVICE

MARLBOROUGH

HULTMAN AQUEDUCT

METROWEST WATER SUPPLY TUNNEL

LEDGE HILL PRV

TOWN SQUARE PRV

NEW EHSA PRV

NEW EHSA PRV

NEW EHSA PRV

MT. VICKERY PRV

PARKERVILLE ROAD PRV

CLEAR HILL
0.46 MG STORAGE TANK
OVERFLOW= 493.3 FT

SUDBURY RESERVOIR

SHAFT NO.3

HOSMER PUMP STATION

FAYVILLE DAM

TARA ROAD
1.3 MG STORAGE TANK
OVERFLOW= 515.0 FT

NEW EHSA PUMP STATION

NEW EHSA TANK
OVERFLOW = 590 FT

OAK HILL
0.275 MG STORAGE TANK
OVERFLOW= 492.7 FT

WESTBOROUGH

FRAMINGHAM

ASHLAND

HOPKINTON

EXTRA HIGH SERVICE
HIGH SERVICE

LEGEND

- TOWN BOUNDARY
- WATER BODY
- HIGH SERVICE AREA
- LOW SERVICE AREA
- EXTRA HIGH SERVICE AREA
- PARK CENTRAL DEVELOPMENT

NODE PRESSURE

- < 20 PSI
- 20-35 PSI
- 35-90 PSI
- 90-120 PSI
- > 120 PSI

PRESSURES SHOWN ARE BASED ON 10 FEET BELOW TANK OVERFLOW ELEVATIONS

Graphic Scale 1"=800'

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TOWN OF SOUTHBOROUGH
WATER SYSTEM MASTER PLAN

SOUTHBOROUGH, MASSACHUSETTS

REVISIONS:

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DESIGNED BY:	SPD
CHECKED BY:	LMG
DRAWN BY:	AKL
APPROVED BY:	TPT

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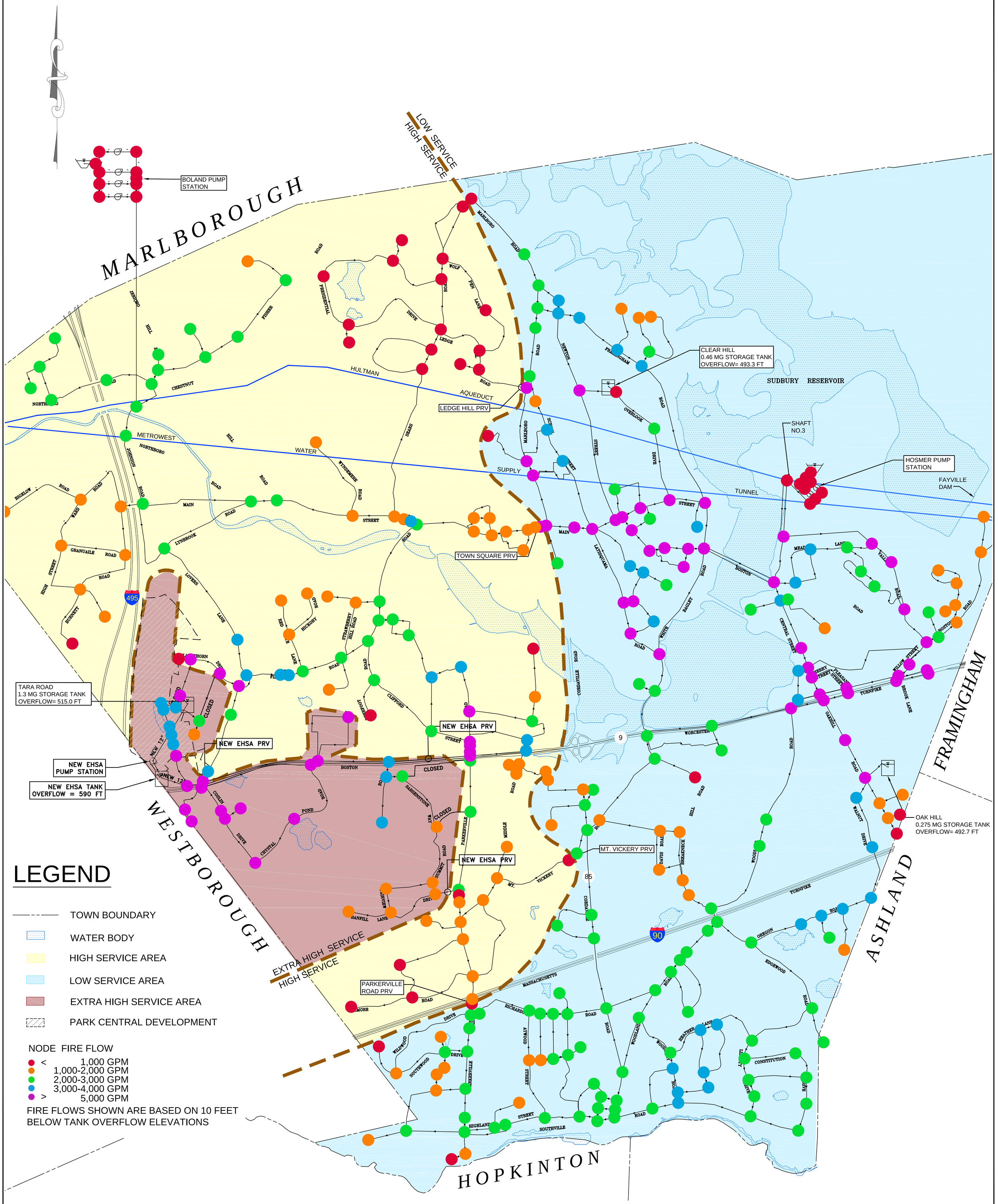
DRAWING NO.:

SHEET NO. 11 OF 12



LEGEND

- TOWN BOUNDARY
- WATER BODY
- HIGH SERVICE AREA
- LOW SERVICE AREA
- EXTRA HIGH SERVICE AREA
- PARK CENTRAL DEVELOPMENT

NODE FIRE FLOW

- < 1,000 GPM
- 1,000-2,000 GPM
- 2,000-3,000 GPM
- 3,000-4,000 GPM
- > 5,000 GPM

FIRE FLOWS SHOWN ARE BASED ON 10 FEET BELOW TANK OVERFLOW ELEVATIONS

Graphic Scale 1"=800'

800' 400' 0 800' 1600' 3200'

PARE CORPORATION
ENGINEERS - SCIENTISTS - PLANNERS
8 BLACKSTONE VALLEY PLACE
LINCOLN, RI 02865
401-334-4100

TOWN OF SOUTHBOROUGH
WATER SYSTEM MASTER PLAN

SOUTHBOROUGH, MASSACHUSETTS

REVISIONS:

PROJECT NO.:	08176.15
DATE:	NOVEMBER 2016
SCALE:	1"=800'
DESIGNED BY:	SPD
CHECKED BY:	LMG
DRAWN BY:	AKL
APPROVED BY:	TPT

DRAWING TITLE: FIRE FLOW OPTION 3

DRAWING NO.:

SHEET NO. 12 OF 12

APPENDIX B

Tank Screening Tables

Screening Criteria
(Original Version, presented at December 13, 2016 Public Meeting)

	Weighted %						
	25	15	10	25	10	15	100
Options	Cost	$/Usable Gallon	Pressure	Available Fire Flow	Unusable Storage	System Redundancy	Weighted Total
1	4	3	1	1	3	1	**2.3**
1A	5	4	2	4	1.5	5	**4.0**
1B	3	2	3	5	1.5	5	**3.5**
2	2	1	4	2	4.5	1	**2.2**
3	1	5	5	3	4.5	1	**2.9**

	Weighted %						
	40	0	10	25	10	15	100
Options	Cost	$/Usable Gallon	Pressure	Available Fire Flow	Unusable Storage	System Redundancy	Weighted Total
1	4	3	1	1	3	1	**2.4**
1A	5	4	2	4	1.5	5	**4.1**
1B	3	2	3	5	1.5	5	**3.7**
2	2	1	4	2	4.5	1	**2.3**
3	1	5	5	3	4.5	1	**2.3**

	Weighted %						
	40	0	10	35	0	15	100
Options	Cost	$/Usable Gallon	Pressure	Available Fire Flow	Unusable Storage	System Redundancy	Weighted Total
1	4	3	1	1	3	1	**2.2**
1A	5	4	2	4	1.5	5	**4.4**
1B	3	2	3	5	1.5	5	**4.0**
2	2	1	4	2	4.5	1	**2.1**
3	1	5	5	3	4.5	1	**2.1**

	Weighted %						
	40	0	20	30	0	10	100
Options	Cost	$/Usable Gallon	Pressure	Available Fire Flow	Unusable Storage	System Redundancy	Weighted Total
1	4	3	1	1	3	1	**2.2**
1A	5	4	2	4	1.5	5	**4.1**
1B	3	2	3	5	1.5	5	**3.8**
2	2	1	4	2	4.5	1	**2.3**
3	1	5	5	3	4.5	1	**2.4**

	Weighted %						
	0	0	25	40	10	25	100
Options	Cost	$/Usable Gallon	Pressure	Available Fire Flow	Unusable Storage	System Redundancy	Weighted Total
1	4	3	1	1	3	1	**1.2**
1A	5	4	2	4	1.5	5	**3.5**
1B	3	2	3	5	1.5	5	**4.2**
2	2	1	4	2	4.5	1	**2.5**
3	1	5	5	3	4.5	1	**3.2**

	Weighted %						
	16.67	16.67	16.67	16.67	16.67	16.67	100
Options	Cost	$/Usable Gallon	Pressure	Available Fire Flow	Unusable Storage	System Redundancy	Weighted Total
1	4	3	1	1	3	1	**2.2**
1A	5	4	2	4	1.5	5	**3.6**
1B	3	2	3	5	1.5	5	**3.3**
2	2	1	4	2	4.5	1	**2.4**
3	1	5	5	3	4.5	1	**3.3**

Revised Screening Criteria with Scaled Costs
(Modified Version, based on Public Comments from December 13, 2016 Public Meeting)

	Weighted %						
	25	15	10	25	10	15	100
Options	Cost	$/Usable Gallon	Pressure	Available Fire Flow	Unusable Storage	System Redundancy	Weighted Total
1	4.4	3	1	1	0.2	1	**2.1**
1A	5	1.6	2	4	0.3	5	**3.5**
1B	4.1	1.3	3	5	0.3	5	**3.6**
2	3.9	3.3	4	2	0.7	1	**2.6**
3	3.1	5	5	3	5	1	**3.4**

	Weighted %						
	40	0	10	25	10	15	100
Options	Cost	$/Usable Gallon	Pressure	Available Fire Flow	Unusable Storage	System Redundancy	Weighted Total
1	4.4	3	1	1	0.2	1	**2.3**
1A	5	1.6	2	4	0.3	5	**4.0**
1B	4.1	1.3	3	5	0.3	5	**4.0**
2	3.9	3.3	4	2	0.7	1	**2.7**
3	3.1	5	5	3	5	1	**3.1**

	Weighted %						
	40	0	10	35	0	15	100
Options	Cost	$/Usable Gallon	Pressure	Available Fire Flow	Unusable Storage	System Redundancy	Weighted Total
1	4.4	3	1	1	0.2	1	**2.4**
1A	5	1.6	2	4	0.3	5	**4.4**
1B	4.1	1.3	3	5	0.3	5	**4.4**
2	3.9	3.3	4	2	0.7	1	**2.8**
3	3.1	5	5	3	5	1	**2.9**

	Weighted %						
	40	0	20	30	0	10	100
Options	Cost	$/Usable Gallon	Pressure	Available Fire Flow	Unusable Storage	System Redundancy	Weighted Total
1	4.4	3	1	1	0.2	1	**2.4**
1A	5	1.6	2	4	0.3	5	**4.1**
1B	4.1	1.3	3	5	0.3	5	**4.2**
2	3.9	3.3	4	2	0.7	1	**3.1**
3	3.1	5	5	3	5	1	**3.2**

	Weighted %						
	0	0	25	40	10	25	100
Options	Cost	$/Usable Gallon	Pressure	Available Fire Flow	Unusable Storage	System Redundancy	Weighted Total
1	4.4	3	1	1	0.2	1	**0.9**
1A	5	1.6	2	4	0.3	5	**3.4**
1B	4.1	1.3	3	5	0.3	5	**4.0**
2	3.9	3.3	4	2	0.7	1	**2.1**
3	3.1	5	5	3	5	1	**3.2**

	Weighted %						
	16.67	16.67	16.67	16.67	16.67	16.67	100
Options	Cost	$/Usable Gallon	Pressure	Available Fire Flow	Unusable Storage	System Redundancy	Weighted Total
1	4	3	1	1	0.2	1	**1.7**
1A	5	1.6	2	4	0.3	5	**3.0**
1B	3	1.3	3	5	0.3	5	**2.9**
2	2	3.3	4	2	0.7	1	**2.2**
3	1	5	5	3	5	1	**3.3**

Revised Screening Criteria with Scaled Costs
(Modified Version, based on Public Comments from March 13, 2017 Public Meeting)

	Weighted %						
	25	15	10	25	10	15	100
Options	Cost	$/Usable Gallon	Pressure	Available Fire Flow	Unusable Storage	System Redundancy	Weighted Total
1	4.4	3	1	1	0.2	2	**2.2**
1A	5	1.6	2	4	0.3	4.5	**3.4**
1B	4.1	1.3	3	5	0.3	4.5	**3.5**
2	3.9	3.3	4	2	0.7	2	**2.7**
3	3.1	5	5	3	5	2	**3.6**

	Weighted %						
	40	0	10	25	10	15	100
Options	Cost	$/Usable Gallon	Pressure	Available Fire Flow	Unusable Storage	System Redundancy	Weighted Total
1	4.4	3	1	1	0.2	2	**2.4**
1A	5	1.6	2	4	0.3	4.5	**3.9**
1B	4.1	1.3	3	5	0.3	4.5	**3.9**
2	3.9	3.3	4	2	0.7	2	**2.8**
3	3.1	5	5	3	5	2	**3.3**

	Weighted %						
	40	0	10	35	0	15	100
Options	Cost	$/Usable Gallon	Pressure	Available Fire Flow	Unusable Storage	System Redundancy	Weighted Total
1	4.4	3	1	1	0.2	2	**2.5**
1A	5	1.6	2	4	0.3	4.5	**4.3**
1B	4.1	1.3	3	5	0.3	4.5	**4.4**
2	3.9	3.3	4	2	0.7	2	**3.0**
3	3.1	5	5	3	5	2	**3.1**

	Weighted %						
	40	0	20	30	0	10	100
Options	Cost	$/Usable Gallon	Pressure	Available Fire Flow	Unusable Storage	System Redundancy	Weighted Total
1	4.4	3	1	1	0.2	2	**2.5**
1A	5	1.6	2	4	0.3	4.5	**4.1**
1B	4.1	1.3	3	5	0.3	4.5	**4.2**
2	3.9	3.3	4	2	0.7	2	**3.2**
3	3.1	5	5	3	5	2	**3.3**

	Weighted %						
	0	0	25	40	10	25	100
Options	Cost	$/Usable Gallon	Pressure	Available Fire Flow	Unusable Storage	System Redundancy	Weighted Total
1	4.4	3	1	1	0.2	2	**1.2**
1A	5	1.6	2	4	0.3	4.5	**3.3**
1B	4.1	1.3	3	5	0.3	4.5	**3.9**
2	3.9	3.3	4	2	0.7	2	**2.4**
3	3.1	5	5	3	5	2	**3.5**

