Routing and Bell Times Study

Masconomet Regional School District and Tri-Town School Union

March 9, 2018

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Dr. Kevin Lyons and Dr. Scott Morrison
Superintendents
Masconomet Regional School District
Tri-Town School Union

Dear Drs. Lyons and Morrison:

School Bus Consultants (SBC) is pleased to submit the following results of our study of transportation operations, bell times, and the possible implementation of a bell time schedule change. In addition to analyses in these areas, we are pleased to provide a series of findings and recommendations to support Tri-Town and Masconomet in their efforts to operate with a high level of efficiency and effectiveness.

The results of this study are based on the data and information provided by district staff, and from the onsite interviews and observations. We would like to take this opportunity to thank you both as well as Susan Givens, Peter Delani, and Steven Greenburg for providing us with this important information.

SBC looks forward to your review of this document and also looks forward to providing continued assistance as we move into the implementation phase. Please do not hesitate to contact us with further questions, comments or concerns.

Sincerely,
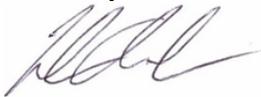
Mike Archer
Project Manager

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Executive Summary

The following summarizes the observations, findings, and recommendations of the primary areas of this study. Additional detail, summary of methodology, and further discussion can be found within the report document.

Current Operations

The preliminary tasking of this study included a comprehensive review of the current transportation service. School Bus Consultants (SBC) has completed this evaluation by visiting and interviewing stakeholders onsite, collecting information from various sources, and observing aspects of the operation in the field. The following findings are the result of SBC's work.

The bus network is efficiently transporting a large number of students on a small number of buses, utilizing seating capacity and the re-use of a bus multiple times. Buses are used twice, with the exception of just one. In addition to this efficient practice, buses are scheduled to be full with an average of 68 students assigned per trip.

Baseline transportation costs are on par with the national average. The procurement of services through a contractor places the vast majority of transportation costs in the hands of the contract itself. In the aggregate, across all four districts, the measured annual cost per bus of $62,042 is consistent the national average of $62,000. Considering the number of students transported on each bus, the overall system is efficient from a financial standpoint.

The trips are explicitly designed to serve Masco first and elementary schools second. As the routes are designed today, it is important to note that they are strategically designed. Some buses are scheduled to arrive at Masco in the morning with plenty of time to perform a long elementary trip thereafter. The strategy comes into play when considering the location of the final stop in the first trip, and the starting point of the second trip. Reversing bell times, as has been evaluated within "Scenario Y" would require significant re-routing of the buses.

Policy dictates nearly all students must be transported. The geography of the area, as well as the district policies and State Law establish that all students within the districts must be transported. In many cases, especially for younger students, a driveway bus stop may be required. This eliminates many opportunities to redesign bus route to allow for efficient re-routing. In many cases, the routes as designed are the most efficient as is possible, given the geography. Significant policy changes would have to occur if the districts wished to consolidate bus stops or establish neighborhood stops.

Bell Time Planning and Considerations

The final two tasks within the SBC scope of work involves evaluating bell time options and planning for implementation. These findings build upon the work performed previously. A comprehensive review of current operations allows for an understanding of impacts resulting from re-aligning bell time schedules. The following findings reflect SBC's work and analysis related to the bell time options themselves, and particularly Option Y.

Options Y as established in the STAC report will require additional fleet. By SBC's estimation, the requirement is approximately 9 to 11 buses each in order to implement the schedule. This is due largely to the window of time between the elementary districts and Masco in the morning and afternoon. Reflecting back to a previous finding, the system is designed for Masco first, and the number of buses currently required for adequate service is a reflection of this.

SBC recommends more time between each tier in order to mitigate the increase in the number of buses. In the report, the number of buses required is listed next to a series of time increments between the Tri-Town bells and the Masco bell. As the time between bells approaches 30 minutes, we see the nine to eleven bus range as estimated for Option Y. As the time widens to 45 minutes, the number drops to 6 and then ultimately to 0 at one hour.

The process of arrivals and dismissals at the elementary districts presents a challenge in time and logistics. Presently, elementary students arrive and depart from the elementary schools in two waves, once for each school per town. This process takes approximately ten minutes at the first school, five minutes of transportation to the second school, and five minutes of boarding at the second school. Even if this was reduced to 15 minutes, it is above what SBC typically sees in dismissals, which is 8 to 12 minutes total. When planning for elementary bus routes, this time must be considered. This adds to the complexity of Option Y.

While the process works and benefits both safety and student accountability, strategy can be applied in some instances. The ability for students to transfer onto a bus continuing onto the second school can combine groups of students into a single transfer, rather than sending the entire fleet of nearly empty buses to make the trip. This would constitute a significant change in culture and training of the personnel in charge of ensuring the safe boarding and unloading, and so requires careful consideration. However, from a logistics standpoint, opportunities for efficiency exist.

Introduction

The Masconomet Regional School District (Masco) and the Tri-Town School Union are located in northeastern Massachusetts, and span three individual Towns. Boxford, Middleton, and Topsfield each operate two elementary schools as part of the Tri-Town School Union, while Masco operates a middle and high school. The Masco schools receive students from the combined attendance areas of the three Tri-Town towns. Serving these schools, a total of 29 regular education buses are deployed to transport students to and from school on a daily basis. In addition, approximately six special education vans are utilized to transport students to the public schools, as well as non-public specialized programming.

The committees representing these school districts approved the proposal of School Bus Consultants (SBC) to engage with the districts in order to provide a comprehensive review of the facilitation of transportation services and the analysis of transportation impacts as a result of a new alignment of bell schedules. The impetus being research supporting a later sleep schedule for adolescents, and thus a later bell time for the secondary Masco schools.

SBC began collecting data in December of 2017, and had reviewed initial findings with the joint committees in January of 2018. This report is a summary of work performed, the analyses, methodologies used, findings, and recommendations. The review goes beyond the review of bell schedules, and aims to review the span of transportation operations in addition to the potential scheduling impacts of bell time shifting.

Baseline Analysis

The scope of the work performed by SBC begins with a review of the system in terms of operations and finances. This section of the report will summarize our findings in these areas, and will establish a summary of the transportation operation at Tri-Town and Masco.

