APPENDIX A
BUS ON SHOULDER

Date June 04, 2008

To Kenneth Kinney, HNTB

From NH I-93 Transit Investment Study:
Bus on Shoulder Alternative - Outline of Potential Implementation Strategy

Subject John Weston

The Bus on Shoulder (BOS) Alternative appears to have significant levels of travel time and cost advantages that should warrant further consideration for implementation. The estimated average daily ridership for the alternative is approximately 5,000 to 5,500 inbound boardings in 2030. This ridership estimate is based on the full-build of the required infrastructure, the anticipated growth in population and employment in 2030, and the implementation of the operating plan that includes about 90 daily bus trips in each direction. In addition to the planned services, existing bus services may also be able to use the shoulder facilities, which would result in additional transportation system benefits.

A benefit of implementation of the BOS Alternative is that the entire project does not need to be implemented at one time. The capital improvements and service improvements could be phased so that improvements could be implemented as funds are available or as conditions permit/warrant.

The following provides a potential strategy for the phasing and implementation of the BOS Alternative.

One of the primary considerations in the development of the phasing plan is the coordination with the schedules of other improvements planned in the corridor. Many of the BOS improvements are conceptualized as additions to these previously planned projects. The phasing of the BOS required improvements so that they can be implemented in conjunction with other projects will minimize costs and construction disruptions. The planned projects in the corridor that were taken into consideration are listed below.

Anticipated Projects Along I-93 Corridor

The following is the list of projects that are anticipated to be completed prior to 2030, the planning year for this study:

- Interstate 93 Improvements – Salem to Manchester, NH
- Route 110/113 Methuen Rotary Improvements (Methuen, MA)
- I-93 Widening (Andover to Methuen, MA)
- I-93 Lowell Junction Interchange (Andover/Tewksbury/Wilmington)
- I-93/I-95 Interchange Improvements (Reading/Woburn)

Another primary consideration in the phasing plan was the implementation of segments where improvements will be most beneficial. The benefits of the BOS Alternative improvements will occur in locations where general traffic speeds are the slowest. In general traffic speeds are slower in the southern segments of the corridor and are projected to be generally faster further north in the corridor.

The following is a proposed phasing strategy for the BOS Alternative.

Phase 1 – Corridor Interchange Project Design Incorporation/Modification

Scope: Incorporate the necessary shoulder improvements into the design of the following projects.

Route 110/113 Methuen Rotary Improvements (Methuen, MA) – The next phase of design is anticipated to begin during 2008. Construction is currently projected to take place between 2014 and 2017. Although the cost for the design and construction modifications to the project is not known at this time it is not anticipated to be substantial.

I-93 Lowell Junction Interchange (Andover/Tewksbury/Wilmington) – The next phase of this project will include additional environmental studies and design. Construction is currently projected to take place between 2013 and 2018. Although the cost for the design and construction modifications to the project is not known at this time it is not anticipated to be substantial.

I-93/I-95 Interchange Transportation Improvements Project (Reading/Woburn/Stoneham) - The next phase of this project will include additional environmental studies and design. Construction is currently projected be completed by 2025. Although the cost for the design and construction modifications to the project is not known at this time it is not anticipated to substantially increase the cost of the project.

Time Frame: The environmental / design efforts are projected to occur during the next five years. 2008 – 2013.

Cost: The cost of incorporating the necessary shoulder improvements are not anticipated to substantially increase the overall cost of any of the projects.

Phase 2 – I-95 to Medford Improvements

Scope: Design and construction of BOS required improvements to I-93 in the segment between I-95 (Woburn, MA) and the Mystic River in Medford, MA. Making improvements to this segment will allow both existing and planned bus services to realize travel time savings. It is anticipated that at a minimum bus services operated by the following agencies could utilize the shoulders:

- MBTA (Routes 352 and 354/355)
- Massport (Logan Express)
- MVRTA
- NH DOT

It is not anticipated that the full operating plan envisioned in the BOS alternative (90 trips in each direction) would be implemented at this time.

Time Frame: The environmental, design, funding and construction efforts necessary to complete the project would likely take a minimum of 3 to 5 years. This would result in the earliest potential completion of the improvements in this section by approximately 2013.

Cost: The anticipated capital cost of incorporating the necessary shoulder improvements are estimated to be approximately $25 million (in 2008$). Assuming construction in 2012-2013 the anticipated cost in "Year of Expenditure" dollars is $29 million[1].

Phase 3 – Corridor Interchange Project Construction

Scope: Incorporate the necessary shoulder improvements into the construction of the following projects. The design of the bus improvements to be incorporated during Phase 1. This will allow implementation of bus shoulder operation between Medford north of the I-95 interchange.

- Route 110/113 Methuen Rotary Improvements (Methuen, MA)
- I-93 Lowell Junction Interchange (Andover/Tewksbury/Wilmington)
- I-93/I-95 Interchange Transportation Improvements Project (Reading/Woburn/Stoneham)

Time Frame: The construction of the above listed projects are anticipated to occur between 2013 and 2025.

Cost: The cost of incorporating the necessary shoulder improvements are not anticipated to substantially increase the overall cost of any of the projects.

Phase 4 – Corridor Interchange Project Construction

Scope: Incorporate the necessary shoulder improvements into the construction of the following projects. The design of the bus improvements to be incorporated during Phase 1. This will allow implementation of bus shoulder operation between Medford, MA to the northern limit of the I-95 interchange project in Woburn, MA.

- Route 110/113 Methuen Rotary Improvements (Metheun, MA)
- I-93 Lowell Junction Interchange (Andover/Tewksbury/Wilmington)
- I-93/I-95 Interchange Transportation Improvements Project (Reading/Woburn/Stoneham)

Time Frame: The construction of the above listed projects are anticipated to occur between 2013 and 2025.

Cost: The cost of incorporating the necessary shoulder improvements are not anticipated to substantially increase the overall cost of any of the projects.

[1] Year of Expenditure (YOE$) costs escalated assuming 3.25% annual inflation

Phase 5 – I-95 to State Line/Bus Services/Bus Stations

Scope: The completion of the I-95/I-93 interchange will allow for the extension of bus shoulder use in the segments between I-95 and the NH/MA border. This phase will incorporate modifications to the planned improvements of I-93 in the Merrimack Valley (Segment 2) as well as the necessary improvements to the corridor in the segment in Wilmington and Woburn (Segment 3). With the bulk of the capital improvements necessary for the project made during this phase, it is anticipated that implementation of the operating plan envisioned in the BOS alternative (90 trips in each direction) would be implemented with the completion of this phase. Implementation of this additional service would necessitate the need to make improvements at the planned stations, purchase buses and provide a bus maintenance facility.

Time Frame: The construction of the I-93 widening project (Segment 2) is projected to be completed in 2025. The associated BOS improvements in that segment would be made as part of that project. The improvements to Segment 3, bus stop improvements, bus maintenance facility and new vehicles are anticipated to be made during the same time frame.

Cost: The anticipated construction cost of incorporating the necessary shoulder improvements are estimated to be approximately $39 to $49 million (in 2008$). Assuming the construction would occur in the 2020-2025 timeframe, the anticipated cost in YOE dollars is approximately $61 to $77 million.

In addition to the construction cost, new buses may be required to operate the planned service. Utilizing FTA's standard cost of $433,000 per bus and the need for approximately 55 new buses, this would cost about $24 million (in 2008$), or about $38 million(YOE$) when adjusted for inflation.

Phase 6 – New Hampshire Improvements

Scope: Upon completion of the BOS improvements in Massachusetts it could then be advantageous to make the improvements to the New Hampshire segment. The identified improvements would include the widening of the shoulder and installation of emergency pull-out areas.

Time Frame: The improvements to the New Hampshire segment would be made following completion of the Massachusetts segments. It would therefore be anticipated that improvement would be made in the NH segment in the 2025 to 2030 time frame.

Cost: The cost of incorporating the necessary shoulder improvements in the New Hampshire segment are estimated to cost approximately $24 to $34 million (in 2008$), or $44 to $62 million (YOE$) when adjusted for inflation.

Phasing/Improvement Re-evaluation

As the phasing plan, as currently proposed, is to occur over a 22 year period, it will be appropriate to re-assess the potential benefits of implementing each phase as it comes time for implementation. This will be most appropriate in the segments in the northern portion of the corridor (Merrimack Valley and New Hampshire) as the assumptions made in this study regarding population and employment projections, traffic congestion, and associated project implementation may need to be modified and therefore will impact the potential benefits of use of the shoulder as compared to bus use of general purpose lanes along the corridor.

Date March 3, 2008

To Kenneth Kinney, HNTB

From NH I-93 Transit Investment Study:

Bus on Shoulder Capital Improvements and Capital Cost Estimates

Subject John Weston

Bus on Shoulder Concept

Bus bypass shoulder use or Bus on Shoulder (BOS) services have been in operation for more than 10 years in parts of the United States. This approach to providing an "exclusive" lane for buses to improve bus travel times and reliability represents a low-cost strategy that can be implemented relatively quickly and easily in comparison to the expansion of highway travel lanes or right-of-way. Use of the right (outside) shoulders also promotes "rapid transit" like service with buses easily exiting and entering the highway network in contrast to bus use of HOV lanes.

Typical concerns about BOS operations include traffic safety (interchange conflicts, speed differentials, sight distances), loss of intended shoulder use (debris hazards, removal and storage of disabled vehicles, emergency vehicle access), physical design requirements and cost. In an examination of existing Bus on Shoulder operations it has been demonstrated that:

- The operation of transit vehicles on the shoulder is safe,
- Most BOS operations offer buses 10 feet of shoulder clearance without causing safety concerns, and
- Buses minimally impact the intended use of shoulders because no barrier is created between the shoulder and the general purpose lanes.[1]

The use of shoulders on a regular basis for bus operations in many places requires improvements to the shoulder. Shoulders on many limited-access roadways are 10 feet wide or less and are not constructed to the same standards of the general purpose lanes. Since buses, with mirrors, are typically close to 10 feet wide and are heavy vehicles, regular use of the shoulders without modification would not be advisable. Additionally the grades of the shoulders, drainage side slopes, and catch basin structures also all often require modification. Additional signage and pavement markings should be considered for safe operations.

The purpose of this memo is to identify the physical design requirements and the infrastructure changes that would be necessary along the I-93 Corridor to accommodate Bus on Shoulder operations.

[1] Bus Use of Shoulders, TCRP Synthesis 64, Transit Cooperative Research Program, 2006.

Typical Cross-Section Requirements

The BOS approach that is being considered as an alternative for the I-93 Corridor is modeled on the operation parameters that are currently utilized in Ottawa, Ontario.

In Ottawa, 14 miles of limited access roadway shoulders are available for bus use. No special speed restrictions are defined and buses are allowed to operate up to the posted speed at their discretion. Buses are allowed to operate at speeds up to 62 mph. The two roadways in the Ontario area on which bus on shoulder use is permitted include a 16.4 foot shoulder and a 11.5 foot bus-use shoulder with an additional 3.2 foot shoulder. A maximum 2 percent cross-slope is allowed for the bus lane. The roadway designed with the 11.5 foot bus travel lane/shoulder was instituted more recently than that with the wider bus travel lane/shoulder, presumably after some years of bus operating experience on the shoulder of the first roadway.

In the United States the standards for shoulder widths on interstate highways has been established by the American Association of State Highway and Transportation Officials (AASHTO) in the publication A Policy on Design Standards - Interstate System. These standards include a minimum outside (right) paved shoulder width of 10 feet and inside (left) shoulder width of 4 feet. It is recommended that highways with three or more lanes in each direction, as I-93 will have by 2030, the inside paved shoulder should be at least 10 feet wide or 12 feet if the roadway is heavily used by truck traffic.

Using the Ottawa example as a template, and the design guidelines for Interstate Highways, the conceptual cross-section design for the bus travel lane/shoulders along the I-93 Corridor have been identified as:

- Minimum Inside Shoulder: 4 feet
- Preferred Inside Shoulder: 10 to 12 feet
- Minimum Outside Bus Lane/Shoulder: 12 feet

Preferred Outside Shoulder: 15 feet (12 foot Bus Lane/Shoulder plus additional 3 foot shoulder)

Cross slope requirements should be consistent with adjacent general purpose travel lanes (typically 2 percent).

In addition to the cross-section requirements, it has been recommended by Mass Highway to include emergency pull-out areas for vehicle drivers to utilize that will ensure a location away from the buses. This would be similar to those areas constructed on the portion of I-93 where shoulders are used by traffic during peak-periods. It is assumed that a emergency pull-outs will be required to be spaced about 1/2 mile apart as was done along the corridor in the area where the shoulders are used by automobiles in peak periods.

Pavement on most interstate highway shoulders is not as thick as that found in the general purpose lanes. This appears to be the case throughout the length of the I-93 study corridor. Prior to use of the shoulder by buses, the shoulders would need to be reassessed to identify the existing pavement materials and determine the appropriate pavement structure necessary to accommodate the use of the shoulder for regular bus use. It is assumed that all shoulders along the corridor will require repaving.

In many locations bridge structures are wide enough to accommodate the existing general purpose lanes plus the minimum shoulder widths identified above (4 foot inside shoulder, 12 foot outside shoulder). This does not leave any additional room for bus operation clearance from those structures. As bus use of shoulders is a new and evolving use of interstate highways, the specific standards and requirements for such an operation have not yet been established. Therefore, the bridge clearance requirements and conditions may need to be revisited as the project advances. Although the existing clearances appear to be viable for this new type of shoulder use it also is a substandard condition as compared to current design standards.

Corridor Definition

The roadway examined for the potential for the addition of bus use of the shoulders was I-93 between Exit 26 in Boston, MA and Exit 6 in Manchester, NH.

Based on results of travel demand modeling it was identified that the segment of I-293 in New Hampshire that is planned for use by buses (between I-93 and Exit 5-Granite Street) is not projected to experience significant congestion in 2030 and therefore has not been included in the segment considered for bus use of shoulders.

Anticipated Projects Along I-93 Corridor

There are multiple improvement projects that are anticipated along the study corridor that will impact the configuration of the shoulders and the requirements for improvements related to bus use of shoulders. The following is the list of projects that are anticipated to be completed prior to 2030, the planning year for this study:

- Interstate 93 Improvements – Salem to Manchester, NH
- Route 110/113 Metheun Rotary Improvements (Metheun, MA)
- I-93 Widening (Andover to Methuen, MA)
- I-93 Lowell Junction Interchange (Andover/Tewksbury/Wilmington)
- I-93/I-95 Interchange Improvements (Reading/Woburn)

Each of these projects has the potential to incorporate into their design the improvements to facilitate the operation of bus services on the shoulders of I-93.

Bus Lane Improvement Locations

The following are the locations that have been identified as requiring improvements to facilitate the operation of buses on shoulders.

Segment 1: Manchester, NH to MA State Line – This 20 mile segment is currently being redesigned to accommodate additional general purpose lanes between the Massachusetts State Line and the I-293 interchange. This outside shoulder being designed and built in this segment does not currently meet the width and pavement depth requirements for the full length of the segment. This segment will require the outside shoulders to be widened from between 0 and 5 feet along with full-depth repaving of the shoulder and the construction of emergency pull-out areas, as necessary.

Segment 2: State Line to Wilmington – This segment is programmed to be widened to add an additional travel lane and a new outside shoulder. All the work for this project is proposed to take place on the inside median, thereby not impacting the loction of the existing outside edge of pavement. This project is currently defined as only including a 10 foot wide outside shoulder in this segment. Similar to the widening of the highway segment in New Hampshire, the roadway would require an additional 2 to 5 feet of space allocated to the outside shoulder from what is currently planned. It is assumed that the additional shoulder width could be designed into the project with only marginal impacts to the overall cost of the project. However, due to the minimal width of the median in some locations and the existing 10 foot width of the shoulder from Exit 45 to the state line the shoulder width necessary for the bus operations may require additional widening.

Segment 3: Wilmington/Woburn – This 6.3 mile segment, which stretches approximately from the Lowell Line Railroad Bridge in Wilmington to West Street in Reading, would need to have the outside shoulders widened by approximately 2 to 5 feet throughout most of the segment. This should be possible by constructing additional roadway surface on the inside shoulder and shifting the travel lanes. This would avoid any impacts outside of the existing highway corridor aside from the emergency pull-outs that would need to be constructed.

Segment 4: I-95 Interchange Area - The segment that encompasses the I-95 Interchange has been the subject of a planning study over the past couple of years. The recommendation of the study is to make improvements to the configuration of the interchange, which would include the segment from West Street in Reading to Salem Street in Winchester. It is assumed that the design of this segment could include the necessary shoulder widening and roadway configuration to accommodate bus operations on the shoulder with only marginal impacts to the overall cost of the project.

Segment 5: I-95 Interchange to Mystic River – The segment between Salem Street in Winchester and the Mystic River has varying shoulder widths that would need to be modified to accommodate use of the buses. The overall width of the roadway is a minimum of 64 feet, with the typical section being 68 feet wide in each direction. This includes four twelve-foot wide lanes and varying widths of inside and outside shoulders. The bridge plans have been reviewed in this segment and it appears that necessary bridge work would be limited to minor modifications of the bridge barriers . The available widths under or across the bridges are close to the 64 foot minimum required. Additional detailed survey and study would be required to identify any specific modification that may be necessary to the bridge structures.

Similar to the segments identified above, the regular use of the shoulder would require, at a minimum, the repavement of the shoulder so that the pavement depth would be appropriate for the new intended use. In addition to the repaving, the general purpose lanes would need to be shifted up to four feet on the roadway to eliminate any impact at the existing bridge abutments. This shift would require full-depth reconstruction to both the inside and outside shoulders, reconstruction of the drainage structures on the inside shoulders, and the modification of some sign poles that currently encroach in the area that would be required for the new travel lane locations.

It appears that all of the necessary work could be conducted generally within the existing edges of pavement, aside from the emergency pull-outs that would need to be constructed. In addition to the minimum 12 foot shoulder width it may be desired to widen the shoulders slightly further to allow extra shoulder width as this segment is anticipated to be the most heavily used by buses.

Segment 6: Mystic River to Exit 30 – The segment stretches between the Mystic River and Exit 30, where the High Occupancy Vehicle (HOV) lane begins on the southbound side of I-93. This 1.25 mile section contains 3 heavily used interchange ramps in each direction thereby resulting in few segments of the shoulder which could truly be used exclusively by bus services. In addition, as buses travel southbound within this 1.25 mile segment, they would need to merge back into the general purpose lanes from the bus shoulder and cross three lanes of traffic to access the HOV lane. Due to the complexity of traffic weaving occurring in this relatively short segment and the resultant minimal time savings it was concluded that the bus use of the shoulder should not occur in this segment.

Segment 7: Exit 30 (Somerville) to Exit 26 (Boston) – The segment between Exit 30 in Somerville and Exit 26 in Boston is primarily on an elevated structure or within a tunnel. In the southbound direction the buses traveling this segment would utilize the existing HOV lane and therefore no use of the shoulder would be necessary. In the northbound direction, there is minimal width available where shoulders could be made wide enough to accommodate bus service. Therefore bus use of shoulders was not considered for this segment.

Ramp Improvement Requirements

In addition to the construction requirements for the shoulders, many of the interchange ramps will also require modification to accomodate bus usage. The existing configuration and design of the ramps did not contemplate the active use of the shoulder. At many of the on-ramps along the corridor the slopes and grade changes of the shoulder would not be acceptable for operation at travel speeds. It is anticipated that seven on-ramps and one off-ramp will require work to regrade the length of the ramp to eliminate the grade changes and slopes along the shoulders.

Bus Maintenance Facility

A new bus maintenance and storage facility would also be required due to the anticipated size of the bus fleet. The facility would include a maintenance building for washing and fueling buses as well as covered space for the overnight storage of buses. Typical maintenance facilities include office space as well as a location for parts storage. A specific site has not been identified but ideally would be located near an I-93 exit.

Bus Station Improvements

The bus stations included in this alternative include a mixture of stations to be existing in 2030 (the Park and Ride lots along I-93) and stations that will need to be built with the implementation of this service. No specific design or location has been identified for bus stops located to be built with this alternative however for budgeting purposes it is assumed that fairly modest bus stops would be built at each location. This would likely be limited to a protected, lighted and heated shelter optimally incorporated into an existing or new building. For budgetary purposes it is assumed that approximately $300,000 would be necessary for each bus station. This budget would include the real estate, design and construction of the station. New stations would be required at Manchester Airport, Derry, Windham, Salem and Methuen.

Other Improvements

In addition to the physical improvement that are required to the shoulders and roadway other costs may be incurred for the preparation of the roadway for bus use of shoulders. One such cost includes signage and striping to notify roadway users that buses may be using the shoulder. Another consideration may be the implementation of Intelligent Transportation Systems (such as bus GPS units, increased video monitoring of travel speeds or shoulder use). Until further discussion and identification of specific issues and concerns related to the use of shoulders for bus operations in the I-93 corridor with all stakeholders, detailed costs for any additional improvements cannot be estimated.

Estimated Costs

The following are the estimated costs for improvements of each segment related to bus shoulder use. These estimated costs are based on limited site field investigation, available data from Mass GIS and other sources and include a 30% contingency:

Segment 1 - $24 to 34 million

Assumes a total of 40 miles of highway (20 miles each direction) with an average 2.5 feet wide of new construction to the outside shoulder @ $15 per square foot. Also assumes 40 lane miles (12 feet wide) of repaving (mill and resurface) @ $250,000 per lane mile. An additional $8 to $10 million may be necessary to build emergency pull-outs at 1/2 mile spacing.

Segment 2 – $0 to 8.5 million

It is assumed that most of the improvements could be incorporated in I-93 Widening Project (Andover to Methuen) with marginal cost impacts. However, further design of the project may reveal that the additional outside shoulder width can not be accommodated without widening the outside edge of the highway. It is estimated that this may be an issue in the 3.7 mile segment between Exit 45 and the NH state line. This additional widening would impact approximately 7.5 miles of highway with an average 2.5 feet wide of new construction to the outside shoulder @ $15 per square foot. In addition, approximately $650,000 per mile would be required for earthwork, resetting of guardrail, resetting signage, lighting and landscaping. New emergency pull-outs would also be required in this segment.

Segment 3 - $16.5 million

Assumes a total of 11.1 miles of highway (6.3 northbound, 4.8 southbound) with an average 2.5 feet wide of new construction to the outside shoulder at $15 per square foot. Assumes 11.1 lane miles (12 feet wide) of repaving (mill and resurface) at $250,000 per lane mile. Also assumes approximately 15,000 square feet of full-depth reconstruction (at $15 per square foot) for the reconfiguration of one on-ramp. In addition approximately $650,000 per mile would be required for earthwork, resetting of guardrail, resetting signage, lighting and landscaping. New emergency pull-outs would also be required in this segment.

Segment 4 – $0

Assumes that any improvements will be incorporated into the I-93/I-95 Interchange Improvements Project

Segment 5 - $22 million

Assumes a total of 11 miles of highway (5.5 miles each direction) with an average 5 feet wide of new construction to both the inside and outside shoulder at $15 per square foot. Assumes 22 lane miles (12 feet wide) of repaving (mill and resurface) at $250,000 per lane mile. Also assumes approximately 15,000 square feet of full-depth reconstruction (at $15 per square foot) for the reconfiguration of seven interchange ramps. Additionally, work will be necessary to facilitate the construction of emergency pull-out areas in appropriate locations spaced about 1/2 mile apart. This is estimated to cost approximately $3.7 million.

Segment 6 – No work anticipated

This 1.25 mile long segment includes limited area for exclusive bus shoulder use due to density of interchange/merge ramps.

Segment 7 – No work anticipated

This segment does not have sufficient right-of-way width on existing structures to accommodate bus use of shoulders.

Bus Maintenance-Layover Facility $13 million

Order of magnitude estimate for Bus Maintenance-Layover Facility to accommodate approximately 50 buses. Site and configuration unknown at this time.

Bus Stations - $1.5 million

Budgetary number estimated based on $300,000 per station for a total of 5 stations.

Total Estimated Cost: $77 to 96 million

Date February 22, 2008

To David Nelson

From Tara Blakey

Subject NH I-93 Transit Investment Study
Additional Bus On Shoulder Services

Introduction

New Hampshire DOT is evaluating transit service for the improved I-93 corridor. As part of that study, draft operating plans were developed for four bus services linking the study corridor with Downtown Boston.

Bus Alternatives

Including the No Build and Baseline scenarios, four bus services were developed:

1. No Build – Existing services and current NHDoT transit commitment.
2. Baseline – Enhanced service along the corridor.
3. Minneapolis Style Bus on Shoulder (BOS) – Same as Baseline with improved travel times due to shoulder operations.
4. Ottawa Style BOS – Same as Minneapolis Style BOS with improved travel times due to higher maximum speeds within shoulders.

Preliminary estimates of travel time suggest that the Minneapolis style BOS alternative would offer limited benefit over the Baseline service. For this reason, the Minneapolis BOS service is not addressed in this memo.

New Methuen Service

A commuter bus service stopping near Methuen's town center and at the existing Pelham Street Park and Ride off of I-93 in Methuen would be added to Baseline and BOS options. Service would operate on 30-minute peak headways and 60-minute off-peak headways, stopping at the downtown station then the Pelham Street P&R en route to I-93 and Downtown Boston.

Under BOS alternatives, buses would travel within BOS lanes on I-93. Near exit 30, buses would cross three lanes to enter Massachusetts's HOV lane. Once in Boston, buses would stop in the vicinity of the MBTA's State station and other downtown locations en route to the South Station terminal.

Figure 1: Methuen Bus Routing at Methuen End

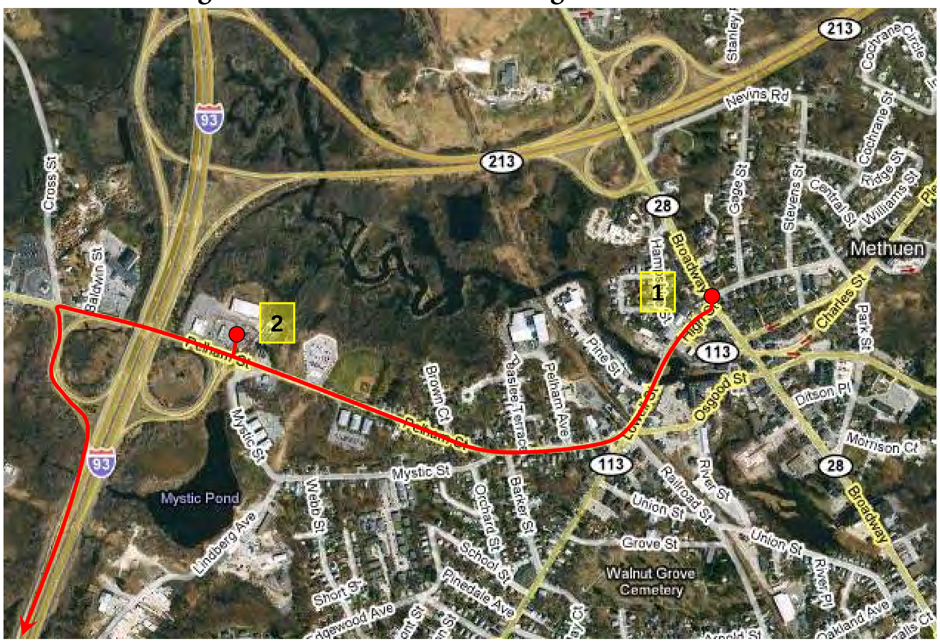


Table 1: Methuen Station Locations	
Station	**Location**
Methuen Town Center	Broadway and High Street
Park and Ride	Pelham Street off I-93 at Exit 47

Service Design

The following assumptions were used for development of operating plans.