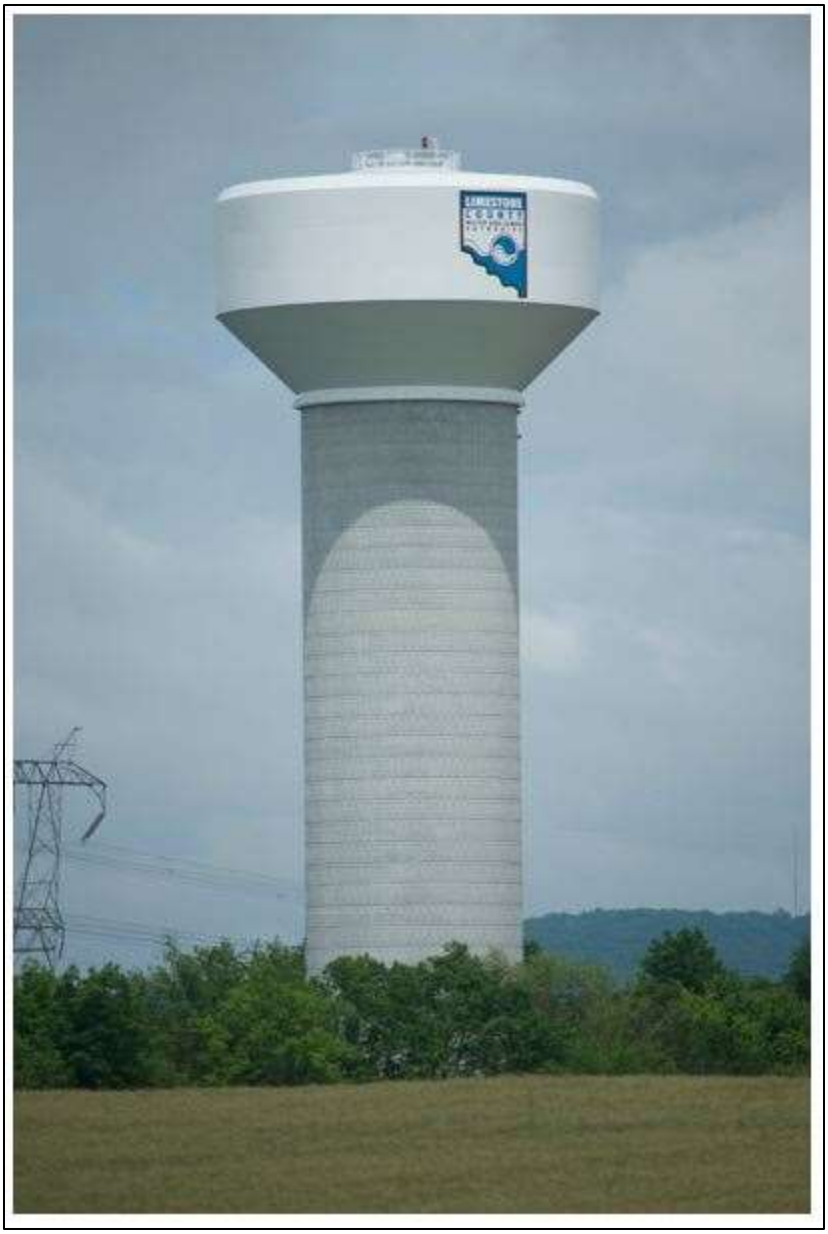
	Weighted %						
	16.67	16.67	16.67	16.67	16.67	16.67	100
Options	Cost	$/Usable Gallon	Pressure	Available Fire Flow	Unusable Storage	System Redundancy	Weighted Total
1	4	3	1	1	0.2	2	**1.9**
1A	5	1.6	2	4	0.3	4.5	**2.9**
1B	3	1.3	3	5	0.3	4.5	**2.9**
2	2	3.3	4	2	0.7	2	**2.3**
3	1	5	5	3	5	2	**3.5**

APPENDIX C

Tank Style Portfolio

Example of a Pre-cast Concrete Storage Tank – Possible style for Options 1, 1A, 1B, and 2.

Example of a Composite Elevated Storage Tank – Possible style for Option 3.



Example of a Composite Elevated Storage Tank – Possible style for Option 3.

Example of a Pedesphere (Elevated Spheroid) Tank – Possible style for Option 3.

APPENDIX D

Agendas, Meeting Minutes, and Presentations from September 27, 2016, November 7, 2016, and December 13, 2016 Public Works Planning Board Meetings

Tank Evaluation Workshop

Southborough Public Works Planning Board

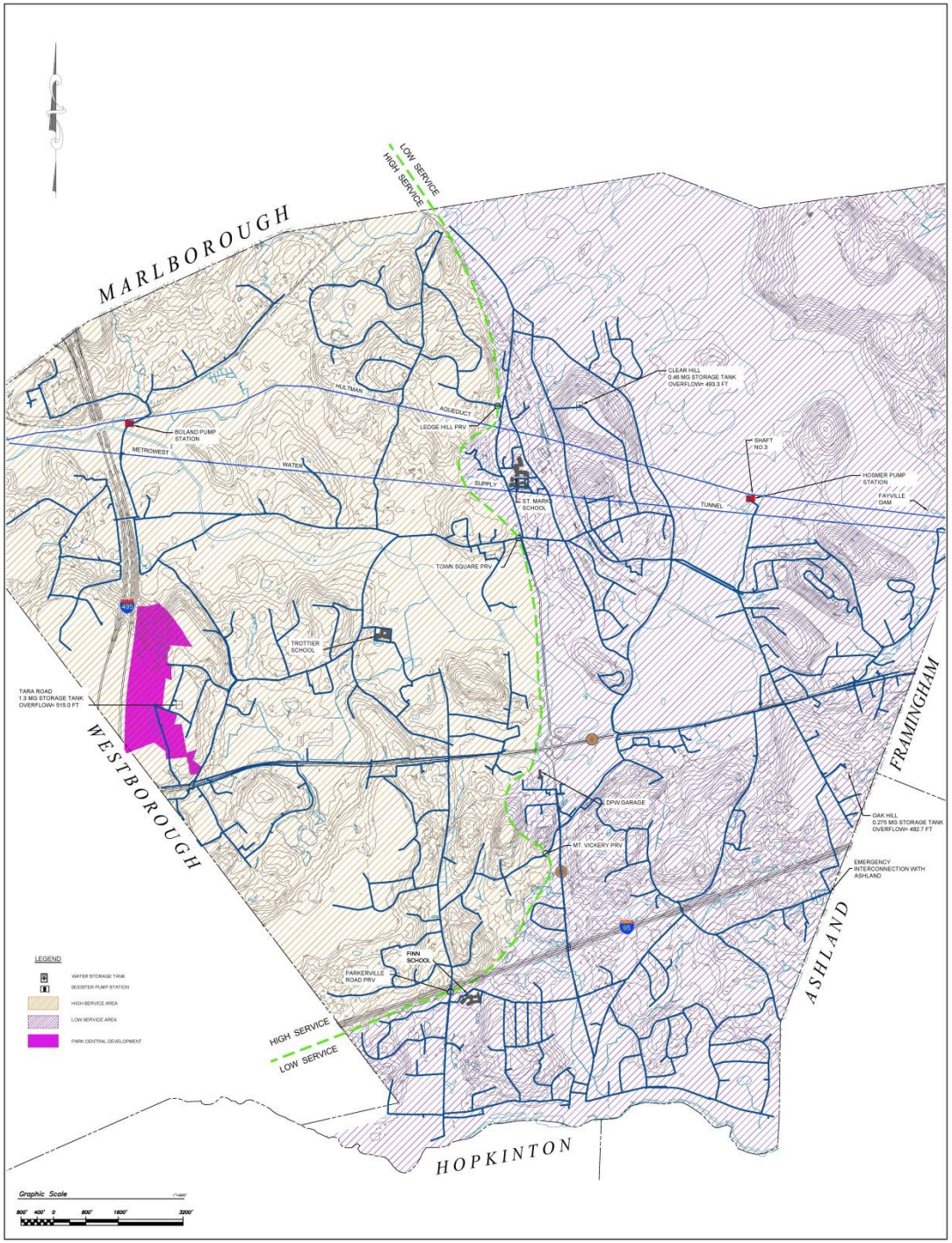
and

Pare Corporation

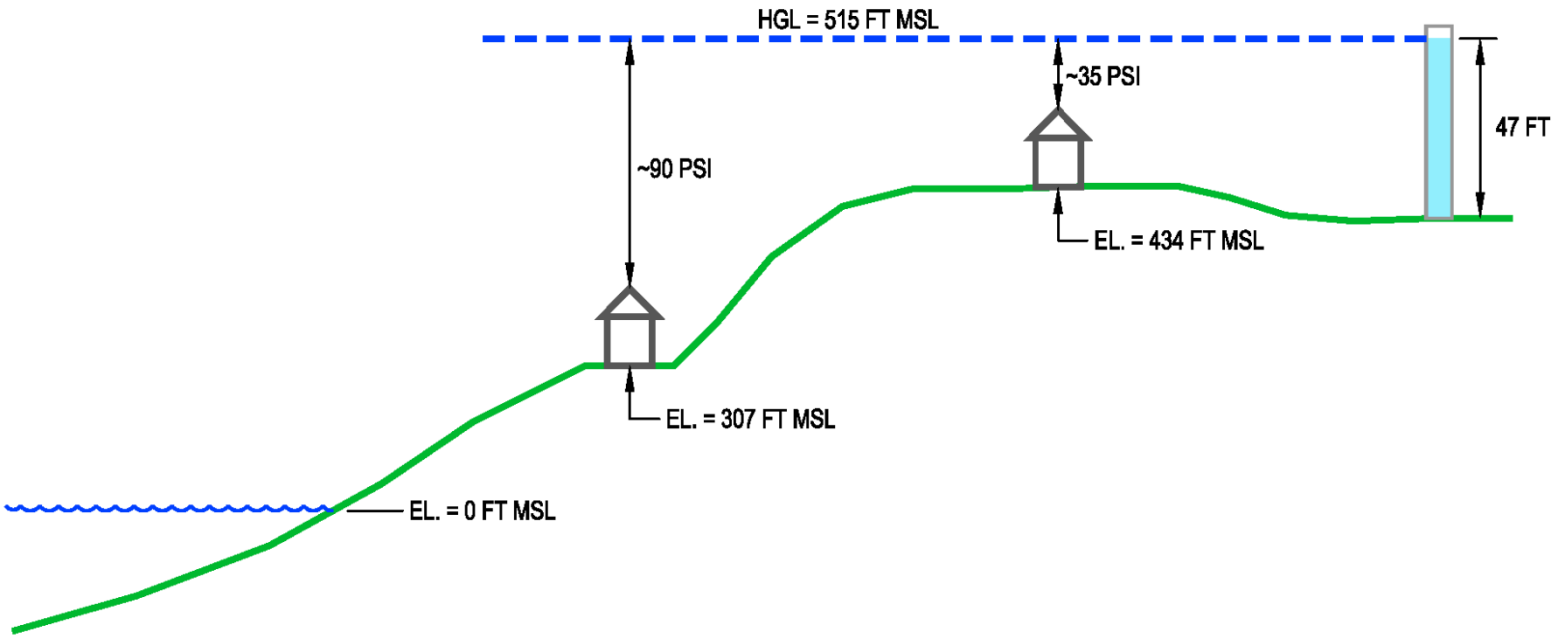
September 27, 2016

7:00 PM at Southborough Library

PARE CORPORATION



PARE CORPORATION



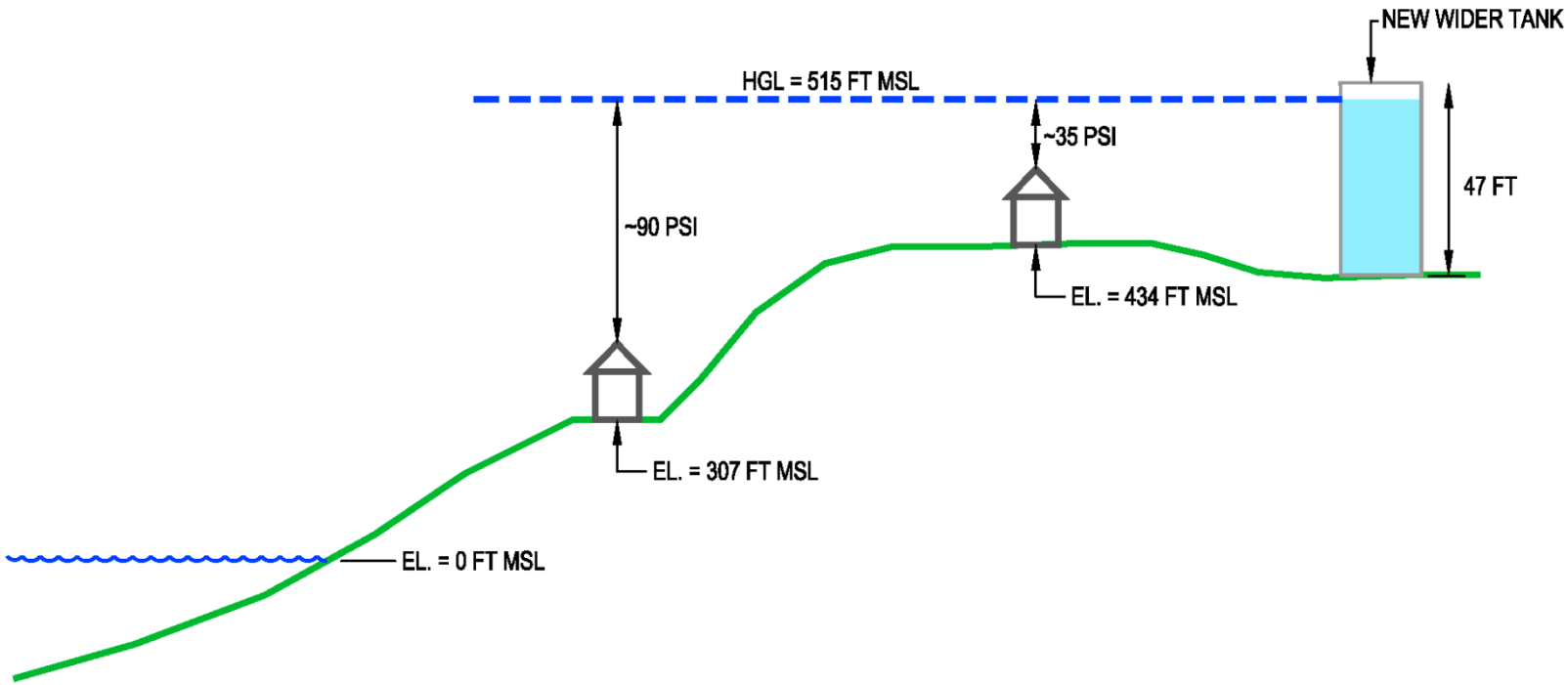
HYDRAULIC GRADE LINE VERSUS PRESSURE
(EXISTING SYSTEM)

PARE CORPORATION

Tank Evaluation

- Option 1 – Build a new larger water storage tank, one with the same overflow elevation as the existing Tara Road tank. The new tank would replace the existing Tara Road tank. It could be built at the Tara Road site, or somewhere else.