Financial Review

The review of transportation is somewhat complicated by the fact that each town procures transportation individually. Each does so under the same transportation contract, however the contract pricing is unique to each town based on respective transportation needs. Transportation is procured through contract with NRT Bus, located nearby. This contract represents nearly all of the costs associated with to-from school transportation. Additional transportation costs are incurred from athletics, field trips, extra-curricular trips, and special education activities. These additional costs vary widely across the towns based on their unique populations and programming.

The contract defines a daily cost per bus for each district; each of the three towns and for Masco. The table below highlights these costs.

Table 1: Contract Costs

District	Average Over 5 Years (shared)	Average Over 5 Years (single)
Masconomet	$33,135	N/A
Middleton	$25,890	$51,012
Topsfield	$25,890	N/A
Boxford	$26,034	N/A

In aggregating the individual contract averages above, and applying them to the true utilization of shared and independent buses, we come to an average cost of $62,042. The costs are favorable for the area. In the Northeastern United States, costs can vary widely but are typically higher than the national average. The national average is $60,000 and as such, NRT Bus is offering a competitive price.

Operational Benchmarking

The districts enlist 29 buses to provide transportation to all students. These 29 buses transport nearly 3,900 students daily across 114 trips (57 in the morning and 57 in the afternoon). The fleet performs two trips in the morning and the afternoon, with the exception of one bus that only does an elementary route.

One an average trip, there are 68 students scheduled to ride the bus. This volume of ridership on each trip represents a very efficient utilization of available seating. The average bus capacity is 72 students when they are sitting three per bench, and thus a load of 68 represents 94 percent of seats occupied. For secondary students, two students per seat is typically the maximum capacity, and so over 100 percent of seats are scheduled to be occupied.

The utilization of available seating capacity produces an average annual cost per student of $462. This compares favorably to the national average of $1,050 annually per student. The high student ridership on each bus, coupled with the fact that buses are deployed more than once throughout the day, drive this average cost down to a favorable level.

Below, a table summarizes some of the important operational benchmarks for service and cost effectiveness.

Table 2: Summary of Operations Metrics

Summary Data	Value
Total Buses	29
Total Trips	114
Trips Per Bus	3.93
Average Time Spent on the Bus	23 minutes
Average Total Trip Time	40 minutes
Average Assigned Riders (system-wide)	64

Overall, the time spent on the bus averages out to be just 23 minutes per trip. This time is measured by the departure of the school driveway to the last stop on the scheduled trip. When considering time spent waiting in the driveway for onboarding and unloading students, the total trip time increases to about 40 minutes.

Findings: Baseline Analysis

The bus network is efficiently transporting a large number of students on a small number of buses, utilizing seating capacity and the re-use of a bus multiple times. Buses are used twice, with the exception of just one. In addition to this efficient practice, buses are scheduled to be quite full. On average throughout all of the districts, 68 students are scheduled to ride a bus on average.

Baseline transportation costs are on par with the national average. The procurement of services through a contractor places the vast majority of transportation costs in the hands of the contract itself. In the aggregate, a cost per bus of $62,042 annually is close to the national average of $62,000. Understanding that there may be some additional administrative costs associated with transportation that are difficult to quantify, the cost is likely to remain close to the average. Combined with the efficient scheduling of the buses, these two factors make for a cost effective bus system.

Route Review

The routes are designed in two tiers or "waves" of transportation. First, Masco buses are deployed followed by a route serving an elementary district. These bus routes, schedules, and policies defining them are evaluated throughout this section of the report.

Routing Analysis

In total, 29 buses perform 57 trips in the morning and then again in the afternoon. This begins with a Masco trip followed by an elementary trip. The elementary trips serve both schools within each respective town. They accomplish this by arriving at the first school and dropping off the appropriate students, then continuing to the second school. The fleet is split in terms of which school they service first and second, so one half of the fleet will switch with the other as they transport to the second school. Masco trips pick up and drop off at the same location. Buses will arrive at Masco starting at 7:08 AM, and dismiss 15 minutes following the bell in the afternoon.

The routes and trips vary in terms of ridership, length of driving time, mileage, and geographic area served. This variety likely contributes to the variation in cost per bus by town. In addition, this variety plans an important role in developing bell time schedules.

Below, both Masco and elementary routes are displayed, organized into measurements of total time on the road.

**Figure 1: Total Driving Time by Route**
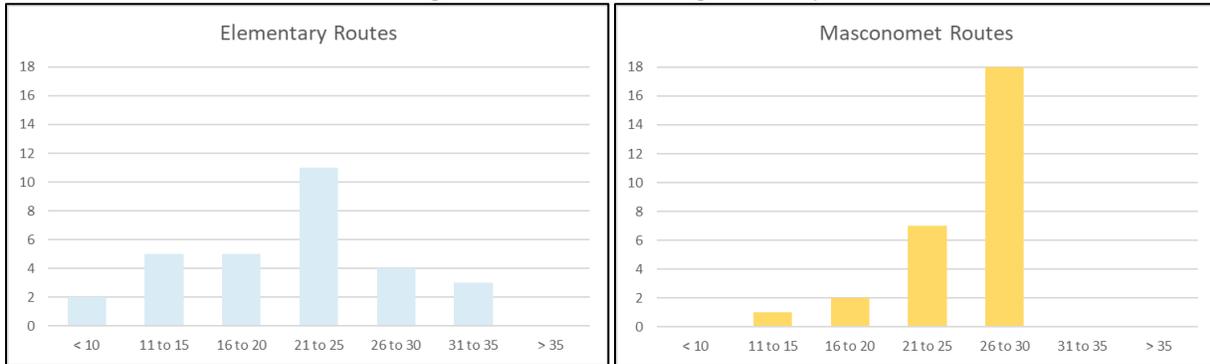
As shown above, the ride times for elementary trips are wide ranging, with the most trips within the 21 to 25 minute range. It is important to remember that when adding in arrival and dismissal procedure, these total trip times are more like 41 to 45 minutes. The lower number representing students time spent on the bus is more of a measure of service than logistical accounting. Bus rides in excess of 45 minute total can begin to be problematic for students and behavior concerns.

For Masco trips, by and large most trips are within the 26 to 30 minute range. No trips are longer than this. This is due to the window of time that buses have to perform a trip in the afternoon before returning to perform a subsequent elementary trip. This is an important consideration for designing a new bell time schedule alignment. A similar distribution would be seen in an elementary route redesign, if elementary schools were to arrive and dismiss first.

In an effort to demonstrate some of the extreme distance traveled by buses within their window to perform a trip, SBC has prepared a map below. The map shows a long Boxford bus route, serving the far northwestern corner of the town.