Travel Times – Travel times were estimated based on the following:

- Buses would travel at an average speed of 55 mph in the BOS lane,
- Bus station dwell time would be one minute at each stop,

Hours and Frequency of Service – The level of service offered was based on the following:

Weekday

- The first inbound bus would arrive at South Station at 6:45 am and the last outbound bus would depart South Station at 11:00 pm,
- Service would operate on one hour headways all day.

Weekends

- The first inbound trip would arrive at South Station at approximately 8:00 am and the last outbound trip would depart South Station at approximately 12:00 am, and
- Service would operate on 90 minute headways.

BASELINE Methuen Service Schedules

Inbound

Trip	3000	3002	3004	3006	3008	3010	3012	3014	3016	3018	3020	3022	3024	3026	3028	3030	3032	3034	3036
Cycle	ccc	ddd	aaa	eee	bbb	aaa	bbb	aaa	bbb	aaa	bbb	aaa	bbb	aaa	ccc	bbb	aaa	ccc	aaa
Methuen	5:45	6:15	6:45	7:15	7:45	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00
Exit 47	5:48	6:18	6:48	7:18	7:48	9:03	10:03	11:03	12:03	13:03	14:03	15:03	16:03	17:03	18:03	19:03	20:03	21:03	22:03
State Street	6:32	7:02	7:32	8:02	8:32	9:32	10:32	11:32	12:32	13:32	14:32	15:32	16:32	17:32	18:32	19:32	20:32	21:32	22:32
South Station	6:52	7:22	7:52	8:22	8:52	9:52	10:52	11:52	12:52	13:52	14:52	15:52	16:52	17:52	18:52	19:52	20:52	21:52	22:52

Outbound

Trip	3001	3003	3005	3007	3009	3011	3013	3015	3017	3019	3021	3023	3025	3027	3029	3031	3033	3035	3037
Cycle	aaa	bbb	aaa	bbb	aaa	bbb	aaa	bbb	aaa	ccc	bbb	ddd	aaa	eee	ccc	bbb	aaa	ccc	aaa
South Station	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	16:30	17:00	17:30	18:00	18:30	19:00	20:00	21:00	22:00	23:00
State Street	8:20	9:20	10:20	11:20	12:20	13:20	14:20	15:20	16:20	16:50	17:20	17:50	18:20	18:50	19:20	20:20	21:20	22:20	23:20
Exit 47	8:49	9:49	10:49	11:49	12:49	13:49	14:49	15:49	16:49	17:37	18:07	18:37	19:07	19:37	20:07	20:49	21:49	22:49	23:49
Methuen	8:52	9:52	10:52	11:52	12:52	13:52	14:52	15:52	16:52	17:40	18:10	18:40	19:10	19:40	20:10	20:52	21:52	22:52	23:52

Weekend

Inbound

Trip	300	302	304	306	308	310	312	314	316	318	320	322
Cycle	aaa	bbb	aaa	bbb	aaa	bbb	aaa	bbb	aaa	bbb	aaa	bbb
Methuen	6:45	8:15	9:45	11:15	12:45	14:15	15:45	17:15	18:45	20:15	21:45	23:15
Exit 47	6:48	8:18	9:48	11:18	12:48	14:18	15:48	17:18	18:48	20:18	21:48	23:18
State Street	7:17	8:47	10:17	11:47	13:17	14:47	16:17	17:47	19:17	20:47	22:17	23:47
South Station	7:37	9:07	10:37	12:07	13:37	15:07	16:37	18:07	19:37	21:07	22:37	0:07

OTTAWA BOS

Outbound

Trip	301	303	305	307	309	311	313	315	317	319	321	323
Cycle	aaa	bbb	aaa	bbb	aaa	bbb	aaa	bbb	aaa	bbb	aaa	bbb
South Station	8:00	9:30	11:00	12:30	14:00	15:30	17:00	18:30	20:00	21:30	23:00	0:30
State Street	8:20	9:50	11:20	12:50	14:20	15:50	17:20	18:50	20:20	21:50	23:20	0:50
Exit 47	8:49	10:19	11:49	13:19	14:49	16:19	17:49	19:19	20:49	22:19	23:49	1:19
Methuen	8:52	10:22	11:52	13:22	14:52	16:22	17:52	19:22	20:52	22:22	23:52	1:22

OTTAWA BOS Methuen Service Schedules

Weekday

Inbound

Trip	3000	3002	3004	3006	3008	3010	3012	3014	3016	3018	3020	3022	3024	3026	3028	3030	3032	3034	3036
Cycle	aaa	ccc	bbb	ddd	aaa	bbb	aaa	bbb	aaa	bbb	aaa	bbb	aaa	bbb	aaa	bbb	aaa	bbb	aaa
Methuen	5:45	6:15	6:45	7:15	7:45	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00
Exit 47	5:48	6:18	6:48	7:18	7:48	9:03	10:03	11:03	12:03	13:03	14:03	15:03	16:03	17:03	18:03	19:03	20:03	21:03	22:03
State Street	6:19	6:49	7:19	7:49	8:19	9:32	10:32	11:32	12:32	13:32	14:32	15:32	16:32	17:32	18:32	19:32	20:32	21:32	22:32
South Station	6:39	7:09	7:39	8:09	8:39	9:52	10:52	11:52	12:52	13:52	14:52	15:52	16:52	17:52	18:52	19:52	20:52	21:52	22:52

Outbound

Trip	3001	3003	3005	3007	3009	3011	3013	3015	3017	3019	3021	3023	3025	3027	3029	3031	3033	3035	3037
Cycle	bbb	aaa	bbb	aaa	bbb	aaa	bbb	aaa	bbb	ccc	aaa	ddd	bbb	ccc	aaa	bbb	aaa	bbb	aaa
South Station	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	16:30	17:00	17:30	18:00	18:30	19:00	20:00	21:00	22:00	23:00
State Street	8:20	9:20	10:20	11:20	12:20	13:20	14:20	15:20	16:20	16:50	17:20	17:50	18:20	18:50	19:20	20:20	21:20	22:20	23:20
Exit 47	8:49	9:49	10:49	11:49	12:49	13:49	14:49	15:49	16:54	17:24	17:54	18:24	18:54	19:24	19:54	20:49	21:49	22:49	23:49
Methuen	8:52	9:52	10:52	11:52	12:52	13:52	14:52	15:52	16:57	17:27	17:57	18:27	18:57	19:27	19:57	20:52	21:52	22:52	23:52

Weekend

Inbound

Trip	300	302	304	306	308	310	312	314	316	318	320	322
Cycle	aaa	bbb	aaa	bbb	aaa	bbb	aaa	bbb	aaa	bbb	aaa	bbb
Methuen	6:45	8:15	9:45	11:15	12:45	14:15	15:45	17:15	18:45	20:15	21:45	23:15
Exit 47	6:48	8:18	9:48	11:18	12:48	14:18	15:48	17:18	18:48	20:18	21:48	23:18
State Street	7:17	8:47	10:17	11:47	13:17	14:47	16:17	17:47	19:17	20:47	22:17	23:47
South Station	7:37	9:07	10:37	12:07	13:37	15:07	16:37	18:07	19:37	21:07	22:37	0:07

Outbound

Trip	301	303	305	307	309	311	313	315	317	319	321	323
Cycle	aaa	bbb	aaa	bbb	aaa	bbb	aaa	bbb	aaa	bbb	aaa	bbb
South Station	8:00	9:30	11:00	12:30	14:00	15:30	17:00	18:30	20:00	21:30	23:00	0:30
State Street	8:20	9:50	11:20	12:50	14:20	15:50	17:20	18:50	20:20	21:50	23:20	0:50
Exit 47	8:49	10:19	11:49	13:19	14:49	16:19	17:49	19:19	20:49	22:19	23:49	1:19
Methuen	8:52	10:22	11:52	13:22	14:52	16:22	17:52	19:22	20:52	22:22	23:52	1:22

Date **November 6, 2007**

To Ken Kinney, Dennis Coffey and John Weston

From Tara Blakey & David Nelson

Subject NH I-93 Improvement: Transit Investment Study
Bus Use of Highway Shoulders

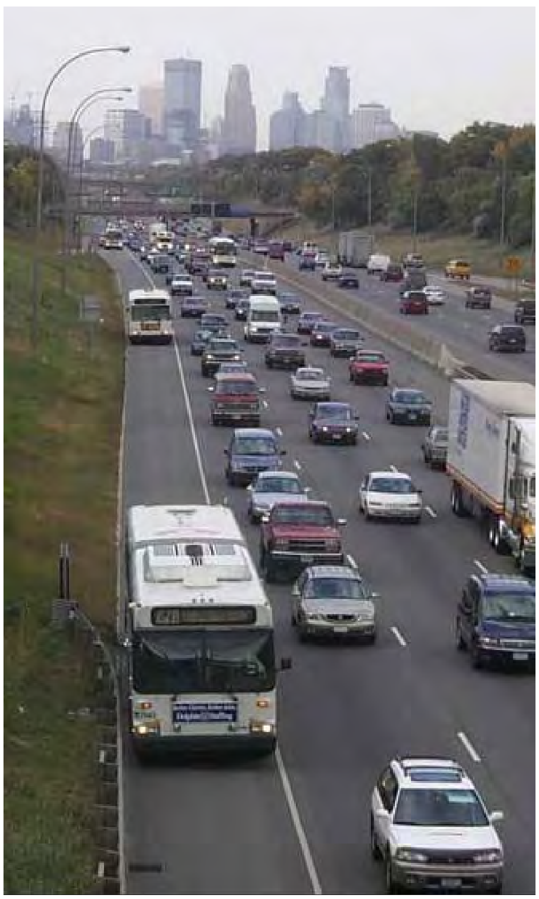


Figure 1: BOS in Minneapolis

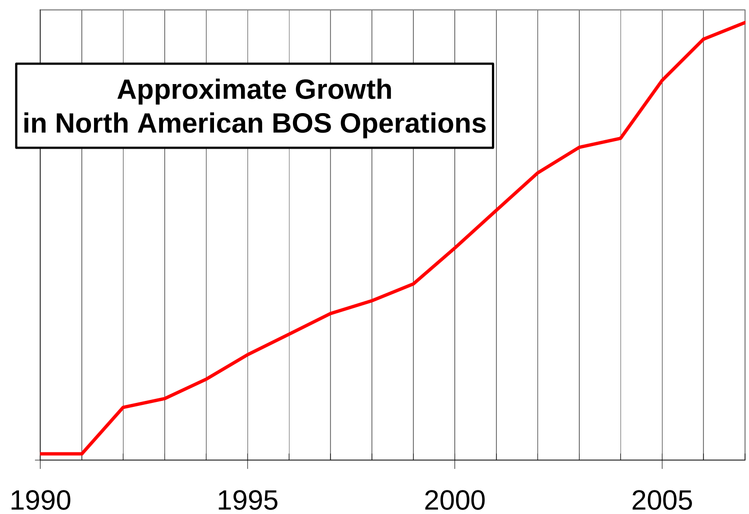
Bus use of highway shoulders has been an operational practice in North America for over 15 years. This growing practice allows professional drivers the discretionary power to drive within highway shoulders to reduce travel times and increase the reliability of transit service. The longstanding history of bus-on-shoulder (BOS) operations and the increasing number of communities pursuing such projects point to the success of this practice in terms of both passenger and institutional benefits and automobile driver acceptance. Many agencies have demonstrated that BOS can safely and cost-effectively improve transit service on congested roadways.

Highway shoulders, generally used as an emergency break down lane and for emergency response vehicles can be easily adapted for bus use. The key design requirements are a minimum lane width of 10 feet (12 feet preferred), adequate shoulder pavement strength, drainage inlets level with roadway, and signage. Conflicts with pavement edge rumble strips and lateral obstructions adjacent to shoulders sometimes need to be addressed. The costs for these upgrades vary widely, but are modest compared with most highway widening and interchange reconstruction costs.[1] In the Minnesota's Twin Cities, the cost of preparing shoulders for BOS were $100,000 per mile.[2]

[1] Martin, Peter C. (2006). *TCRP Synthesis 64*: *Bus Use of Shoulders, A Synthesis of Transit Practice*, Transportation Research Board, National Research Council, Washington D.C. 2006, 100 pp.
[2] Metropolitan Council (2005). Bus-only Shoulder Lanes Draw National Attention. Retrieved October 24, 2007 from http://www.metrocouncil.org/Directions/transit/transit2005/shoulders.htm

Two of the earliest and most extensive BOS networks are operated in Minneapolis and Ottawa. Both systems have been in safe operation for more than 15 years. In Ottawa, buses can use the shoulders of limited access highways at any time with maximum allowable speeds of 62. The more conservative, Minneapolis system allows buses to use the shoulder of the highway when the speed of general traffic drops below 35 mph. Buses on the shoulder may operate at speeds 15 mph faster than travel in other lanes up to a maximum speed of 35 mph. The more liberal Ottawa approach is consistent with current general purpose vehicle use of highway shoulders on I-93 and I-95 in Greater Boston where automobiles are allowed to travel at 65 mph in the shoulder during peak periods.

While the Twin Cities and Ottawa examples, with over 250 miles of bus-on-shoulder operations, are the most extensive American BOS networks, many North American communities have found this practice to be advantageous. As of 2006, transit buses were also operating on shoulders in Virginia, Maryland, Washington, New Jersey, Georgia, Delaware, California, Florida, and Ontario. New bus-only shoulder lanes are currently being developed in Ohio, Illinois and Kansas not including studies on the feasibility of BOS that are in progress nationwide.



Responding to growing interest from all over the nation, the Transit Cooperative Research Program is presently developing a "Guide for Implementing Bus-On-Shoulder (BOS) Systems". This decision-making tool will provide guidance for operational planning and functional design of BOS operations on heavily congested roads, such as I-93. The primary focus of this research is to develop recommended measures to safely move more people through congested roads. The research will (1) identify conditions under which shoulders can be used for bus travel, including design and operational criteria; (2) identify the advantages and disadvantages and the cost/benefit potential of BOS operations programs; and (3) identify procedures and strategies that may be used by various stakeholders (such as state and local transportation and transit agencies) to successfully implement a BOS project[3].

[3] For more information: see http://www.trb.org/TRBNet/ProjectDisplay.asp?ProjectID=1092

Table 1: Capacity Required for Rail Alternatives						
Area	**State**	**Date Started**	**Type of Facility**	**Miles of Highway**	**Interchanges**	**Notes**
In Operation[4]						
Seattle	WA	1970s	SR-520 westbound corridor BBS	2.7	Yes	Buses and 3+ carpools are allowed to use shoulder with no speed or time of day restrictions.
Seattle Region	WA	1975	SR-522 Bus Lane	2.2	Signalized Intersections	Bus only shoulders with no restrictions on time of day or speed.
Twin Cities	MN	1991	Comprehensive network	271	Yes	Bus drivers use shoulder when speed in general traffic drops below 35mph. Buses may travel 15 mph faster than general purpose traffic up to a maximum speed of 35 mph. Signs warn drivers of bus shoulder use at on ramps and along shoulder periodically. Planning to expand network for another five years at which point most of the essential highway shoulders will be incorporated in the system.[5]
Ottawa	Ontario	1992	Highways 417 and 174	12	Yes	Public transit buses allowed to travel at posted speed limit of 62mph. Part of a 30 mile BRT network.
Falls Church	VA	2001	Queue jumper	1.3	No	Facilitates access to the West Falls Church Metrorail Station.
Toronto	Ontario	2003	Highway 403	3	Yes	Buses allowed to travel 12 mph faster than general purpose traffic when traffic slows below 38 mph.
Alpharetta	GA	2005	GA-400 freeway	6	Yes	Bus use only when general traffic drops to 35mph. Buses allowed to go 15mph faster than traffic up to 35mph. Expanding to 12 miles.
San Diego	CA	2005	I-805, SR-52	4	Yes	Based on the success of the demonstration project, SANDAG and Caltrans will be looking at other corridors in the region that could benefit from this innovative way to battle congestion.[6]

[4] Source, unless otherwise noted: Martin, Peter C. (2006). *TCRP Synthesis 64*: *Bus Use of Shoulders, A Synthesis of Transit Practice*, Transportation Research Board, National Research Council, Washington D.C. 2006, 100 pp.

[5] Metropolitan Council (2005). Bus-only Shoulder Lanes Draw National Attention. Retrieved from http://www.metrocouncil.org/Directions/transit/transit2005/shoulders.htm

[6] Dave Schumacher, Sandag (November 2006). Buses on Shoulders – A Smooth Ride. Retrieved October 31, 2007 from http://sandag.org/enewsletter/archives/november2006/feature_1.html

Table 1: Capacity Required for Rail Alternatives						
Area	**State**	**Date Started**	**Type of Facility**	**Miles of Highway**	**Interchanges**	**Notes**
Miami	Florida	2006	SR-878, SR-874	4	Yes	Bus use only when general traffic drops to 25mph. Buses allowed to go up to 35mph. Many other corridors to follow initial project.[7]
Columbus[8]	OH	2006	I-70	11	Yes	Pilot Project, buses may travel on shoulders when general traffic falls below 25 mph
Old Bridge[9]	NJ	2006	Route 9 Commuter Bus Lane	3	Yes	Buses allowed during am and pm peaks at a maximum of 35 mph. Cars are allowed to make right turns from the bus shoulder and use it as a breakdown lane if needed.
Bethesda	MD	unknown	I-495 queue jumper	3	Yes	Allows eastbound buses on I-495 to avoid I-270 interchange in northbound direction in morning and evening peak periods. I-495 is five lanes in this area.
Burtonsville	MD	unknown	US-29 corridor	4	Yes	Buses operate in peak direction, SB 6am - 9am, NB 3pm -8pm. Appears to have been operational for some years.
Wilmington	DE	unknown	Route 202 Southbound	0.3	1 signalized intersection	No time of day restriction
In Planning						
Kansas City[10]	MO		I-35	20	Yes	Preliminary plans would allow bus use when general traffic falls below 40 mph.
Seattle Region[11]	WA		I-405 Queue jumper for P+R access	1	No	Will improve transit service to the Brickyard Park and Ride facility by constructing a new transit-only shoulder use lane in the southbound direction of I-405.

[7] Havens, April (2007). Buses on Shoulder program tests well in Kendall, officials report. Retrieved from http://www.miamitodaynews.com/news/070614/story7.shtml

[8] Stutz, Marty (2006). COTA and ODOT Take First Steps to Implement Express Buses on Freeway Shoulders Pilot Project. Retrieved from http://www.cota.com/import/20061110%20News%20Release%20-%20COTA-ODOT%20Freeway%20Shoulder%20Project.pdf

[9] Phalon, Erin (2006). NJDOT to open Route 9 Bus shoulder lanes in Old Bridge. Retrieved November 5, 2007 from http://www.state.nj.us/transportation/about/press/2006/112906.shtm

[10] Kansas City Start (2007). With express buses, I-35 is expected to shoulder more of the traffic burden. Retrieved from http://www.topix.com/content/kri/2007/07/with-express-buses-i-35-is-expected-to-shoulder-more-of-the-traffic-burden

[11] Puget Sound Regional Council (2006). PSRC's 2006 FTA Regional Competition Application. Retrieved from

Safety

Despite the long history of BOS, communities considering new BOS systems are often concerned with potential safety impacts. These concerns often focus on the ability of buses to merge in and out of general purpose lanes around highway entrances and exits or vehicles stopped on the shoulder (disabled vehicles, tow trucks, emergency responders, etc.). BOS networks in operation, however, have proven that thoughtfully designed BOS operations are inherently safe.

The San Diego Association of Governments (SANDAG) recently released a review of their BOS demonstration project. No accidents or operational issues related to shoulder operations were reported. Before and after surveys of passenger and driver perceptions were conducted: 90% of the surveyed passengers felt safe with buses operating on freeway shoulders.[12]

In the Twin Cities area approximately half of all bus routes operated by the region's two largest transit providers operate on corridors that have the option to use BOS at some point along the route. The number of accidents involving these buses is low considering the scope of BOS operations. During the initial ten years, between 1991 and 2001, there were 200 BOS accidents. Since the Twin Cities BOS system averaged 90 miles over this period, the number of accidents can be expressed as 0.2 accidents per mile per year. Most accidents were minor scrapes or mirror clips. No injuries were reported. Since 2001, there has been one injury.[13] An automobile struck a BOS bus from the rear killing the automobile driver. After 15 years of operations, Minneapolis Metro Transit reserves only $7,000 per year for damages resulting from BOS-related accidents. In other words, Metro Transit currently budgets approximately $26 per mile, annually, for BOS-related damages and contingencies.

BOS is typically designed with supplementary safety measures such as maximum shoulder speeds, requirements that buses yield to autos in all cases, or contracted towing service to quickly clear disabled vehicles. Beyond BOS specifications designed to ensure safety, intrinsic BOS characteristics contribute to safe interactions between buses and private autos. By definition, BOS is characterized by highly visible vehicles operated by professional drivers under congested roadway conditions.

Travel on the shoulder is advantageous only under congested conditions when buses have an opportunity to bypass slow moving traffic. Because buses only operate on shoulders when traffic in general purpose lanes is slow, the potential for accidents, especially those causing injury, are low. Whether operating a bus or private auto, drivers' ability to react to changing conditions is much greater at low speeds. For example, merging around obstructions is relatively easy for both buses and slow moving traffic on congested roadways.

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http://www.psrc.org/projects/tip/selection/2006/FTA_Applications/app19_WSDOT_I405TransitOnlyShoulderLane_FTA_app.pdf

[12] Dave Schumacher, Sandag (November 2006). Buses on Shoulders – A Smooth Ride. Retrieved October 31, 2007 from http://sandag.org/enewsletter/archives/november2006/feature_1.html

[13] State and Local Policy Program, Hubert H. Humphrey Institute of Public Affairs, University of Minnesota (June 2007). Bus-only Shoulders in the Twin Cities. Prepared for the FTA. Retrieved from http://www.hhh.umn.edu/img/assets/11475/Bus%20Only%20Shoulders%20Report%20FINAL.pdf

The size of buses also reduces the chance of unsafe interactions with autos. Buses are large enough to be easily noticed by other motorists who will then have adequate time to avoid conflicts. Additionally, the height of buses provides bus operators with an enhanced view of the operating environment allowing them advance warning of potential hazards ahead.

It is important to note that transit buses are operated by trained, accountable drivers. Moreover, agencies typically require additional driver training for BOS routes. Operators are not compelled to drive on shoulders, but are permitted to call upon their professional judgment to determine when BOS can be safely employed. Given the characteristics of BOS operations, professional drivers are well equipped to manage BOS routes safely.

Benefits of BOS

The range of benefits that are achievable at relatively low cost make BOS projects extremely attractive. The direct benefits include reduced travel times, and increased service reliability. Indirect benefits may include reduced highway congestion, increased transit service, increased transit patronage, and decreased operational costs. Agencies operating BOS systems have found the practice to be successful, often expanding the scope of their BOS network after preliminary trials.

Not only are actual travel times reduced once buses are allowed to bypass congestion, but customers' perceive even greater reductions in travel time. This may be a reflection of the feeling of preference a bus passenger experiences when passing automobiles in stop-and-go traffic. Respondents to a Minneapolis Metro Transit on-board survey conducted in 1998 overestimated the actual amount of time saved through BOS operations by two to three times.[14] Since perceptions are a key determinant in travel mode decisions, perceived travel time savings are a real catalyst for increased transit market share. Shorter travel times and deadhead trips also allow the same number of trips to be completed by fewer vehicles, reducing operational costs to the agency.

BOS allows bus operators to maintain travel speeds, even in the case of unexpected traffic conditions, in turn increasing the reliability of the transit service. San Diego's bus route 906 reported a 99 percent on-time performance during its BOS demonstration project.[15] More reliable service can have ripple effects throughout the transit system, making transfers to connecting trips less problematic and transit service in general more attractive. In Minneapolis, more reliable travel times have reduced the amount of driver overtime paid[16], and improved scheduling capabilities.

[14] State and Local Policy Program, Hubert H. Humphrey Institute of Public Affairs, University of Minnesota (June 2007). Bus-only Shoulders in the Twin Cities. Prepared for the FTA. Retrieved from http://www.hhh.umn.edu/img/assets/11475/Bus%20Only%20Shoulders%20Report%20FINAL.pdf
[15] Dave Schumacher, Sandag (November 2006). Buses on Shoulders – A Smooth Ride. Retrieved October 31, 2007 from http://sandag.org/enewsletter/archives/november2006/feature_1.html
[16] State and Local Policy Program, Hubert H. Humphrey Institute of Public Affairs, University of Minnesota (June 2007). Bus-only Shoulders in the Twin Cities. Prepared for the FTA. Retrieved from http://www.hhh.umn.edu/img/assets/11475/Bus%20Only%20Shoulders%20Report%20FINAL.pdf

BOS on I-93 in New Hampshire and Massachusetts

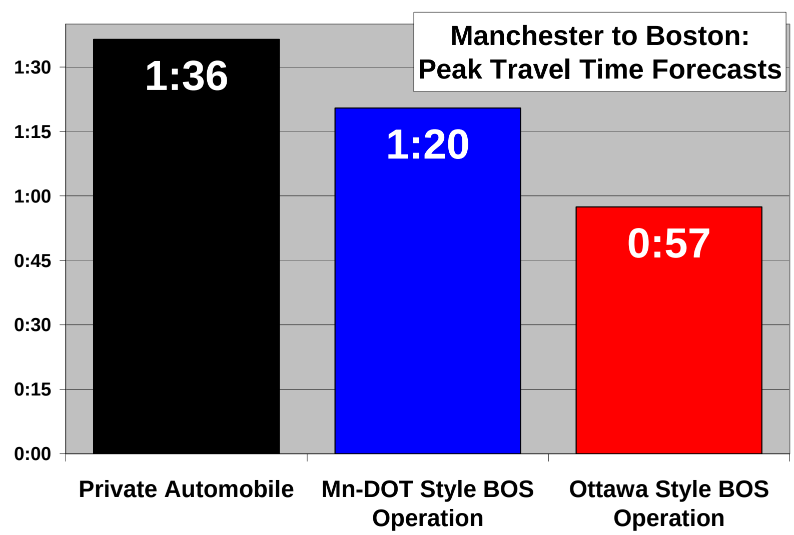
The state of New Hampshire is currently evaluating transit investment options for their improved I-93 corridor. BOS operation appears to be a cost-effective strategy for achieving attractive commuter service on I-93 from New Hampshire to Boston. Preliminary estimates of travel time savings are in excess of 30 minutes on BOS routes.