PARE CORPORATION



HYDRAULIC GRADE LINE VERSUS PRESSURE

(LARGER TANK, SAME OVERFLOW)

PARE CORPORATION

Option 1

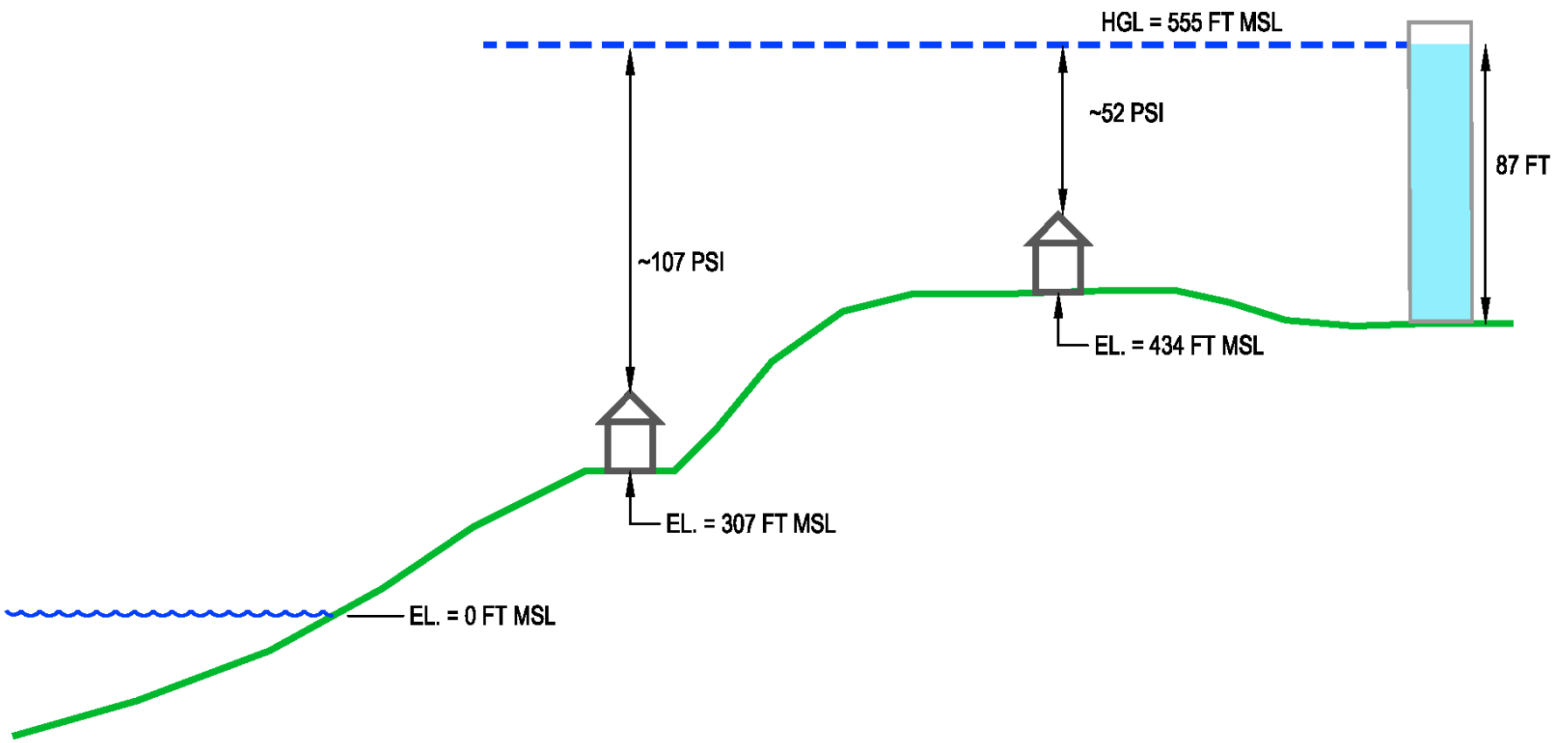
- Advantages
  - Increase storage volume in the HSA.
- Disadvantages
  - Would not address any pressure issues in the existing system.
  - Would only provide a marginal increase in usable storage.

PARE CORPORATION

Tank Evaluation

- Option 2 – Build a new larger water storage tank, but one with a higher overflow elevation than the existing Tara Road tank. The new tank would replace the existing Tara Road tank. Tank could be built at Tara Road site, Park Central lot, or elsewhere in Town.

PARE CORPORATION



HYDRAULIC GRADE LINE VERSUS PRESSURE
(LARGER TANK, TALLER OVERFLOW)

PARE CORPORATION

Option 2

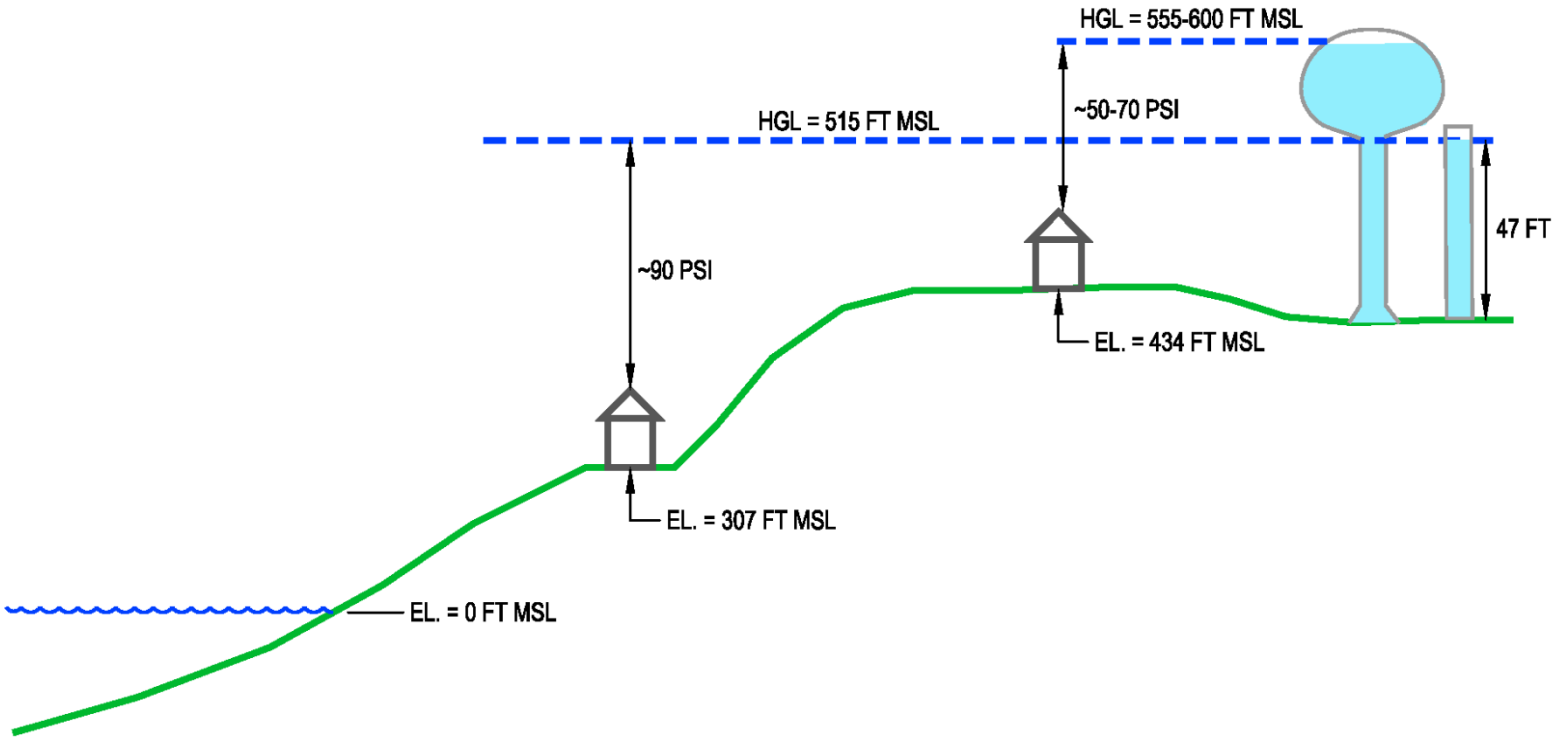
- Advantages
  - Increase storage volume in the HSA.
  - Would increase pressure to areas in the HSA that currently experience low pressure.
  - Would increase fire flow in the HSA.
- Disadvantages
  - Pressure increase would be small (only about 18 psi)
  - Would increase pressure too much for some customers that already get high pressure.
  - Would require upgrades to Boland Pump Station
  - Would require relocating existing zone valves.

PARE CORPORATION

Tank Evaluation

- Option 3 – Build a new water tank on the Park Central property with a higher overflow elevation than the existing Tara Road tank. The new tank would be the basis for a new pressure zone (Extra High Service Area), and would supplement the storage in the Tara Road tank (the Tara Road tank would remain) through a PRV.

PARE CORPORATION



HYDRAULIC GRADE LINE VERSUS PRESSURE
(NEW TALLER TANK IN EXTRA HIGH SERVICE AREA)

PARE CORPORATION

Option 3

- Advantages
  - Increase storage volume in the HSA through shared water.
  - Would increase pressure to some areas in the HSA that currently experience low pressure, but not all.
  - Would limit the number of customers that get over-pressurized.
- Disadvantages
  - Would require a new booster pump station near Tara tank.

PARE CORPORATION

Next Steps

- Advanced of hydraulic modeling of preferred scenario(s).
- Conceptual designs and costs.
- Meet again with this group to review findings.

PARE CORPORATION

Town of Southborough, MA
Meeting of the Public Works Planning Board (PWPB)
Tuesday, September 27, 2016
7:00PM
Library Large Conference Room (in the basement)
25 Main Street

AGENDA

New Business:

Introductions and election of PWPB Officers

Develop schedule to address most recently assigned Selectmen's task regarding new storage tank opportunities

Review Southborough's water system and begin discussion of storage options

Other business properly before the PWPB

Mark Bertonazzi
Vice Chairman

Public Works Planning Board
September 27, 2016 7:00 pm
Cordaville Hall

Meeting Minutes

Board Members Present: Mark Bertonazzi, Bob Bezokas, Jamie Hellen, Jim Harding, Sue Baust
DPW representative: Karen Galligan
Also present: Tim Thies (Pare Corp), Stan Tanenholtz, Yan Huang

Mark called the meeting to order at 7:10pm.

Approve minutes of April 26, 2016

Jamie made a motion to approve the minutes and Mark seconded it. The motion passed unanimously.

Introductions and election of Officers

We all welcomed new member Jim Harding.

For the record, Mark said that it was an honor and privilege to work with Desiree. She did great work. We appreciate all of her hard work and will miss her.

Bob nominated Jamie as Chair, Mark as Vice Chair and Sue as Recording Secretary. Jim seconded the motion. It passed unanimously with Mark Bertonazzi, Bob Bezokas, Jamie Hellen, Jim Harding and Sue Baust all voting in favor of the motion.

Mark turned the meeting over to Jamie.

Southborough Water System and Storage options

Tim and Karen discussed the need for more storage in the system. More storage is a part of the FY18 Master Plan. Tim handed out a packet with a description of the system and options for increasing storage.

From the Master Plan: "The Town's current sole source of supply is the Massachusetts Water Resource Authority (MWRA) via two connections to the Hultman Aqueduct, one connection to the Metrowest Water Supply Tunnel, and one direct connection to the John J. Carroll Water Treatment Plant. Existing customers are served by three water storage tanks, two pump stations, and 86 miles of transmission and distribution piping.