Figure 2: Bus Route Example
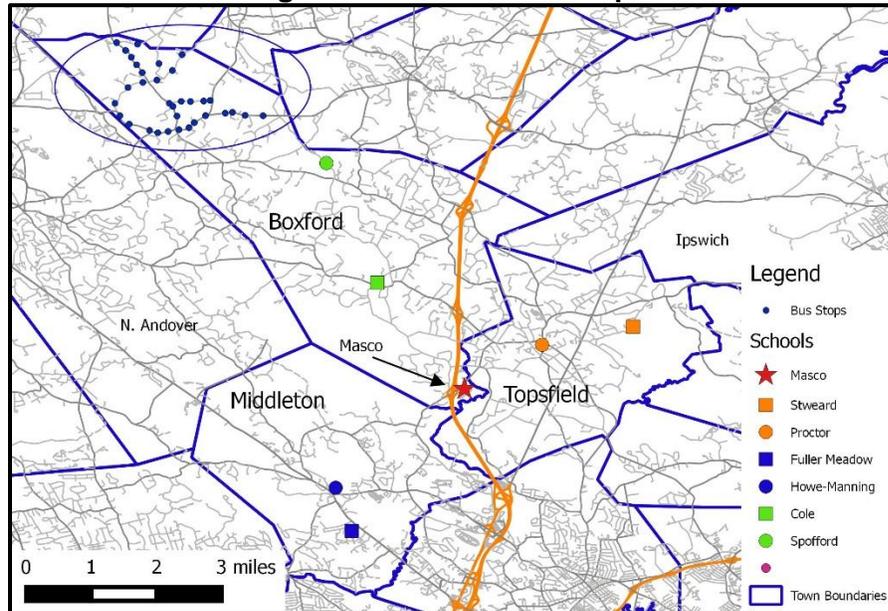
As shown, in the far corner of Boxford, the bus makes several stops along Washington Street, Main Street, Lakeshore Road, and Lily Pond Road. These roads are narrow and lacking sidewalks, so buses must make a stop at the driveway. This route is designed so that it ends near Spofford Pond Elementary, however if this route were to be performed with an immediate turnaround to Masco, the length of time required for this would be higher. Below, we see the furthest points of the three towns, with a mileage distance and estimated time requirement for returning to Masco from the respective points.

Figure 3: Distance from Last Stop to Masco
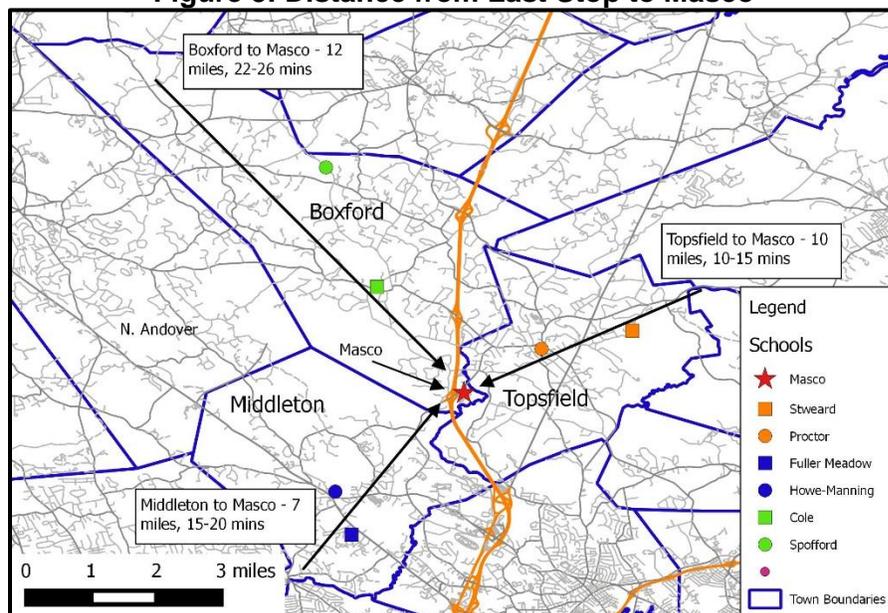
Shown above, the least amount of time required for a trip within the three towns to Masco is 10 minutes coming from Topsfield. In Middleton, buses would require between 15 and 20 minutes to return to the vicinity of Masco and for Boxford the highest range of 22 to 26 minutes. All ranges of time can fluctuate from day to day with traffic and unforeseen hang-ups while in transit.

To reiterate, this is important to consider because at present, the routes are designed to prevent this from occurring. In the afternoon, buses perform a Masco trip and this trip is strategically designed to go towards the respective subsequent elementary trip. When performing an elementary trip first, buses must make all of the driveway stops required for elementary trips, and thus may end up in an inconvenient area of town, requiring significant time to turn around and return to Masco for a subsequent trip.

Policy Assessment

The policies associated with transportation are herein reviewed and assessed for both Masco and Tri-Town School Union. For each, transportation is provided and the schedules related to transportation are determined by the School Committee in conjunction with the bus company. There is very little policy with regard to the safe location of school bus stops, walking distance limits to bus stops or schools, or the length of time students are permitted to ride the bus. The policies refer to State Law, which contains an important description of transportation requirements, pertinent to the geography of the region.

The Massachusetts General Law mandates transportation for pupils attending an assigned school if they reside further than two miles from the school itself. An important exception to this reads as follows: "Exceptions to this policy may be made when road conditions do not provide for the physical safety of the children and when the health of students make this service essential." In all three towns, significant safety concerns are present along many roadways. These concerns include lack of sidewalks, lack of wide shoulders, sharp curves with poor lines of sight, and lack of pedestrian traffic control devices at intersections.

The transportation of pupils residing within the three towns is necessary in nearly every scenario due to safety concerns along roadways. The bus routes are designed to accommodate this, and in many cases buses are making frequent stops at intervals of just a few hundred feet or less. SBC finds this to be necessary unless a comprehensive traffic and pedestrian study is performed by a certified engineer.

The elementary schools all have related documentation in the policy handbooks. Each outlines the behavior requirements, requirements for changing bus stops, and riding a different bus than what is assigned. All of the various elementary policy establishes that transportation is available for all students. The policies are all within what SBC typically sees in bus operations that are procured through a private vendor.