Existing Conditions – I-93 in New Hampshire is currently undergoing reconstruction to add two general purpose lanes in each direction as a congestion mitigation measure. The planned reconstruction of I-93 provides an opportunity to consolidate construction efforts and efficiently upgrade shoulders for BOS operations. Travel is not currently permitted on the shoulders.

I-93 in Massachusetts is three lanes in either direction between the State Line and Exit 41 (Route 125) in Andover. South of Exit 41, an additional general travel lane is added in each direction.

Vehicles in Massachusetts are already traveling at 65 mph on the shoulder of I-93 north of Exit 41. Traffic flow in the peak periods is facilitated by the use of the shoulder in the peak direction between 6 am and 10 am in the morning, and between 3 pm and 7 pm in the afternoon. The hard shoulder is not currently used by transit vehicles or commercial buses. Use of the breakdown lane for travel in the peak periods was instituted in 1999 after State Representative Barry Finegold brought legislators and officials from Massachusetts and New Hampshire together to discuss options to reduce congestion on I-93. Permission to use the breakdown lane for full speed general purpose traffic operations was extended by the Federal Highway Administration as an interim measure until a fourth lane is added north of Exit 41. BOS operations would preclude shoulder use for private automobiles so that some mitigating measure may be necessary if BOS were implemented on this portion of I-93 before I-93 is widened in Massachusetts' Essex County. There are currently no funded Massachusetts' plans to widen I-93 between the State Line and Exit 41.

Preliminary Evaluation – Morning Peak travel times on I-93 southbound between the State Line and Boston are 63 minutes on average and can be as high as 83 minutes, while free flow travel time is 29 minutes[17]. The 20 minute difference between average and maximum peak travel times highlights the improvement in service reliability achievable with BOS. Preliminary travel time calculations for BOS routes traveling from Manchester to Boston, assuming Ottawa-style 60 mph operations, indicate that BOS operations could save commuters



[17] Smartraveler website at www.smartraveler.com/scripts/bostraffic.asp?index=7&city=bos&cityname=Boston

39 minutes compared to travel by private auto. Assuming MnDOT-style operations with 35 mph maximum shoulder speeds, it is very roughly estimated that BOS operations could save commuters from Manchester to Boston 16 minutes compared to travel by private auto.[18]

Enhancing highway shoulders for BOS would also provide benefits for Massachusetts transit services that operate on I-93. These services, including the MVRTA's Boston Commuter Bus and the MBTA's express buses from Burlington and Woburn, could take advantage of bus-only shoulders for travel to Boston saving in excess of 30 minutes of travel time under Ottawa-style operations. Assuming, that these Massachusetts services could double in frequency due to decreased travel times, the frequency of Massachusetts and New Hampshire buses in the shoulder of I-93 in Massachusetts would be approximately every two minutes during the peak. While this level of service would be frequent enough to make BOS a highly visible practice it would not be so frequent as to obstruct the bus operator's view or place undue stress on automobile drivers.

[18] Under MnDOT BOS operating rules (buses are only allowed on shoulders once general purpose traffic speeds fall below 35 mph), the only portion of I-93 in New Hampshire where buses would be allowed to travel on the shoulder is the 1.35 miles between the Exit 1 and the State Line. The peak travel speed for general purpose traffic is forecast to be 20 mph on this segment.

Date October 2, 2007

To Ken Kinney, Dennis Coffey, John Weston, Julia Suprock

From David Nelson, Tara Blakey

Subject New Hampshire I93 Transit Investment Study: "Suburban Mobility" with Enhanced Bus Services

At the last TAC Meeting, Dennis DiZoglio was very interested in evaluating "suburban mobility" services connecting southern New Hampshire homes with Massachusetts employment districts north of Route 128 along I-93. David Nelson was not very encouraging with respect to carrying this alternative in the analysis because it had been evaluated previously and had not fared well. This memo summarizes the findings for the earlier work.

Phase II of the EIS study process for the New Hampshire I93 improvements included the conceptual development, evaluation, and screening of study alternatives. Evaluation of the alternatives as well as the rationale for eliminating specific alternatives from further consideration was documented in the so-called "I-93 Rationale Report"[1]. One alternative transit modes evaluated was an "enhanced bus" service connecting New Hampshire Park & Ride lots with northern Massachusetts employment sites. This memo describes the operating plan and the ridership forecast for that service.

Operating Plan

The "Enhanced Bus" service was designed to provide access from the study corridor to employment centers along the I93 corridor in Northern Massachusetts. In Massachusetts, buses would stop at Exit 45 (River Road), Exit 42 (Dascomb Road), Exit 38 (Route 129), and Exit 37 (Anderson RTC). The service would include two routes, each originating at two New Hampshire Park and Ride lots:

A. Exits 5 and 4

B. Exits 4 and 3.

[1] Vanasse Hangen Brustlin, Inc. (2001). Appendix B. *Interstate 93 Improvements, Salem to Manchester, New Hampshire*. Prepared for the New Hampshire Department of Transportation and Federal Highway Administration. Bedford, NH: VHB.

C.

Enhanced Bus Route A	
Exit 5	Londonderry
Exit 4	Derry
Exit 45	River Road
Exit 42	Dascomb Road
Exit 38	Route 129
Exit 37	Anderson RTC

Enhanced Bus Route B	
Exit 4	Derry
Exit 3	Windham
Exit 45	River Road
Exit 42	Dascomb Road
Exit 38	Route 129
Exit 37	Anderson RTC

The Park and Ride lot at Exit 2 was not considered due to its proximity to the Massachusetts employment centers and the increase in travel time that would result from stopping there.

Ridership

Ridership forecasts for the “Enhanced Bus” service were presented in the Rationale Report. IN all thirteen mode combinations were modeled, evaluating the interactive affect of various options. Combinations differed in highway design and rail and bus service provided. Mode Combination 10 modeled Enhanced Bus service with:

- Concurrent Expanded Bus service[2],
- No rail service,
- Four lanes in each direction on I93, and
- No New Hampshire HOV lane.

Table 1 reports the forecast 2020 ridership.

Table 1: Forecast Boardings and Alightings for Enhanced Bus service (Rational Report Mode Combination 10)			
Station	**Boardings**	**Station**	**Alightings**
Exit 5	162	Exit 45	174
Exit 4	154	Exit 42	61
Exit 3	36	Exit 38	70
		Exit 37	46
Total	351	Total	351

A total of 351 people are expected to use the enhanced bus service on a typical weekday. By comparison, the weekday ridership forecast under Mode Combination 10 for the direct Boston express bus service was 1,248.

[2] Express bus service from NH Exits 5, 4, 3, and 2 to Boston.

I-93 Shoulder Bus Operation - Medford to Woburn

This project would allow the buses currently operating along the 5 miles segment of the I-93 Corridor, between Exit 37 (I-95/Route 128) in Stoneham and Exit 32 (Route 60) in Medford to utilize the shoulders during periods of congestion. This segment of highway is currently utilized by MBTA's route 354/355 and 352. On average (especially northbound in the PM) this segment operates at speeds below 35 miles per hour. Use of the shoulder by the buses would allow them to operate at speed (55 m.p.h.) saving time and improving service reliability.

Use of highway shoulders for peak period transit use is becoming a more widely used and accepted use of the highway system across the country. In addition to the capital improvements the use of the shoulders for bus operations will require the development of specialized safety procedures and safety training for bus operators. This project has been developed as part of a study of transit alternatives between Manchester, NH and Boston, MA along the I-93 Corridor.

Capital Features

The use of the shoulder for bus services will require making improvements to both the inside and outside shoulders, including some drainage system improvements, modification to some of the on-ramps exit ramps, and installation of signage and other safety related improvements.

Estimated Capital Cost: $25 million

Operating Cost: No additional cost

Travel Time Savings: 96 hours per weekday (savings for existing riders)

In addition to the bus services operated by the MBTA there are other additional services that operate along the corridor that could also potentially use the shoulder depending on what sort of policy is developed for shoulder use. These could include the following services Concord Coach/Boston Express, Greyhound, MVRTA Commuter Bus, Massport Logan Express, and MBTA Express buses.

The following are the current buss services and the number of peak period buses that could also utilize the shoulders thereby increasing the effectiveness of the improvement.

- Boston Express (Londonderry): 6 peak period buses - to start Nov. 2008
- Concord Coach/Dartmouth Coach (to/from NH): 2 peak period buses
- Greyhound (to/from VT): 1 peak period bus
- MVRTA Boston Commuter Bus: 3 peak period buses
- Boston Express (Nashua): 3 peak period buses
- Massport Logan Express: 6 peak period buses

I-93 Shoulder Bus Operation – Phase 2 Woburn to NH State Line

This project would extend the use of the I-93 shoulders for bus operations from Stoneham (conducted as part of Phase 1) to the NH State Line. This 17.5 miles section of roadway experiences congestion levels on a regular basis that limits the speed of traffic. Use of the shoulder by the buses would allow them to operate at speed (55 m.p.h.) saving time and improving service reliability. Various portions of this segment of highway is currently utilized by the following buses.

- Boston Express (Londonderry): 6 peak period buses - to start Nov. 2008
- Concord Coach/Dartmouth Coach (to/from NH): 2 peak period buses
- Greyhound (to/from VT): 1 peak period bus
- MVRTA Boston Commuter Bus: 3 peak period buses
- Boston Express (Nashua): 3 peak period buses
- Massport Logan Express: 6 peak period buses

Capital Features

The use of the shoulder for bus services will require making improvements to both the inside and outside shoulders and will require the widening the shoulder by 2 to 4 feet in some segments. In addition modification to some of the on-ramps exit ramps, and installation of signage and other safety related improvements will be required. It is anticipated that the requirements for bus on shoulder operation could be integrated into design projects occurring within the corridor at no substantial cost.

Estimated Capital Cost: $40 million

Operating Cost: No additional cost

Travel Time Savings: Dependent on level of utilization by bus operators

The extension of the Bus on Shoulder operations northward of I-95 in Woburn would continue the efficient and effective use of the highway without additional substantial cost. As noted above currently there are 21 buses operating over this segment during peak periods. It is anticipated that with the improved travel times and increased reliability additional services, both public and private, would be initiated to take advantage of the improvement.

PRELIMINARY CAPITAL IMPROVEMENT PROGRAM FOR BUS ON SHOULDER ALTERNATIVE

Estimated Costs

The following are the estimated costs for improvements of each segment related to bus shoulder use. These estimated costs are based on our limited site field investigation, available data from Mass GIS and other sources and include a 30% contingency:

Segment 1 - $24 million

Assumes a total of 40 miles of highway (20 miles each direction) with an average 2.5 feet wide of new construction to the outside shoulder @ $15 per square foot. Also assumes 40 lane miles (12 feet wide) of repaving (mill and resurface) @ $250,000 per lane mile.

Segment 2 – $0

Assumes that any improvements will be incorporated in I-93 Additional Lane Project (Andover to Methuen) with marginal cost impacts.

Segment 3 - $7 million

Assumes a total of 11.1 miles of highway (6.3 northbound, 4.8 southbound) with an average 2.5 feet wide of new construction to the outside shoulder at $15 per square foot. Assumes 11.1 lane miles (12 feet wide) of repaving (mill and resurface) at $250,000 per lane mile. Also assumes approximately 15,000 square feet of full-depth reconstruction (at $15 per square foot) for the reconfiguration of one on-ramp.

Segment 4 - $0

Assumes that any improvements will be incorporated into the I-93/I-95 Interchange Improvements Project

Segment 5 - $21 million

Assumes a total of 11 miles of highway (5.5 miles each direction) with an average 5 feet wide of new construction to both the inside and outside shoulder at $15 per square foot. Assumes 22 lane miles (12 feet wide) of repaving (mill and resurface) at $250,000 per lane mile. Also assumes approximately 15,000 square feet of full-depth reconstruction (at $15 per square foot) for the reconfiguration of seven interchange ramps.

Segment 6 – No work anticipated

This 1.25 mile long segment includes limited area for exclusive bus shoulder use due to density of interchange/merge ramps.

Segment 7 – No work anticipated

This segment does not have sufficient right-of-way width on existing structures to accommodate bus use of shoulders.

Bus Maintenance-Layover Facility $13 million

Order of magnitude estimate for Bus Maintenance-Layover Facility to accommodate approximately 50 buses. Site and configuration unknown at this time.

Bus Stations - $1.5 million

Budgetary number estimated based on $300,000 per station for a total of 5 stations.

Total Estimated Cost: $66.5 million

Potential Daily Volume of I-93 Shoulder Use (with implementation of Bus on Shoulder alternative)				
		Average Daily Shoulder Volume*		Avg. Peak Period
From	To	Northbound Shoulder	Southbound Shoulder	Bus Frequency (min.)
Exit 31 (MA 60)	Exit 36 (Montvale Ave.)	72	72	2.5
Exit 36 (Montvale Ave.)	Exit 37 (I-95)	62	61	3
Exit 37 (I-95)	Exit 41 (MA 125)	53	53	3.5
Exit 41 (MA 125)	Exit 2 (NH 97)	50	50	3.5
Exit 2 (NH 97)	Exit 3 (NH 111)	39	39	4.5
Exit 3 (NH 111)	Exit 4 (NH 102)	33	33	5.5
Exit 4 (NH 102)	Exit 5 (NH 28)	23	23	8
Exit 5 (NH 28)	I-293	12	12	15

* Assumes each bus operating in Peak Period (peak direction) will use shoulder, Buses operating in off-peak period will use general purpose lanes

Note: Includes existing Concord Trailways, Vermont Transit, MVRTA and MBTA Services (Does not include Logan Express or Manchester Airport Shuttle)

APPENDIX B
MANCHESTER AND LAWRENCE BRANCH

MANCHESTER AND LAWRENCE RIGHT-OF-WAY ENGINEERING REPORT: LAWRENCE TO MANCHESTER AIRPORT

Field Inspection, Costs Estimates – January, 2008

I. BACKGROUND

The Manchester and Lawrence Branch (M&L) ran a distance of 26.97 miles between its namesake cities. The M&L for most of its existence was a secondary or branch line of the Boston & Maine Railroad. This status is evidenced in that it has always been single track (except a short segment in Lawrence and part of Methuen), had a large number of highway crossings at-grade, and had light rail (85 pounds per yard).

At Lawrence the M&L connects to the Portland Division Main Line, also known as the Western Route, of the former Boston & Maine Railroad, running between Boston and Portland, Maine. The Western Route through Lawrence is now referred to as the MBTA's Haverhill Line, with Pan Am Railway (the successor of the Boston & Maine) having trackage rights for freight service.

Currently, only the first mile of the M&L Branch in Lawrence is active for freight service, serving a plastic products company in Lawrence. Pan Am Railway now refers to the M&L as the Salem Industrial Track. At Manchester the M&L connected to the Boston & Maine Railroad's New Hampshire Main Line running from Boston to Concord, New Hampshire and beyond. Currently, the New Hampshire Main Line is referred to as Pan Am Railway's Northern Main Line running between North Chelmsford, Massachusetts and Concord, New Hampshire.

Scheduled passenger service on the M&L ended in 1953 although special summer trains from North Station to Rockingham Park in Salem operated sporadically until the early 1970's. Freight service on this line was local only for much of the 20th century. Most rail served business was located at both ends of the line so the abandonment process started just north of the remaining business on the south end in Salem and progressed northward towards Manchester. In 1983, 8 1/2 miles were abandoned between Salem (MP 7.6) and Derry (MP 16.1) and in 1984 from MP 16.1 in Derry through to MP 20.93 in North Londonderry. Expansion of the Manchester Airport soon extinguished from MP 22 to about MP 24 in Manchester. From about MP 22.1 to just short of MP 24, the right-of-way is almost completely gone under the runway extension, perimeter roads, parking areas and other features of the expanded airport. The last few miles into Manchester saw less and less service as the few remaining consignees and shippers ceased using rail service.

II. PHYSICAL CHARACTERISTICS

As noted above, the line could generally be described as a rural branch line serving small shippers and consignees. Both ends were urban in nature and served more extensive mill complexes, especially at the south end in Lawrence and Methuen. Most of line was laid with 85-pound per yard rail, typical of Boston & Maine branch lines.

There are many grade crossings, the exception being some streets in Lawrence and Methuen where vehicular traffic would have been an issue early on and a few major highways built in more recent times, such as Route 213 in Massachusetts and Routes I-93 and I-293 in New Hampshire.

Curvature is generally fairly generous with most curves not over two degrees. A two degree curve may allow passenger train operation up to 79 MPH with maximum possible track superelevation of six inches plus three inches of unbalanced elevation. The exceptions are the beginning curve in Lawrence in excess of three degrees and a 2º - 45' curve in Windham south of Milepost 16 and the very north, end coming into Manchester.

Grades are generally moderate and would not have significant impact on passenger operations. Northward, the maximum grade is 0.77 percent while southward it is 1.20 percent leaving Manchester and beyond that, does not exceed 0.73 percent. The profile is generally upgrade from Lawrence (elevation 55) to a summit just north of the Windham/Derry town line (elevation 339) and then downgrade to a point just south of Derry center (elevation 271) and then upgrade to a summit between mileposts 18 and 19 in Londonderry (elevation 339) and then down grade in stages to Manchester (elevation 173).

III. CURRENT OWNERSHIP

Current ownership of the line is primarily the MBTA, the State of New Hampshire, the Manchester Airport Authority and some private developers. Beginning in Lawrence, at the connection to the Haverhill Main Line, the MBTA owns approximately 3.70 miles to the State Line. From the State Line through Salem and Windham to the Windham/Derry Town Line at milepost 13.05 is owned by the State of New Hampshire. The State has granted the Town of Windham rights to construct and maintain a multi-use trail within the Town of Windham between mileposts 8.81 and 13.05.

The Town of Derry owns the right-of-way from the Windham/Derry town line, milepost 13.05, to the High Street crossing, milepost 16.58, located north of the center of Derry. The Town's agreement with the state requires that a 30 foot corridor be protected for future transportation use unless otherwise approved by the state. From High Street, Derry, milepost 16.58, to Route 28 in Londonderry, milepost 17.63 is owned by a private developer, Delaware Rock, Inc. North of Route 28 in Londonderry, most of the right-of-way is owned by the state with some portions on either side of I-93 owned by developers. The Manchester Airport Authority is the owner between Harvey and Goff's Falls Roads. North of the airport, the state is again the owner to Elm Street, Manchester, milepost 26.8. The last half mile or so to the connection with the present Pan Am Northern Line is apparently retained by the railroad.

IV. FIELD INSPECTION – LAWRENCE TO MANCHESTER-BOSTON AIRPORT

A field reconnaissance of the right-of-way between Route 113 in Methuen, north to the Manchester Airport on the Manchester/North Londonderry line (approximately 19.4 miles) was conducted on September 24, 2007. The most southerly segment in Lawrence and Methuen, Massachusetts was not observed on the ground as this is still operated in freight service by Pan Am Railway. Data on this segment and the section north of the Airport in Manchester was obtained from electronic/internet medium noted below. Reference material included:

Boston & Maine Railroad right-of-way and track maps (valuation plans)

Portions of an I-93 Corridor Improvements report by VHB in 2005 for the New Hampshire Railroad Revitalization Association

Various other studies and reports

Mapquest

Google Earth

Microsoft "Map.Live" oblique aerial photographs (used as noted in aerial photos herein)

The purpose of the inspection was to evaluate the right-of-way for potential use for regional transportation needs.

The observed conditions noted during the inspection are described in sequence starting in the south within Lawrence and moving northward. The first 2.3 miles in Lawrence, Massachusetts and the southern part of Methuen and the northerly 2.66 miles in Manchester were not observed on the ground, but only from aerial photography from the "Map.Live" and Google Earth web sites. Approximate mileposts (MP) are noted in the following descriptions, with the "0" Milepost being near the beginning of the M&L in Lawrence.

A. Connection to MBTA West Route (Haverhill Line) in Lawrence (MP 0.03±) to Route 113, Methuen (MP 2.64)

Most of this segment of the M&L appears to have been double track since the bridges can accommodate two tracks. Only one track is in place for most of this segment, generally on the west side of the right-of-way.

Figure 1 - Looking south from Salem Street overhead bridge in Lawrence. M&L is track to the right with crossover connection to the MBTA's West Route Main Line to the left.

The M&L Branch begins in Lawrence, diverging from the former Boston & Maine Railroad Portland or Western Division Main Line between the grade crossing of Andover Street and the overhead bridge carrying Salem Street over the railroad. The MBTA now owns this former B&M main line now known as the Haverhill Line. The M&L diverges from the westbound Main Line track via a power operated turnout, part of the Andover Street Interlocking. The turnout is located in the body of a 3º - 34' curve. This connecting turnout forms a crossover with another turnout that connects the M&L back in the opposite direction to an industrial track referred to as the Lowell Hill Industrial Track, used by Pan Am Railway to access several freight consignees on the west side of Lawrence. The connection point is MP 25.70 on the Main Line, but appears to be slightly above MP 0 on the M&L. This was the location of a railroad signal tower (now mostly demolished) and track changes have occurred here over the years so that the original M&L connection point may have moved slightly north.

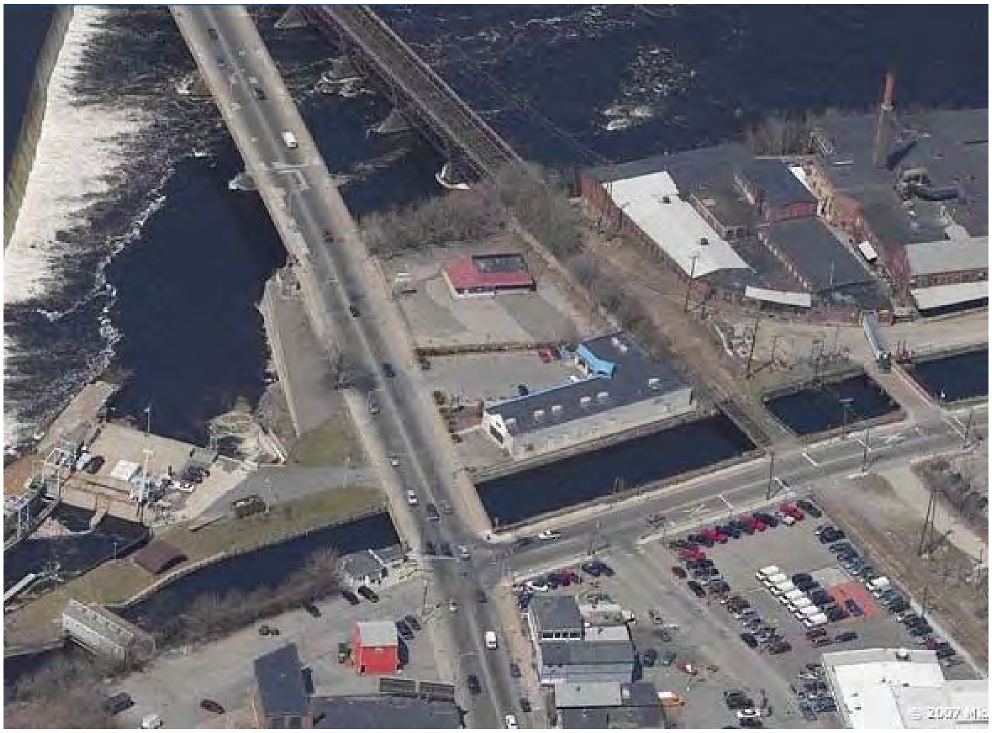


Figure 2 - Crossing Merrimack Street, the South Canal and the Merrimack River –from "Local.Live".

The M&L continues north, concentric with and on the west side of the Main Line, passing under the Salem Street Bridge at MP 0.08. Just past Salem Street the M&L diverges away from the Main Line to the left (northwest direction) forming one leg of a wye that existed between the M&L and the Main Line. The other or east leg of the wye is no longer in place. The M&L then crosses Merrimac Street (MP 0.25) at-grade (Figure 2) and immediately passes over a canal on a 58 foot long steel bridge. The track then crosses what is actually an island between the canal and the Merrimac River and then onto a 542 foot long steel bridge over the Merrimac River (MP 0.32). Coming off the bridge, the tracks cross in quick succession: Broadway - Route 28 (MP 0.40), which is a very flat skew angle grade crossing, another canal on a 95 foot long bridge (MP 0.48) and Water Street (MP 0.50). (Figure 3) Water Street and Broadway intersect close by the grade crossings and both streets carry high volumes of vehicular traffic, being close to the center of downtown Lawrence.

After crossing Water Street, the M&L passes through an area that was a small freight yard and crosses Essex Street (MP 0.64) at grade and then under Lowell Street (MP 0.80). Just past Lowell Street, on the east side of the railroad, is a siding where covered hopper cars of plastic resins are set off for Eastern Packaging Company, Inc., the only apparent freight consignee remaining on the M&L. (Figure 4) The railroad continues north through an area of old mill complexes and some dense residential housing, crossing Haverhill Street (MP 1.03) at grade and then over Manchester Street (MP 1.42) on a single span, double track, through girder bridge.

Figure 3 - Crossing Broadway, North Canal and Water Street from "Map. Live"

Figure 4 - Lowell Street overhead bridge, Lawrence, and last remaining freight consignee from "Map.Live"

The boundary line between Lawrence and Methuen is at MP 1.70 in a relatively open area with the Spicket River to the east and cemetery to west and across Railroad Street which is parallel to the M&L. The M&L then passes under Oakland Avenue (MP 2.15) and then crosses Union Street (MP 2.36) at grade. The former Methuen Station building still exists on the east side of the track at MP 2.50 (Figure 5). The tracks soon come to the 150 foot long underpass under Route 113 (MP 2.56) described below.

Figure 5 - Union Street grade crossing and former Methuen Station building. From "Map.Live"

B. Route 113, Methuen (MP 2.56) to New Hampshire State Line near Hampshire Road (MP 3.70)

Track is in place over this 1.14 mile segment but vegetation growth indicates that no trains have operated for several years. Route 113 (Lowell Street) intersects both Pelham and Osgood Streets at a flat angle, creating a long intersection that the railroad passes under via a 150 foot long (measured along the tracks) single span underpass (Figure 6). At MP 2.82 the track passes over the Spicket River on two short bridges, separated by a small, rectangular "island" formed by granite block walls on all four sides (Figures 8 and 9). The bridges are in fair condition. At MP 3.02, the tracks pass beneath Route 213, a divided highway, via two separate single span bridges (Figure 10). Just north of Route 213 the track passes under overhead power lines, then under an old timber overpass, then over a private, gravel grade crossing, followed by a culvert over a water course. There are markers for a gas pipeline crossing in the vicinity of the power lines crossing. The state line is crossed into Salem, New Hampshire at about MP 3.70 and then Hampshire Road at grade at MP 3.77.