J. Esposito

Tank Evaluation Workshop No.2

Southborough Public Works Planning Board

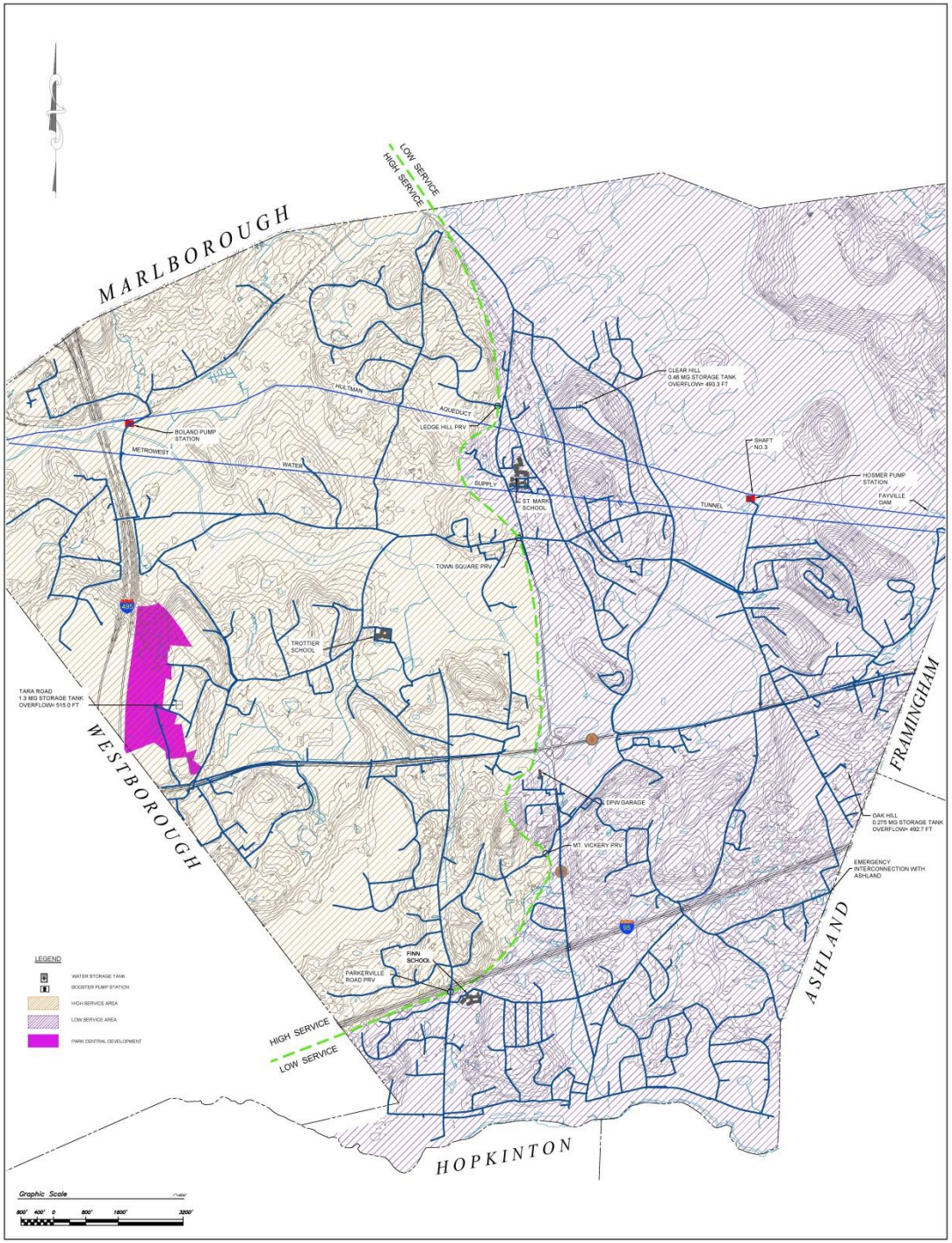
and

Pare Corporation

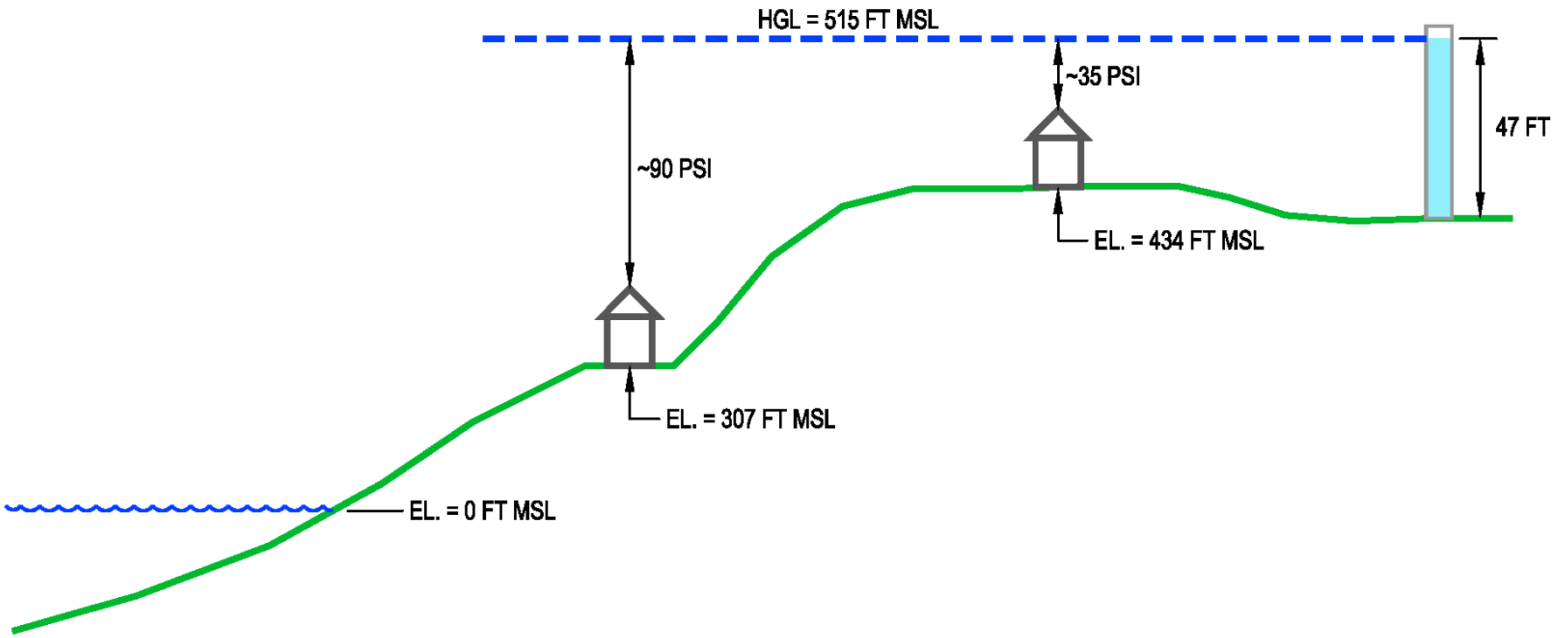
November 7, 2016

7:00 PM at Southborough Library

PARE CORPORATION

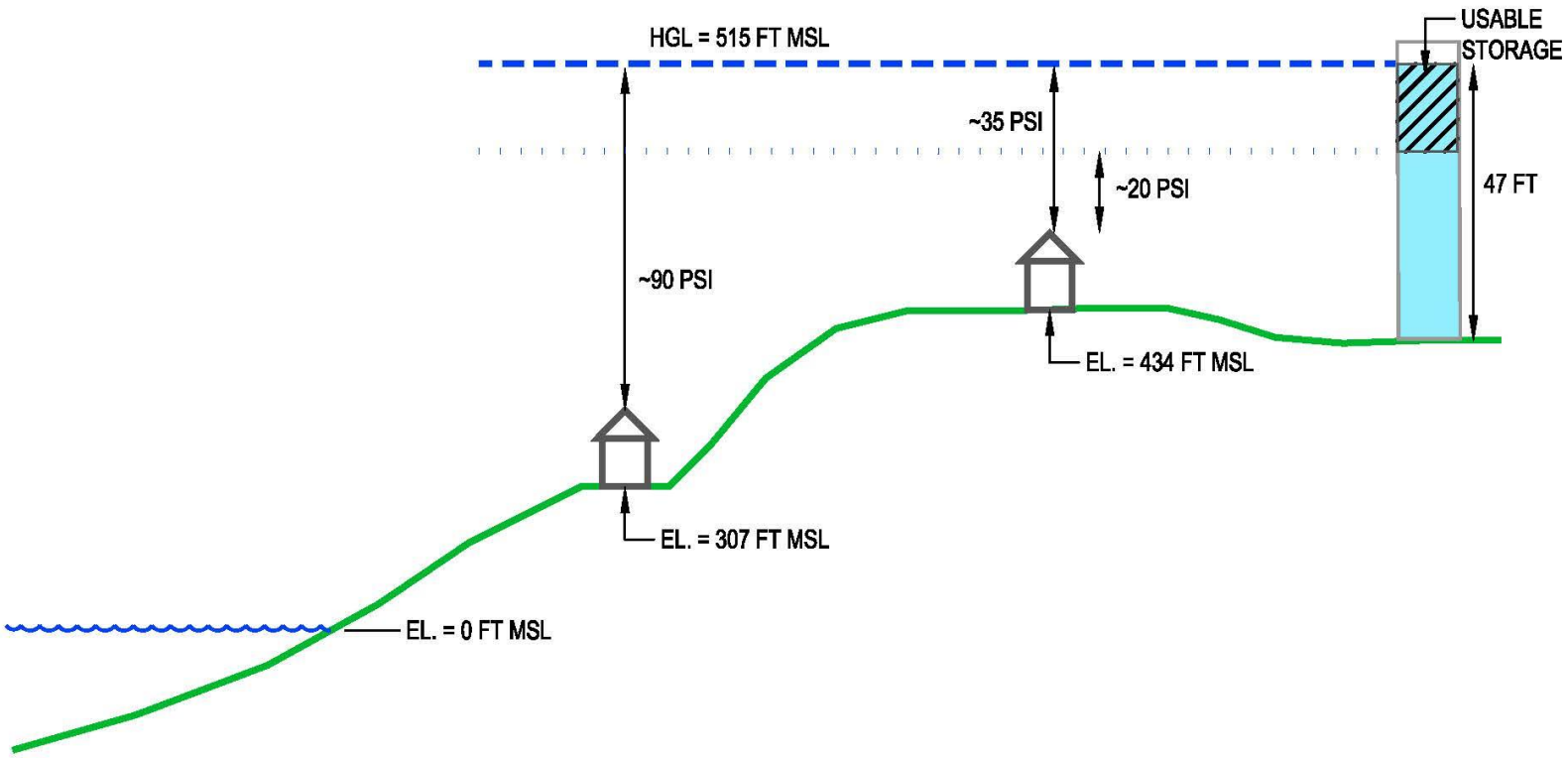


PARE CORPORATION



HYDRAULIC GRADE LINE VERSUS PRESSURE
(EXISTING SYSTEM)

PARE CORPORATION



USABLE STORAGE

Refresher on Options

- Option 1 – New larger water storage tank; same overflow as the existing Tara Road tank; built at the Tara Road site, or somewhere else.
- Option 2 – New larger water storage tank; one with a higher overflow elevation than the existing Tara Road tank;. replace the existing Tara Road tank. Tank could be built at Tara Road site, Park Central lot, or elsewhere in Town.
- Option 3 – New water tank with a higher overflow elevation than the existing Tara Road tank. The new tank would be the basis for a new pressure zone (Extra High Service Area), and would supplement the storage in the Tara Road tank (the Tara Road tank would remain) through a PRV.

PARE CORPORATION

Option 1

- Overview
  - 2.5 MG Tank at Tara Road. Tank style would be ground storage.
  - $4.4 M.
- Advantages
  - Increase storage volume in the HSA.
- Disadvantages
  - Would not address any pressure issues in the existing system.
  - Would only provide a marginal increase in usable storage (550,000 gallons).
  - Would not improve fire flow in the HSA.

PARE CORPORATION

Text in BLUE is new information, developed since the September 27, 2016 Meeting.

Option 2

- Overview
  - 1.2 MG Tank at Tara Road, overflow of 555 feet (40 feet taller than Tara). Tank would be elevated style. Would require a new boundary between the HSA and LSA.
  - $5.0 M.
- Advantages
  - Increase storage volume in the HSA, significant increase in usable (600,000 gallons).
  - Would increase pressure to areas in the HSA that currently experience low pressure.
  - Would increase fire flow in the HSA.
- Disadvantages
  - Pressure increase would be small (only about 18 psi)
  - Would increase pressure too much for some customers that already get high pressure.
  - ~~Would require upgrades to Boland Pump Station~~
  - Would require relocating existing zone valves.
  - Would increase the size of the LSA and demand on Hosmer PS.

PARE CORPORATION

Option 3

- Overview
  - 0.75 MG Tank, overflow at 590 feet (75 feet taller than Tara). Tank would be built on Park Central property and would be elevated storage style.
  - $6.2 M.
- Advantages
  - Increase storage volume in the HSA through shared water.
  - Significantly increase usable storage, both in EHSA and HSA (1,300,000 gallons).
  - Would increase pressure to some areas in the HSA that currently experience low pressure, but not all.
  - Would limit the number of customers that get over-pressurized.
- Disadvantages
  - Would require a new booster pump station near Tara tank.
  - Would require new PRVs along EHSA/HSA boundary.

New Options

- Two options came out of last month's meeting (variations on Option 1).
- Option 1A – New water storage tank at Fairview Parcel, same overflow as Tara (two tanks in the HSA).
- Option 1B – Same as 1A, but with additional piping to improve fire flow.

PARE CORPORATION

Option 1A

- Overview
  - 1.4 MG Tank at Fairview site, overflow at 515 feet (same height as Tara). Tank would be ground storage style.
  - $3.9 M.
- Advantages
  - Increase storage volume in the HSA.
  - Would improve fire flow to some areas of the HSA.
- Disadvantages
  - Would not significantly improve pressure in the HSA (some customers would see more stable pressure).
  - Would only provide a marginal increase in usable storage (260,000 gallons).

PARE CORPORATION

Option 1B

- Overview
  - 1.4 MG Tank at Fairview site, overflow at 515 feet (same height as Tara). Tank would be ground storage style.
  - New water main connecting Fairview Drive and Deerfoot Road.
  - $4.8 M.
- Advantages
  - Increase storage volume in the HSA.
  - Would significantly improve fire flow to some area of the HSA.
- Disadvantages
  - Would not significantly improve pressure in the HSA (some customers would see more stable pressure).
  - Would only provide a marginal increase in usable storage (260,000 gallons).
  - More costly than Option 1B.

PARE CORPORATION

Option Summary

Tank Option	Cost	Cost/gallon (usable)	Pressure	Fire Flow	Unusable Storage
1	$4.4M	$8.00/gal	No Change	No Change	1.95 MG
1A	$3.9M	$15.00/gal	No Change	Modest Improvement	1.14 MG
1B	$4.8M	$18.46/gal	No Change	Significant Improvement	1.14 MG
2	$5.0M	$7.25/gal	Increase (18 psi)	Modest Improvement	0.51 MG
3	$6.2M	$4.77/gal	Increase (32 psi)	Modest Improvement	0.07 MG

PARE CORPORATION

Option Summary

Tank Option	Cost	Cost/gallon (usable)	Pressure	Fire Flow	Unusable Storage	Weighted Total
Weighted Percentage	30%	20%	10%	25%	15%	
1	4	3	1	1	1	2.3
1A	5	2	2	4	2.5	3.5
1B	3	1	3	5	2.5	3.0
2	2	4	4	2	4	2.9
3	1	5	5	3	5	3.3

PARE CORPORATION

Next Steps/Discussion

- _____
- _____
- _____

PARE CORPORATION

Town of Southborough
Public Works Planning Board
Agenda
November 7, 2016
7:00 PM
Room A, Southborough Senior Center
9 Cordaville Road

Items to Discuss

1. Review Committee Minutes --
   The Board will review and approve previous meeting minutes.

2. Water Storage Tank Discussion --
   The Board will continue a discussion from the previous meeting of analyzing the Town's water storage capacity and the possible siting of a new water storage facilities in town.

3. Truck Exclusions Requests --
   The Board may discuss truck exclusion studies.

4. DPW Superintendent's Report
   a. FY18 Budget Discussion

5. Adjourn

Karen Galligan
Karen Galligan, DPW Superintendent

Tank Evaluation Presentation

Department of Public Works,

Public Works Planning Board,

and

Pare Corporation

December 13, 2016

7:00 PM at Cordaville Hall

PARE CORPORATION

Presentation Topics

1. Discussion of Need: What is the problem with Southborough's storage and why do we need more?
2. System Overview: How does Southborough's water system work?
3. System History: Discussion of some of the major system changes that have happened over time and what has been done with storage.
4. Discuss of Options: What are the most viable options for improving storage.
5. Analysis of Options: How do these options rank relative to each other.
6. Conclusions: What are the overall findings of this evaluation and what are the next steps moving forward.

PARE CORPORATION

Project Need

- There is a significant need to increase storage in the Town for three reasons:
  1. Increase effective storage (i.e., storage volume that is available under all circumstances);
  2. Reinforce storage to minimize disruptions in service; and
  3. Increase the amount of volume available specifically for fire protection.

PARE CORPORATION

Project Need (cont…)

- Effective Storage is the storage above 20 psi.
  - Southborough has approximately 0.5 MG in the HSA, but 1 MG would be more appropriate.
- HSA has only one tank, which means substantial vulnerability to a disruption in service.
  - Two storage tanks would reduce system vulnerability and improve system performance, while making maintenance easier.

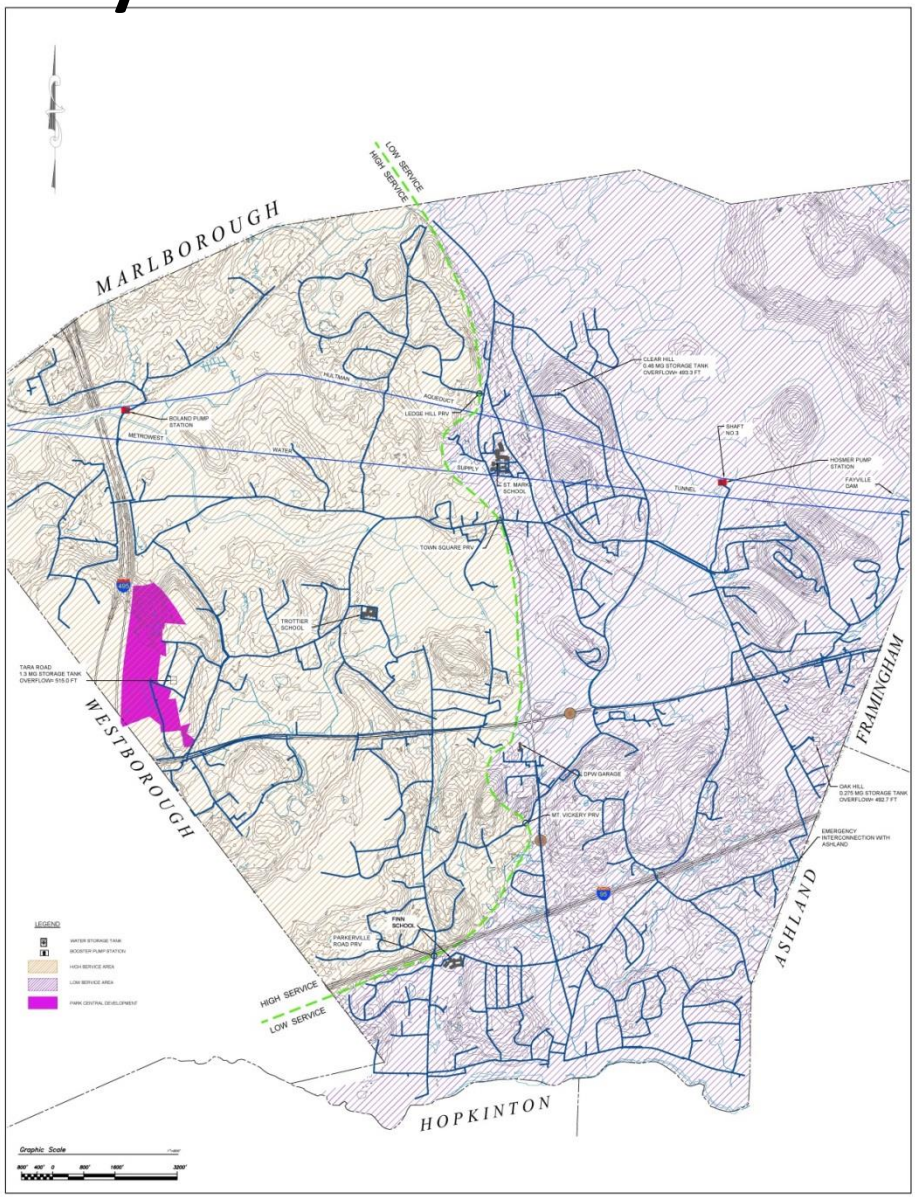
PARE CORPORATION

Project Need (cont…)

- HSA should have 540,000 gallons in reserve for fire protection (only 200,000 to 230,000 gallons is in reserve currently).
  - 540,000 gallons is based on a needed fire flow of 3,000 gpm for three hours.
- Some areas of the HSA have fire flow delivery issues.
  - Particularly near Trottier School and on Rt. 9.
  - This issue is not a deficiency in storage, but could be improved with more storage.