Findings: Route Review

The trips are designed to serve Masco first and elementary schools second. As the routes are designed today, it is important to note that their organization strategy is built around Masco bell occurring first, and the elementary bells occurring second. Some buses arrive at Masco early in the morning, and line up in the front of the line in the afternoon, because their subsequent route may be longer. Likewise, some are designed to perform a Masco trip and subsequently perform a local trip that

may allow for more slack time in between trips. The important finding is that the ending, or last stop on first trips is strategic in relation to the starting point of the second trip. This strategy requires significant re-design if bell schedules align elementary as first with Masco as second.

Policy dictates all students must be transported. The geography of the area, as well as the district policies and State Law establish that all students within the districts must be transported. In many cases, especially for younger students, a driveway bus stop may be required. This eliminates many opportunities to redesign bus route to allow for efficient re-routing. In many cases, the routes as designed are the most efficient as is possible, due to the nature of the road network. Many bus routes travel down one or two roadways, stopping along the way. Because the roads are narrow, wooded, and rural, there is very little opportunity to condense bus stops or re-design the route. The bus must serve the students living on these roads by actually traveling the roads, students cannot walk to a nearby pickup point.

Contracting Analysis

Masco and Tri-Town School Union procure transportation from the same company operating the same fleet for all schools. Each contract is priced and approved separately, however a single vendor is responsible for the operation. Doing business this way has a number of benefits in areas such as communication, routing and scheduling, and contract oversight. A well-constructed contract for services should clearly establish both the level of service to be provided and how those service are to be delivered.

The contract award should not be viewed as the final outcome of a competitive procurement process, but rather the start of a phase within an ongoing improvement process. The contract terms and conditions should reflect the overall goals of the districts for the provision of services. The bus contractors should then be subjected to a rigorous and consistent program of compliance monitoring and performance measurement relative to the requirements of the contract and the districts operating procedures and policies.

Implications to Bell Schedule Development

The culture for many years has been to align bus schedules between the four school systems. As discussed elsewhere in the report, the two tiers of service allows for a re-use of the bus and that efficiency is passed onto the individual committees in terms of cost per bus. This alignment of services should be continued if possible to do so, as it presents the best opportunity for cost effectiveness.

One point of focus within Massachusetts General Law is Chapter 30B, Section 13. It states that when service contracts fluctuate by more than 25 percent, this warrants a breach in the contract terms. Absent of the requirement, changing a bus contract by 25 percent or more is a tremendous ask of the bus company. Buses must be purchased, which can sometimes take several months or more to procure. Drivers must be hired, and today across the nation qualified drivers are in short supply. These new hires must be trained, certified, and assigned to a route. In many cases, existing drivers may need to learn a new route. Beyond the regulation, there are a number of operational obstacles for the bus company to consider when undergoing significant change in the contracted service volume.

Findings: Contract Analysis

The redesign of the bus network cannot exceed an addition of seven buses without breaking contract terms. The regulation found in MGL 30B Section 13 establishes the 25 percent rule, and in the case of the current contract between Tri-Town, Masco, and NRT Bus this means seven buses total across the contracted districts.

No formal contract oversight program is established, however communication between current bus company staff and school administration remains positive. Transportation is a significant component cost in the overall operating budget of school districts. Often it represents four to six percent of the total budget. While these costs are separated into four individual school districts, the volume is still significant. As such, the services being provided cannot be entirely outsourced without some level of oversight. At present, the organization of responsibility appears to work for all parties. SBC recommends that more specific descriptions of the roles and responsibilities for both the bus contractor and the districts' administrations be spelled out in the next contract.

Development of Options

To date, there have been several options developed and researched by the Start Times Advisory Committee (STAC). These options are referred to as options X, Y, and Z. This section of the report summarizes the transportation impacts arising from these options, as well as provides an analysis of options not yet discussed by the STAC.

Previously Researched Options

The three options developed and shared with the public each have a unique set of impacts to transportation. The options are listed below:

Table 3: STAC Bell Schedule Options

HEADER	Masco Time	Elementary Time
Option X	8:00 AM to 2:55 PM	8:55 AM to 3:25 PM
Option Y	8:30 AM to 3:10 PM	8:00 AM to 2:30 PM
Option Z	8:20 AM to 3:00 PM	Unchanged

Each option successfully moves Masco's schedule to a later start time, however option Y achieves the most desirable 8:30 AM timeframe. At the time of STAC report published in May 2017, the number of buses estimated for both options X and Y stood at three. Upon voting to proceed with option Y, the bus provider had increased the estimated fleet requirement to nine total buses in addition to the 29 that are presently operated.

SBC's process is to identify the current routes and schedules, adjust them to meet the revised bell times, make note of where conflicts are created, and suggest possible options for re-routing. This gives a general sense of the scale of the impact to transportation. Using this methodology to provide a preliminary analysis of the options, SBC found that each option would require some level of increase

in required buses. For options X and Y, SBC found the fleet requirement to be greater than 10 additional buses. For option Z, a fleet nearly double the size would be required due to the fact that all schools would be starting and ending around the same time, eliminating the ability to share buses. The models used in this initial analysis of the options can be found in Appendix A.

The primary reason for the increase in fleet is the time between each start and end time. Presently, buses have about one hour in the morning, and forty minutes in the afternoons between each arrival and dismissal period. These windows are reduced in each of the options. By reducing the time between bells, the routes must be shortened. By shortening routes, the ability to pick up and drop off the same number of students is reduced, and thus more buses are required to transport the same number of students. The bus company providing transportation services to the districts has designed a revised route schedule to meet the option Y schedule.

Analysis Related to Option Y

The plan presented to the districts by the current bus transportation provider is summarized in this section, along with additional recommendations. Below, a figure displays the existing bus routes in a timeline. Because the routes must all be reduced to less than 30 minutes in actual driving time, routes presently longer than this are highlighted in red.