Figure 6 - Passing under Route 113 in Methuen - from "Map.Live"

Figure 7 - Typical right-of-way vicinity of Route 113 in Methuen

Figure 8 - Spicket River crossing, milepost 2.82. North is to the right - from "Map.Live"

Figure 9 - Timber trestle over Spicket River, milepost 2.82, Methuen


Figure 10 - Passing under Route 213 bridges, milepost 3.02, Methuen

C. New Hampshire State Line (MP 3.70) to Salem/Windham Town Line (MP 8.81)

The 5.11 mile segment in Salem, New Hampshire runs in a north-north/west direction, generally parallel to and at varying distances west of Route 28 which is Broadway in Salem. Most of Route 28 in Salem is a highly commercial, built-up area with many grade crossings passing over the right-of-way with intersections of Route 28 very close to the rail crossings. Most of the track is still in place but has been removed through all road crossings. The grade crossings range from multi-lane roadways with intersections of Route 28, often with traffic islands and turning lanes in the rail corridor, down to small, private crossings. There is also a 63 foot long timber trestle over the Spicket River at MP 4.65. The road crossings, their approximate milepost, number of traffic lanes crossed, and if their intersection of Route 28 may be an issue are listed below:

Milepost	Name	Traffic Lanes	Intersection of Route 28 Near-by
3.77	Hampshire Road	2	Yes
4.37	Cuomo Drive	1	No
4.60	Doris Court	1	No
4.87	Kelly Road	2	Yes
5.03	Mall Entrance	5	Yes – very close

5.19	Hagop Road	2	Yes – little used road
5.60	Cluff Crossing Road	5	Yes – very close
5.88	Rockingham Park Blvd.	9	Yes – tracks in traffic islands
6.2 to 6.4	Private gated accesses	X	
	to Rockingham Park	X	
6.47	Rockingham Park Entrance.	4	Yes
6.89	Route 97 – Main Street	3	Yes
6.96	Private Drive	2	No
7.04	Willow Street	2	No
7.62	Old Rockingham Road	3	Yes – very close
8.73	Route 111 – Range Road	7	Yes – very close

Of the 16 crossings noted above, six would require safety devices because of the high traffic volumes, number of traffic lanes crossed and the fact that the grade crossing would pass through the intersection with Route 28. The aerial photograph (Figure 11) shows one of the larger of these intersections at Rockingham Park Boulevard.

In the vicinity of the Route 97 crossing, new buildings have been built very close to or on the railroad right-of-way (Figure 14). However, the railroad valuation drawings indicate the right-of-way is only about 36 feet wide north of Route 97 so that there is likely no encroachment. Just north towards the Willow Street crossing, there are storage buildings and storage trailers parked in the right-of-way behind buildings that are close to the right-of-way and fronting on Route 28 (Figure 15). These trailers are behind the Dodge Grain Company and appear to be an encroachment of the rail corridor.

Figure 11 - Rockingham Park Boulevard, MP 5.88 Note the track in place either side of the crossing and darker band where tracks would cross the pavement and islands. - from "Map.Live"

Figure 12 - Typical secondary road crossing in Salem

North of Willow Street crossing, the right-of-way pulls back further from Route 28 into the fringe of a wooded area behind the buildings fronting on the highway. The rail corridor again comes close to Route 28 at the Old Rockingham Road intersection of Route 28. From Old Rockingham Road to Route 111, Range Road, the right-of-way is close to Route 28 with no

Figure 13 - Cluff Crossing Road, milepost 5.60

Figure 14 - Route 97 crossing (milepost 6.89), old depot to the right and new buildings to the left

Figure 15 - Right-of-Way behind Dodge Grain Company, Salem

commercial development between the two. The right-of-way then crosses a major signalized intersection at Range Road and Route 28 and comes upon the Salem/Windham Town Line several hundred feet to the north.

Figure 16 - Route 111-Range Road. Tracks were approximately where black lines are indicated. Looking east with Route 28 running left to right.
- From "Map.Live"

D. Salem/Windham Town Line (MP 8.81) to Windham/Derry Town Line (MP 13.05)

The 4.24 mile segment in the Town of Windham is generally rural and most has or is being converted to a bicycle trail.

Figure 17 - New bicycle/pedestrian bridge over new highway, milepost 9.25

After crossing Route 111, Range Road in Salem, the right-of-way diverges from Route 28 heading in a north-northwest direction while Route 28 continues north. At about MP 9.25 a new east-west highway is being constructed. This highway is bridged by a new bicycle/pedestrian bridge on the rail alignment (Figure 17). At MP 9.52 Raulston Road is crossed at grade (Figure 18).

Figure 18 - Raulston Road crossing and bicycle trail

Figure 19 - Typical bicycle trail in Windham

This is the current south end of the bicycle trail that has now taken over the right-of-way through most of the balance of Windham. The paved trail with an adjacent shoulder for pedestrian and horse users (Figure 19) passes through wooded terrain with wetlands and several ponds. There are several long curves as the alignment seeks to avoid elevated areas, ponds, and maintain a reasonable grade. At several points there are causeways across small ponds and the right-of-way (Figure 20) passes along the shores of several other ponds. There is a single span, deck plate girder bridge at MP 9.89 within this segment. This bridge spans over a gravel road.

Figure 20 - Windham bicycle trail on causeway between two ponds - From "Map.Live"

At MP 12.80 the former Windham Depot structure is still standing, used for storage by the Windham Department of Public Works (Figure 21). Depot Road is crossed at MP 12.82, Frost Road at 12.84 and finally Windham Road at MP 13.00. The bicycle trail ends at Windham Road and just beyond is the Town Line into Derry at MP 13.05.

Figure 21 - Former Windham Depot structure next to bicycle trail

E. Windham/Derry Town Line (MP 13.05) to Derry/North Londonderry Town Line (MP 17.01)

Beyond Derry Road into Derry, the right-of-way is a partially cleared, dirt track apparently used by pedestrians, horses and off-road vehicles.

Figure 22 - South of Bowers Road, Derry, looking north

The area is heavily wooded and the right-of-way passes close to Route I-93 about 1 ½ miles south of Exit 4. The right-of-way is crossed by Bowers Road (MP 14.54) where there is also a 5 foot diameter corrugated steel pipe culvert passing under both the right-of-way and Bowers Road. (Figure 23).

Figure 23 - Five foot diameter corrugated steel pipe under Bowers Road, Derry

Continuing north from Bowers Road, the area is generally wooded but changes to a more suburban character with residential streets paralleling the right-of-way as Kendal Pond Road (MP 15.12) is approached and crossed at grade. North of Kendal Pond Road, the right-of-way is again paved for a bicycle trail, passing through a suburban area but generally well screened by trees (Figure 24).

Figure 24 - Kendal Pond Road, Derry - Paved north of crossing and gravel south from "Map.Live"

At MP 15.42 the right-of-way crosses Hall Avenue, (Figure 25) a narrow road accessing housing, continues north and ends as a distinctive right-of-way at the south end of a parking area for a complex of housing, west of the right-of-way (Figure 26).

Figure 25 - At Hall Road crossing, looking north


Figure 26 - Path ending at parking area, housing complex to the left - From "Map.Live"

The right-of-way, in the form of a vehicular drive to the parking area, referred to as Chelmsford Hardy Drive, next crosses over South Avenue (MP 15.81) and again assumes the identity of a distinct bicycle path for a short distance before coming upon a paved parking area next to the former Derry railroad depot (MP 15.96). The depot is now a restaurant and the bicycle path is just a walkway between the restaurant and the parking area. This is the built-up center of Derry and much of the right-of-way through this area is not well defined, being covered by brick and asphalt walkways, parking areas and access roadways.

Figure 27 - Looking south, across South Avenue to Chelmsford Hardy Drive, the access to parking area shown in Figure 25

Figure 28 - Derry business area - former depot in center and crossing of Broadway just above. Dark line is approximate track alignment - From "Map.Live"

Figure 29 - Looking north next to former depot, now a restaurant

Figure 30 - Along rail corridor - shown by black line - north of Broadway, Derry - From "Map.Live"

Just past the old depot, Route 102, Broadway (MP 15.97) is crossed at grade. The right-of-way remains obscured under pavement comprised of a brick walkway or plaza area, Manning Street, parking, and perhaps part of Derry Feed and Supply (Figures 30 and 31). To the north, the right-of-way again becomes a dirt track for a short distance before passing over Rollins Street (MP 16.20). The dirt track continues north with Hoods Pond to the right (there used be a large H. P. Hood & Sons creamery in this location) and shortly becomes obscured by a lawn adjacent to an apartment complex.

Figure 31 - View south towards the old depot. Right-of-way passed in area of Derry Feed and Supply sign

No trespassing signs are located at each end of the lawn area. (Figure 32). North of the lawn area, High Street, which is been parallel to the right-of-way to the west, is crossed at-grade at a very flat skew angle (MP 16.58) (Figure 33). From High Street north to the Route 28 crossing (MP 17.63) is now owned by a private developer.

Figure 32 - Lawn area between Rollins and High Streets - Looking north

Shortly after High Street, Madden Road (MP 16.67) is crossed, the right-of-way begins a broad curve to the left (west), and an area of wide-spaced industrial development is entered.

Figure 33 - High Street, showing flat skew angle crossing and then Madden Road to the left, looking east - From "Map.Live"

Just north of Madden Road, the right-of-way has been washed away (or perhaps dug out) for a short distance by a stream where there was a culvert (Figure 34). At MP 16.96 a gravel drive (the westward extension of B Street) is passed and then Coteville Road at MP 17.05 which is next to the Town Line at MP 17.01.

Figure 34 - Portion of right-of-way severed by stream - just north of Madden Road, Derry - from "Map.Live"

F. Derry/North Londonderry Town Line (MP 17.01) to the Manchester Airport (MP 22.18).

From the Town Line near Coteville Road, the right-of-way runs north-north/west to Route 28, Rockingham Road (MP 17.63). After crossing Route 28, the alignment turns slightly left to a northwest alignment and passes through a wooded, swampy area on a long tangent to a developing industrial park area around the intersection of Liberty and Independence Drives. Liberty Drive (MP 19.06) is crossed at grade next to its intersection of Independence Drive which the right-of-way then parallels to Auburn Road (MP 19.47). After crossing Auburn Road, the right-of-way is occupied by Verani Way as it curves further left, exits from Verani Way as a dirt track and passes under I-93.

Figure 35 - Crossing of Auburn Road. Independence Drive back to the right and Verani Way is within the right-of-way to the left - from "Map.Live"

The I-93 bridges (MP 19.55 and 19.59) are typical 3-span, steel highway structures with stub abutments. It appears that the center span, occupied by the rail corridor, could accommodate two tracks.

Coming out from under I-93, the right-of-way continues to curve left on a long curve, becomes tangent, now facing almost due west and crosses over Symmes Drive (MP 19.87), a new roadway accessing several large new industrial developments. The area around Symmes Drive is under construction that appears to encroach upon the right-of-way. Continuing on the westerly tangent, the right-of-way passes through a wooded area being developed as an industrial park and passes over Enterprise Drive (MP 20.25), a new road accessing some additional development. Next is Clark Road (MP 20.39), a residential street, then a wooded, wet area and then the right-of-way approaches the center of North Londonderry, passing over Sanborn Road (MP 20.87), Route 28, - Rockingham Road (MP 20.97), and Mammoth Road (MP 21.07). Between Clark Road and Sanborn Road there is a natural gas distribution facility adjacent to the corridor. Markers indicate that there is a gas pipe line in the corridor from here to some point to the west.

Figure 36 - North Londonderry, Sanborn Road at bottom, Route 28 crossing left to right and Mammoth Road just off the top of the frame - From "Map.Live"

Leaving North Londonderry center the right-of-way continues the westerly tangent for a short distance through a wooded area. The right-of-way is heavily overgrown in this area and difficult to walk in season. Soon, a long, 1° - 45' curve to the right starts and then a wet area and a pond where there is a 10 foot span stone culvert passing under the road bed (MP 21.70) (Figure 37).

Figure 37 - Ponds and culvert at MP 21.70. Rail corridor to the right. Dirt path to the left is a former trolley or interurban street railway line, long abandoned- From "Map.Live".

The right-of-way continues on the curve, crossing Harvey Road (MP 22.13) and then Mill Pond Brook (MP 22.18) where the right-of-way has been mostly obliterated by new roadways and other construction related to Manchester Airport (Figure 38).

Figure 38 - End of discernable right-of-way at Harvey Road (bottom roadway) and beginning of construction related to Manchester Airport, looking west - From "Map.Live"

V. CONCLUSIONS – SEGMENT SOUTH OF MANCHESTER-BOSTON AIRPORT

The 22 mile section of the M&L right-of-way between the MBTA's Haverhill Line at Lawrence and the Manchester Airport limits could support track construction and train operations. There are however several exceptions and issues that would need to be addressed in some manner to allow that to happen.

There are 45 **road crossings**, 6 in Massachusetts and 39 in New Hampshire. Of these, 3 in Massachusetts and 9 in New Hampshire could be characterized as major crossings in terms of traffic volumes and/or nearby intersections that would complicate operating trains. To operate a passenger rail service, each crossing would have to have railroad crossing warning systems installed and the major crossings would need additional measures such as traffic signal pre-emption, geometric roadway improvements and modifications to allow safe passenger rail operations.

There are a significant number of **bridges** and **major culverts** carrying the M&L right-of-way over roads or waterways. These bridges would have to be rehabilitated to make them suitable for modern, safe railroad passenger service. The timber trestles would need to be replaced completely. The new roadway that cuts across the right-of-way at MP 9.25 in Windham would require a new railroad bridge constructed to cross where currently there is only a bicycle/pedestrian bridge.

The 3.5-mile **Windham Bicycle Path** between Raulston Road. and Windham Road is well patronized. There is insufficient right-of-way to maintain both the trail and an active railroad without property acquisition and significant wetland impacts. The trail would have to be relocated to accommodate passenger rail operations.

The extensive **public and private development** along the rail corridor on both sides of Broadway, in the center of Derry, will require considerable effort to modify to allow the passage of trains. The rail corridor has almost disappeared under various access roads, drives, walkways and parking areas. The Town of Derry is obligated to protect a 30 foot wide corridor for future transit needs under terms of their agreement with the Department of Transportation.

Private Uses -- There are portions of the right-of-way used by private developers with apparently no provision in the sale agreements to address possible re-use of the land for transportation purposes. Further development encroaching on or too close to the rail corridor will make future use for rail service more costly to rectify.

In addition, other infrastructure, such as one or more double track sections to allow trains to pass, appropriate station locations with access roads and parking, a layover facility to store train sets overnight, a signal system and communications systems will also be required to safely implement passenger rail services on the branch.

A. Other Limitations on Connecting Lines in Massachusetts

If a new passenger service on the M&L were to connect to the present MBTA Haverhill Line in Lawrence, there are modifications and upgrades to that line and connection point that need to be addressed. The major issue is that the Haverhill line is single track from the connection point (Andover Street Interlocking in Lawrence) to Ash Street in Reading, a distance of about 14 miles. Alternatively, the new service could operate over a shorter segment of the Haverhill Line south to Wilmington Junction, about 7.8 miles, diverting there to the so-called “Wildcat” Branch.

The Wildcat in effect crosses trains over to the MBTA’s double track New Hampshire Main Line (Lowell Line) at Wilmington. However, the Wildcat is also single track over its 2.99 mile length, resulting in almost 12 miles of single track operation from Lawrence to Wilmington. Adding the trains of a new service to and from the M&L to the existing trains on those single track segments will require double tracking of the Haverhill Line from Andover Street Interlocking in Lawrence to Wilmington Junction in Andover and the Wildcat to just short of its connection to the New Hampshire Main Line in Wilmington.

The single track segments in Massachusetts are addressed in the following section of this report. In addition, a potential new alignment through the Airport, accessing the main passenger terminal and upgrading the north segment of the M&L from the airport into downtown Manchester is addressed in an appendix to this report.

VI. DOUBLE TRACKING AND OTHER IMPROVEMENTS ON EXISTING MBTA ROUTES, LAWRENCE TO WILMINGTON

As noted above there are existing single track constrictions on the current MBTA lines that the M&L would connect to that would need to be addressed if additional trains were to be run into Boston. Following is a brief description of the work that would be required to double track the present MBTA West Route or Haverhill Line south from Lawrence to Wilmington Junction in Andover and the Wildcat Line from its junction of the West Route to its connection to the New Hampshire or Lowell Main Line at Wilmington. The total distance is just under 12 miles and would impact several existing junctions or interlockings.

Access to Boston via the New Hampshire Main Line (also known as the Lowell Line) is preferred over staying on the Western Route or Haverhill Line because the New Hampshire Main Line is a better route that is fully double track, has few grade crossings and more capacity than the West Route into Boston by way of Reading.

The improvements required to this 12 miles of existing, active rail lines are described herein from north to south, starting on the New Hampshire Main Line in Wilmington where the Wildcat Branch diverges.

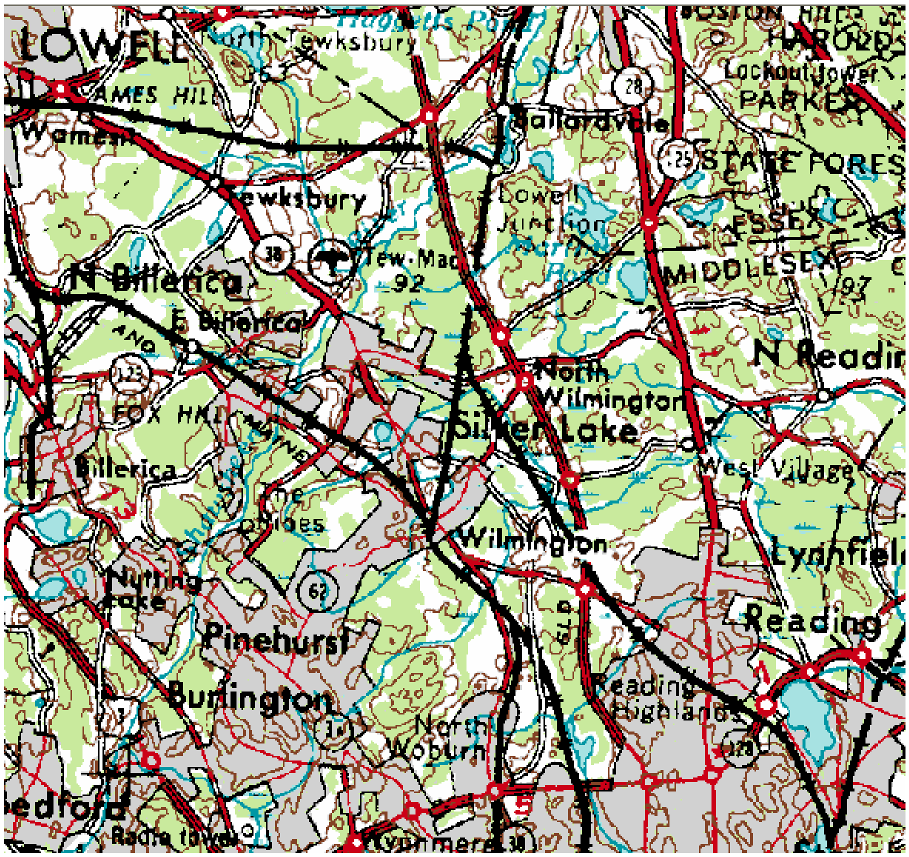
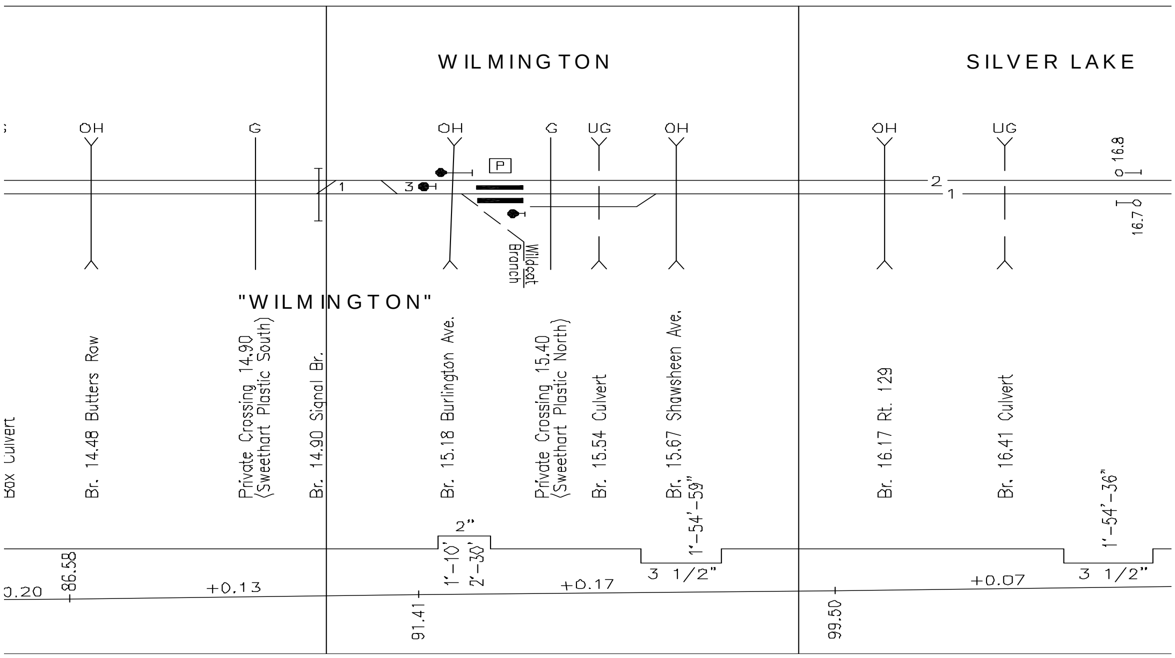


Figure 39 - The New Hampshire Main Line is the left of the rail lines indicated in black. The Merrimac Valley Line is off to the right. The Wildcat Branch is the short, north-south piece between the two lines.

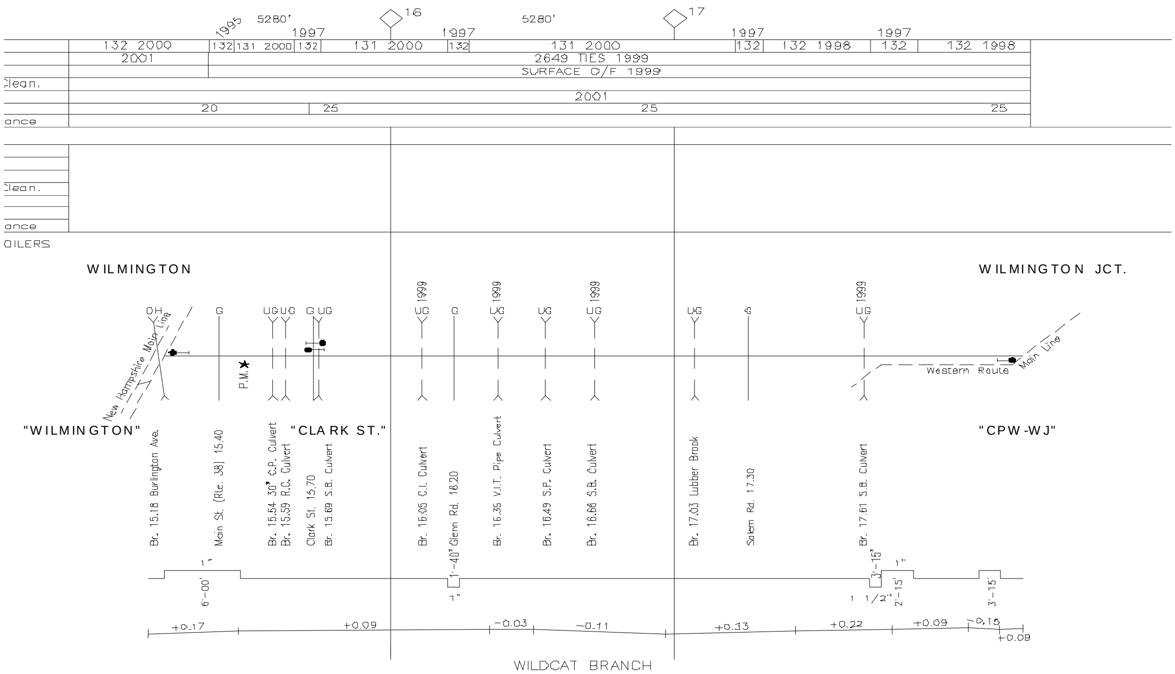
The map of the area (Figure 39) showing the rail lines, illustrates that at Wilmington, the New Hampshire Main Line to Lowell is only about one mile west of the more or less parallel West Route Main Line to Lawrence and Haverhill. The Wildcat is essentially a 2.99 mile long north-south crossover that connects these two parallel rail lines.



The track chart fragment of the New Hampshire Main Line above shows the double track route with Boston to the left and Lowell to the right. The Wildcat line branches off to the right from the northbound track (Track 1) in the Wilmington station area. Just south (left) of the junction of the two rail routes is a universal number 20 crossover; two sets of crossovers, one in each direction. This track arrangement allows trains moving on and off the Wildcat to access or come from either track towards Boston. A double track connection of the Wildcat at this location would be challenging due to the location of the station at the junction and other physical restrictions. An aerial photo of the junction is shown below.

Figure 40 - Wilmington, - the double track New Hampshire Main Line with Boston to the left. Part of the northbound station platform is visible on left side of picture. The single track Wildcat Branch swings away to upper right corner of the picture - from maps.live.com

Figure 41 - Wilmington looking north, with New Hampshire Main Line tracks in the lower left and the Wildcat swinging off to the right, crossing Route 38 at grade - from maps.live.com



Above is a track chart showing the full length of the Wildcat Branch. The "UG" and "G" on the vertical lines across the single track route are Undergrade Bridges and Grade Crossings.

Figure 42 - Wildcat Branch, looking north. This shows that the line has been single track for most of its recent existence, evidenced by the small, single track bridge over Lubber Brook (shown at milepost 17.03 on the previous track chart) - From maps.live.com

Figure 43 - Wilmington Junction - existing tracks defined in Black with potential new track and turnouts shown in red. Top is towards Lawrence, at bottom is Wildcat to the left and West Route to right towards Reading - from maps.live.com

On the Wildcat, a new single to double track interlocking would be installed on the north side of the Clark Street grade crossing and double track would run from there to Wilmington Junction. Wilmington Junction would change from a single turnout connecting the two single track lines to an end of double track on each line and a right hand crossover to allow trains to and from the Wildcat to access both tracks on the new double track West Route north towards Lawrence. (Figure 43 on previous page).

A little over two miles of new second main track would be constructed on the Wildcat; the existing track would have to be shifted slightly west to allow the new second track to fit within the existing right-of-way and on embankments, two grade crossings would be rebuilt, six culverts under the tracks modified or extended and a new or enlarged bridge built at Lubber Brook (Figure 42).

The West Route would have to be double tracked from a point just south of where the Wildcat connects, all the way to the present end of double track at Andover Street in Lawrence. Part of this segment is shown on Figure 44 below. The Wildcat connection is shown on the left side of the track chart, with north towards

Lawrence to the right. Within this segment are two existing passenger stations, Ballardvale (part of Andover) and Andover Station. Both of these stations are single track with one platform so that modifications would be necessary at both stations to provide platform access to both tracks. .

In addition, Lowell Junction, where Pan Am Railway's "Freight Main" to the west diverges, would need to be modified and expanded to allow access to and from their Freight Main to both tracks of the double tracked Merrimac Valley Line. A full universal crossover interlocking here would facilitate both passenger and freight operations on the new double track.