PARE CORPORATION

System Overview

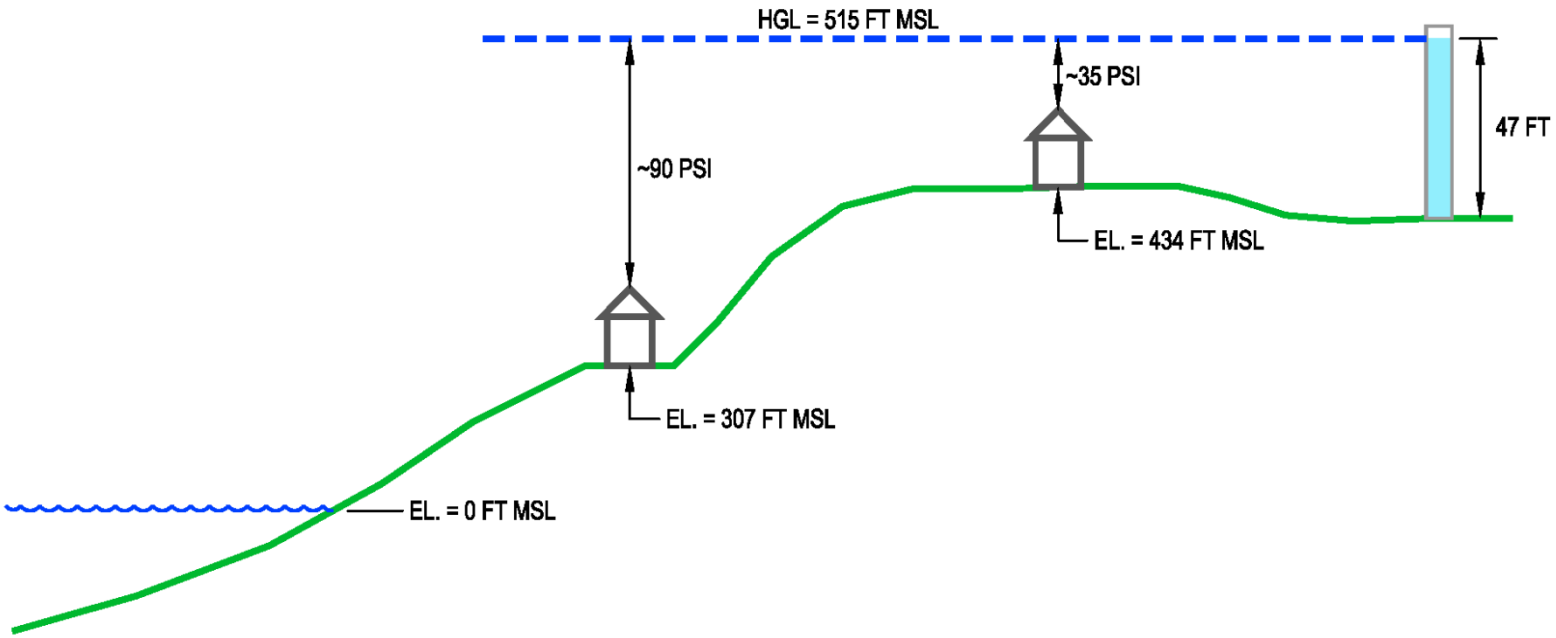


PARE CORPORATION

System Overview (cont…)

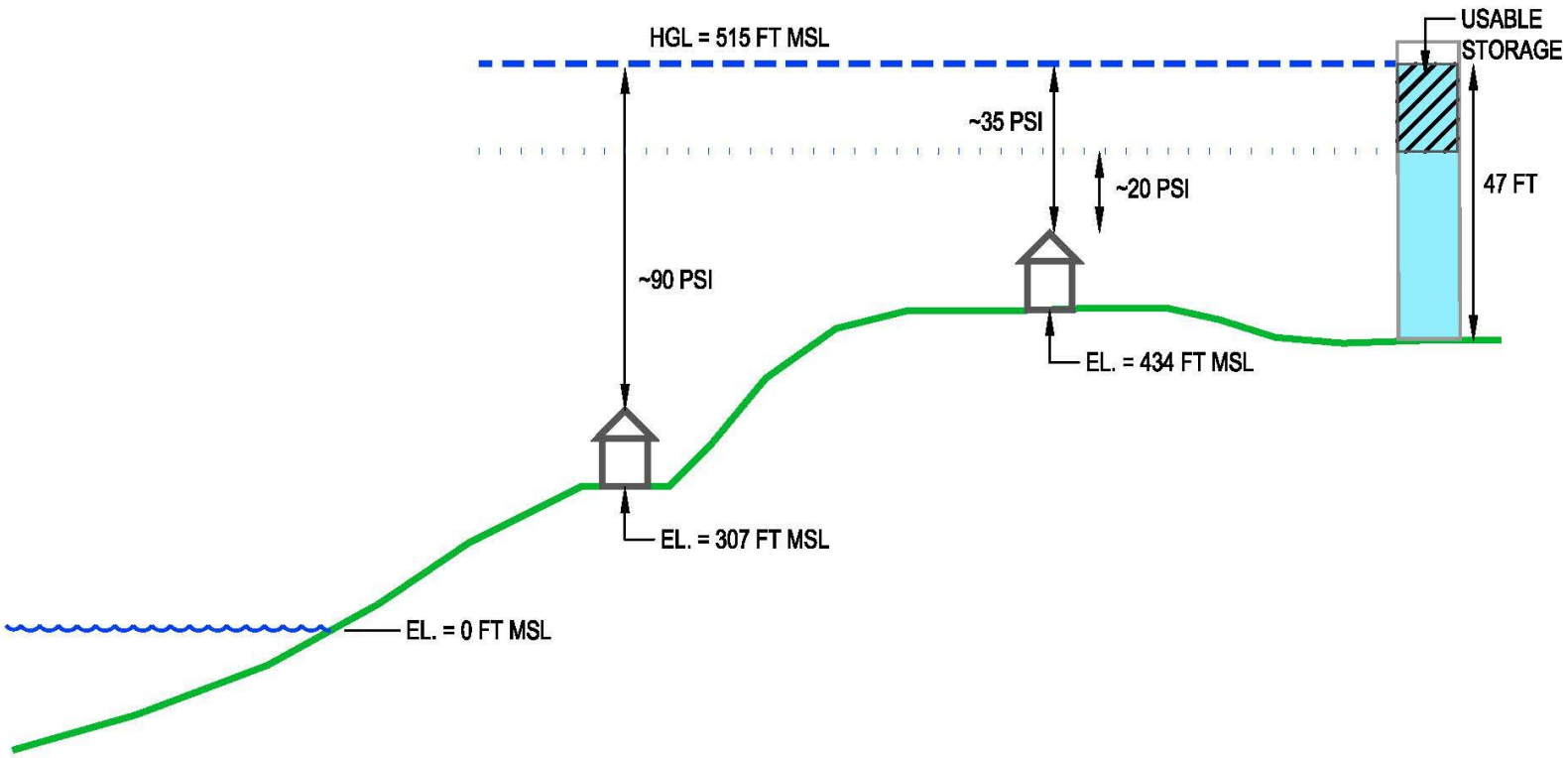
- Southborough's water system has:
  - Two pressure zones;
  - Two pump stations (Boland and Hosmer);
  - Three tanks (one in the high, two in the low);
  - Four pressure reducing valves;
  - 86 miles of pipe, 6-inch through 12-inch; and
  - 1 MGD average day demand, 2.8 MGD in the summer.

PARE CORPORATION



HYDRAULIC GRADE LINE VERSUS PRESSURE
(EXISTING SYSTEM)

PARE CORPORATION



USABLE STORAGE

System History

- Fayville Dam built in 1898, effectively creating the Southborough water system.
- Tara Road Tank built in 1960.
- Boland PS built in 1962.
- Town acquires Fairview Hill site for new tank in 1978 (land was first identified in 1959 Water System Master Plan for use as a tank site).
- Town divided into two service areas in 1988.
- 1998 Water System Master Plan identified the need for more storage in Town, up to 2 MG.

PARE CORPORATION

System History (cont…)

- 2008 Tank Siting Report evaluated 25 potential tank sites in Town, with Tara Road, Fairview Hill, and Flatley (Park Central) as the top three sites.
- 2009 Water System Master Plan confirmed the need for more storage, approximately 2 MG in the HSA.
- Since 2009, the Town has set out to complete other water system improvements to lessen the need for more storage;
  - Upgrades to Boland PS --- Four new PRVs
  - Upgrades to Hosmer (on-going) --- New SCADA System
  - Two water main projects on Rt.9 --- Parkerville water main

PARE CORPORATION

System History (cont…)

- These upgrades have lessened the need for storage to a degree, but they have not eliminated the need for more storage.
- The Town still has a storage deficit, particularly in fire volume.
- As demand in the system increases, the need for more storage will become more critical.

PARE CORPORATION

Options to Improve Storage

- Option 1 – New larger water storage tank; same overflow as the existing Tara Road tank; built at the Tara Road site, or somewhere else.
- Option 1A – New water storage tank at Fairview Hill parcel, same overflow as Tara (two tanks in the HSA).
- Option 1B – Same as 1A, but with additional piping to improve fire flow.

PARE CORPORATION

Options to Improve Storage

- Option 2 – New larger water storage tank; one with a higher overflow elevation than the existing Tara Road tank that would replace the existing Tara Road tank. Tank could be built at Tara Road site, Park Central lot, or elsewhere in Town.
- Option 3 – New water tank with a higher overflow elevation than the existing Tara Road tank. The new tank would be the basis for a new pressure zone (Extra High Service Area), and would supplement the storage in the Tara Road tank (the Tara Road tank would remain) through a PRV.

PARE CORPORATION

Option 1

- Overview
  - 2.5 MG Tank at Tara Road. Tank style would be ground storage.
  - $4.4 M.
- Advantages
  - Increase storage volume in the HSA.
- Disadvantages
  - Would not address any pressure issues in the existing system.
  - Would only provide a modes increase in usable storage (500,000 gallons), while adding 700,000 gallons of unusable storage.
  - Would not improve fire flow in the HSA.

PARE CORPORATION

Option 1A

- Overview
  - 1.5 MG Tank at Fairview site, overflow at 515 feet (same height as Tara). Tank would be ground storage style.
  - $3.9 M.
- Advantages
  - Increase storage volume in the HSA.
  - Would improve fire flow to some areas of the HSA, particularly areas that need it most (Trottier School area and Route 9).
- Disadvantages
  - Would not significantly improve pressure in the HSA (some customers would see more stable pressure).
  - Would provide a modest increase in usable storage (500,000 gallons) while adding about 1 MG of unusable storage.

PARE CORPORATION

Option 1B

- Overview
  - 1.5 MG Tank at Fairview site, overflow at 515 feet (same height as Tara). Tank would be ground storage style.
  - New water main connecting Fairview Drive and Deerfoot Road.
  - $4.8 M.
- Advantages
  - Increase storage volume in the HSA.
  - Would improve fire flow to some areas of the HSA, particularly areas that need it most (Trottier School area and Route 9), even more so than 1A.
- Disadvantages
  - Would not significantly improve pressure in the HSA (some customers would see more stable pressure).
  - Would provide a modest increase in usable storage (500,000 gallons) while adding about 1 MG of unusable storage.
  - More costly than Option 1B.

PARE CORPORATION

Option 2

- Overview
  - 1.3 MG Tank at Tara Road, overflow of 555 feet (40 feet taller than Tara). Tank would be elevated style. Would require a new boundary between the HSA and LSA.
  - $5.0 M.
- Advantages
  - Increase storage volume in the HSA, significant increase in usable (600,000 gallons).
  - Would increase pressure to areas in the HSA that currently experience low pressure.
  - Would increase fire flow in the HSA.
- Disadvantages
  - Pressure increase would be relatively small (only about 18 psi)
  - Would increase pressure too much for some areas of Town that already get high pressure.
  - Would require relocating existing zone valves.
  - Would increase the size of the LSA and increase demand on the Hosmer PS.

PARE CORPORATION

Option 3

- Overview
  - 0.75 MG Tank, overflow at 590 feet (75 feet taller than Tara). Tank would be built on Park Central property and would be elevated storage style.
  - $6.2 M.
- Advantages
  - Increase storage volume in the HSA through shared water.
  - Significantly increase usable storage, both in EHSA and HSA (1,300,000 gallons).
  - Would increase pressure to some areas in the HSA that currently experience low pressure, but not all.
  - Would limit the number of customers that get over-pressurized.
- Disadvantages
  - Would require a new booster pump station near Tara tank.
  - Would require new PRVs along EHSA/HSA boundary.

PARE CORPORATION

Option Summary

Tank Option	Cost	Cost/gallon (usable)	Pressure	Fire Flow	Ineffective (Unusable) Storage	Promotes System Redundancy
1	$4.4M	$8.80/gal	No Change	No Change	1.5 MG	No
1A	$3.9M	$7.80/gal	No Change	Modest Improvement	1.8 MG	Yes
1B	$4.8M	$9.60/gal	No Change	Significant Improvement	1.8 MG	Yes
2	$5.0M	$13.26/gal	Increase (18 psi)	Modest Improvement	0.4 MG	No
3	$6.2M	$4.77/gal	Increase (32 psi)	Modest Improvement	0.4 MG	No

PARE CORPORATION

Analysis of Options

Table 1 – Equal Weighted Options

Tank Option	Cost	Cost/gallon (usable)	Pressure	Fire Flow	Unusable Storage	Promotes Redundancy	Weighted Total
Weighted Percentage	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	
1	4	3	1	1	1	1	1.8
1A	5	2	2	4	2.5	5	3.4
1B	3	1	3	5	2.5	5	3.3
2	2	4	4	2	4	1	2.8
3	1	5	5	3	5	1	3.3

All criteria are ranked 1-5, with 1 being the worst and 5 being the best.

PARE CORPORATION

Analysis of Options

Table 2 – Screening Variation (1st)*

Tank Option	Cost	Cost/gallon (usable)	Pressure	Fire Flow	Unusable Storage	Promotes Redundancy	Weighted Total
Weighted Percentage	25%	15%	10%	25%	10%	15%	
1	4	3	1	1	1	1	2.1
1A	5	2	2	4	2.5	5	3.8
1B	3	1	3	5	2.5	5	3.5
2	2	4	4	2	4	1	2.6
3	1	5	5	3	5	1	2.9

*Weighting of criteria changed to reflect recent similar projects completed by Pare.

PARE CORPORATION

Analysis of Options

Table 3 – Screening Variation (2nd)*

Tank Option	Cost	Cost/gallon (usable)	Pressure	Fire Flow	Unusable Storage	Promotes Redundancy	Weighted Total
Weighted Percentage	40%	0%	10%	25%	10%	15%	
1	4	3	1	1	1	1	2.2
1A	5	2	2	4	2.5	5	4.2
1B	3	1	3	5	2.5	5	3.8
2	2	4	4	2	4	1	2.3
3	1	5	5	3	5	1	2.3

*Weighting of criteria changed to reflect more emphasis on total cost and less on cost/usable gallon.