Figure 4: Current Route Timeline (routes greater than 30 minutes dark red)
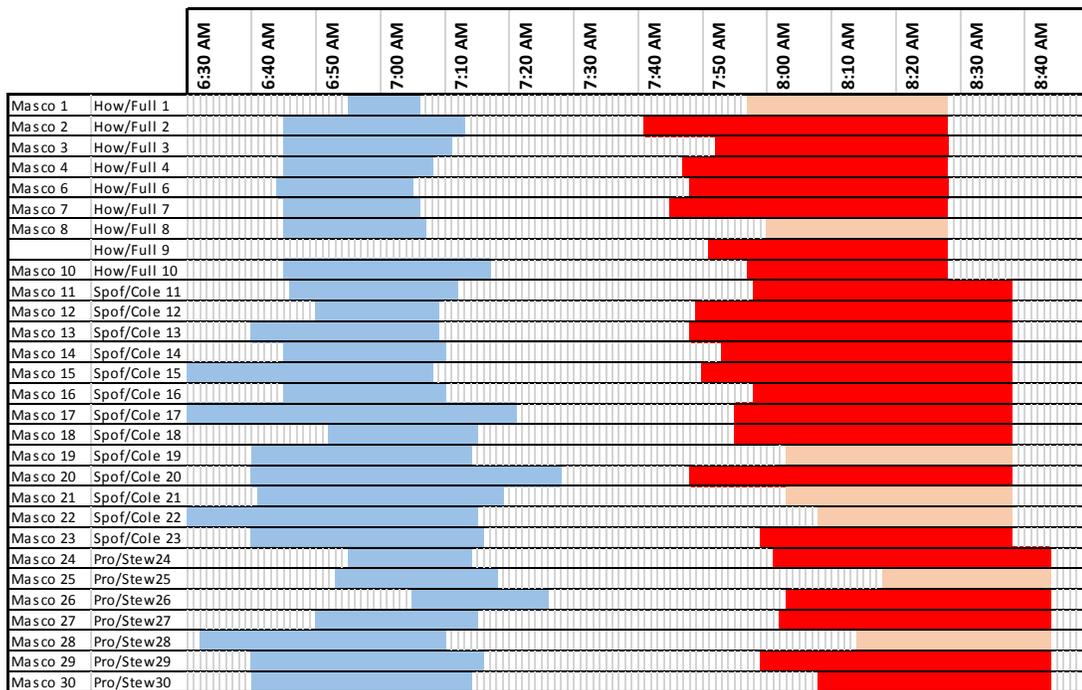
As shown, the vast majority of buses take more than 30 minutes to perform their elementary route. The bus company deigned new routes that split up these highlighted red routes. The new bus schedule is listed below in the Figure 5.

Figure 5: Bus Company Proposed Redesign Timeline
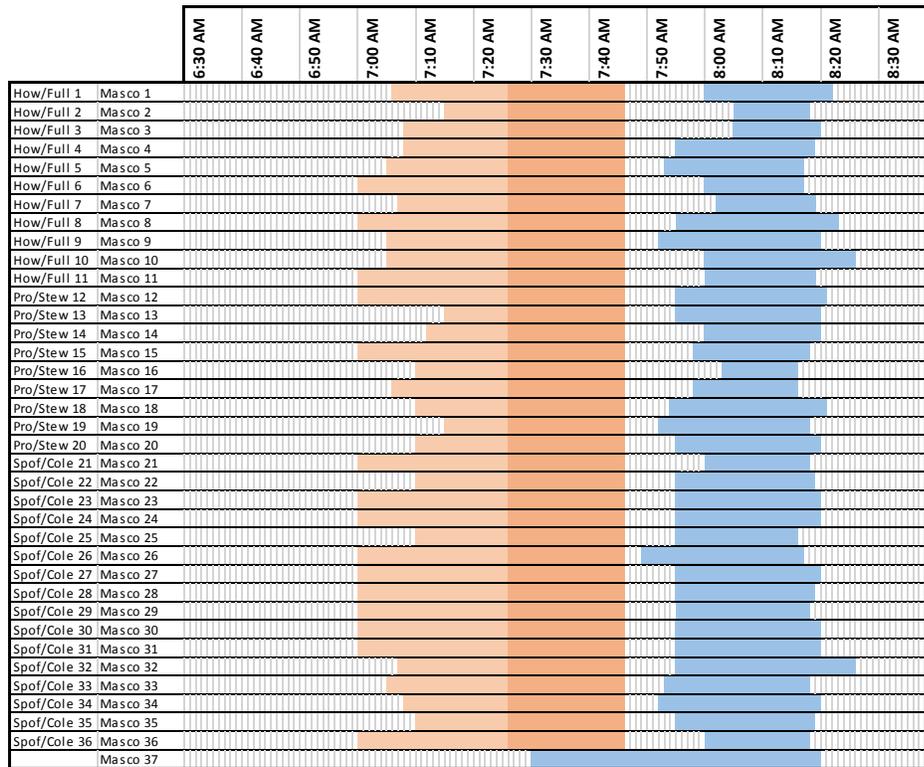
Comparing the two, we notice that all routes are dramatically shorter. In addition, the time between the conclusion of a first trip, and the beginning of a second trip is greatly reduced. This is concerning because the impacts of having less "turnaround" time is not predictable until the first few weeks of school. As changes occur with traffic patterns, bus ridership patterns, and the bus drivers' schedules, many moving parts suggest the more slack that can be added into the schedule, the better. After the first year, additional revisions and efficiencies can possibly be realized if the data supports it.

The key factor in establishing the fleet size will be the window of time between opening and closing bells. The more time that buses have available to perform a trip, the fewer buses will be required because they can be filled with riders. Presently, the window of time between Masco and the elementary districts is up to 80 minutes in the morning. In the afternoon, the window between Masco dismissing and the elementary districts dismissing is approximately 45 minutes, meaning that Masco bus routes must be scheduled for less than 30 minutes.

Below, the figure counts the amount of buses that would be required to add to the fleet under a range of spacing between bell times. The number of buses is based on the current length of the bus routes, and the ability to make changes to the routes in order to accommodate the new bell times.

Table 4: Fleet Requirement with Tri-Town 1ˢᵗ, Masco 2ⁿᵈ Alignment

Spacing	AM Fleet Increase	PM Fleet Increase
60 Minutes	0	0
55 Minutes	3	1
50 Minutes	5	5
45 Minutes	6	6
40 Minutes	9	9
35 Minutes	9	9
30 Minutes	9	11
25 Minutes	29	29
20 Minutes	29	29
15 Minutes	29	29
10 Minutes	29	29