Figure 44 - Track chart fragment showing single track from Wilmington Junction on the left to the beginning of Lawrence Yard at "Frye" on the right.

In the above track chart, what appears to be the beginning of double track to the right at "Frye" or by its interlocking designation "CPF FY," is actually not the beginning of a second main track but the beginning of a lead track to the south end of Pan Am Railway's Lawrence Freight Yard. The track chart below depicts from Frye to Lawrence through Lawrence Yard to Andover Street.

Figure 45 - Track Chart fragment through Lawrence Freight Yard. Track designated as "Old East" is a yard track and switching lead to the left of the yard. MBTA double track starts at Andover Street ("CPF-AS") with the M&L Branch diverging from this same interlocking. (See Figure 51 following)

Converting the "Old East" track from a yard track to a passenger main line will have an impact on Pan Am Railway's freight operations. Long freight trains dropping or picking up cars from the yard currently use the "Old East" track. The next track below is too short to allow the longest train to clear the main track and provide room to switch cars to and from the various yard tracks. Some additional crossovers and other modifications will be necessary to mitigate some of the loss of operating flexibility Pan Am currently has at Lawrence with just a single main track south of Andover Street.

Preliminary range of cost estimates have been developed to provide a double track main line between Wilmington Station on the New Hampshire Main Line to Andover Street on the West Route, together with modified interlockings, signals, stations, bridges and culverts. These estimates are summarized starting on page 36.

Additional photographs of the required double tracking in Andover and Lawrence are shown on the following pages. Referring back and forth between the photographs and the above track charts will be helpful in understanding the existing configuration and potential issues at various locations.

Figure 46 - Lowell Junction – looking north. MBTA West Route to the right would have new track to the right and then a right hand crossover between the existing and new track. This will allow the Pan Am Freight Main that curves in from the left to access both tracks. Also, a new left-hand crossover south of the freight connection - from maps.live.com)

Figure 47 - Existing Ballardvale Station, looking north. New track would be to the right of existing, requiring new platforms on both sides. Private property on left side will make platform on left side difficult. Several grade crossings are just south of station - from maps.live.com

Figure 48 - Andover Station, looking north. Existing station platform is on left side and continues off the top of the photo. New track to right shown in red would need new platform. Grade crossing at bottom is at intersection of Essex and Pearson Streets. - from maps.live.com

Figure 49 - South end of Lawrence Yard. Locomotive (lower right) has just crossed onto what currently is the "Old East" track shown on track charts. Existing single main is below locomotive. Overhead bridge and buildings limit ability to lengthen the lead track that the left end of the train is on. - from maps.live.com

Figure 50 - South end of Lawrence Yard. This view is further north than view in Figure 49. Two tracks below the bottom freight cars are the existing single main and the "Old East" track in the yard. from maps.live.com

Figure 51 - Andover Street Interlocking. The MBTA's existing main tracks are shown in red to show how they come to single track just north of the Andover Street grade crossing. Pan Am Railway's freight tracks are shown in blue going to the yard at bottom of picture. Start of M&L Branch is shown in yellow at top - From maps.live.com

IX. PRELIMINARY COST ESTIMATES

Below are preliminary cost estimates to put the Manchester and Lawrence rail line back into service as a single track, commuter rail operation, with passing sidings, between the connection to the existing MBTA West Route (Haverhill Line) in Lawrence to the Exit 5 Park & Ride facility in Londonderry, a distance of about 21.5 miles. Also included is the cost to double track the existing MBTA Wildcat Branch and West Route Main Line between Wilmington Station and Andover Street in Lawrence, an additional 10.9 miles.

A. Assumptions

The M&L will remain single track except passing tracks will be provided about in the middle and at the north end near North Londonderry.

New stations will be built at Lawrence, Methuen Salem, Windham, Derry and Londonderry.

Station platforms will have high level platforms.

B. Not Included in Estimates

1. Any required land acquisition such as re-purchase of privately owned right-of-way in Derry and Londonderry, town owned right-of-way or additional land for stations, parking and access drives.
2. Environmental permitting and possible mitigation measures beyond minimal amounts estimated.
3. Noise/vibration mitigation.
4. Any municipal requirements.

C. Estimate Summary

A more detailed breakdown of the cost estimates is shown on a separate spread sheet. The estimated project cost, for work in both Massachusetts and New Hampshire, if built to just short of the Manchester-Boston Airport in Londonderry, is summarized by segments from south to north as follows:

Double Track Wildcat Branch, Wilmington to Wilmington Jct. (2.99 miles)

General Civil Work	$2,451,000
Track Work	$2,906,800
Grade Crossings	$ 472,000
Railroad Signalization	$2,325,000
Stations	$ 0
Sub-Total	$8,154,800
Mitigation Measures (3%)	$ 244,644
General Contingency (15%)	$1,223,220
Sub-Total Constr. Cost	$9,622,664
Engineering (10%)	$ 962,266
Constr. Mgmt. & Admin. (8%)	$ 769,813
Total Estimated Cost 2008 dollars	**$11,354,744**

Double Track West Route, Wilmington Jct. Andover Street, Lawrence. (7.9 miles)

General Civil Work	$ 2,775,700
Track Work	$10,712,150
Grade Crossings	$ 1,598,600
Railroad Signalization	$11,750,000
Stations	$ 6,500,000
Sub-Total	$33,336,450
Mitigation Measures (3%)	$ 1,000,094
General Contingency (15%)	$ 5,000,468
Sub-Total Constr. Cost	$39,337,011
Engineering (10%)	$ 3,933,701
Constr. Mgmt. & Admin. (8%)	$ 3,146,961
Total Estimated Cost 2008 dollars	**$46,417,673**

Rehabilitiate M & L Branch in Massachusetts . (3.7 miles)

General Civil Work	$ 3,849,675
Track Work	$ 3,219,150
Grade Crossings	$ 981,150
Railroad Signalization	$ 650,000
Stations	$14,000,000
Sub-Total	$23,699,975
Mitigation Measures (3%)	$ 711,000
General Contingency (15%)	$ 3,554,996
Sub-Total Constr. Cost	$27,965,971
Engineering (10%)	$ 2,796,597
Constr. Mgmt. & Admin. (8%)	$ 2,237,278

Total Estimated Cost 2008 dollars **$32,999,846**

Total Estimated Cost in Massachusetts $90,772,263

Rehabilitiate M & L Branch State Line to Londonderry, New Hampshire . (18.4 miles)

General Civil Work	$12,245.150	
Track Work	$17,493,235	
Grade Crossings	$11,637,950	
Railroad Signalization	$ 5,800,000	
Layover Facility	$ 1,224,000	
Stations	$28,000,000	
Sub-Total	$76,400,335	
Mitigation Measures (3%)	$ 2,292,010	
General Contingency (15%)	$11,460,050	
Sub-Total Constr. Cost	$90,152,395	
Engineering (10%)	$ 9,015,240	
Constr. Mgmt. & Admin. (8%)	$ 7,212,192	
Total Estimated Cost 2008 dollars		**$106,379,827**

Total Estimated Cost to Londonderry **$197,152,090**

(Total Distance = 32.9 miles)

In addition to the above estimates, preliminary estimates were prepared for extending the railroad through the Manchester-Boston Airport on new alignment to the existing passenger terminal and then north on the original alignment north of airport to Manchester. This option is illustrated in the attached Appendix A.

The extension is broken into two segments:

1. From the end of the proposed track estimated above in Londonderry, through the airport on new alignment to where the alignment rejoins the original right-of-way north of the airport.

2. From the new airport alignment, north along the original right-of-way to the end of the M & L at the junction with the New Hampshire Main Line Tracks in Manchester.

New Alignment through the Manchester- Boston Airport via Exist. Terminal. (3.66 miles)

General Civil Work	$42,370,760
Tunnel Construction	$85,320,000
Track Work	$ 6,494,750
Grade Crossings	$ 236,000
Railroad Signalization	$ 3,600,000
Underground Station	$ 19,900,000
Sub-Total	$157,921,510
Mitigation Measures (3%)	$ 4,737,645
General Contingency (15%)	$ 23,688,227
Sub-Total Constr. Cost	$186,247,382
Engineering (10%)	$ 18,634,738
Constr. Mgmt. & Admin. (8%)	$ 14,907,791
Total Estimated Cost 2008 dollars	**$219,889,911**

Rehabilitiate M & L Branch North side of Airport to Manchester . (2.66 miles)

General Civil Work	$ 1,447,000
Track Work	$ 2,749,800
Grade Crossings	$ 1,703,900
Railroad Signalization	$ 3,000,000
Sub-Total	$ 8,900,700

Mitigation Measures (3%)	$ 267,021
General Contingency (15%)	$ 1,335,105
Sub-Total Constr. Cost	$10,502,826
Engineering (10%)	$ 1,050.283
Constr. Mgmt. & Admin. (8%)	$ 840,226

Total Estimated Cost 2008 dollars **$12,393,335**

Total Estimated Cost – Through Airport to Manchester **$232,283,246**

Total Estimated Cost – Wilmington to Manchester **$429,435,336**

(Total Distance = 39.31 miles)

APPENDIX A

POTENTIAL ALIGNMENT THROUGH MANCHESTER-BOSTON AIRPORT AND NORTH TO DOWNTOWN MANCHESTER

General Description

A preliminary graphic layout was prepared to pass from the present end of railroad right-of-way east of the Airport property across the south end approach to runway 17-35, looping around and then entering under the airport terminal area in a cut and cover tunnel starting at the South Perimeter Road, across the various apron and parking areas to a new underground station between the existing parking garage and the main terminal building.

Figure 52 - Southern portion of potential alignment from existing right-of-way around the end of Runway 17-35. Tunnel would start at paved area on left side. Station would be in front of parking garage.

Leaving the terminal, the alignment then curves left, still in a cut and cover tunnel to a point south west of the intersection of the two runways where a segment of 800 feet of bored tunnel would pass under Runway 6-24 and then under the North Perimeter Road and exit onto a fill section and then across Cohas Brook on new bridge and then a reverse curve along the terraces above and on the north side of Cohas Brook to rejoin the present M&L alignment just south of the Goff's Falls Road overhead bridge. (See Figure A-2 on the following page)

Figure 53 - Northern portion of potential alignment. Cut and cover would continue from garage to an 800 foot bored tunnel under Runway, emerging just before the North Perimeter Road. Cohas Brook would be crossed on a new bridge.

The total length of this new alignment is about 3.66 miles with about 6,000 feet in a tunnel. The new alignment would be about 0.82 miles longer than the original, straight alignment along the east side of the Airport.

The new alignment would begin at the west end of the long east-west rail tangent east of the 10 foot box culvert over Little Brook near the beginning of the Airport property. The new alignment would curve slightly left, passing south of Plainview Drive and buildings north of that short dead-end street. The tracks would be on about a 0.50% upgrade in this area and be in a cut up to 30 feet deep passing under Harvey Road and an Airport perimeter road with a new bridge over the railroad. Since this is the area of the ALS for Runway 17-35, the railroad would be below the existing ground level passing south of runway.

The alignment would then curve to the right on a 1º - 45' curve and start to descend on a 1.8% grade, crossing over Industrial Drive at grade just north of its intersection with Pettingil Road. The alignment would then come tangent and follow a ridge downgrade to a valley formed by Little Brook. This valley would be crossed on an 840 foot long double track bridge and then pass under the South Perimeter Road with a bridge over and enter a tunnel starting at the paved parking area just north of the Perimeter Road. The alignment would be on a 3º - 30' curve to the right to set up a long tangent the misses the end of the present terminal building and just east of the main parking garage structure where a new station would be located. The station would be 600 feet long and fully below grade. (See Figure A-3 below).

Leaving the station area the alignment would clear the parking garage and curve left, still in a cut and cover tunnel across various parking areas and roadways then under Runway 6-24 and taxiways in a bored tunnel. Curving left the tunnel would emerge just before the alignment passes under the North Perimeter Road that would be on a bridge over (See Figure A-4 on following page). The alignment would then come tangent on a fill to Cohas Brook that would be passed over on a 150 foot long bridge, curve to the right to follow the north side of Cohas Brook along terraces above the flood plain, curve left, cutting off part of a parking area and rejoining the railroad alignment just south of the Goff's Falls Road bridge over the railroad. The track would be on an upgrade between the tunnel under the airport and the connection to the existing railroad right-of-way.

Figure 54 - Approximate alignment of cut and cover tunnel, skirting terminal building and continuing to a station in front of the parking garage.

Figure 55 - Approximate alignment under Runway 6-24. Tunnel would end just before passing under the North Perimeter Road which would be on a bridge over the railroad.

Figure 56 - Approximate alignment, cutting through a parking area and joining existing right-of-way just south of the Goff's Falls Road overhead bridge.

MANCHESTER-BOSTON AIRPORT TO PAN AM RAILWAY'S NEW HAMPSHIRE MAIN LINE IN MANCHESTER

This 2.66 mile segment begins just south of the Goff's Falls Road overhead bridge (MP 24.34) as shown in Figure A-5, passes through a commercial, warehouse area, passes under the Route I-293 bridges (MP 24.76), and then passes over Gold Street (MP 24.96) at grade, curves slightly to the right on a one degree curve and begins a descent to Manchester.

Starting at Gold Street, the right-of-way has been paved as a bicycle trail and soon passes a pond on the right (east side), part of Precourt Park. (Figure A-6).

Figure A-6 - Right-of-Way passing Precourt Park in Manchester. Note side trails connecting to park and ends of streets.

The right-of-way continues on a tangent and comes upon four grade crossings in quick succession. These are what appears to be an encroachment by a rear entrance to a shopping center from Beach Street (Figure A-7), then Spring Garden Street, then Beech Street at a flat skew angle and finally an entrance to a Cemetery. The bicycle trail apparently ends at Beech Street but the right-of –way continues through a residential area to Queen City Avenue (MP 26.27) whose four lanes are crossed at grade a flat skew angle (Figure A-8). Baker Avenue used to cross the railroad at grade in this area but has been truncated by the later constructed Queen City Avenue.

The right-of-way continues downgrade coming into a more commercial area and passing under Elm Street – Route 3 (MP 26.77). After emerging from under Elm Street, the right-of-way curves right and crosses over a private driveway and shortly connects to the existing PanAm Railway New Hampshire Main Line at MP 26.97 (Figure A-9).

Figure 57 - Three of four grade crossings - at bottom, the driveway entrance to a shopping center, then Spring Garden Street. then Beech Street at skew angle. Cemetery crossing just off top of view.

Figure 58 - Grade crossing of Queen City Avenue. Baker Street used to cross here but was cut off by newer Queen City Avenue.

Figure 59 - Passing over private drive and then connection to Pan Am Railway's New Hampshire Main Line. Note old railroad single story signal tower (hip roof) just above private crossing.

Preliminary cost estimates of the Airport alignment and the segment into Manchester are included in the main report, starting on page 36.

APPENDIX A
POTENTIAL ALIGNMENT THROUGH MANCHESTER-BOSTON AIRPORT AND NORTH TO DOWNTOWN MANCHESTER

A. General Description

A preliminary graphic layout was prepared to pass from the present end of railroad right-of-way east of the Airport property across the south end approach to runway 17-35, looping around and then entering under the airport terminal area in a cut and cover tunnel starting at the South Perimeter Road, across the various apron and parking areas to a new underground station between the existing parking garage and the main terminal building.

Figure 1 - Southern portion of potential alignment from existing right-of-way around the end of Runway 17-35. Tunnel would start at paved area on left side. Station would be in front of parking garage.

Leaving the terminal, the alignment then curves left, still in a cut and cover tunnel to a point south west of the intersection of the two runways where a segment of 800 feet of bored tunnel would pass under Runway 6-24 and then under the North Perimeter Road and exit onto a fill section and then across Cohas Brook on new bridge and then a reverse curve along the terraces above and on the north side of Cohas Brook to rejoin the present M&L alignment just south of the Goffs Falls Road overhead bridge. (See Figure 39 on the following page)

Figure 2 - Northern portion of potential alignment. Cut and cover would continue from garage to an 800 foot bored tunnel under Runway, emerging just before the North Perimeter Road. Cohas Brook would be crossed on a new bridge.

The total length of this new alignment is about 3.66 miles with about 6,000 feet in a tunnel. The new alignment would be about 0.82 miles longer than the original, straight alignment along the east side of the Airport.

The new alignment would begin at the west end of the long east-west rail tangent east of the 10 foot box culvert over Little Brook near the beginning of the Airport property. The new alignment would curve slightly left, passing south of Planeview Drive and buildings north of that short dead-end street. The tracks would be on about a 0.50% upgrade in this area and be in a cut up to 30 feet deep passing under Harvey Road and an Airport perimeter road with a new bridge over the railroad. Since this is the area of the ALS for Runway 17-35, the railroad would be below the existing ground level passing south of runway.

The alignment would then curve to the right on a 1° - 45' curve and start to descend on a 1.8% grade, crossing over Industrial Drive at grade just north of its intersection with Pettingil Road. The alignment would then come tangent and follow a ridge downgrade to a valley formed by Little Brook. This valley would be crossed on an 840 foot long double track bridge and then pass under the South Perimeter Road with a bridge over and enter a tunnel starting at the paved parking area just north of the Perimeter Road. The alignment would be on a 3° - 30' curve to the right to set up a long tangent the misses the end of the present terminal building and just east of the main parking garage structure where a new station would be located. The station would be 600 feet long and fully below grade. (See Figure 40 below).

Leaving the station area the alignment would clear the parking garage and curve left, still in a cut and cover tunnel across various parking areas and roadways then under Runway 6-24 and taxiways in a bored tunnel. Curving left the tunnel would emerge just before the alignment passes under the North Perimeter Road that would be on a bridge over (See Figure 41 on following page). The alignment would then come tangent on a fill to Cohas Brook that would be passed over on a 150 foot long bridge, curve to the right to follow the north side of Cohas Brook along terraces above the flood plain, curve left, cutting off part of a parking area and rejoining the railroad alignment just south of the Goffs Falls Road bridge over the railroad. The track would be on an upgrade between the tunnel under the airport and the connection to the existing railroad right-of-way.

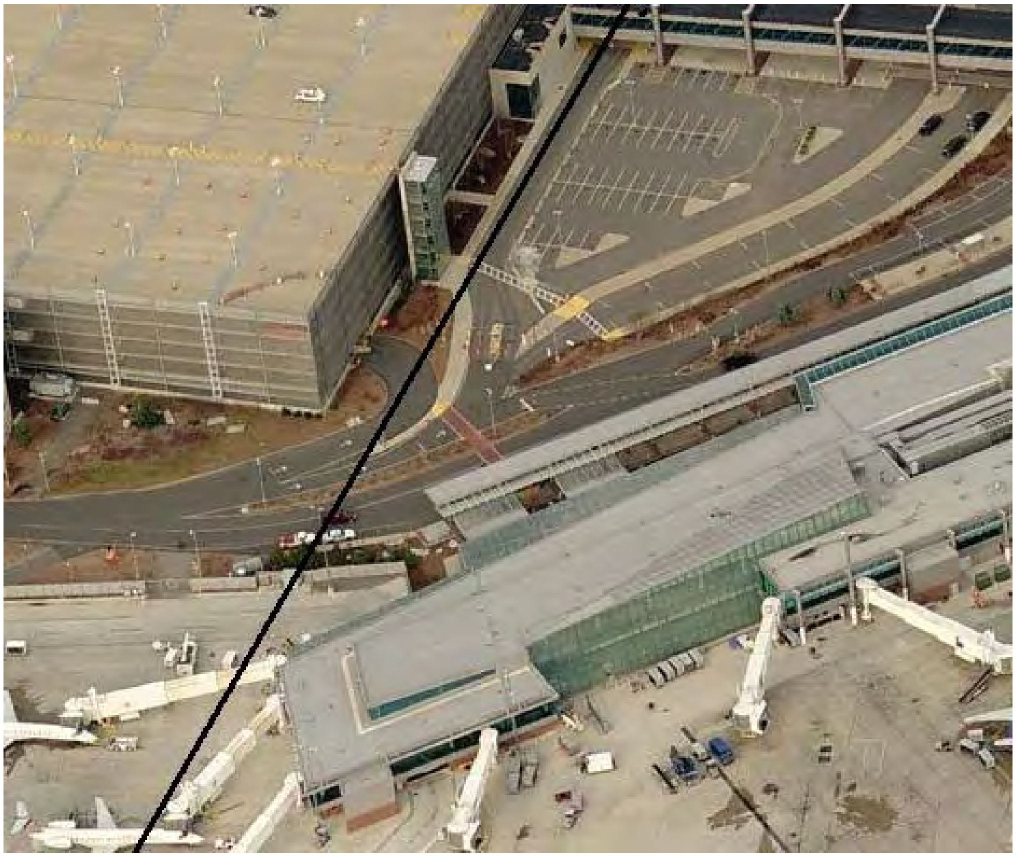


Figure 3 - Approximate alignment of cut and cover tunnel, missing terminal building and continuing to a station in front of the parking garage.

Figure 4 - Approximate alignment under Runway 6-24. Tunnel would end just before passing under the North Perimeter Road which would be on a bridge over the railroad.

Figure 5 - Approximate alignment, cutting through a parking area and joining existing right-of-way just south of the Goff's Falls Road overhead bridge.

VII. MANCHESTER-BOSTON AIRPORT TO PANAM RAILWAY'S NEW HAMPSHIRE MAIN LINE IN MANCHESTER

This 2.66 mile segment begins just south of the Goff's Falls Road overhead bridge (MP 24.34) as shown in Figure 42, passes through a commercial, warehouse area, passes under the Route I-293 bridges (MP 24.76), and then passes over Gold Street (MP 24.96) at grade, curves slightly to the right on a one degree curve and begins a descent to Manchester.

Starting at Gold Street, the right-of-way has been paved as a bicycle trail and soon passes a pond on the right (east side), part of Precourt Park. (Figure 43).

Figure 6 - Right-of-Way passing Precourt Park in Manchester. Note side trails connecting to park and ends of streets.

The right-of-way continues on a tangent and comes upon four grade crossings in quick succession. These are what appears to be an encroachment by a rear entrance to a shopping center from Beach Street (Figure 44), then Spring Garden Street, then Beech Street at a flat skew angle and finally an entrance to a Cemetery. The bicycle trail apparently ends at Beech Street but the right-of –way continues through a residential area to Queen City Avenue (MP 26.27) whose four lanes are crossed at grade a flat skew angle (Figure 45). Baker Avenue used to cross the railroad at grade in this area but has been truncated by the later constructed Queen City Avenue.

The right-of-way continues downgrade coming into a more commercial area and passing under Elm Street – Route 3 (MP 26.77). After emerging from under Elm Street, the right-of-way curves right and crosses over a private driveway and shortly connects to the existing PanAm Railway New Hampshire Main Line at MP 26.97 (Figure 46).

Figure 7 - Three of four grade crossings - at bottom, the driveway entrance to a shopping center, then Spring Garden Street. then Beech Street at skew angle. Cemetery crossing just off top of view.

Figure 8 - Grade crossing of Queen City Avenue. Baker Street used to cross here but was cut off by newer Queen City Avenue.

Figure 9 - Passing over private drive and then connection to PanAm Railway's New Hampshire Main Line. Note old railroad single story signal tower (hip roof) just above private crossing.

Preliminary cost estimates of the Airport alignment and the segment into Manchester are included to the rear of the main report, starting on page 36

APPENDIX C

OPERATION PLANS

Date **March 11, 2008**

To Ken Kinney, Dennis Coffey, and John Weston

From Tara Blakey & David Nelson

Subject New Hampshire I-93 Transit Investment Study

Operating and Maintenance Cost Estimates for Final Transit Alternatives

Four final transit investment alternatives are being evaluated for the improved I-93 corridor in New Hampshire. Estimates of operating and maintenance (O&M) costs were developed for the final documentation and evaluation of alternatives. Four classes of costs were considered:

1. Transportation Expense

Crew

Fuel

Supplies

2. Mechanical Maintenance Expense

Labor

Supplies

3. Maintenance of Way Expense

Labor

Supplies

4. Administration

Alternatives

Operating and maintenance costs were estimated for the four final alternatives:

1. No Build – Existing bus services and current NHDOT transit commitment.

2. Baseline – Enhanced bus service along the corridor.

3. BOS (Ottawa Style) – Same as Baseline with improved travel times due to shoulder operations.

4. Rail – Direct rail service to Boston along the Manchester & Lawrence (M&L) Railway.

No Build – The No Build scenario includes existing bus service between the Manchester Transportation Center, on Canal Street, and downtown Boston and planned commuter bus service from four park and ride (P&R) lots along I-93 in New Hampshire. The New Hampshire Department of Transportation (NHDOT) has committed to improving existing service to Boston from the P&R lot at Exit 4 and implementing new service from P&R lots at Exits 5, 3, and 2. Peak headways from Exit 5 in Londonderry to downtown Boston would be 30 minutes with peak travel time of 64 minutes to/from State Street.

Baseline – The baseline alternative would serve Manchester and the P&R lots with improved service frequency. Additional stops would be added at town centers near Exits 5, 4, 3, 2 and 47 and at a P&R lot at Exit 47 in Methuen. Buses would travel within general purpose lanes on I-93. Near Exit 30, buses would enter Massachusetts's HOV lane. Once in Boston, buses would stop in the vicinity of the MBTA's State station and other downtown locations en route to the South Station terminal. Peak headways from Exit 5 in Londonderry to downtown Boston would be 15 minutes with peak travel time of 64 minutes to/from State Street.

BOS (Ottawa Style)– The mix of service for this alternative would be the same as the Baseline, except buses would be allowed to travel along the I-93 shoulder of the highway between Manchester and Boston. Near Exit 30, southbound buses would cross three lanes to enter Massachusetts's HOV lane. Buses would be permitted to travel up to 60 mph on shoulders at any time when congestion warranted.

MVRTA buses from Lawrence and Andover and MBTA buses from Burlington and Woburn would also be allowed to use the shoulders under the same conditions as the buses from New Hampshire and Methuen. Service frequencies on all routes would be unchanged from the Baseline. Peak headways from Exit 5 in Londonderry to downtown Boston would be 15 minutes with peak travel time of <u>50</u> minutes to/from State Street.

Rail – The rail alternative would use the historic Manchester and Lawrence (M&L) right-of-way in New Hampshire. New Hampshire stations would be located at Exit 5 and near town centers in Derry and Salem. The rail alternative would use the M&L line from Salem, New Hampshire to the Haverhill line in Lawrence, Massachusetts. Trains would switch from the Haverhill Line to the Lowell line via the Wildcat Branch. Trains would remain on the Lowell line for access to Boston's North Station.

Massachusetts stations served under this alternative would include the MBTA's Andover and Anderson stations and new stations in Methuen and Lawrence on the M&L. Peak headways from Exit 5 in Londonderry to downtown Boston would be 30 minutes on average with peak travel time of 65 minutes to/from North Station.

