SECTION 5.0
FUTURE SYSTEM EVALUATION

After entering the build-out information into the model, PARE used the model to evaluate future system performance. As with the existing system evaluation, PARE evaluated an ADD, a MDD, and a PH demand scenario, as well as a fire flow analysis for a build-out condition. PARE evaluated the available pressure throughout the system, as well as the available fire flow. PARE also evaluated the performance of the system pump stations and the rate at which the system storage tanks either filled or drained during each scenario.

5.1 DEMAND DATABASE

PARE updated the hydraulic model demand database to reflect the addition of future water demand town-wide. In order to more accurately reflect the distribution of future water demand in the system, PARE addressed residential and non-residential water demand in two different ways.

5.1.1 *Residential Demand*

The future water demand added to the High Service Area for the ADD is approximately 98,400 gpd, which was distributed over the 133 nodes in the High Service area (i.e., 0.51 gpm/per node) in addition to any existing demand on those nodes. The future water demand added to the Low Service Area for the ADD is approximately 120,300 gpd, which was distributed over the 195 nodes in the Low Service Area (i.e., 0.43 gpm/per node).

5.1.2 *Non-Residential Demand*

To update the non-residential demand for the future system analysis, PARE assumed that the future non-residential build-out would occur only in areas currently zoned for business and/or industry and in addition would be generally limited to the parcels abutting Rt. 9. There are 43 nodes in the model along Rt. 9 that PARE assumed would represent future non-residential use. As indicated in Table 4-3, the ADD for non-residential water demand at build-out is approximately 214,000 gpd, which was distributed over 43 nodes along Rt. 9 (i.e., 3.46 gpm/per node) in addition to any existing demand on those nodes. After PARE applied the non-residential water demand to the 43 nodes along Rt. 9, PARE utilized the same methodology as was used in the existing system evaluation to apply the future residential water demand by service area. The future water demand was subdivided in the model into the two (2) service areas, the High Service Area and the Low Service Area.

5.1.3 *Future Peak Demands*

PARE utilized the same peaking factors established in the sections 2.1.2 and 2.1.3 for the maximum day (2.53) and the peak hour (5.18) water demands. Table 5-1 provides the total water demand for each service area for an average day, maximum day, and peak hour demand scenario.

TABLE 5-1: Future Water demand in Southborough by Service Area

	Average Day (GPD)	Maximum Day (GPD)	Peak Hour (GPD)
High Service Area	810,000	2,049,000	4,196,000
Low Service Area	712,000	1,802,000	3,688,000
TOTAL	**1,522,000**	**3,851,000**	**7,884,000**

Under the existing contract with MWRA, the average annual and maximum daily limit on water withdrawals will be 475 MGY and 3.9 MGD by the end of this contract in 2016. If Southborough reaches build-out before 2016, which it is not anticipated to do, the average annual demand of the system (i.e., 556 MGY, or 1.52 MGD) would exceed the limit imposed by MWRA of 475 MGY. However, the Town will be slightly below the maximum daily limit of 3.9 MGD.

5.2 STEADY STATE ANALYSIS

PARE created a steady state demand scenario for the ADD, MDD, and PHD future demand scenarios. The same methodology was utilized to evaluate future build-out of the system as was used for the evaluation of the existing system, i.e., AWWA M32 was used as a guide, the largest pump in each station was off-line, etc.

5.2.1 *Hydraulic Evaluation*

As with the existing system evaluation, a steady state analysis was used to evaluate typical system pressures and the net change in system storage for the ADD, MDD, and PHD scenarios for the future system.

The results of the steady-state analysis evaluation are summarized in the table below and the hydraulic model reports are attached as Appendix M.