Figure 6: Fleet Requirement with Tri-Town 1ˢᵗ, Masco 2ⁿᵈ Alignment
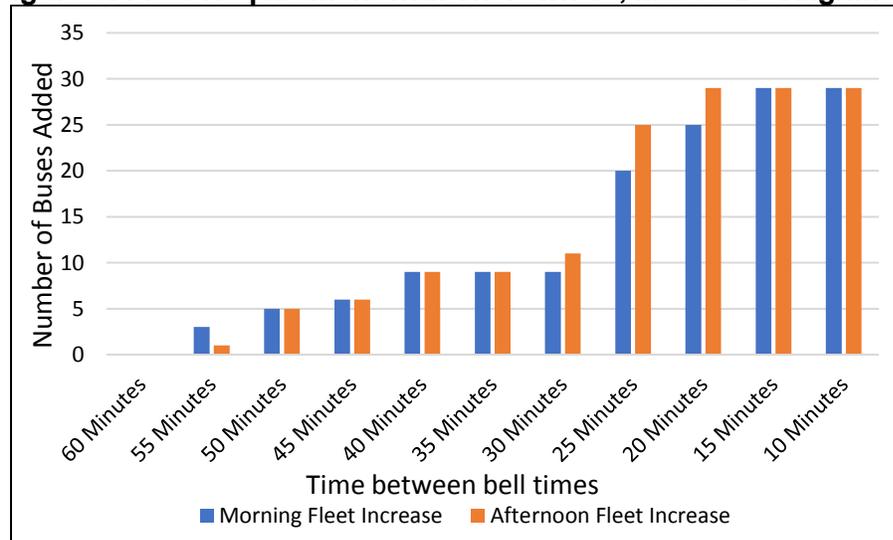
As shown above, the primary takeaway is that the fleet requirement is directly correlated with the window of time between Tri-Town and Masco bells. At 60 minutes, no additional fleet would be required. At 45 minutes, the fleet requirement is 6. Finally, once the window is closed to less than 30 minutes, the fleet requirement essentially doubles because no bus is able to be shared across two tiers.

Absent of any substantial changes to the transportation service itself, SBC stands by these findings. Examples of substantial change includes a policy to restrict eligibility for busing to a given radius such as one or two miles; establishing collection points rather than driveway bus stops; or enlisting a bus pass program for which busing is granted only to those who sign up and pay for it. These are tactics that SBC has seen in our experience, however these would represent a significant change to the service provided at the present time.

Findings: Options Development

Options X and Y as they are established in the STAC report will require additional fleet. By SBC's estimation, they will require an additional ten buses each in order to implement. This is due largely to the window of time between the elementary districts and Masco in the morning and afternoon. Increasing the time between each bell will reduce the number of buses required to run the system.

The increase in required bus fleet is impacted by a shrinking of the window between bell times: SBC has analyzed the busing and has provided estimations for the required total bus requirement for a range of spacing between the bell times. The fleet requirement increases as the window between bell times gets smaller.

Elementary routes will require at least 30 minutes to complete, even if improvements to the dismissal and arrival procedures reduce the time necessary to complete. Presently, elementary students arrive and depart from the elementary schools in two waves, once for each school per town. This process takes approximately ten minutes at the first school, five minutes of transportation to the second school, and five minutes of boarding at the second school. Even if this was reduced to 15 minutes total, buses still require 10 to 15 minutes to drive from their preceding trip, or to their subsequent trip. So when planning for elementary bus routes, a general rule of thumb is that 30 minutes will be required before making any stops. Most trips make their stops within 15 to 25 minutes on top of the other time, making for a 45 to 55 minute trip in total.

Implementation Considerations

A significant amount of work remains before the decided upon start and end schedules for schools can be finalized and implemented. Once a vote to approve the schedule occurs, implementation planning must begin immediately, and will not conclude until the school year begins. A plan of action is required to guide the process and to engage stakeholders with areas of responsibility. The following provides a blueprint for establishing functional areas within the school systems from which respective planning, tasking, and implementation steps can be established.

Academic and Program Planning
Outside of the school day itself, before and after school programming would be affected by shifting of bell times. In addition, the disruption to staff and faculty schedule may affect the availability of faculty sponsors, coaches, and monitors. Within the scope of this report, bus ridership will likely be affected and thus some variability in the route schedules must be assumed. Beyond this report, impacts to program enrollment, attendance, and staffing availability is likely.

Stakeholder Communications
Experience suggests that early, frequent, and repetitive communication is most effective. Communication must reach all stakeholder groups including community, staff, parents, students, athletes, district contractors, and others. A detailed community outreach plan is recommended. As there has been a significant amount of work done by STAC in the research phase of the process, many of the stakeholder groups have already been identified.

Logistical Planning
The logistics behind the school schedule goes beyond transportation, however this remains a significant component to the change and is the focus of this report. A completely revised set of bus routes may be required, and new bus routes and schedules must be communicated to parents. The security of knowing bus availability for extra-curricular and athletics trips must be established.

Family and Community Schedules
The communication will be required for community members involved in the school system, but also those who are not. Many in the community base their schedules around the schedule of the school system. Tutoring services, after and before school care providers, employers of high school students, locations of high school volunteer work, and other community members must be informed throughout the implementation process.

SBC recommends that at least one full calendar year be granted to the respective administrations, school committees, and school staff in order to ensure that implementation does not occur in haste. The organization of the various stakeholders takes time in being respectful of everyone's competing schedules.

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Appendix A

As part of our initial discovery, SBC collected data related to the bus routes and schedules. SBC used this information to analyze the potential impacts of options X, Y, and Z as outlined in the STAC report. While the primary focus of the report is option Y, the analysis performed on all options is included within this appendix.