Table 1: Summary of Final Alternatives				
	No Build	Baseline	BOS (Ottawa)	Rail
Peak Transit Headway from Exit 5	30	15	15	30
Peak Travel Time from Exit 5 to Downtown Boston	64	64	50	65

Estimating Operating and Maintenance Costs

All unit costs used to develop O&M estimates are based on actual and budgeted costs from transit agencies currently operating services similar those provided by the alternatives. Bus services would be managed by New Hampshire authorities and either directly operated or contracted out to private operators. Because of the level of coordination required between potential service from New Hampshire and MBTA services, it was assumed that the rail alternatives would be operated by the MBTA.

Transportation Expense - Transportation costs, which are primarily crew and fuel, generally vary with the amount of service that is offered in each alternative.

It was assumed that bus transportation costs would be driven by the revenue hours operated. The unit-cost for bus transportation includes both fuel and crew components.

For the rail alternative, the study team estimated the cost for crew and fuel based on current MBTA unit costs (see Table 2).

Table 2: Estimates of Rail Transportation Cost Components		
Crew Unit Costs[1] (fully loaded/per hour)	Engineer Conductor	$55.01 $46.30
Fuel[2]	Diesel Gallon	$1.92
Dispatching	Dispatcher	$55.01

Each three-car train set would be operated by an engineer and one conductor. In the opinion of the study team, the limited stops between Lawrence and Boston would provide ample time for a single conductor to service three cars of passengers. Regular crew hours were derived by factoring revenue vehicle hours up by 20 percent. Spare crew hours were estimated assuming that each crew member misses an average of 35 days per year including vacations, training, holidays and illness resulting in a 15.6% spare board to cover all absentees. The net impact of these assumptions provides, approximately, 1.4 crew hours for every hour of revenue service.

The fuel consumption rate of 1.607 gallons per train-mile[3], for a train set made of two DMUs and one coach, was used to convert vehicle miles into gallons of fuel required.

[1] As reported by MBTA's Deputy Director of Railroad Operations, July 2007.
[2] Average price of diesel fuel in the MBTA's 2007 budget.

Dispatchers would be added to manage the 20 miles of new track in New Hampshire and additional traffic on the existing MBTA network. There would be two additional dispatchers working 40 hours per week, one covering morning and midday service and one covering afternoon and evening service. It was assumed that dispatchers would be compensated at engineer rates.

Table 3: Estimates of Transportation Variable Costs		
Cost Category	**Unit**	**Unit-Cost**
Bus Transportation: Fuel and Crew	Revenue Hour	$40.63
Rail Fuel	Train-Mile	$3.10
Rail Crew	Crew Hour	$101.31

Mechanical Maintenance Expense - The mechanical cost factors are presented in Table 4. It was assumed that bus service would employ over-the road coaches with a 51-person seating capacity. Rail service would be operated by DMU train sets consisting of a mix of two DMU cars and one unpowered coach.

Bus maintenance estimates were based on cost figures reported by the Merrimack Valley Regional Transit Authority (MVRTA) [4] which operates commuter bus service within the study corridor through a contract with a private operator. Bus maintenance costs were assumed to be driven by revenue miles operated. MVRTA costs from 2006 were escalated by 5% to derive 2007 costs.

For the rail alternative, a recent self-powered rail car (DMU) study for New Jersey Transit[5] provided two similar estimates of the costs for maintaining a fleet of DMUs. The 2004 estimates were:

- $134,064 per unit for agency maintenance[6]
- $134,279 per unit for contract maintenance by Colorado Railcar Manufacturing LLC[7]

[3] Christina Rader, Colorado Railcar (2003). "Economics of FRA-Compliant Diesel Multiple Units (DMUs)". Prepared for the 2003 APTA Rail Conference.
[4] Reported in the 2006 National Transit Database.
[5] New Jersey Institute of Technology and KKO and Associates, *Northern Branch Case Study: Strategic Analysis of the Application of Self-Powered Rail Cars in New Jersey.* Prepared for New Jersey Transit Spring 2004. pp. 54
[6] Labor cost of $86,647 per vehicle based on NJ TRANSIT commuter rail maintenance labor cost in 2002 calculated from NTD 2002 figures for vehicle maintenance labor costs and hours. Result was inflated to 2004 dollars by 5% annually. Annual parts cost per DMU vehicle of $49,787 based on 1995 KKO survey of DMU manufacturers inflated to 2004 dollars.
[7] Colorado Railcar Manufacturing LLC, Economic and Performance Modeling of the CRM DMU for New Jersey Transit prepared for Dave Carter of New Jersey Transit, April 2004.

Escalating the average of these two values to 2007 at 5% per annum yields an estimated annual maintenance expense of $155,320 per unit[8].

The study team used MBTA budgeted maintenance costs for to estimate the mechanical cost for coaches.[9]

Table 4: Estimates of Annual Mechanical Costs		
Vehicle Type	Unit	Unit Cost
Bus	Revenue-Mile	$0.79
DMU	Vehicle	$155,320
Coach	Vehicle	$90,720

Maintenance of Way – Maintenance of Way (MOW) costs include the everyday direct costs for inspection and maintenance of infrastructure, including labor and materials.

It was assumed for the purposes of this analysis that bus alternatives would not incur maintenance of way expenses.
For the rail alternative, it was assumed that the MBTA would supplement its maintenance of way work force with 10 full-time staff:

- one supervisor/chief engineer,
- one signal inspector,
- three signal maintainers and
- five track, bridge and station maintainers.

The supervisor would earn a fully-loaded hourly rate of $37.67 while other personnel earn $31.39 per regular hour[10]. Overtime pay, estimated to be 10 percent of annual regular hours, was added for non-supervisory staff to account for contingencies such as snow removal and grade crossing accidents. Overtime rates would be 1.5 times the regular hourly rates.

8

	2004	2005	2006	2007
NJT Staff	$134,064	$140,767	$147,806	$155,196
CRM Contract	$134,279	$140,993	$148,043	$155,445
Average	$134,172	$140,880	$147,924	$155,320
Inflation Rate	5%			

9 Vanasse Hangen Brustlin, Inc. & KKO and Associates (April 2004). MBTA commuter Rail Infrastructure Needs Assessment. Submitted to Massachusetts Bay Transportation Authority. Boston, MA.
10 Assuming MOW performed by the MBTA, rates were derived from reported hourly rates for shortline maintenance work in Maine adjusted to reflect 2007 conditions in the Boston area.

It is assumed that MOW materials cost would mirror MBTA commuter rail experience as reported to the National Transit Database. The estimated average materials cost per MOW labor hour, escalated to reflect costs in 2007, was $16.98.

	2004	2005	2006	2007
NJT Staff	$134,064	$140,767	$147,806	$155,196
CRM Contract	$134,279	$140,993	$148,043	$155,445
Average	$134,172	$140,880	$147,924	$155,320
Inflation Rate	5%			

Administration - In addition to the direct operational expenses estimated, an additive for administration and management is appropriate. For bus, an additive of 17% for system administration and management was applied to estimates of mechanical and transportation costs.[11] For rail, an additive of 16.5% for system administration and management was applied to estimates of mechanical, transportation and MOW costs.[12]

Operating and Maintenance Cost Estimates

Using the cost estimation approach described, operating costs were estimated for the seven alternatives.

Transportation – The annual transportation costs for the alternatives range from $2 to $4 million. Table 5 summarizes the forecast transportation costs.

Table 5: Estimates of Annual Transportation Cost						
Alternative	Annual Miles (millions)	Annual Staff Hours	Fuel Costs (millions)	Crew Costs (millions)	Dispatching (millions)	Total Costs (millions)
No Build	1.4	46,475				$1.9
Baseline	2.4	82,934				$3.4
BOS (Ottawa)	2.4	76,809				$3.1
M&L Rail	0.6	48,581	$1.7	$2.5	$0.2	$4.4

Mechanical – Mechanical costs for the alternatives range from $1 to $2 million as shown in Table 6.

Table 6: Estimates of Annual Mechanical Cost							
Alternative	New DMUs	New Coaches	New Buses[13]	DMU Costs (millions)	Coach Costs (millions)	Bus Cost (millions)	Total Costs (millions)

[11] Based on National Transit Database reports for the MVRTA (2006).
[12] Based on available National Transit Database reports for the MBTA (2003).
[13] Assuming 10% spare ratio.

No Build			31			$1.1	$1.1
Baseline			57			$1.9	$1.9
BOS (Ottawa)			55			$1.9	$1.9
M&L Rail	12	6		$1.9	$0.5		$2.4

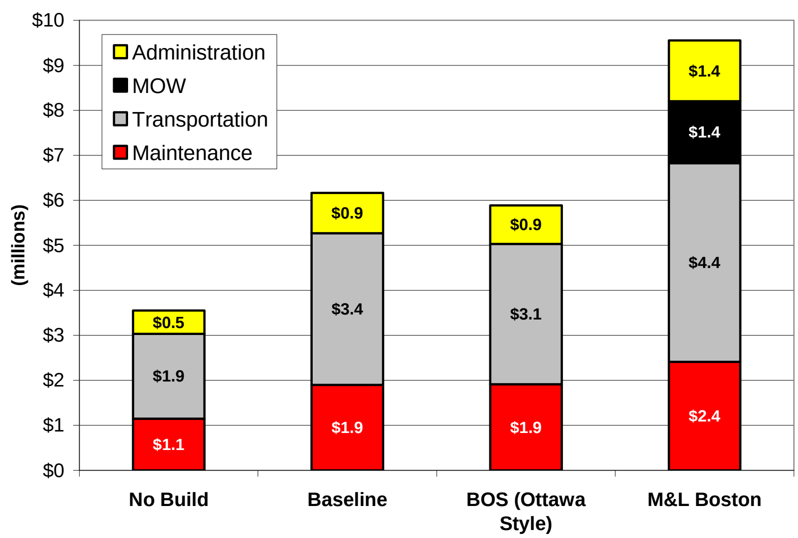
Maintenance of Way – The annual MOW costs are $0 for the bus alternatives and, approximately, $1.4 million for the rail alternative.

Total O&M Costs – Operating and maintenance costs for the alternatives range from $3.6 for the No Build scenario to $9.6 million for rail service as shown in Table 7 and Figure 1.

Table 7: Estimates of Annual Overall Operating and Maintenance Cost (millions)

Alternative	Transportation Costs	Mechanical Costs	MOW Costs	Administration Costs	Total Annual Costs
No Build	$1.9	$1.1		$0.5	$3.6
Baseline	$3.4	$1.9		$0.9	$6.2
BOS (Ottawa)	$3.1	$1.9		$0.9	$5.9
M&L Rail	$4.4	$2.4	$1.4	$1.4	$9.6

Figure 1: Estimates of Annual Overall Operating and Maintenance Cost



Date **February 27, 2008**

To David Nelson

From Tara Blakey

Subject NH I-93 Transit Investment: Bus Alternatives, Final Operating Plans

cc: Dennis Coffey, John Weston, Ken Kinney

New Hampshire DOT is evaluating transit service for the improved I-93 corridor. As part of that study, draft operating plans were developed for four bus services linking the study corridor with Downtown Boston. This memo describes the four bus alternatives, documents planning assumptions, and presents service statistics.

Bus Alternatives

Including the No Build and Baseline scenarios, four sets of bus services were developed:

1. No Build – Existing services and current NHDOT transit commitment.
2. Baseline – Enhanced service along the corridor.
3. Minneapolis Style Bus on Shoulder (BOS) – Same as Baseline with improved travel times due to shoulder operations.
4. Ottawa Style BOS – Same as Minneapolis Style BOS with improved travel times due to higher maximum speeds within shoulders.

No Build – The No Build scenario includes existing bus service between the Manchester Transportation Center, on Canal Street, and downtown Boston and planned commuter bus service from four park and ride (P&R) lots along I-93 in New Hampshire. The New Hampshire Department of Transportation (NHDoT) has committed to improving existing service to Boston from the P&R lot at Exit 4 and implementing new service from P&R lots at Exits 5, 3, and 2.

Bus service would pick-up and drop-off passengers at offline stations in New Hampshire including the Manchester Transportation Center and P&R lots at I-93 Exits 5, 4, 3, and 2. Buses would travel within general purpose lanes on I-93. Near exit 30, buses would enter Massachusetts's HOV lane. Once in Boston, buses from P&R lots would stop in the vicinity of the MBTA's State station and other downtown locations en route to the South Station terminal.[1]

[1] Bus service from New Hampshire would make multiple Downtown Boston stops similar to commuter bus services provided by the Merrimack Valley Regional Transit Authority (MVRTA) and by Concord Trailways. The MVRTA's service from Methuen stops at Government Center,

Buses from Manchester would retain their current route in Boston, stopping at South Station and Logan Airport with no other downtown Boston stops. The existing Manchester service originates in Concord, with three trips a day in each direction serving New Hampshire towns as far as three hours north of Concord. For the No Build scenario, it was assumed that the combined service to Manchester, Concord and other New Hampshire towns would continue to operate as it does today.

In Massachusetts, present MVRTA service from Methuen, Lawrence and Andover via routes 28 125 and I-93 to Boston would continue. Present service is limited to two roundtrips per day. Further south, MBTA service on routes 352, serving Burlington, and 354 and 355, serving Woburn, via I-93 would continue to operate as today.

Table 1 presents the peak and off-peak service frequencies for New Hampshire services provided under the No build scenario.

Table 1: Service Characteristics of No Build Bus Routes

Route	Station	Peak Headway (minutes)	Off-Peak Headway (minutes)
1	Manchester: 119 Canal Street	60	120
2	Exit 5	30	60
3	Exit 4	30	120
4	Exit 3	30	None
5	Exit 2	60	60

Baseline – The baseline alternative would serve Manchester and the P&R lots with improved frequency and additional stops would be added at town centers near Exits 5, 4, 3, 2 and Methuen and at a P&R lot off of I-93 in Methuen. Buses would travel within general purpose lanes on I-93. Near exit 30, buses enter Massachusetts's HOV lane. Once in Boston, buses would stop in the vicinity of the MBTA's State station and other downtown locations en route to the South Station terminal.

Park Street MBTA Station, Stuart and Tremont Streets, the Transportation Building in Park Square, Copley Square, and Essex Street and Atlantic Avenue (near South Station). Concord Trailways' commuter service, from the Exit 4 Park & Ride in Londonderry, offers stops at State Street MBTA Station, Park Street MBTA Station, Tufts New England Medical Center, and South Station. By offering downtown stops that are convenient to passengers' employment destinations, travel times are reduced making the transit service more attractive. Expanded bus service from the study corridor would, at a minimum, offer the same Downtown Boston stops currently provided on Londonderry commuter service.

The future capacity constraints at South Station were not assessed. Should the South Station Bus Terminal not have adequate capacity for expanded bus service from the study corridor, there are various options for berthing in Downtown Boston. For example, the MVRTA commuter bus from Methuen stops on Essex Street outside of the South Station Bus Terminal. MBTA 500 series express commuter buses terminate at 100 Federal Street, with capacity to berth five or more buses simultaneously.

Bus service would pick-up and drop-off passengers at offline stations in New Hampshire including the Manchester Transportation Center, P&R lots at Exits 5, 4, 3, 2 and Exit 47 and near town centers in Derry, Windham, Salem and Methuen. The bus stopping at the Exit 5 P&R lot would serve the Manchester Airport. Since travel times increase significantly with each offline station served (time to exit and return to I-93), it was assumed that each peak bus would serve one town center, then one P&R station and travel directly between that Park & Ride station and Boston. Table 2 displays the stations served by, and the peak headway associated with, each of the five peak routes. The bus serving the Manchester station would use I-293 to travel between Manchester and I-93 and would not serve a P&R lot or any other New Hampshire stations. Travel between the airport and the Exit 5 P&R would be via North Perimeter Road and Route 28.

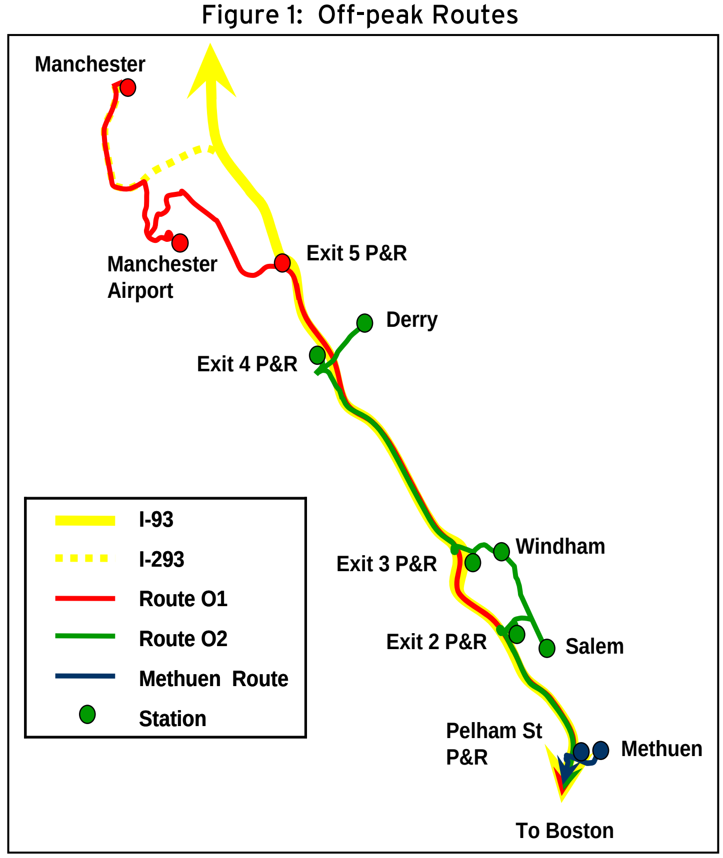
Table 2: Service Characteristics of Baseline Bus Routes

Route	Town Center Station	Park & Ride Station	Peak Headway (minutes)
1	Manchester: 119 Canal Street	None	30
2	Airport/Londonderry: Manchester Airport	Exit 5	15
3	Derry: Broadway near Railroad Square	Exit 4	15
4	Windham: North Broadway and Lake Street	Exit 3	30
5	Salem: South Broadway at Rockingham Park	Exit 2	15
6	Methuen: Broadway and High Street	Pelham Street	30

During the off-peak, the six peak routes would be combined into three routes. The Off-peak routes would be operated on 60 minute headways on weekdays and 90 minute headways on weekends. Off peak Route O1 would serve Manchester station, Manchester airport and the Exit 5 Park & Ride lot before entering I-93 for travel to Boston. Buses would travel I-293 and Route 3A between Manchester and the Manchester Airport.

Off peak Route O2 would originate at the Derry Station, and call at the Exit 4 Park & Ride, the Exit 3 Park & Ride, Windham Station, Salem Station, and the Exit 2 Park & Ride en route to Boston. Travel between towns would be via I-93, except between Windham and Salem stations where buses would use Route 28. Unlike peak southbound service, the Exit 3 Park & Ride lot in Windham would be served before the town center lot on southbound trips during the off peak.

Figure 1: Off-peak Routes



The third off peak route would serve the Methuen town center station and the Pelham Street P&R en route to Boston. For details see Figure 1 and schedules attached to this memorandum.

Limited MVRTA express bus service from Lawrence and Andover and MBTA service from Burlington and Woburn would continue to use I-93 as operated today. No changes to MVRTA or MBTA service frequencies were assumed.

Minneapolis Style BOS – The mix of service for this alternative would be the same as the Baseline, except buses would be allowed to travel along the shoulder I-93 when running between Manchester and Boston. Near Exit 30, BOS operations would stop. Southbound buses would cross three lanes to enter Massachusetts's HOV lane. Buses would be permitted to travel in shoulder only when the speed of general flow traffic falls below 35 mph. The maximum speed for buses operating within shoulders would be 10 mph above the general flow of traffic up to 35 mph.

MVRTA buses from Lawrence and Andover and MBTA buses from Burlington and Woburn would also be allowed to use the shoulders under the same conditions as the buses from New Hampshire and Methuen. Service frequencies on all routes would be unchanged from the Baseline.

Ottawa Style BOS – This alternative would be the same as Minneapolis Style BOS, except buses would be permitted to travel up to 60 mph on shoulders at any time when congestion warranted.

Table 3: Peak Southbound Travel Time to Boston (State Station) (min)

P&R Station	No Build/ Baseline	Minneapolis BOS	Ottawa BOS
Manchester	75	75	61
Exit 5	64	64	50
Exit 4	62	61	47
Exit 3	53	52	40
Exit 2	50	49	37
Exit 47	44	43	31

Figure 2: 2030 Peak Period Travel Time to State Street Station

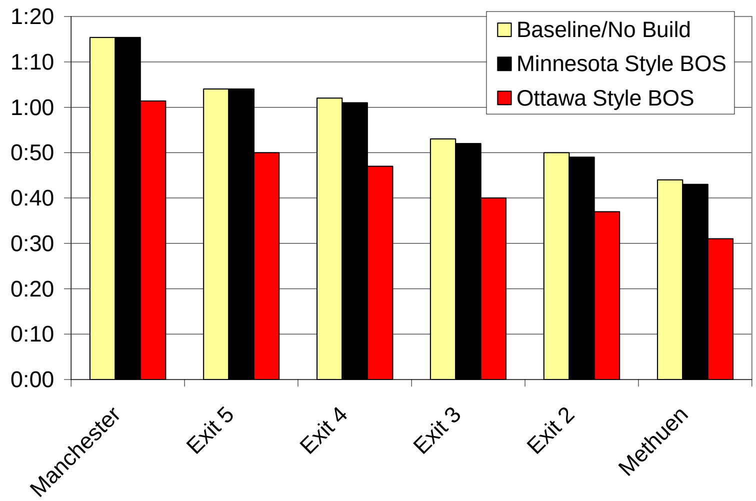


Table 3 and Figure 2 compare peak travel times to Boston for the four bus alternatives. Private auto travel times would be comparable to Baseline/No Build travel times.

While Ottawa BOS was estimated to save I-93 Merrimack Valley and New Hampshire bus commuters an average of 13 minutes travel time, models of Minneapolis style BOS did not support the finding of a consistent substantial travel time benefit for the Minneapolis BOS.

Minneapolis BOS requires that the speed of the highway fall below 35 mph before buses can use the shoulder and gain travel time savings over the use of general purpose lanes. The available data used in the travel forecasting process identified limited segments along the corridor with average peak period speeds below 35 mph during both the current year (2000) and the future year (2030). However, peak period speeds used in the forecasting model are based on the average both within a 3-hour peak period, and from day-to-day. Empirical data on travel times along I-93 within the study area identified extreme day-to-day and season-to-season variability in travel times along the corridor. Due to this variability in data and the assumed intra-peak distribution of travel in the corridor, it is difficult to model the travel time benefits of the Minneapolis approach to BOS. On average, the forecasts indicate that Minneapolis BOS is one minute faster than the Baseline alternative using general purpose lanes.

Since the level of benefits that would be delivered by the Minneapolis BOS alternative cannot be reliably estimated with the travel demand forecasting methods currently available, further evaluation of the costs and benefits or feasibility of this alternative would be ineffective and was not carried out. Because of the potential for travel time benefits during the busiest portion of the peak period or other traffic events, the Minneapolis BOS approach could be considered as a fallback position as implementation goes forward.

Planning Assumptions

The following assumptions were used for development of operating plans.

Travel Times – Travel times were estimated based on the following:

- Baseline and No Build buses would travel at the general flow of traffic within I-93 general purpose lanes,
- Ottawa BOS buses would travel at an average speed of 55 mph when in the shoulder lane,
- Buses would travel at free flow speed in the Massachusetts HOV lane,
- Bus station dwell time would be one minute at each stop,

No Build Scenario: Hours and Frequency of Service – The frequency of service offered under the No Build scenario was based on the following:

- Existing service from Concord and Manchester would continue to operate as today,
- MVRTA service from Lawrence and Andover would continue to operate as today,
- MBTA routes 352, 355, and 354 would continue to operate as today,
- New and enhanced services:

Weekday

- Exit 5 service would be provided between 4:30 am and 7:30 pm in the southbound direction and between 8 am and 11 pm northbound. Southbound peak service would be from 4:30 am to 7:30 am and northbound peak service would be between 4 pm and 7 pm.
- Exit 4 service would be provided between 4:30 am and 6:30 pm in the southbound direction and between 8 am and 10 pm northbound. Southbound peak service would be from 5:30 am to 7:30 am and northbound peak service would be between 4:30 pm and 7 pm.
- Exit 3 service would be provided during the peaks only, between 5:30 am and 9 am in the southbound direction and between 4 pm and 7:30 pm northbound.
- Exit 2 service would be provided between 5 am and 8 pm in the southbound direction and between 8 am and 11 pm northbound. Headways would be 60 minutes all day, [2]

[2] See Table 1 for peak and off-peak frequencies on all No Build routes.

Weekends

- The first inbound trip would arrive at South Station at approximately 8:00 am and the last outbound trip would depart South Station at approximately 12:00 am, and
- Service would operate on 90 minute headways.

Build Scenarios: Hours and Frequency of Service – The frequency of service offered by all bus alternatives except the No Build scenario was based on the following:

– Existing service from Concord and Manchester would continue to operate as today,

– MVRTA service from Lawrence and Andover would continue to operate as today,

– MBTA routes 352, 355, and 354 would continue to operate as today,

– New and enhanced services:

Weekday

- The first inbound bus would arrive at South Station at 6:45 am and the last outbound bus would depart South Station at 11:00 pm,
- Off peak service would operate on one hour headways.

Weekends

- The first inbound trip would arrive at South Station at approximately 8:00 am and the last outbound trip would depart South Station at approximately 12:00 am, and
- Service would operate on 90 minute headways.

Vehicles – The number of vehicles required was estimated based on:

– All New Hampshire and Methuen passenger services would be offered with over-the-road coaches with a 51 seat loaded capacity, and

– Service levels would be sufficient to offer seats to all passengers forecast in preliminary modeling efforts.

– No buses currently providing service from Concord and Manchester to Boston could be diverted to operate new commuter services along the I-93 corridor.

– No changes in the frequency and vehicle types for MVRTA Lawrence/Andover and MBTA services were assumed.

Service Statistics

Estimates of the number of buses required for each alternative were prepared based on the peak service frequency. Schedules of service are presented in an Appendix to this memo.

No Build – the No Build alternative would require 28 buses to offer peak service at headways between 30 and 60 minutes on its five routes. Twenty of these buses would layover in Boston (or be available for charters and other uses) during the midday.

Baseline – the Baseline alternative would require 51 buses to offer peak service at headways between 15 and 30 minutes on its six routes. Forty-one of these buses would layover in Boston (or be available for charters and other uses) during the midday.

Ottawa BOS – this alternative would require 50 buses to offer peak service at headways between 15 and 30 minutes on its six routes. Forty of these buses would layover in Boston (or be available for charters and other uses) during the midday.

Table 5: Vehicle Requirements by Alternative
Not Including Spares

	Peak Vehicles	Base Vehicles
No Build	28	8
Baseline	51	10
Ottawa BOS	50	10

Table 6 presents summary statistics on the alternative bus services.