PARE CORPORATION

Analysis of Options

Table 4 – Screening Variation (3rd)*

Tank Option	Cost	Cost/gallon (usable)	Pressure	Fire Flow	Unusable Storage	Promotes Redundancy	Weighted Total
Weighted Percentage	40%	0%	10%	35%	0%	15%	
1	4	3	1	1	1	1	2.2
1A	5	2	2	4	2.5	5	4.4
1B	3	1	3	5	2.5	5	4.0
2	2	4	4	2	4	1	2.1
3	1	5	5	3	5	1	2.1

*Weighting of criteria changed to reflect more emphasis on total cost and fire flow, less on cost/usable gallon and unusable storage.

PARE CORPORATION

Analysis of Options

Table 5 – Screening Variation (4th)*

Tank Option	Cost	Cost/gallon (usable)	Pressure	Fire Flow	Unusable Storage	Promotes Redundancy	Weighted Total
Weighted Percentage	0%	0%	25%	40%	10%	25%	
1	4	3	1	1	1	1	1.0
1A	5	2	2	4	2.5	5	3.6
1B	3	1	3	5	2.5	5	4.3
2	2	4	4	2	4	1	2.5
3	1	5	5	3	5	1	3.2

*Weighting of criteria changed to eliminate cost considerations.

PARE CORPORATION

Findings

- Options No.1A and No.1B consistently ranked the highest.
  - Both options increase usable storage and fire flow at the lowest cost of all the options.
  - Only options that provide truly reinforce storage.
- Option No. 1 consistently ranked last in all the screening variations.

PARE CORPORATION

Questions/Comments

PARE CORPORATION

BOLAND PUMP STATION

LOW SERVICE
HIGH SERVICE

MARLBORO

HULTMAN AQUEDUCT

LEDGE HILL PRV

CLEAR HILL
0.46 MG STORAGE TANK
OVERFLOW= 493.3 FT

SUDBURY RESERVOIR

SHAFT NO.3

HOSMER PUMP STATION

FAYVILLE DAM

TUNNEL

METROWEST WATER SUPPLY

TOWN SQUARE PRV

TARA ROAD
1.3 MG STORAGE TANK
OVERFLOW= 515.0 FT

MT. VICKERY PRV

PARKERVILLE ROAD PRV

OAK HILL
0.275 MG STORAGE TANK
OVERFLOW= 492.7 FT

WESTBOROUGH

FRAMINGHAM

ASHLAND

HOPKINTON

LEGEND

- TOWN BOUNDARY
- WATER BODY
- HIGH SERVICE AREA
- LOW SERVICE AREA

NODE PRESSURE

- < 20 PSI
- 20-35 PSI
- 35-90 PSI
- 90-120 PSI
- > 120 PSI

PRESSURES SHOWN ARE BASED ON 10 FEET BELOW TANK OVERFLOW ELEVATIONS

Graphic Scale 1"=800'

800' 400' 0 800' 1600' 3200'

PARE CORPORATION
ENGINEERS - SCIENTISTS - PLANNERS
8 BLACKSTONE VALLEY PLACE
LINCOLN, RI 02865
401-334-4100

TOWN OF SOUTHBOROUGH
WATER SYSTEM MASTER PLAN

SOUTHBOROUGH, MASSACHUSETTS

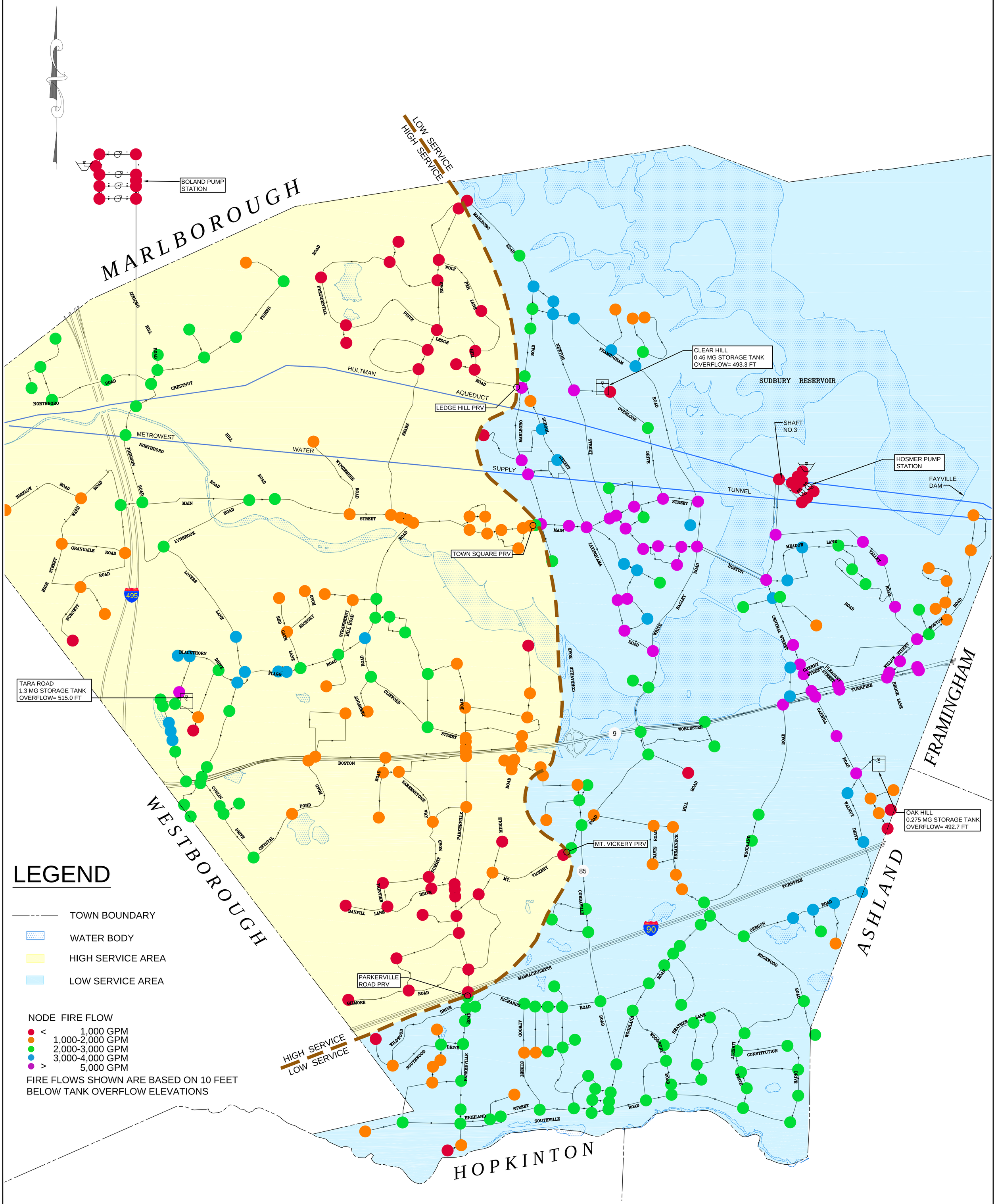
REVISIONS:

PROJECT NO.:	08176.15
DATE:	NOVEMBER 2016
SCALE:	1"=800'
DESIGNED BY:	SPD
CHECKED BY:	LMG
DRAWN BY:	AKL
APPROVED BY:	TPT

DRAWING TITLE: MDD PRESSURE EX. CONDITIONS

DRAWING NO.:

SHEET NO. 1 OF 12



LEGEND

- TOWN BOUNDARY
- WATER BODY
- HIGH SERVICE AREA
- LOW SERVICE AREA

NODE FIRE FLOW

- < 1,000 GPM
- 1,000-2,000 GPM
- 2,000-3,000 GPM
- 3,000-4,000 GPM
- > 5,000 GPM

FIRE FLOWS SHOWN ARE BASED ON 10 FEET BELOW TANK OVERFLOW ELEVATIONS

Graphic Scale 1"=800'

800' 400' 0 800' 1600' 3200'

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TOWN OF SOUTHBOROUGH
WATER SYSTEM MASTER PLAN

SOUTHBOROUGH, MASSACHUSETTS

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DRAWING TITLE: FIRE FLOW EX. CONDITIONS

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SHEET NO. 2 OF 12

BOLAND PUMP STATION

LOW SERVICE
HIGH SERVICE

MARLBORO

HULTMAN AQUEDUCT

LEDGE HILL PRV

CLEAR HILL
0.46 MG STORAGE TANK
OVERFLOW= 493.3 FT

SUDBURY RESERVOIR

SHAFT NO.3

HOSMER PUMP STATION

FAYVILLE DAM

TUNNEL

METROWEST WATER SUPPLY

TOWN SQUARE PRV

TARA ROAD
2.5 MG STORAGE TANK
OVERFLOW= 515.0 FT

MT. VICKERY PRV

PARKERVILLE ROAD PRV

OAK HILL
0.275 MG STORAGE TANK
OVERFLOW= 492.7 FT

WESTBOROUGH

FRAMINGHAM

ASHLAND

HOPKINTON

LEGEND

- TOWN BOUNDARY
- WATER BODY
- HIGH SERVICE AREA
- LOW SERVICE AREA

NODE PRESSURE

- < 20 PSI
- 20-35 PSI
- 35-90 PSI
- 90-120 PSI
- > 120 PSI

PRESSURES SHOWN ARE BASED ON 10 FEET BELOW TANK OVERFLOW ELEVATIONS

Graphic Scale 1"=800'

800' 400' 0 800' 1600' 3200'

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TOWN OF SOUTHBOROUGH
WATER SYSTEM MASTER PLAN

SOUTHBOROUGH, MASSACHUSETTS

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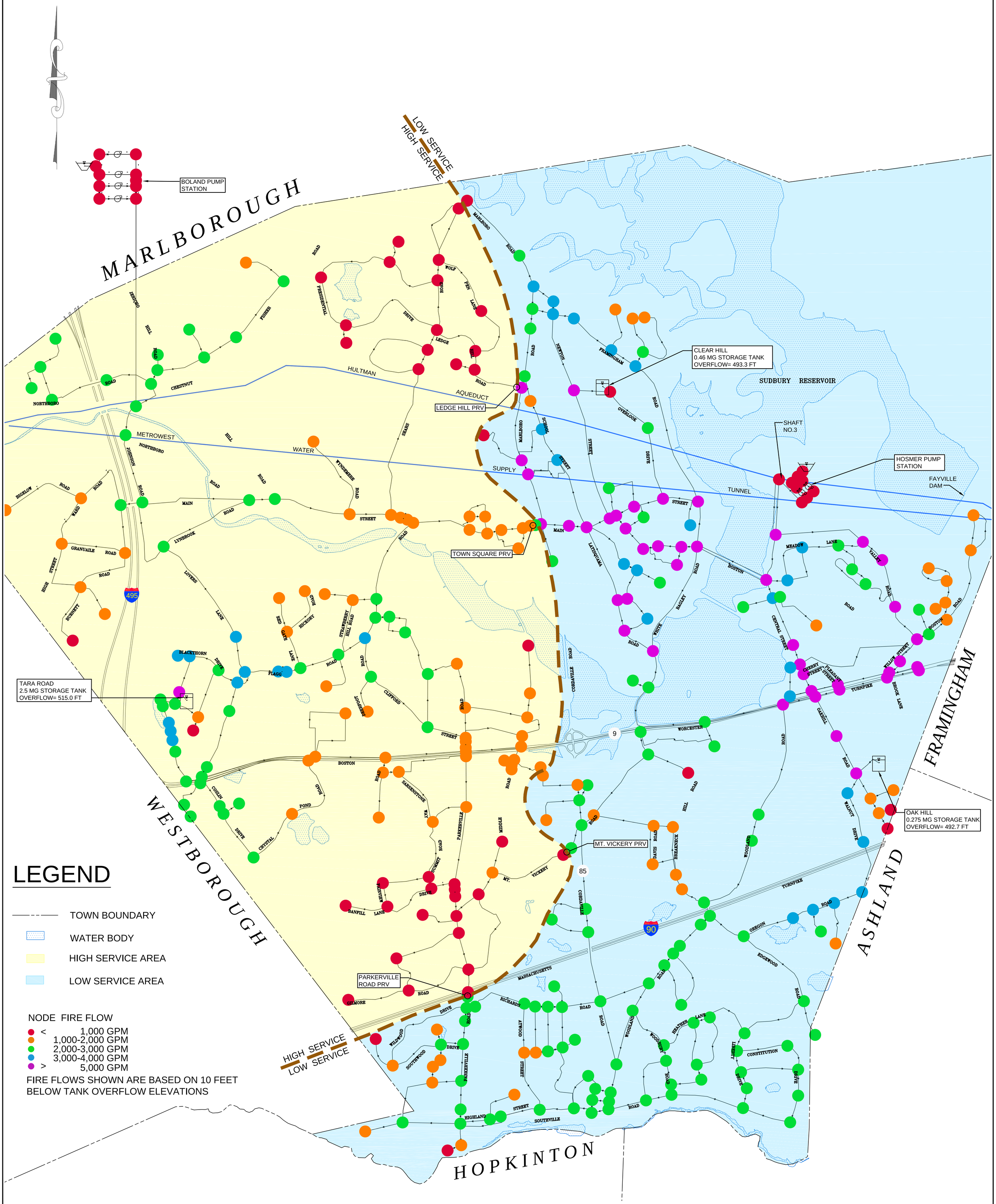
SHEET NO. 3 OF 12



LEGEND

- TOWN BOUNDARY
- WATER BODY
- HIGH SERVICE AREA
- LOW SERVICE AREA

NODE FIRE FLOW

- < 1,000 GPM
- 1,000-2,000 GPM
- 2,000-3,000 GPM
- 3,000-4,000 GPM
- > 5,000 GPM

FIRE FLOWS SHOWN ARE BASED ON 10 FEET BELOW TANK OVERFLOW ELEVATIONS

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TOWN OF SOUTHBOROUGH
WATER SYSTEM MASTER PLAN

SOUTHBOROUGH, MASSACHUSETTS

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DRAWING TITLE: FIRE FLOW OPTION 1

DRAWING NO.:

SHEET NO. 4 OF 12

BOLAND PUMP STATION

LOW SERVICE
HIGH SERVICE

MARLBORO

HULTMAN AQUEDUCT

LEDGE HILL PRV

CLEAR HILL
0.46 MG STORAGE TANK
OVERFLOW= 493.3 FT

SUDBURY RESERVOIR

SHAFT NO.3

HOSMER PUMP STATION

FAYVILLE DAM

TUNNEL

METROWEST WATER SUPPLY

TOWN SQUARE PRV

TARA ROAD
1.3 MG STORAGE TANK
OVERFLOW= 515.0 FT

FAIRVIEW ROAD
1.4 MG STORAGE TANK
OVERFLOW=515.0 FT

PARKERVILLE ROAD PRV

MT. VICKERY PRV

OAK HILL
0.275 MG STORAGE TANK
OVERFLOW= 492.7 FT

WESTBOROUGH

FRAMINGHAM

ASHLAND

HOPKINTON

LEGEND

- TOWN BOUNDARY
- WATER BODY
- HIGH SERVICE AREA
- LOW SERVICE AREA

NODE PRESSURE

- < 20 PSI
- 20-35 PSI
- 35-90 PSI
- 90-120 PSI
- > 120 PSI

PRESSURES SHOWN ARE BASED ON 10 FEET BELOW TANK OVERFLOW ELEVATIONS

Graphic Scale 1"=800'

800' 400' 0 800' 1600' 3200'