TABLE 5-2: Future System Evaluation (Steady State Analysis)

	Available Pressure			Available Fire Flow
	Average Day Demand	Maximum Day Demand	Peak Hour Demand	
High Service Area	23 - 105 psi	23 - 109 psi	22 - 105 psi	640 - 3,600 gpm
Low Service Area	29 - 123 psi	29 - 122 psi	28 - 124 psi	825 - 4,850 gpm
Tank Filling Rate (HSA)	124 gpm	-153 gpm	-1,207 gpm	
Tank Filling Rate (LSA)	174 gpm	-599 gpm	-1,551 gpm	

It appears as though the increase in system demand at build-out will not have a significant impact on system pressure. The results for the build-out scenario are similar to the results for the existing system. The pressure in the High Service Area ranges from 22 to 105 psi, with 8 nodes (out of 133 nodes) falling below 35 psi and 49 nodes above 90 psi on a regular basis. The pressure in the Low Service Area ranges from 29 to 124 psi, with 1 node (out of 195 nodes) falling below 35 psi and 55 nodes above 90 psi on a regular basis.

5.2.2 *Supply Evaluation*

During a future ADD scenario, it appears as though the existing system pumps would be able to keep up with system demand even with the largest pump in each station off-line, as is evident by the net filling rate of the system storage tanks. On a MDD when the largest pump in each station is off-line, demand significantly outpaces the pump stations' ability to supply water, as is evident by the net draining rate of the system storage tanks.

The existing capacity of the Boland Station is approximately 1.58 MGD (with the largest pump off-line). The future MDD for the High Service Area is approximately 2.05 MGD, or 130 percent of the station's capacity.

The existing capacity of the Hosmer Station is approximately 0.79 MGD (with the largest pump off-line). The maximum day demand for the Low Service Area is approximately 1.80 MG, or 228 percent of the station's capacity.

Based on these results, it appears as though both stations have a significant capacity deficit during the future maximum day demand scenario, with one pump off-line. With both pumps on-line, the station capacity of Hosmer is approximately 1.73 MGD, which is still inadequate for the future maximum day demand in the Low Service Area. In the Boland Station, there is an additional emergency backup pump, which was turned-off for this evaluation. With that pump on-line, the total station capacity would be approximately 3.02 MGD, which would be adequate for future demand in the High Service Area. However, it is unlikely that the Town would opt to run that pump in conjunction with the other two pumps, given that it needs to be manually started, which would make it difficult to keep pace with changes in demand. In addition, the station may see a reduction in overall capacity if that pump were run with the other two pumps given that it is so much larger than the other two pumps. It is anticipated that the overall station capacity would be much lower than the sum of the three pumps' rated capacity.

If the existing PRVs between the High Service Area and the Low Service Area allow water to be shared between the two service areas, the total pump station capacity would be approximately 2.37 MGD, still 1.48 MGD short of the total system demand on a maximum day (i.e., 3.85 MGD). Therefore, even if the PRVs allowed water to be shared between the two services areas, the system would have a deficit in pump station capacity.

Based on the results of this evaluation, it appears as though an increasing portion of system demand will be met through system storage. As a result, system storage will become increasingly depleted, which could have an adverse impact on system pressure and water available for fire flow. To rectify this issue, the Town should consider increasing the capacity of both system pump stations.

5.2.3 *Storage Tank Evaluation*

The existing deficit in system storage will become worse as the system gets built-out. Based on similar assumptions made in section 3.1.3 (i.e., equalization and emergency storage should equal approximately one-half a maximum day's demand, and fire flow storage should equal approximately 0.63 MG), the future storage requirement in the Low Service Area is approximately 2.4 MG. The future storage requirement in the High Service Area is approximately 2.6 MG. Total future system storage is approximately 5.0 MG, approximately 4.0 MG more than what is currently available system-wide.

5.2.4 *Pipe Evaluation*

PARE used the hydraulic model to evaluate the system's piping network after full town-wide build-out. The evaluation was conducted during a PH scenario, which is consistent with our evaluation of the existing system. Based on the model results, there are no water mains in the system that have velocities in excess of 5-ft/sec. The highest velocity in the system is in the 12-inch main along the service road to Hosmer, which has a velocity of 4.03-ft/sec.

In general, the added demand of the system at full build-out does not appear to have a significant impact on the performance of the piping system.

5.2.5 *Fire Flow Evaluation*

The model results indicate that the available fire flow in the High Service Area ranges from 580 gpm to 3,150 gpm and in the Low Service Area range from 840 gpm to 5,000 gpm. Therefore, it appears as though fire flow would be generally adequate in most areas of Town after full build-out, even though some areas would experience a slight reduction in available fire flow over what is available now.