Table 6: Weekday Service Statistics for Alternative Bus Services [3, 4]

	Weekday Daily Trips	Weekend Daily Trips	Weekday Daily Vehicle Hours	Weekend Daily Vehicle Hours	Weekday Daily Vehicle Miles	Weekend Daily Vehicle Miles	Annual Vehicle Hours	Annual Vehicle Miles
No Build	110	24	150.5	35.4	4,514	1,279	41,519	1,269,162
Baseline	179[5]	72	279.2	119.4	8,114	3,358	82,934	2,397,811
Ottawa BOS	179[6]	72	254.7	119.4	8,175	3,358	76,809	2,413,111

[3] Assuming 250 weekdays and 110 weekend service days per year.
[4] Does not include existing MVRTA and MBTA services nor existing Concord Trailways service from Concord and Manchester.
[5] Does not include one deadhead trip. Deadhead trips accounted for in the vehicle hours and miles summations.
[6] Does not include three deadhead trips. Deadhead trips are accounted for in the vehicle hours and miles summations.

Fare Structure

The study team considered two potential fare structures for commuter bus service into downtown Boston, one based on current bus services within the corridor and the second based on the MBTA's zonal commuter rail fares. Table 7 displays the fare from each origin under both potential fare structures.

Table 7: Fares from Origin Communities		
Origin	**Based on Current Bus Fares**	**Based on MBTA Commuter Rail Fares**
Manchester	$10.00	$5.75
Londonderry	$9.00	$5.75
Derry	$8.00	$5.75
Windham	$7.00	$5.00
Salem	$6.00	$4.50
Methuen	$5.00	$4.25

The fare structure based on current bus fares was assumed for the No Build option. It was also assumed that there would not be parking charges at P&R lots under the No Build option. For the Baseline and Ottawa BOS alternatives, the MBTA commuter rail fare structure and two dollar daily parking fees were assumed.

Existing Bus Service within the Corridor

The BOS alternative would operate in the highway shoulder between the State Line and Exit 30 in Massachusetts. Once the shoulders are available for bus operations, it is presumed that other services currently operating on I-93 would take advantage of the transit exclusive lane for travel to Boston. Services currently operating in the corridor during the peak include the MVRTA's Boston Commuter Bus and the MBTA's express buses from Burlington, Route 352, and Woburn, Routes 354 and 355. Decreases in travel times could result in increased frequency of service on these routes. Table 8 presents an estimate of the travel time savings achievable on these existing services under either BOS alternative.

Table 8: Potential Travel Time Savings from Ottawa BOS Operation	
Route	**Time Savings (minutes)**
MVRTA Commuter Bus	6
MBTA Route 352	3
MBTA Route 354	2
MBTA Route 355	2

Frequency of Buses in Highway Shoulder

Table 9 presents estimates of the number of shoulder running buses passing a point near Exit 30 in Massachusetts during the morning peak hour under the Ottawa BOS alternative. There would be approximately 27 buses during the peak hour, or a bus every 2.2 minutes on average, including existing services operating at their current frequency. For comparative purposes, the total number of automobiles passing a point near Exit 30 was estimated to be 8,000. LOS E was assumed, conservatively, for this section of highway during the peak hour.

Table 9: Peak Hour Vehicles on I-93 Southbound in Massachusetts (arriving in Boston between 7:30 and 8:30 am)	
New Hampshire I-93 Improvement Buses	18
MVRTA Buses	2
MBTA Buses	7
Total Peak Hour Buses	27
Minutes Between Peak Hour Buses	2.2
Total Peak Hour Autos	8,000

Summary

Table 10 presents a summary of the bus alternatives being considered for New Hampshire's I-93 transit investment.

Table 10: Summary of NH I-93 Transit Investment Bus Alternatives[7]			
	No Build	**Baseline**	**Ottawa BOS**
Number of Stations Served[8]	5	11	11
Peak Range Headway (minutes)	30-60	15-30	15-30
Number of Peak Buses Required	28	51	50
Fare Structure	MBTA Rail	Current Bus	Current Bus
Daily Parking Fee	None	$2.00	$2.00
Benefits Existing MVRTA and MBTA Bus Services	No	No	Yes
Annual Vehicle Hours	41,519	82,934	76,809
Annual Vehicle Miles	1,269,162	2,397,811	2,413,111

[7] Does not include existing MVRTA and MBTA services nor existing Concord Trailways service from Concord and Manchester.
[8] Does not include Boston stops.

Appendix A: Schedules

This appendix documents conceptual schedules of service for the four bus alternatives.

No Build - Weekday

Inbound

Trip	1500	1502	1100	1504	1506	1102	1508	1510	1104	1512	1514	1106	1108	1516	1518	1110	1520	1522	1112	1524	1526	1114	1528	1530	1116	1532	1534	1118	1536
Cycle	d	e	CT	f	g	CT	a	h	CT	b	c	CT	CT	a	b	CT	c	a	CT	b	c	CT	a	b	CT	c	a	CT	b
Manchester			5:30			6:00			7:00			8:30	9:30			11:30			13:30			15:30			17:30			19:30	
Exit 5	4:30	5:00		5:30	6:00		6:30	7:00		7:30	8:30			9:30	10:30		11:30	12:30		13:30	14:30		15:30	16:30		17:30	18:30		19:30
State Street	5:34	6:04		6:34	7:04		7:34	8:04		8:34	9:13			10:13	11:13		12:13	13:13		14:13	15:13		16:13	17:13		18:13	19:13		20:13
South Station	5:54	6:24	6:40	6:54	7:24	7:45	7:54	8:24	8:45	8:54	9:33	9:50	10:30	10:33	11:33	12:30	12:33	13:33	14:30	14:33	15:33	16:30	16:33	17:33	18:30	18:33	19:33	20:30	20:33

Outbound

Trip	1501	1101	1503	1103	1505	1507	1509	1105	1511	1107	1513	1515	1109	1111	1517	1113	1519	1521	1115	1523	1525	1117	1527	1529	1119	1531	1121	1533	1535	1123	1537
Cycle	a	CT	b	CT	c	a	b	CT	c	CT	a	b	CT	CT	c	CT	d	a	CT	e	b	CT	f	c	CT	a	CT	b	g	CT	h
South Station	8:00	8:00	9:00	9:00	10:00	11:00	12:00	12:01	13:00	13:15	14:00	15:00	15:15	15:45	16:00	16:15	16:30	17:00	17:15	17:30	18:00	18:15	18:30	19:00	19:15	20:00	20:15	21:00	22:00	22:15	23:00
State Street	8:20		9:20		10:20	11:20	12:20		13:20		14:20	15:20			16:20		16:50	17:20		17:50	18:20		18:50	19:20		20:20		21:20	22:20		23:20
Exit 5	9:03		10:03		11:03	12:03	13:03		14:03		15:03	16:03			17:27		17:57	18:27		18:57	19:27		19:57	20:27		21:03		22:03	23:03		0:03
Manchester		9:00		10:00				13:00		14:25			16:15	17:05		17:35			18:30			19:35			20:25		21:15			23:15	

Inbound

Trip	2400	2200	2300	2402	2202	2302	2404	2304	2406	2204	2306	2408	2308	2410	2206	2310	2412	2312	2208	2314	2210	2414	2212	2214	2416	2216	2218	2418	2220	2222	2420	2224	2226	2422	2228	2230
Cycle	pp	ff	hh	qq	gg	ii	rr	jj	ss	cc	kk	aa	ll	tt	dd	mm	bb	nn	cc	oo	dd	aa	cc	dd	bb	cc	dd	aa	cc	dd	bb	ee	cc	aa	dd	ee
Exit 4	4:30			5:30			6:00		6:30			7:00		7:30			8:30					10:30			12:30			14:30			16:30			18:30		
Exit 3			5:30			6:00		6:30			7:00		7:30			8:00		8:30		9:00																
Exit 2		4:45			5:45					6:45					7:45				9:00		10:00		11:00	12:00		13:00	14:00		15:00	16:00		17:00	18:00		19:00	20:00
State Street	5:11	5:35	6:23	6:32	6:35	6:53	7:02	7:23	7:32	7:35	7:53	8:02	8:23	8:32	8:35	8:53	9:11	9:23	9:33	9:53	10:33	11:11	11:33	12:33	13:11	13:33	14:33	15:11	15:33	16:33	17:11	17:33	18:33	19:11	19:33	20:33
South Station	5:31	5:55	6:43	6:52	6:55	7:13	7:22	7:43	7:52	7:55	8:13	8:22	8:43	8:52	8:55	9:13	9:31	9:43	9:53	10:13	10:53	11:31	11:53	12:53	13:31	13:53	14:53	15:31	15:53	16:53	17:31	17:53	18:53	19:31	19:53	20:53

Outbound

Trip	2201	2401	2203	2205	2403	2207	2209	2405	2211	2213	2407	2215	2301	2217	2303	2409	2219	2305	2411	2307	2413	2221	2309	2415	2311	2417	2223	2313	2419	2315	2225	2227	2421	2423	2229	2231
Cycle	cc	aa	dd	cc	bb	dd	cc	aa	dd	cc	bb	dd	hh	cc	ii	aa	dd	jj	pp	kk	qq	ee	ll	bb	mm	rr	cc	nn	ss	oo	dd	ee	aa	tt	ff	gg
South Station	8:00	8:30	9:00	10:00	10:30	11:00	12:00	12:30	13:00	14:00	14:30	15:00	16:00	16:00	16:30	16:30	17:00	17:00	17:00	17:30	17:30	18:00	18:00	18:00	18:30	18:30	19:00	19:00	19:00	19:30	20:00	21:00	21:00	22:00	22:00	23:00
State Street	8:20	8:50	9:20	10:20	10:50	11:20	12:20	12:50	13:20	14:20	14:50	15:20	16:20	16:20	16:50	16:50	17:20	17:20	17:20	17:50	17:50	18:20	18:20	18:20	18:50	18:50	19:20	19:20	19:20	19:50	20:20	21:20	21:20	22:20	22:20	23:20
Exit 2	8:53		9:53	10:53		11:53	12:53		13:53	14:53		15:53		17:13			18:13					19:13					20:13				20:53	21:53			22:53	23:53
Exit 3													17:16		17:46			18:16		18:46			19:16		19:46			20:16		20:46						
Exit 4		9:31			11:31			13:31			15:31					17:55			18:25		18:55			19:25		19:55			20:25				22:01	23:01		

No Build - Weekend

Inbound

Trip	100	102	104	106	108	110	112
Cycle	CT	CT	CT	CT	CT	CT	CT
Manchester (dep)	5:30	7:30	11:30	13:30	15:30	17:30	19:30
South Station (arr)	6:30	8:30	12:30	14:30	16:30	18:30	20:30

Outbound

Trip	101	103	105	107	109	111	113	115	117
Cycle	CT	CT	CT	CT	CT	CT	CT	CT	CT
South Station (arr)	8:00	10:00	12:00	13:15	16:16	17:15	19:15	20:15	22:15
Manchester (dep)	9:00	11:00	13:00	16:15	17:15	18:30	20:15	21:15	23:15

Inbound

Trip	200	202	204	206	208	210	212	214	216	218	220	222
Cycle	a	b	a	b	a	b	a	b	a	b	a	b
Exit 5	6:30	8:00	9:30	11:00	12:30	14:00	15:30	17:00	18:30	20:00	21:30	23:00
Exit 4	6:34	8:04	9:34	11:04	12:34	14:04	15:34	17:04	18:34	20:04	21:34	23:04
Exit 3	6:42	8:12	9:42	11:12	12:42	14:12	15:42	17:12	18:42	20:12	21:42	23:12
Exit 2	6:48	8:18	9:48	11:18	12:48	14:18	15:48	17:18	18:48	20:18	21:48	23:18
State Street	7:22	8:51	10:21	11:51	13:21	14:51	16:21	17:51	19:21	20:51	22:21	23:51
South Station	7:42	9:11	10:41	12:11	13:41	15:11	16:41	18:11	19:41	21:11	22:41	0:11

Outbound

Trip	201	203	205	207	209	211	213	215	217	219	221	223
Cycle	a	b	a	b	a	b	a	b	a	b	a	b
South Station	8:00	9:30	11:00	12:30	14:00	15:30	17:00	18:30	20:00	21:30	23:00	0:30
State Street	8:20	9:50	11:20	12:50	14:20	15:50	17:20	18:50	20:20	21:50	23:20	0:50
Exit 2	8:54	10:24	11:54	13:24	14:54	16:24	17:54	19:24	20:54	22:24	23:54	1:24
Exit 3	9:00	10:30	12:00	13:30	15:00	16:30	18:00	19:30	21:00	22:30	0:00	1:30
Exit 4	9:08	10:38	12:08	13:38	15:08	16:38	18:08	19:38	21:08	22:38	0:08	1:38
Exit 5	9:12	10:42	12:12	13:42	15:12	16:42	18:12	19:42	21:12	22:42	0:12	1:42

Baseline - Weekday

Inbound

Trip	1500	1100	1502	1504	1102	1506	1508	1104	1510	1512	1106	1514	1516	1108	1518	1520	1110	1000	1002	1004	1006	1008	1010	1012	1014	1016	1018	1020	1022	1024
Cycle	h	d	i	j	e	k	l	a	m	n	f	o	p	b	q	r	c	d	a	b	c	d	a	b	c	d	a	b	c	d
Manchester		5:15			5:45			6:15			6:45			7:15			7:45	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00
Airport/Londonderry	5:10		5:25	5:40		5:55	6:10		6:25	6:40		6:55	7:10		7:25	7:40		9:12	10:12	11:12	12:12	13:12	14:12	15:12	16:12	17:12	18:12	19:12	20:12	21:12
Exit 5	5:25		5:40	5:55		6:10	6:25		6:40	6:55		7:10	7:25		7:40	7:55		9:27	10:27	11:27	12:27	13:27	14:27	15:27	16:27	17:27	18:27	19:27	20:27	21:27
State Street	6:29	6:30	6:44	6:59	7:00	7:14	7:29	7:30	7:44	7:59	8:00	8:14	8:29	8:30	8:44	8:59	9:00	10:11	11:11	12:11	13:11	14:11	15:11	16:11	17:11	18:11	19:11	20:11	21:11	22:11
South Station	6:49	6:50	7:04	7:19	7:20	7:34	7:49	7:50	8:04	8:19	8:20	8:34	8:49	8:50	9:04	9:19	9:20	10:31	11:31	12:31	13:31	14:31	15:31	16:31	17:31	18:31	19:31	20:31	21:31	22:31

Outbound

Trip	1001	1003	1005	1007	1009	1011	1013	1015	1017	1501	1101	1503	1505	1103	1507	1509	1105	1511	1513	1107	1515	1517	1109	1519	1521	1111	1019	1021	1023	1025
Cycle	a	b	c	d	a	b	c	d	a	h	d	i	j	b	k	l	e	m	n	c	o	p	f	q	r	d	a	b	c	d
South Station	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	16:20	16:25	16:35	16:50	16:55	17:05	17:20	17:25	17:35	17:50	17:55	18:05	18:20	18:25	18:35	18:50	18:55	20:00	21:00	22:00	23:00
State Street	8:20	9:20	10:20	11:20	12:20	13:20	14:20	15:20	16:20	16:40	16:45	16:55	17:10	17:15	17:25	17:40	17:45	17:55	18:10	18:15	18:25	18:40	18:45	18:55	19:10	19:15	20:20	21:20	22:20	23:20
Exit 5	9:03	10:03	11:03	12:03	13:03	14:03	15:03	16:03	17:03	17:47		18:02	18:17		18:32	18:47		19:02	19:17		19:32	19:47		20:02	20:17		21:03	22:03	23:03	0:03
Airport/Londonderry	9:18	10:18	11:18	12:18	13:18	14:18	15:18	16:18	17:18	18:02		18:17	18:32		18:47	19:02		19:17	19:32		19:47	20:02		20:17	20:32		21:18	22:18	23:18	0:18
Manchester	9:31	10:31	11:31	12:31	13:31	14:31	15:31	16:31	17:31		18:03			18:33			19:03			19:33			20:03			20:33	21:31	22:31	23:31	0:31

Inbound

Trip	2300	2200	2400	2202	2402	2302	2204	2404	2206	2406	2304	2208	2408	2210	2410	2306	2212	2412	2214	2414	2308	2216	2416	2218	2418	2310	2220	2000	2002	2004	2006	2008	2010	2012	2014	2016	2018	2020	2022	2024
Cycle	ll	rr	ee	ss	ff	mm	tt	gg	uu	hh	nn	vv	aa	ww	ii	oo	xx	jj	yy	kk	pp	zz	bb	AA	cc	qq	BB	dd	aa	bb	cc	dd	aa	bb	cc	dd	bb	cc	dd	aa
Derry			5:30		5:45			6:00		6:15			6:30		6:45			7:00		7:15			7:30		7:45			9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:11	19:11	20:11	21:11
Exit 4			5:34		5:49			6:04		6:19			6:34		6:49			7:04		7:19			7:34		7:49			9:04	10:04	11:04	12:04	13:04	14:04	15:04	16:04	17:04	18:15	19:15	20:15	21:15
Windham	5:30					6:00					6:30					7:00					7:30					8:00														
Exit 3	5:32					6:02					6:32					7:02					7:32					8:02		9:16	10:16	11:16	12:16	13:16	14:16	15:16	16:16	17:16	18:27	19:27	20:27	21:27
Windham (off-peak)																												9:19	10:19	11:19	12:19	13:19	14:19	15:19	16:19	17:19	18:30	19:30	20:30	21:30
Salem		5:32		5:47			6:02		6:17			6:32		6:47			7:02		7:17			7:32		7:47			8:02	9:26	10:26	11:26	12:26	13:26	14:26	15:26	16:26	17:26	18:37	19:37	20:37	21:37
Exit 2		5:37		5:52			6:07		6:22			6:37		6:52			7:07		7:22			7:37		7:52			8:07	9:32	10:32	11:32	12:32	13:32	14:32	15:32	16:32	17:32	18:43	19:43	20:43	21:43
State Street	6:26	6:28	6:37	6:43	6:52	6:56	6:58	7:07	7:13	7:22	7:26	7:28	7:37	7:43	7:52	7:56	7:58	8:07	8:13	8:22	8:26	8:28	8:37	8:43	8:52	8:56	8:58	10:06	11:06	12:06	13:06	14:06	15:06	16:06	17:06	18:06	19:17	20:17	21:17	22:17
South Station	6:46	6:48	6:57	7:03	7:12	7:16	7:18	7:27	7:33	7:42	7:46	7:48	7:57	8:03	8:12	8:16	8:18	8:27	8:33	8:42	8:46	8:48	8:57	9:03	9:12	9:16	9:18	10:26	11:26	12:26	13:26	14:26	15:26	16:26	17:26	18:26	19:37	20:37	21:37	22:37

Outbound

Trip	2001	2003	2005	2007	2009	2011	2013	2015	2017	2301	2401	2201	2403	2203	2303	2405	2205	2407	2207	2305	2409	2209	2411	2211	2307	2413	2213	2415	2215	2309	2417	2217	2419	2219	2311	2221	2019	2021	2023	2025	2027
Cycle	aa	bb	cc	dd	aa	bb	cc	dd	aa	ll	ee	rr	bb	ss	mm	ff	tt	gg	uu	nn	hh	vv	cc	ww	oo	ii	xx	jj	yy	pp	kk	zz	dd	AA	qq	BB	aa	bb	cc	dd	aa
South Station	8:05	9:05	10:05	11:05	12:05	13:05	14:05	15:05	16:05	16:20	16:20	16:24	16:35	16:39	16:50	16:50	16:54	17:05	17:09	17:20	17:20	17:24	17:35	17:39	17:50	17:50	17:54	18:05	18:09	18:20	18:20	18:24	18:35	18:39	18:50	18:54	19:00	20:00	21:00	22:00	23:00
State Street	8:25	9:25	10:25	11:25	12:25	13:25	14:25	15:25	16:25	16:40	16:40	16:44	16:55	16:59	17:10	17:10	17:14	17:25	17:29	17:40	17:40	17:44	17:55	17:59	18:10	18:10	18:14	18:25	18:29	18:40	18:40	18:44	18:55	18:59	19:10	19:14	19:20	20:20	21:20	22:20	23:20
Exit 2	8:59	9:59	10:59	11:59	12:59	13:59	14:59	15:59	16:59			17:37		17:52			18:07		18:22			18:37		18:52			19:07		19:22			19:37		19:52		20:07	19:54	20:54	21:54	22:54	23:54
Salem	9:05	10:05	11:05	12:05	13:05	14:05	15:05	16:05	17:05			17:43		17:58			18:13		18:28			18:43		18:58			19:13		19:28			19:43		19:58		20:13	20:00	21:00	22:00	23:00	0:00
Windham (off-peak)	9:12	10:12	11:12	12:12	13:12	14:12	15:12	16:12	17:12																												20:07	21:07	22:07	23:07	0:07
Exit 3	9:15	10:15	11:15	12:15	13:15	14:15	15:15	16:15	17:15	17:36					18:06					18:36					19:06					19:36					20:06		20:10	21:10	22:10	23:10	0:10
Windham										17:39					18:09					18:39					19:09					19:39					20:09						
Exit 4	9:27	10:27	11:27	12:27	13:27	14:27	15:27	16:27	17:27		17:45		18:00			18:15		18:30			18:45		19:00			19:15		19:30			19:45		20:00				20:22	21:22	22:22	23:22	0:22
Derry	9:31	10:31	11:31	12:31	13:31	14:31	15:31	16:31	17:31		17:50		18:05			18:20		18:35			18:50		19:05			19:20		19:35			19:50		20:05				20:26	21:26	22:26	23:26	0:26

Inbound

Trip	3000	3002	3004	3006	3008	3010	3012	3014	3016	3018	3020	3022	3024	3026	3028	3030	3032	3034	3036
Cycle	ccc	ddd	aaa	eee	bbb	aaa	bbb	aaa	bbb	aaa	bbb	aaa	bbb	aaa	ccc	bbb	aaa	ccc	aaa
Methuen	5:45	6:15	6:45	7:15	7:45	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00
Exit 47	5:48	6:18	6:48	7:18	7:48	9:03	10:03	11:03	12:03	13:03	14:03	15:03	16:03	17:03	18:03	19:03	20:03	21:03	22:03
State Street	6:32	7:02	7:32	8:02	8:32	9:32	10:32	11:32	12:32	13:32	14:32	15:32	16:32	17:32	18:32	19:32	20:32	21:32	22:32
South Station	6:52	7:22	7:52	8:22	8:52	9:52	10:52	11:52	12:52	13:52	14:52	15:52	16:52	17:52	18:52	19:52	20:52	21:52	22:52

Outbound

Trip	3001	3003	3005	3007	3009	3011	3013	3015	3017	3019	3021	3023	3025	3027	3029	3031	3033	3035	3037
Cycle	aaa	bbb	aaa	bbb	aaa	bbb	aaa	bbb	aaa	ccc	bbb	ddd	aaa	eee	ccc	bbb	aaa	ccc	aaa
South Station	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	16:30	17:00	17:30	18:00	18:30	19:00	20:00	21:00	22:00	23:00
State Street	8:20	9:20	10:20	11:20	12:20	13:20	14:20	15:20	16:20	16:50	17:20	17:50	18:20	18:50	19:20	20:20	21:20	22:20	23:20
Exit 47	8:49	9:49	10:49	11:49	12:49	13:49	14:49	15:49	16:49	17:37	18:07	18:37	19:07	19:37	20:07	20:49	21:49	22:49	23:49
Methuen	8:52	9:52	10:52	11:52	12:52	13:52	14:52	15:52	16:52	17:40	18:10	18:40	19:10	19:40	20:10	20:52	21:52	22:52	23:52

Ottawa BOS - Weekday

Inbound

Trip	1500	1100	1502	1504	1102	1506	1508	1104	1510	1512	1106	1514	1516	1108	1518	1520	1110	1000	1002	1004	1006	1008	1010	1012	1014	1016	1018	1020	1022	1024
Cycle	g	e	h	i	f	j	k	a	l	m	g	n	o	b	p	q	c	d	a	b	c	d	a	b	c	d	a	b	c	d
Manchester		5:30			6:00			6:30			7:00			7:30			8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00
Airport/Londonderry	5:20		5:35	5:50		6:05	6:20		6:35	6:50		7:05	7:20		7:35	7:50		9:13	10:13	11:13	12:13	13:13	14:13	15:13	16:13	17:13	18:13	19:13	20:13	21:13
Exit 5	5:35		5:50	6:05		6:20	6:35		6:50	7:05		7:20	7:35		7:50	8:05		9:28	10:28	11:28	12:28	13:28	14:28	15:28	16:28	17:28	18:28	19:28	20:28	21:28
State Street	6:25	6:31	6:40	6:55	7:01	7:10	7:25	7:31	7:40	7:55	8:01	8:10	8:25	8:31	8:40	8:55	9:01	10:11	11:11	12:11	13:11	14:11	15:11	16:11	17:11	18:11	19:11	20:11	21:11	22:11
South Station	6:45	6:51	7:00	7:15	7:21	7:30	7:45	7:51	8:00	8:15	8:21	8:30	8:45	8:51	9:00	9:15	9:21	10:31	11:31	12:31	13:31	14:31	15:31	16:31	17:31	18:31	19:31	20:31	21:31	22:31

Outbound

Trip	1001	1003	1005	1007	1009	1011	1013	1015	1017	1101	1103	1105	1107	1109	1111	1501	1503	1505	1507	1509	1511	1513	1515	1517	1519	1521	1019	1021	1023	1025
Cycle	a	b	c	d	a	b	c	d	a	e	b	f	c	g	d	g	h	i	j	k	l	m	n	o	p	q	a	b	c	d
South Station	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	16:30	17:00	17:30	18:00	18:30	19:00	16:25	16:40	16:55	17:10	17:25	17:40	17:55	18:10	18:25	18:40	18:55	20:00	21:00	22:00	23:00
State Street	8:20	9:20	10:20	11:20	12:20	13:20	14:20	15:20	16:20	16:50	17:20	17:50	18:20	18:50	19:20	16:45	17:00	17:15	17:30	17:45	18:00	18:15	18:30	18:45	19:00	19:15	20:20	21:20	22:20	23:20
Exit 5	9:03	10:03	11:03	12:03	13:03	14:03	15:03	16:03	17:03							17:38	17:53	18:08	18:23	18:38	18:53	19:08	19:23	19:38	19:53	20:08	21:03	22:03	23:03	0:03
Airport/Londonderry	9:18	10:18	11:18	12:18	13:18	14:18	15:18	16:18	17:18							17:53	18:08	18:23	18:38	18:53	19:08	19:23	19:38	19:53	20:08	20:23	21:18	22:18	23:18	0:18
Manchester	9:31	10:31	11:31	12:31	13:31	14:31	15:31	16:31	17:31	17:54	18:24	18:54	19:24	19:54	20:24												21:31	22:31	23:31	0:31