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TOWN OF SOUTHBOROUGH
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SOUTHBOROUGH, MASSACHUSETTS

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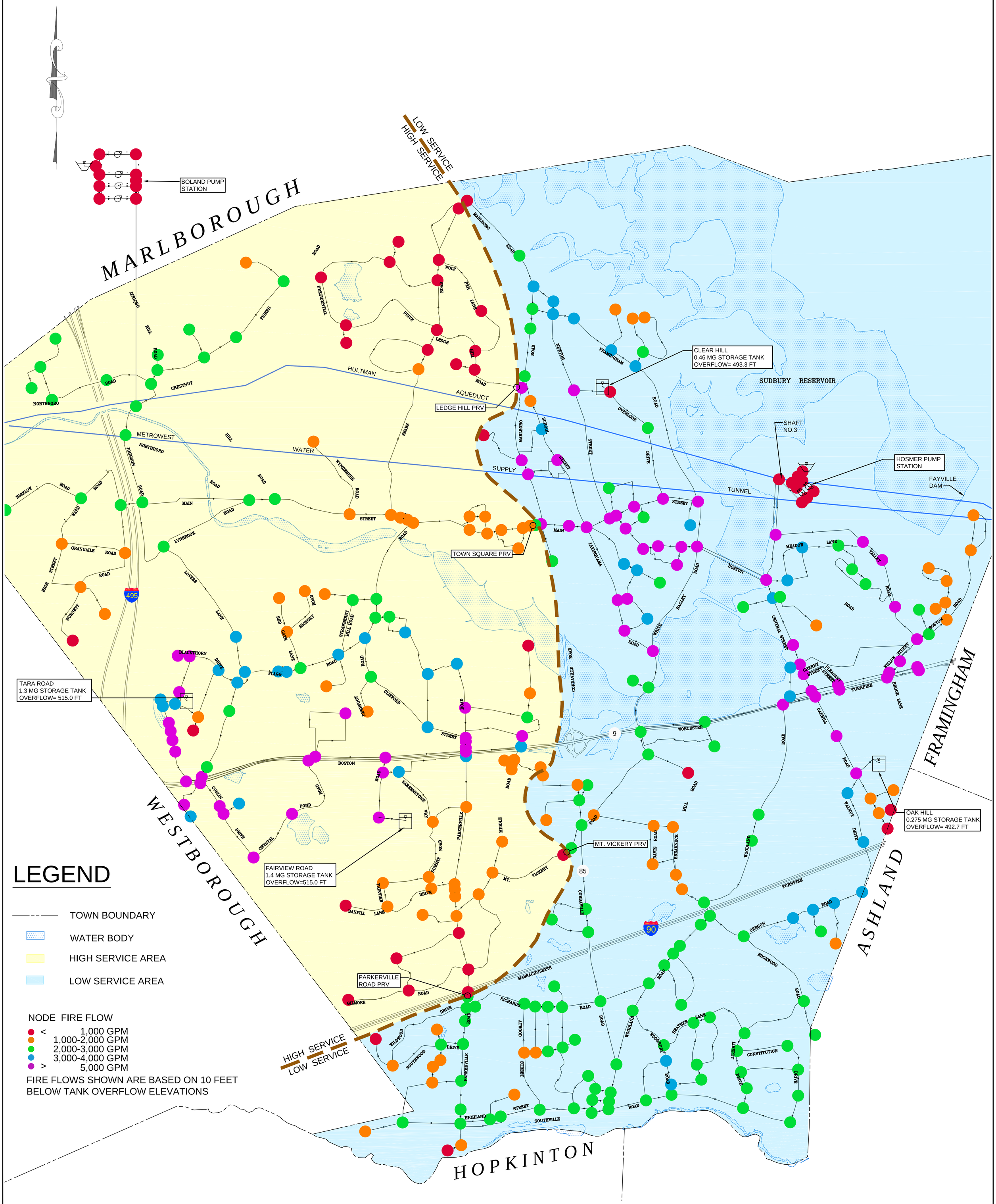

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TOWN OF SOUTHBOROUGH
WATER SYSTEM MASTER PLAN

SOUTHBOROUGH, MASSACHUSETTS

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FIRE FLOW
OPTION 1A

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SHEET NO. 6 OF 12

BOLAND PUMP STATION

LOW SERVICE
HIGH SERVICE

MARLBORO

HULTMAN AQUEDUCT

LEDGE HILL PRV

CLEAR HILL
0.46 MG STORAGE TANK
OVERFLOW= 493.3 FT

SUDBURY RESERVOIR

SHAFT NO.3

HOSMER PUMP STATION

FAYVILLE DAM

TUNNEL

METROWEST WATER SUPPLY

TOWN SQUARE PRV

TARA ROAD
1.3 MG STORAGE TANK
OVERFLOW= 515.0 FT

FAIRVIEW ROAD
1.4 MG STORAGE TANK
OVERFLOW=515.0 FT

MT. VICKERY PRV

PARKERVILLE ROAD PRV

OAK HILL
0.275 MG STORAGE TANK
OVERFLOW= 492.7 FT

WESTBOROUGH

FRAMINGHAM

ASHLAND

HOPKINTON

LEGEND

- TOWN BOUNDARY
- WATER BODY
- HIGH SERVICE AREA
- LOW SERVICE AREA

NODE PRESSURE

- < 20 PSI
- 20-35 PSI
- 35-90 PSI
- 90-120 PSI
- > 120 PSI

PRESSURES SHOWN ARE BASED ON 10 FEET BELOW TANK OVERFLOW ELEVATIONS

Graphic Scale 1"=800'

800' 400' 0 800' 1600' 3200'

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TOWN OF SOUTHBOROUGH
WATER SYSTEM MASTER PLAN

SOUTHBOROUGH, MASSACHUSETTS

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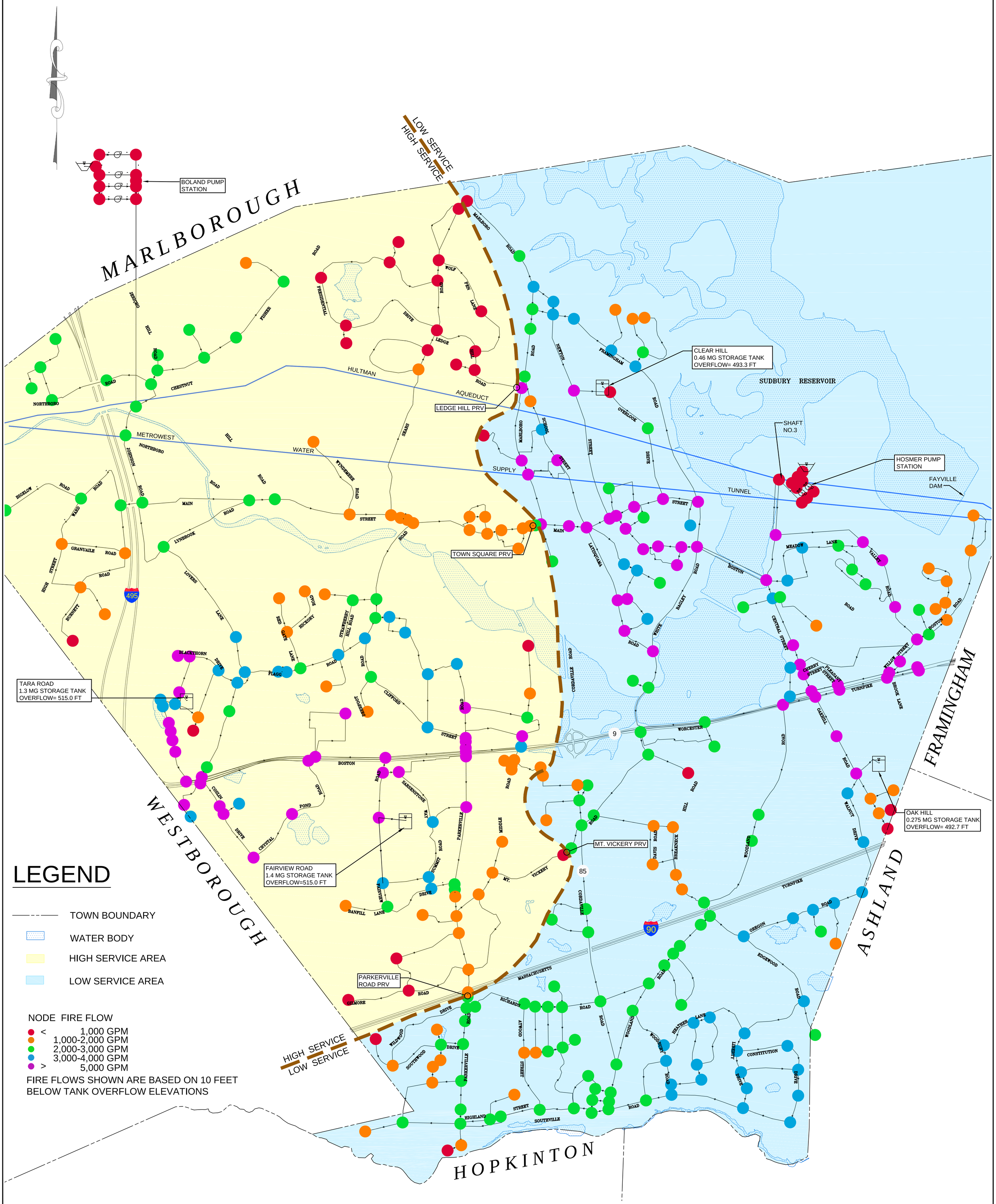

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TOWN OF SOUTHBOROUGH
WATER SYSTEM MASTER PLAN

SOUTHBOROUGH, MASSACHUSETTS

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SHEET NO. 8 OF 12

BOLAND PUMP STATION

MARLBORO

LOW SERVICE
HIGH SERVICE

HULTMAN AQUEDUCT

METROWEST WATER SUPPLY TUNNEL

LEDGE HILL PRV
ONLINE

NEW HSA PRV

OFFLINE
TOWN SQUARE PRV

CLEAR HILL
0.46 MG STORAGE TANK
OVERFLOW= 493.3 FT

SUDBURY RESERVOIR

SHAFT NO.3

HOSMER PUMP STATION

FAYVILLE DAM

TARA ROAD
1.2 MG STORAGE TANK
OVERFLOW= 555.0 FT

NEW HSA PRV

NEW HSA PRV

NEW HSA PRV
CLOSED

OFFLINE
PARKERVILLE ROAD PRV

OFFLINE
MT. VICKERY PRV

OAK HILL
0.275 MG STORAGE TANK
OVERFLOW= 492.7 FT

WESTBOROUGH

FRAMINGHAM

ASHLAND

HOPKINTON

HIGH SERVICE
LOW SERVICE

LEGEND

- TOWN BOUNDARY
- WATER BODY
- HIGH SERVICE AREA
- LOW SERVICE AREA

NODE PRESSURE

- < 20 PSI
- 20-35 PSI
- 35-90 PSI
- 90-120 PSI
- > 120 PSI

PRESSURES SHOWN ARE BASED ON 10 FEET BELOW TANK OVERFLOW ELEVATIONS

Graphic Scale 1"=800'

800' 400' 0 800' 1600' 3200'

PARE CORPORATION
ENGINEERS - SCIENTISTS - PLANNERS
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LINCOLN, RI 02865
401-334-4100

TOWN OF SOUTHBOROUGH
WATER SYSTEM MASTER PLAN

SOUTHBOROUGH, MASSACHUSETTS

REVISIONS:

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APPROVED BY:	TPT

DRAWING TITLE: MDD PRESSURE OPTION 2

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SHEET NO. 9 OF 12

BOLAND PUMP STATION

MARLBORO

LOW SERVICE
HIGH SERVICE

HULTMAN AQUEDUCT

METROWEST WATER SUPPLY TUNNEL

LEDGE HILL PRV
ONLINE

NEW HSA PRV

OFFLINE
TOWN SQUARE PRV

CLEAR HILL
0.46 MG STORAGE TANK
OVERFLOW= 493.3 FT

SUDBURY RESERVOIR

SHAFT NO.3

HOSMER PUMP STATION

FAYVILLE DAM

TARA ROAD
1.2 MG STORAGE TANK
OVERFLOW= 555.0 FT

NEW HSA PRV

NEW HSA PRV

NEW HSA PRV
CLOSED

OFFLINE
PARKERVILLE ROAD PRV

OFFLINE
MT. VICKERY PRV

OAK HILL
0.275 MG STORAGE TANK
OVERFLOW= 492.7 FT

WESTBOROUGH

HIGH SERVICE
LOW SERVICE

FRAMINGHAM

ASHLAND

HOPKINTON

LEGEND

- TOWN BOUNDARY
- WATER BODY
- HIGH SERVICE AREA
- LOW SERVICE AREA

NODE FIRE FLOW

- < 1,000 GPM
- 1,000-2,000 GPM
- 2,000-3,000 GPM
- 3,000-4,000 GPM
- > 5,000 GPM

FIRE FLOWS SHOWN ARE BASED ON 10 FEET BELOW TANK OVERFLOW ELEVATIONS

Graphic Scale 1"=800'

800' 400' 0 800' 1600' 3200'

PARE CORPORATION
ENGINEERS - SCIENTISTS - PLANNERS
8 BLACKSTONE VALLEY PLACE
LINCOLN, RI 02865
401-334-4100

TOWN OF SOUTHBOROUGH
WATER SYSTEM MASTER PLAN

SOUTHBOROUGH, MASSACHUSETTS

REVISIONS:

PROJECT NO.:	08176.15
DATE:	NOVEMBER 2016
SCALE:	1"=800'
DESIGNED BY:	SPD
CHECKED BY:	LMG
DRAWN BY:	AKL
APPROVED BY:	TPT

DRAWING TITLE: FIRE FLOW OPTION 2

DRAWING NO.:

SHEET NO. 10 OF 12

BOLAND PUMP STATION

MARLBOROUGH

LOW SERVICE
HIGH SERVICE

HULTMAN AQUEDUCT

METROWEST WATER SUPPLY TUNNEL

LEDGE HILL PRV

TOWN SQUARE PRV

CLEAR HILL
0.46 MG STORAGE TANK
OVERFLOW= 493.3 FT

SUDBURY RESERVOIR

SHAFT NO.3

HOSMER PUMP STATION

FAYVILLE DAM

TARA ROAD
1.3 MG STORAGE TANK
OVERFLOW= 515.0 FT

NEW EHSA PRV

NEW EHSA PUMP STATION

NEW EHSA TANK
OVERFLOW = 590 FT

MT. VICKERY PRV

PARKERVILLE ROAD PRV

OAK HILL
0.275 MG STORAGE TANK
OVERFLOW= 492.7 FT

WESTBOROUGH

FRAMINGHAM

ASHLAND

HOPKINTON

EXTRA HIGH SERVICE
HIGH SERVICE

HIGH SERVICE
LOW SERVICE

LEGEND

- TOWN BOUNDARY
- WATER BODY
- HIGH SERVICE AREA
- LOW SERVICE AREA
- EXTRA HIGH SERVICE AREA

NODE PRESSURE

- < 20 PSI
- 20-35 PSI
- 35-90 PSI
- 90-120 PSI
- > 120 PSI

PRESSURES SHOWN ARE BASED ON 10 FEET BELOW TANK OVERFLOW ELEVATIONS

Graphic Scale 1"=800'

800' 400' 0 800' 1600' 3200'

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ENGINEERS - SCIENTISTS - PLANNERS
8 BLACKSTONE VALLEY PLACE
LINCOLN, RI 02865
401-334-4100