Below, the graphics are used to depict the deployment of fleet during the morning and afternoon periods of transportation. If a bus is scheduled to be driving with students, the bus is counted along the Y axis. Time throughout the morning and afternoon is counted along the X axis. Clearly depicted in the graphics are two distinct tiers of transportation, the first being Masconomet and the second being Tri-Town elementary schools.
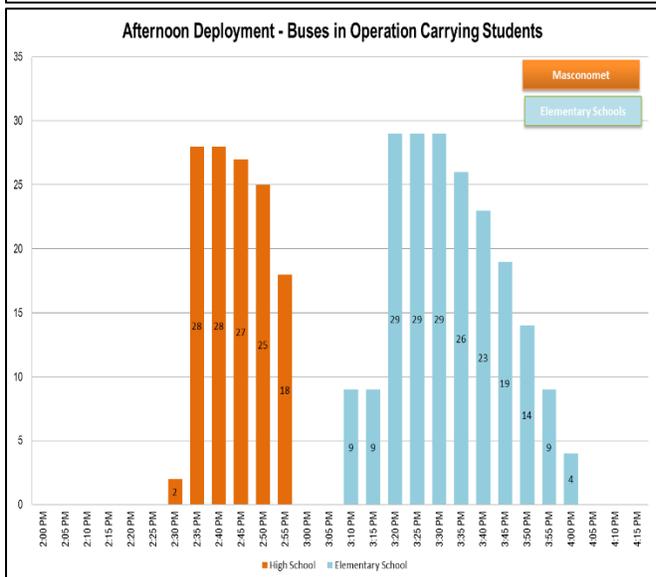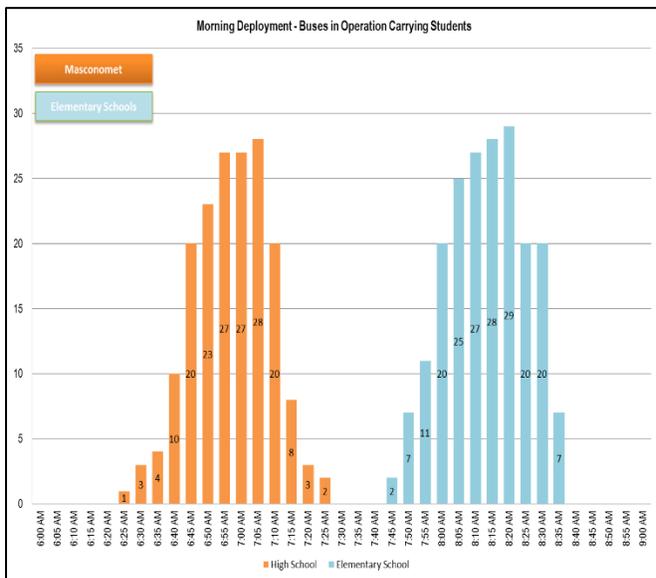
This diagram is repeated for each of the options, in order to depict the impact of changing times to the current bus routes as they are designed today. These are displayed below. Each bus route includes 20 minutes for unloading and loading, 15 minutes for travel time between the last stop on its first trip and the first stop on its second trip, as well as the time scheduled to be driving students.

Option X Diagrams
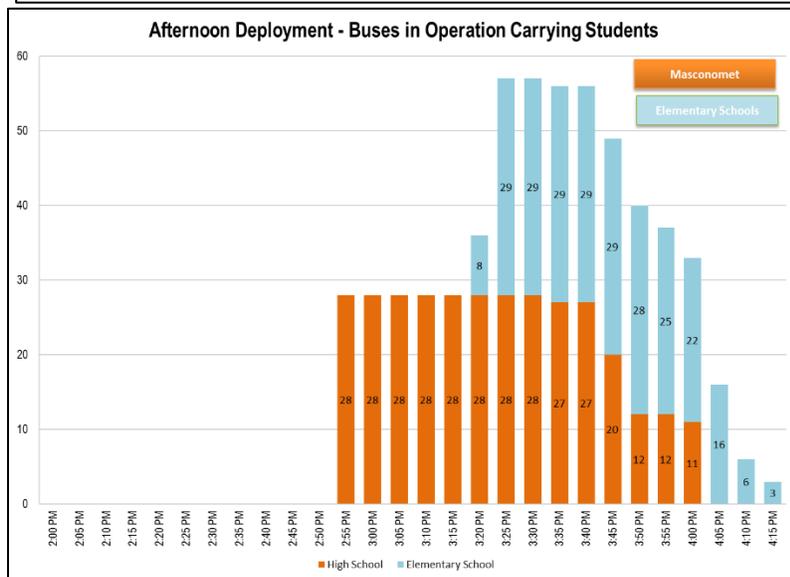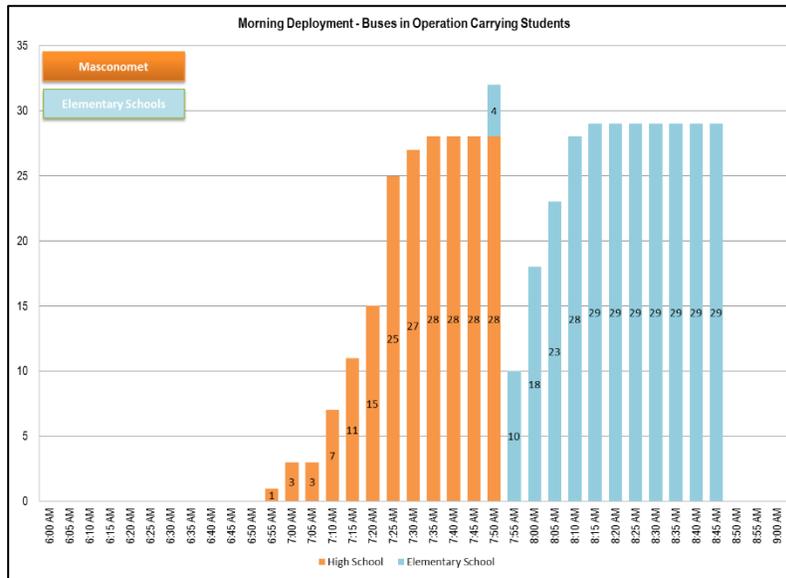
Shown above, there is a significant concern in the afternoon, where many Masconomet buses could potentially interfere with Tri-Town dismissal. Because buses hold at Masconomet for 10 to 15 minutes before leaving the school property, this leaves very little time to drop students at their bus stops and return to the elementary school for that trip.