TOWN OF SOUTHBOROUGH
WATER SYSTEM MASTER PLAN

SOUTHBOROUGH, MASSACHUSETTS

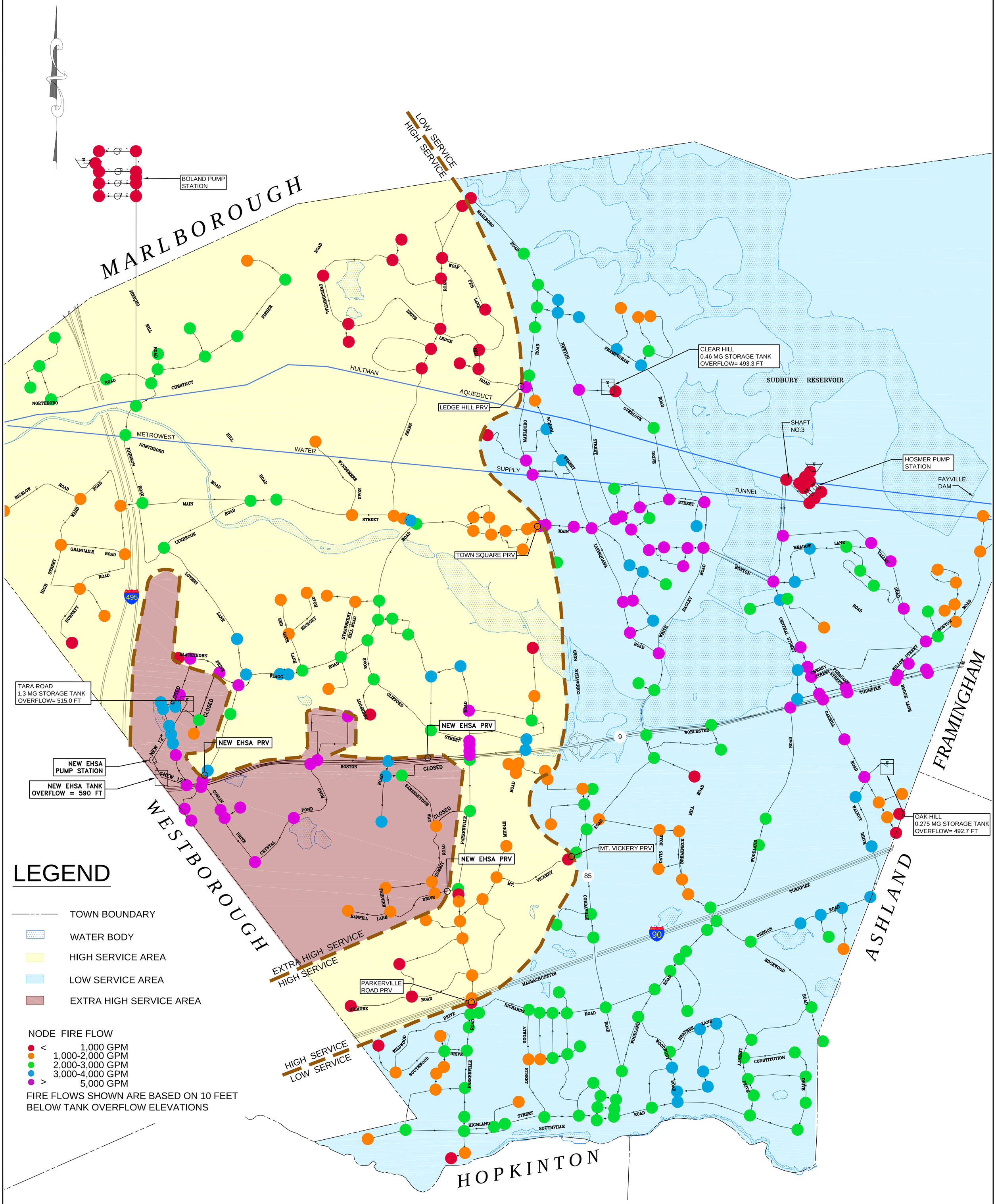
REVISIONS:

PROJECT NO.:	08176.15
DATE:	NOVEMBER 2016
SCALE:	1"=800'
DESIGNED BY:	SPD
CHECKED BY:	LMG
DRAWN BY:	AKL
APPROVED BY:	TPT

DRAWING TITLE: MDD PRESSURE OPTION 3

DRAWING NO.:

SHEET NO. 11 OF 12



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ENGINEERS - SCIENTISTS - PLANNERS
8 BLACKSTONE VALLEY PLACE
LINCOLN, RI 02865
401-334-4100

TOWN OF SOUTHBOROUGH
WATER SYSTEM MASTER PLAN

SOUTHBOROUGH, MASSACHUSETTS

REVISIONS:	

PROJECT NO.:	08176.15
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SCALE:	1"=800'
DESIGNED BY:	SPD
CHECKED BY:	LMG
DRAWN BY:	AKL
APPROVED BY:	TPT

DRAWING TITLE: FIRE FLOW OPTION 3

DRAWING NO.:

SHEET NO. 12 OF 12

Town of Southborough, MA
Meeting of the Public Works Planning Board (PWPB)
Tuesday, December 13, 2016
7:00PM
Room A&B Cordaville Hall
9 Cordaville Road

AGENDA

New Business:

Accept Minutes from November 7th meeting

Presentation of Draft Water System Storage Tank Evaluation Report by Pare Corporation

Discussion of report and audience comments/questions

Other business properly before the PWPB

Karen Galligan

Karen Galligan
DPW Superintendent

Public Works Planning Board
December 13, 2016 7:00 pm
Cordaville Hall Room A

Meeting Minutes

Board Members Present: Mark Bertonazzi, Bob Bezokas, Jamie Hellen, Jim Harding, Sue Baust
DPW representative: Karen Galligan
Also present: Tim Thies (Pare Corp), abutters

Jamie called the meeting to order at 7:02pm.

Approve minutes of November 7, 2016

Bob made a motion to approve the minutes and Jamie seconded it. The motion passed unanimously.

Water Storage Tank Discussion

Jamie introduced the main top for tonight. He said there would be no decision made tonight. Our comments on the report will be given to Pare Corp. Our recommendations will be delivered to the Board of Selectmen on a date to be determined in January.

Tim (Pare Corp) made a presentation beginning with a brief description of the continuing effort to increase water storage capacity in town. We need more storage for fire protection. They are looking at how to solve the pressure problem, the need for additional "usable" storage and redundancy.

There were questions about the number of homes affected and the costs of getting to the site. Currently 50 homes have low pressure.

Options include Tara or Flatley, fire pond option. There is the possibility of pumping water from the reservoir for fire.

Flatley as a separate option does not have as much redundancy as the Fairview option.

They are looking at other ways to solve the pressure problems

Property values - what would happen to property values with a water tower nearby. There is the possibility of reimbursing people for loss of property value. There is case law for mitigation dollars. Aesthetics are important.

They discussed water supply vs storage vs psi

The Fire Chief will weigh in on the ratings before we go to the Board of Selectmen.

Builders benefit from town water

Future Meeting

To be determined

We adjourned at 9:30pm.

Respectfully submitted,

Sue Baust

Pare Comment: The following pages were provided by a resident of the Fairview neighborhood at the March 13, 2017 meeting.

Water Storage Tank Evaluation: Resident Input

March 13, 2017

Resident Input from 12/13/16 Meeting not Addressed

- **Usable Storage:**
  - If storage is the primary objective, why is usable storage not used as an evaluation criteria and weighted accordingly?
  - A request was made to include a table that provides a direct comparison of the usable and unusable storage of each option (existing, new, total)

- **Pressure and Fire Flow:**
  - What quantifiable data supports the "significant improvement" rating of Fairview Hill option 1B vs the "modest improvement" rating of the Park Central option 3?
  - The report states that the Park Central development includes certain land that is too high to be served by the existing storage tanks. How was this factored into the overall evaluation of the options, particularly Option 3?
  - At the December meeting there was discussion that the creation of an EHSA provides better pressure and fire flow to meet the development potential of the EHSA. How is this factored into the evaluation of the options, particularly the Park Central Option 3?

- **Cost:**
  - Why is the cost evaluation a simple comparison of total cost vs consideration of what is achieved with each option, i.e. what you get for the dollars spent?
  - Why isn't the "efficiency" of the capital investment as measured by cost/usable gallon given more consideration?
  - Has potential cost mitigation from developer(s) been factored into the cost assessment?
  - Has litigation risk and liability for residential property value impact been factored into the cost assessment?

- **Redundancy:**
  - Explain why the Park Central Option 3 does not promote some level of redundancy when operationally there is the ability to share water between the HSA and EHSA?

- **Weighted Scenarios and Rating Scale**:
  - Why are no new weighted screenings presented that take into account the residents' input?
  - The additional screens presented in Appendix B attempt to use a scale but does not apply a scale to all criteria. Why isn't a scale applied to all the evaluation criteria?
  - Why is there inconsistency in the Pare ratings when the criteria is evaluated the same between options? (see pg. 14, Table 4)

Additional Screens Using Pare Methodology

Comparison of Weighted Screenings

#	Screen Description (Emphasis)	Screening Criteria - Weighting							Tank Option - Weighted Total				
		Cost ($M)	Cost/Gallon (usable)	Pressure	Fire Flow	Unusable Storage (MG)	Promotes System Redundancy	Total	1	1A	1B	2	3
1	Equal Weighted (Pare)	16.7%	16.7%	16.7%	16.7%	16.7%	16.7%	100.2%	1.8	3.4	3.3	2.8	3.3
2	1st (Pare)	25.0%	15.0%	10.0%	25.0%	10.0%	15.0%	100.0%	2.1	3.8	3.5	2.6	2.9
3	2nd (Pare) -emphasize cost	40.0%	0.0%	10.0%	25.0%	10.0%	15.0%	100.0%	2.2	4.2	3.8	2.3	2.3
4	3rd (Pare) - emphasize cost and fire flow	40.0%	0.0%	10.0%	35.0%	0.0%	15.0%	100.0%	2.2	4.4	4.0	2.1	2.1
5	4th (Pare) -eliminate cost, emphasize fire flow	0.0%	0.0%	25.0%	40.0%	10.0%	25.0%	100.0%	1.0	3.6	4.3	2.5	3.2
6	Capital efficiency (repeat 2nd above)	0.0%	40.0%	10.0%	25.0%	10.0%	15.0%	100.0%	1.8	3.0	3.0	3.1	3.9
7	Capital efficiency and fire flow (repeat 3rd above)	0.0%	40.0%	10.0%	35.0%	0.0%	15.0%	100.0%	1.8	3.2	3.2	2.9	3.7
8	Storage and fire flow (others equal weight)	10.0%	10.0%	10.0%	30.0%	30.0%	10.0%	100.0%	1.5	3.4	3.5	2.9	3.6
9	Equal weight cost, storage and fire flow only	16.7%	16.7%	0.0%	33.3%	33.3%	0.0%	100.0%	1.8	3.3	3.2	3.0	3.7
10	Consider only storage and fire flow	0.0%	0.0%	0.0%	50.0%	50.0%	0.0%	100.0%	1.0	3.3	3.8	3.0	4.0

- Original Pare screens (#1-5 above)
  - The primary objective of storage is minimized in all five Pare screening

- Additional screens (#6-10 above):
  - #6 – Repeat 2nd Pare using Capital Efficiency (cost/gallon) instead of Total Cost
  - #7 – Repeat 3rd Pare using Capital Efficiency (cost/gallon) instead of Total Cost
  - #8 – Emphasize primary objectives of Storage and Fire Flow, all other criteria equal weight
  - #9 – Equal weight Storage, Fire Flow and Cost
  - #10 – Equal weight Storage and Fire Flow only

The additional screens demonstrate an equally compelling case can be made for Park Central Option 3 as the top rated option, particularly when weighting is given to the primary objectives of Storage and Fire Flow.

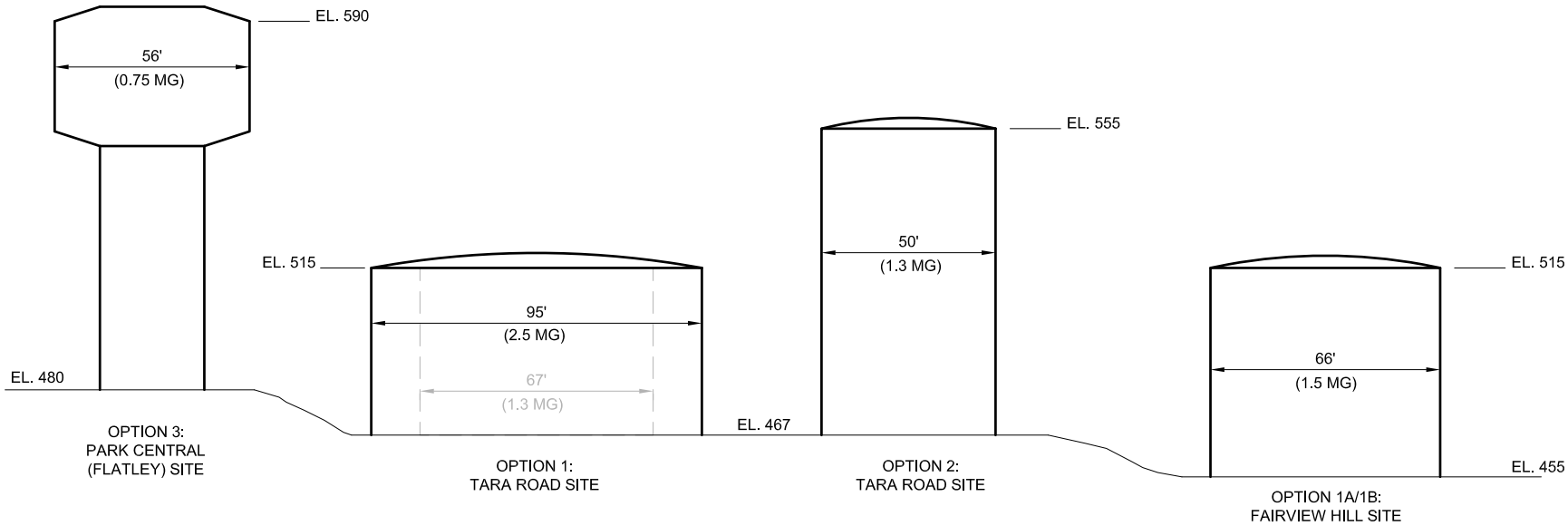
Direct Comparison of Fairview Hill and Park Central Options

Criteria	Option 1A/1B Fairview Hill	Option 3 Park Central
Total Usable Storage for HSA/EHSA	.98 MG	1.6MG
Additional storage capacity for unforecasted demand or operational flexibility	No	Yes
Pressure Increase	No Change	Increase (32 psi)
Fire Flow Improvement	Modest/Significant	Modest
Ability to serve Park Central high ground	No	Yes
Promotes System Redundancy	Yes	?
Total Cost	$4.8M	$6.2M
Cost/Usable Gallon (Investment efficiency)	$18.45/gal	$4.77/gal
Cost mitigation potential from developer	No	Yes
Residential property value impact/litigation risk	Yes	No

- **Park Central favorability over Fairview Hill:**
  - Better meets the combined operational needs of usable storage, pressure and fire flow improvement (redundancy TBD)
  - Better positions to meet the demands of the ground too high for the existing HSA.
  - Better investment efficiency, i.e. achieves more for the dollars invested
  - Better opportunity to mitigate costs
  - Avoids residential property value impact, litigation risk

APPENDIX E

Water Tank Profile – Storage Tank Evaluation



PARE CORPORATION
ENGINEERS - SCIENTISTS - PLANNERS
8 BLACKSTONE VALLEY PLACE
LINCOLN, RI 02865
401-334-4100

PROJECT NO. 08146.18 DATE: FEBRUARY 2017

WATER TANK PROFILE
STORAGE TANK EVALUATION
APPENDIX E

SOUTHBOROUGH, MASSACHUSETTS SCALE: NOT TO SCALE

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