Option Y Diagrams

Morning Deployment - Buses in Operation Carrying Students

Afternoon Deployment - Buses in Operation Carrying Students
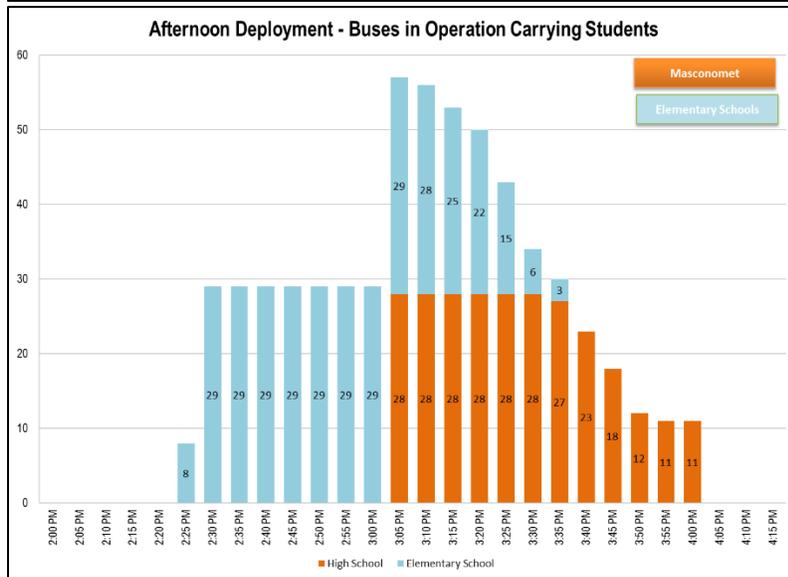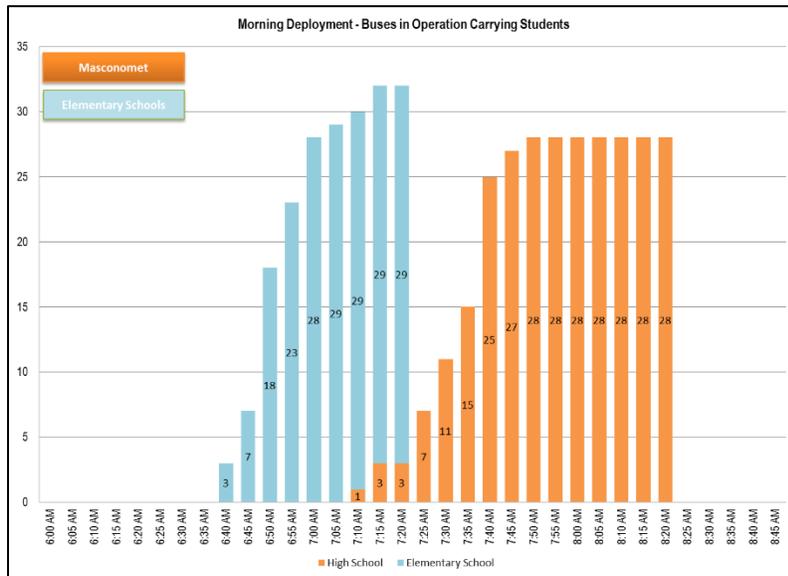
As shown above, the afternoon is particularly challenging for busing, as busing is scheduled and designed today. Significant re-routing would be required in order to shorten routes and strategically align them so they are in proximity of Masconomet at the final stop.

Option Z Diagram
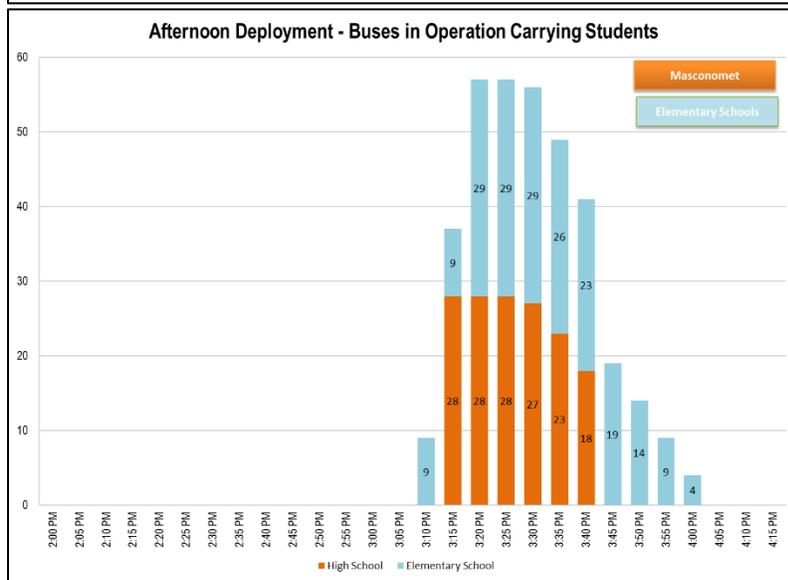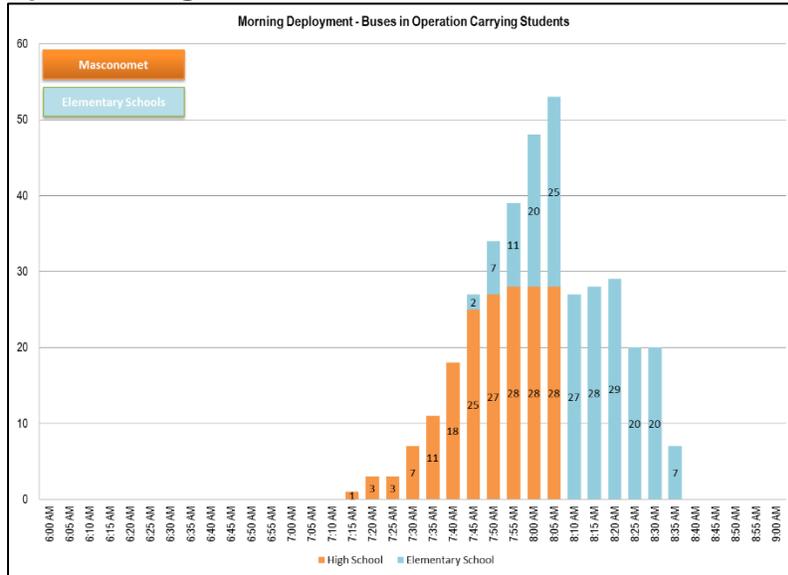
Above, in option X, we see a double the quantity of buses as 28 are required for Masconomet busing, and 29 are required for Tri-Town busing, which would occur at the same time. The only economical option to mitigate the busing costs would be to share buses with a neighboring district that may have a bell time that is earlier, in the 7:30 AM timeframe.

Appendix B

In the final section of the report, a chart is shown to illustrate the increase in fleet requirement as the window of time between Tri-Town and Masconomet is made smaller. This same illustration is performed for the Option X scenario, with Masco continuing to be first and Tri-Town following thereafter with its bell times. The graphics are included below for reference.

Fleet Requirement under Masco 1st, Tri-Town 2nd Alignment

Spacing	AM Fleet Increase	PM Fleet Increase
60 Minutes	0	0
55 Minutes	0	0
50 Minutes	2	0
45 Minutes	3	3
40 Minutes	5	5
35 Minutes	9	11
30 Minutes	10	12
25 Minutes	16	20
20 Minutes	24	24
15 Minutes	29	29
10 Minutes	29	29

Fleet Requirement under Masco 1st, Tri-Town 2nd Alignment