Inbound

Trip	2202	2200	2400	2204	2402	2206	2300	2404	2208	2406	2210	2302	2408	2212	2410	2214	2304	2412	2216	2414
Cycle	rr	ll	ee	ss	ff	tt	mm	gg	uu	hh	vv	nn	aa	ww	ii	xx	oo	jj	yy	kk
Derry			5:45		6:00			6:15		6:30			6:45		7:00			7:15		7:30
Exit 4			5:49		6:04			6:19		6:34			6:49		7:04			7:19		7:34
Windham		5:45					6:15					6:45					7:15			
Exit 3		5:47					6:17					6:47					7:17			
Windham (off-peak)																				
Salem	5:40			5:55		6:10			6:25		6:40			6:55		7:10			7:25	
Exit 2	5:45			6:00		6:15			6:30		6:45			7:00		7:15			7:30	
State Street	6:23	6:28	6:37	6:38	6:52	6:53	6:58	7:07	7:08	7:22	7:23	7:28	7:37	7:38	7:52	7:53	7:58	8:07	8:08	8:22
South Station	6:43	6:48	6:57	6:58	7:12	7:13	7:18	7:27	7:28	7:42	7:43	7:48	7:57	7:58	8:12	8:13	8:18	8:27	8:28	8:42

Trip	2218	2306	2416	2220	2418	2222	2308	2200	2202	2204	2206	2208	2210	2212	2214	2216	2218	2220	2222	2224
Cycle	zz	pp	bb	AA	cc	BB	qq	dd	aa	bb	cc	dd	aa	bb	cc	dd	bb	cc	dd	aa
Derry			7:45		8:00			9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00
Exit 4			7:49		8:04			9:04	10:04	11:04	12:04	13:04	14:04	15:04	16:04	17:04	18:04	19:04	20:04	21:04
Windham		7:45					8:15													
Exit 3		7:47					8:17	9:16	10:16	11:16	12:16	13:16	14:16	15:16	16:16	17:16	18:16	19:16	20:16	21:16
Windham (off-peak)								9:19	10:19	11:19	12:19	13:19	14:19	15:19	16:19	17:19	18:19	19:19	20:19	21:19
Salem	7:40			7:55		8:10		9:26	10:26	11:26	12:26	13:26	14:26	15:26	16:26	17:26	18:26	19:26	20:26	21:26
Exit 2	7:45			8:00		8:15		9:32	10:32	11:32	12:32	13:32	14:32	15:32	16:32	17:32	18:32	19:32	20:32	21:32
State Street	8:23	8:28	8:37	8:38	8:52	8:53	8:58	10:06	11:06	12:06	13:06	14:06	15:06	16:06	17:06	18:06	19:06	20:06	21:06	22:06
South Station	8:43	8:48	8:57	8:58	9:12	9:13	9:18	10:26	11:26	12:26	13:26	14:26	15:26	16:26	17:26	18:26	19:26	20:26	21:26	22:26

Outbound

Trip	2001	2003	2005	2007	2009	2011	2013	2015	2017	2301	2401	2201	2403	2203	2303	2405	2205	2407	2207	2305
Cycle	aa	bb	cc	dd	aa	bb	cc	dd	aa	ll	ee	rr	bb	ss	mm	ff	tt	gg	uu	nn
South Station	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	16:15	16:20	16:24	16:35	16:39	16:45	16:50	16:54	17:05	17:09	17:15
State Street	8:20	9:20	10:20	11:20	12:20	13:20	14:20	15:20	16:20	16:35	16:40	16:44	16:55	16:59	17:05	17:10	17:14	17:25	17:29	17:35
Exit 2	8:54	9:54	10:54	11:54	12:54	13:54	14:54	15:54	16:54			17:24		17:39			17:54		18:09	
Salem	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00			17:30		17:45			18:00		18:15	
Windham (off-peak)	9:07	10:07	11:07	12:07	13:07	14:07	15:07	16:07	17:07											
Exit 3	9:10	10:10	11:10	12:10	13:10	14:10	15:10	16:10	17:10	17:18					17:48					18:18
Windham										17:21					17:51					18:21
Exit 4	9:21	10:21	11:21	12:21	13:21	14:21	15:21	16:21	17:21		17:30		17:45			18:00		18:15		
Derry	9:25	10:25	11:25	12:25	13:25	14:25	15:25	16:25	17:25		17:35		17:50			18:05		18:20		

Trip	2409	2209	2411	2211	2307	2413	2213	2415	2215	2309	2417	2217	2419	2219	2311	2221	2019	2021	2023	2025	2027
Cycle	hh	vv	cc	ww	oo	ii	xx	jj	yy	pp	kk	zz	dd	AA	qq	BB	aa	bb	cc	dd	aa
South Station	17:20	17:24	17:35	17:39	17:45	17:50	17:54	18:05	18:09	18:15	18:20	18:24	18:35	18:39	18:45	18:54	19:00	20:00	21:00	22:00	23:00
State Street	17:40	17:44	17:55	17:59	18:05	18:10	18:14	18:25	18:29	18:35	18:40	18:44	18:55	18:59	19:05	19:14	19:20	20:20	21:20	22:20	23:20
Exit 2		18:24		18:39			18:54		19:09			19:24		19:39		19:54	19:54	20:54	21:54	22:54	23:54
Salem		18:30		18:45			19:00		19:15			19:30		19:45		20:00	20:00	21:00	22:00	23:00	0:00
Windham (off-peak)																	20:07	21:07	22:07	23:07	0:07
Exit 3					18:48					19:18					19:48		20:10	21:10	22:10	23:10	0:10
Windham					18:51					19:21					19:51						
Exit 4	18:30		18:45			19:00		19:15			19:30		19:45				20:21	21:21	22:21	23:21	0:21
Derry	18:35		18:50			19:05		19:20			19:35		19:50				20:25	21:25	22:25	23:25	0:25

Inbound

Trip	3000	3002	3004	3006	3008	3010	3012	3014	3016	3018	3020	3022	3024	3026	3028	3030	3032	3034	3036
Cycle	aaa	ccc	bbb	ddd	aaa	bbb	aaa	bbb	aaa	bbb	aaa	bbb	aaa	bbb	aaa	bbb	aaa	bbb	aaa
Methuen	5:45	6:15	6:45	7:15	7:45	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	17:00	18:00	19:00	20:00	21:00	22:00
Exit 47	5:48	6:18	6:48	7:18	7:48	9:03	10:03	11:03	12:03	13:03	14:03	15:03	16:03	17:03	18:03	19:03	20:03	21:03	22:03
State Street	6:19	6:49	7:19	7:49	8:19	9:32	10:32	11:32	12:32	13:32	14:32	15:32	16:32	17:32	18:32	19:32	20:32	21:32	22:32
South Station	6:39	7:09	7:39	8:09	8:39	9:52	10:52	11:52	12:52	13:52	14:52	15:52	16:52	17:52	18:52	19:52	20:52	21:52	22:52

Outbound

Trip	3001	3003	3005	3007	3009	3011	3013	3015	3017	3019	3021	3023	3025	3027	3029	3031	3033	3035	3037
Cycle	bbb	aaa	bbb	aaa	bbb	aaa	bbb	aaa	bbb	ccc	aaa	ddd	bbb	ccc	aaa	bbb	aaa	bbb	aaa
South Station	8:00	9:00	10:00	11:00	12:00	13:00	14:00	15:00	16:00	16:30	17:00	17:30	18:00	18:30	19:00	20:00	21:00	22:00	23:00
State Street	8:20	9:20	10:20	11:20	12:20	13:20	14:20	15:20	16:20	16:50	17:20	17:50	18:20	18:50	19:20	20:20	21:20	22:20	23:20
Exit 47	8:49	9:49	10:49	11:49	12:49	13:49	14:49	15:49	16:54	17:24	17:54	18:24	18:54	19:24	19:54	20:49	21:49	22:49	23:49
Methuen	8:52	9:52	10:52	11:52	12:52	13:52	14:52	15:52	16:57	17:27	17:57	18:27	18:57	19:27	19:57	20:52	21:52	22:52	23:52

Build Alternatives – Weekends

Inbound

Trip	100	102	104	106	108	110	112	114	116	118	120	122
Cycle	a	b	a	b	a	b	a	b	a	b	a	b
Manchester	6:30	8:00	9:30	11:00	12:30	14:00	15:30	17:00	18:30	20:00	21:30	23:00
Airport/Londonderry	6:30	8:00	9:30	11:00	12:30	14:00	15:30	17:00	18:30	20:00	21:30	23:00
Exit 5	6:45	8:15	9:45	11:15	12:45	14:15	15:45	17:15	18:45	20:15	21:45	23:15
State Street	7:28	8:58	10:28	11:58	13:28	14:58	16:28	17:58	19:28	20:58	22:28	23:58
South Station	7:48	9:18	10:48	12:18	13:48	15:18	16:48	18:18	19:48	21:18	22:48	0:18

Outbound

Trip	101	103	105	107	109	111	113	115	117	119	121	123
Cycle	a	b	a	b	a	b	a	b	a	b	a	b
South Station	8:00	9:30	11:00	12:30	14:00	15:30	17:00	18:30	20:00	21:30	23:00	0:30
State Street	8:20	9:50	11:20	12:50	14:20	15:50	17:20	18:50	20:20	21:50	23:20	0:50
Exit 5	9:03	10:33	12:03	13:33	15:03	16:33	18:03	19:33	21:03	22:33	0:03	1:33
Airport/Londonderry	9:18	10:48	12:18	13:48	15:18	16:48	18:18	19:48	21:18	22:48	0:18	1:48
Manchester	9:19	10:49	12:19	13:49	15:19	16:49	18:19	19:49	21:19	22:49	0:19	1:49

Inbound

Trip	200	202	204	206	208	210	212	214	216	218	220	222
Cycle	aa	bb	cc	aa	bb	cc	aa	bb	cc	aa	bb	cc
Derry	6:30	8:00	9:30	11:00	12:30	14:00	15:30	17:00	18:30	20:00	21:30	23:00
Exit 4	6:34	8:04	9:34	11:04	12:34	14:04	15:34	17:04	18:34	20:04	21:34	23:04
Exit 3	6:46	8:16	9:46	11:16	12:46	14:16	15:46	17:16	18:46	20:16	21:46	23:16
Windham (off-peak)	6:49	8:19	9:49	11:19	12:49	14:19	15:49	17:19	18:49	20:19	21:49	23:19
Salem	6:56	8:26	9:56	11:26	12:56	14:26	15:56	17:26	18:56	20:26	21:56	23:26
Exit 2	7:02	8:32	10:02	11:32	13:02	14:32	16:02	17:32	19:02	20:32	22:02	23:32
State Street	7:36	9:06	10:36	12:06	13:36	15:06	16:36	18:06	19:36	21:06	22:36	0:06
South Station	7:56	9:26	10:56	12:26	13:56	15:26	16:56	18:26	19:56	21:26	22:56	0:26

Outbound

Trip	201	203	205	207	209	211	213	215	217	219	221	223
Cycle	aa	bb	cc	aa	bb	cc	aa	bb	cc	aa	bb	cc
South Station	8:05	9:35	11:05	12:35	14:05	15:35	17:05	18:35	20:05	21:35	23:05	0:35
State Street	8:25	9:55	11:25	12:55	14:25	15:55	17:25	18:55	20:25	21:55	23:25	0:55
Exit 2	8:59	10:29	11:59	13:29	14:59	16:29	17:59	19:29	20:59	22:29	23:59	1:29
Salem	9:05	10:35	12:05	13:35	15:05	16:35	18:05	19:35	21:05	22:35	0:05	1:35
Windham (off-peak)	9:12	10:42	12:12	13:42	15:12	16:42	18:12	19:42	21:12	22:42	0:12	1:42
Exit 3	9:15	10:45	12:15	13:45	15:15	16:45	18:15	19:45	21:15	22:45	0:15	1:45
Exit 4	9:26	10:56	12:26	13:56	15:26	16:56	18:26	19:56	21:26	22:56	0:26	1:56
Derry	9:30	11:00	12:30	14:00	15:30	17:00	18:30	20:00	21:30	23:00	0:30	2:00

Inbound

Trip	300	302	304	306	308	310	312	314	316	318	320	322
Cycle	aaa	bbb	aaa	bbb	aaa	bbb	aaa	bbb	aaa	bbb	aaa	bbb
Methuen	6:45	8:15	9:45	11:15	12:45	14:15	15:45	17:15	18:45	20:15	21:45	23:15
Exit 47	6:48	8:18	9:48	11:18	12:48	14:18	15:48	17:18	18:48	20:18	21:48	23:18
State Street	7:17	8:47	10:17	11:47	13:17	14:47	16:17	17:47	19:17	20:47	22:17	23:47
South Station	7:37	9:07	10:37	12:07	13:37	15:07	16:37	18:07	19:37	21:07	22:37	0:07

Outbound

Trip	301	303	305	307	309	311	313	315	317	319	321	323
Cycle	aaa	bbb	aaa	bbb	aaa	bbb	aaa	bbb	aaa	bbb	aaa	bbb
South Station	8:00	9:30	11:00	12:30	14:00	15:30	17:00	18:30	20:00	21:30	23:00	0:30
State Street	8:20	9:50	11:20	12:50	14:20	15:50	17:20	18:50	20:20	21:50	23:20	0:50
Exit 47	8:49	10:19	11:49	13:19	14:49	16:19	17:49	19:19	20:49	22:19	23:49	1:19
Methuen	8:52	10:22	11:52	13:22	14:52	16:22	17:52	19:22	20:52	22:22	23:52	1:22

Date **November 6, 2007**

To David Nelson

From Tara Blakey

Subject New Hampshire I-93 improvement – Transit Investment Study
Vehicle Requirements

Capacity requirements were estimated for the six transit alternatives being evaluated for New Hampshire's I-93 Transit Investment Study. The number and length of vehicles required was estimated using preliminary ridership estimates and draft schedules of service. These requirements were then multiplied by observed per vehicle costs to estimate the capital costs of equipment for each alternative. Differences in equipment cost may aid in the evaluation of transit alternatives.

Capacity Required

Ridership forecasts presented in VHB's Interstate 93 Improvements, Salem to Manchester, New Hampshire Rationale Report[1] were used to roughly estimate the amount of capacity that would be required on transit service within the corridor.

- **Rail** - The following was assumed to estimate train capacity requirements:
  - Ridership would be around 1,500 inbound boardings since VHB forecasts[2] did not include proposed new stations Methuen and Lawrence,
  - Peak service would be provided at 30 minute headways,
  - Cars would seat approximately 100 people,
  - 37 % of all inbound boardings occur within the peak hour, and
  - Train sets would consist of a mix of DMU cars and unpowered coaches.

This yields 275 passengers per peak hour train which would require three cars to seat all passengers.

From preliminary schedules, it was determined that direct services, HRB and ERB, would require five peak train sets to provide 30 minute headway service. Connecting services, HRA and ERA, would require 4 train sets to provide 30 minute headway service. Table 1 presents the capacity requirements assuming a 20% spare ratio for DMUs and a 10% spare ratio for coaches.

[1] Vanasse Hangen Brustlin, Inc. (2001). Appendix B. *Interstate 93 Improvements, Salem to Manchester, New Hampshire*. Prepared for the New Hampshire Department of Transportation and Federal Highway Administration. Bedford, NH: VHB.
[2] Vanasse Hangen Brustlin, Inc. (2001). Appendix B. *Interstate 93 Improvements, Salem to Manchester, New Hampshire* (pp. 12, 20)

Table 1: Capacity Required for Rail Alternatives					
	Peak Train Sets	Train Length	Total DMUs Required	Total Coaches Required	Total New Vehicles
HRB	5	3	12	6	18
HRA	4	3	10	5	15
ERB	5	3	12	6	18
ERA	4	3	10	5	15

Lowell trains receiving passengers transferring from connecting services at Anderson would need to accommodate approximately three cars worth of new peak passengers. The additional capacity required on existing MBTA services was not formally evaluated.

Bus - The following was assumed to estimate bus capacity requirements:

- Ridership would equal that forecast for the enhanced bus portion of Mode Combination 7[3],
- Purchased over-the-road coaches would seat 51 people, and
- 37 % of all inbound boardings occur within the peak hour.

HBBR: Table 2 presents the capacity findings for buses that would operate in the I-93 transit reservation under the HBBR alternative. These buses would serve all station and en route to Boston.

Table 2: Capacity Required for HBBR				
Inbound Boardings	Peak Hour Ridership	Peak Hour Buses Required	Peak Hour Headway (min)	Total Peak Buses Required
1,721	637	13	4.6	25

Thirteen buses stopping at all stations would be required to provide seats for all peak hour travelers. The headway associated with 13 buses per hour is 4.6 minutes. Extending this frequency to the entire peak brings the total number of peak vehicles required to 25. Assuming a 10 percent spare ratio for buses, the total amount of vehicles required is 28.

HBBS: Table 3 presents the capacity findings for buses that would operate in I-93 HOV lanes and shoulders under the HBBS alternative. These buses would serve one station and express to Boston.

[3] Mode Combination 7 differs from presumed bus operations in two ways: it (1) includes a New Hampshire HOV lane and (2) does not incorporate shoulder running in Massachusetts. It was assumed that the negative ridership impact from not constructing an HOV lane would be offset by the positive impact of decreasing travel times through shoulder operations.

Table 3: Capacity Required for HBBS						
Station	Boardings[4]	Peak Hour Ridership	Peak Hour Buses Required	Peak Hour Headway Required (min)	Peak Headway Assumed (min)	Total Peak Buses Required
Downtown Manchester	137	51	1	60	30	5
Exit 5	492	182	4	15	15	9
Exit 4	439	162	4	15	15	9
Exit 3	203	75	2	30	30	5
Exit 2	450	167	4	15	15	9
Total	1,721	637	15			37

15 buses would be required to seat all peak hour travelers from all 5 stations. If the maximum peak headway is set at 30 minutes, another peak Manchester bus would be required, bringing the total number of peak hour buses to 16. Applying peak hour frequencies to the entire peak brings the total number of peak vehicles required to 37. Assuming a 10 percent spare ratio for buses, the total amount of vehicles required is 41.

Capital Costs for Equipment

Table 4 presents the per vehicle costs used to estimate the capital cost for rolling stock procurement.

Table 4: Estimates of Rolling Stock Costs		
Description	Cost (millions)	Source
New DMU	$3.70	Colorado Rail Car Estimates
New Single-level coach	$2.14	American Public Transit Authority Rail Statistics5
New Over the Road Coach	$0.52	NH I-93 Final EIS6

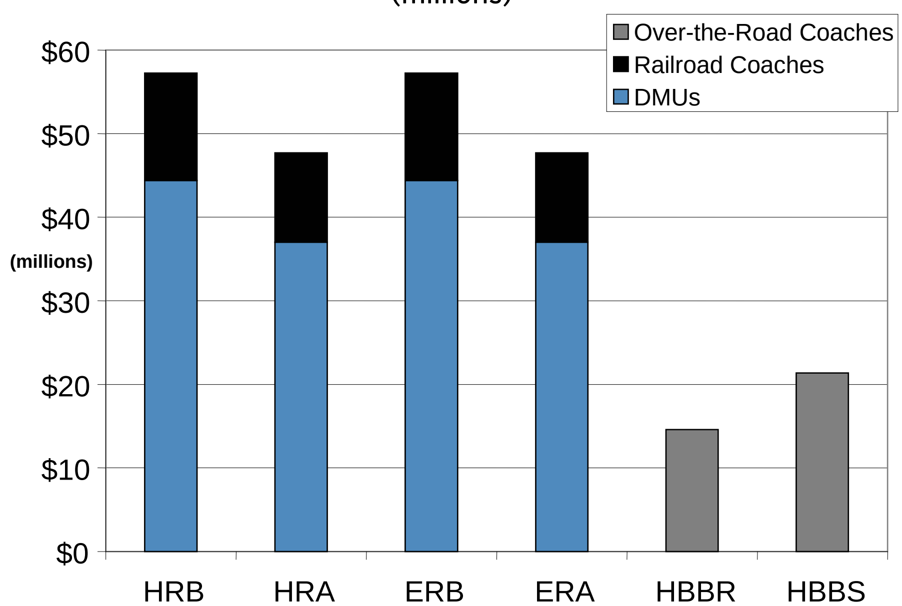
The capital cost for rolling stock procurement is estimated by applying per vehicle costs to the capacity requirements presented in Tables 1 through 3 as shown in Table 5 and Figure 1. The total cost for required vehicles and spares ranges from $14.6 million for HBBR to $57.2 million for either direct to Boston train service.

[4] Vanasse Hangen Brustlin, Inc. (2001). Appendix B. *Rationale Report* (Appendix, pp. 14). Prepared for New Hampshire DOT and FHWA
[5] American Public Transit Authority (APTA). Average New Rail Vehicle Costs, 2005-2006. Retrieved July 23, 2007 from http://www.apta.com/research/stats/rail/railcost.cfm.
[6] Costs reported in: Vanasse Hangen Brustlin, Inc. (2004). Chapter 2 - Alternatives. *Final Environemntal Impact Statement.* Prepared for New Hampshire DOT and FHWA and inflated annually by 5%.

Table 5: Estimated Capital Cost for Rolling Stock (millions)

	DMUs	Coaches	Over-the-Road Coaches	Total
HRB	$44.4	$12.8		$57.2
HRA	$37.0	$10.7		$47.7
ERB	$44.4	$12.8		$57.2
ERA	$37.0	$10.7		$47.7
HBBR			$14.6	$14.6
HBBS			$21.4	$21.4

Figure 1: Estimated Capital Cost for Rolling Stock (millions)



Date **October 30, 2007**

To David Nelson

From Tara Blakey

Subject NH I-93 Transit Investment: Rail Alternatives, Operating Plans

cc: Dennis Coffey, John Weston, Ken Kinney

New Hampshire DOT is evaluating future transit service options for the I-93 corridor. As part of that study, draft operating plans were developed for four rail alternatives providing service between Londonderry and Downtown Boston. This memo describes the four rail alternatives, documents planning assumptions, and presents estimated service statistics.

Rail Alternatives

Four rail services were developed:

- Highway Alignment - Within I-93 Median in New Hampshire
    1. HRB: Direct Service to Boston
    2. HRA: Service to Boston through a Transfer at Anderson
- East Alignment – Along the Manchester & Lawrence (M&L) right-of-way in New Hampshire
    1. ERB: Direct Service to Boston
    2. ERA: Service to Boston through a Transfer at Anderson

All alignments would use the M&L line from Salem, New Hampshire to the Haverhill line in Lawrence, Massachusetts. Trains would switch from the Haverhill Line to the Wildcat Branch at Wilmington Junction, and then to the Lowell line near Wilmington Station. Trains would remain on the Lowell line for access to Boston or Anderson.

All rail alternatives would include two new stations on the M&L line in Massachusetts. One new station would be constructed at the site of the historic depot in Methuen, near the intersection of Pelham and Railroad Streets. The second new station would be in Lawrence, near the intersection of Lowell and Winter Streets.

Direct Services would also call on Andover and Anderson stations in Massachusetts and travel non-stop between Anderson and Boston.

Connecting services would generally travel non-stop between New Hampshire and Anderson but may also make stops at Andover and Ballardvale Stations to facilitate service integration. All connecting trains would terminate at Anderson station where commuters would transfer to or from Lowell trains for Boston service. Lowell trains make three stops between Anderson and North Station at Winchester, Wedgemere and West Medford stations. Operations planning has not advanced to the point where final estimates of capacity requirements for trains has been developed. The seating capacity of peak MBTA trains connecting with New Hampshire trains at Anderson may be a problem for the connecting service designs. Table 1 lists Massachusetts station stops for direct and connecting alternatives.

Table 1: Massachusetts Stations Served		
Station	**Direct**	**Connecting**
Methuen	X	X
Lawrence	X	X
Andover	X	
Anderson	X	X
Winchester		X
Wedgemere		X
West Medford		X
North Station	X	X

Highway Alignment – Under this alternative, rail service would operate within the I-93 transit reservation, stopping at highway exits in Londonderry, Derry, Windham and Salem in New Hampshire (see Table 2). Passengers using park & ride lots would walk from the parking lot to the highway, cross over four lanes of I-93 then descend to station platforms in the highway median.

Eastern Alignment – The Eastern Alignment uses the historic M&L right-of-way in New Hampshire. Stations would be located at Exit 5 and near town centers in Derry and Salem (see Table 2).

Table 2: New Hampshire Stations Served		
Community	**Highway Station Location**	**Eastern Station Location**
Londonderry	Exit 5	Exit 5
Derry	Exit 4	Near Broadway & Railroad Ave
Windham	Exit 3	None
Salem	Exit 2	Near South Broadway & Rockingham Park Blvd

Table 3: Peak Period Travel Time to Boston (North Station) (min)					
Station	**HRB**	**HRA**	**ERB**	**ERA**	**Private Auto**
Londonderry	68	77	65	74	86
Derry	62	71	60	69	83
Windham	54	63	-	-	76
Salem	49	58	48	57	72

Figure 1: AM Peak Travel Time to Boston

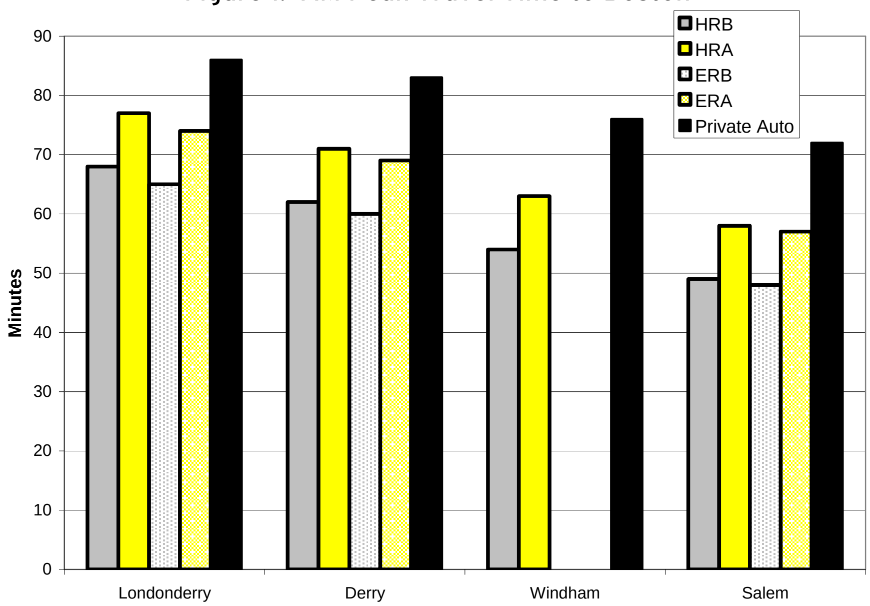


Table 3 and Figure 1 compare travel times to Boston for the four rail alternatives and private auto.

Planning Assumptions

The following assumptions were used for development of operating plans.

Track Configuration –

- Wildcat Branch would be double tracked with maximum allowable speeds raised to 60 mph,
- Haverhill Line would be double tracked from Andover Street in Lawrence to Wilmington Junction in Wilmington with no increase in maximum allowable speeds,
- New switches within the Andover Street Interlocking would provide for movement to/from either Haverhill Line main track to the single tracked M&L, and
- Passing sidings would be developed on the M&L Branch or in the Highway Alignment as necessary to provide desired service frequency and to facilitate schedule integration with other services operated on the main lines in Massachusetts.
- Maximum train speeds on the M&L and Highway Alignment would be those specified by the FRA for Class III track,[1]
-

[1] Curvature data from the proposed Highway Alignment track charts and historic M&L track charts were used to constrain speeds based on Class III standards.

Travel Times – Travel times were estimated based on the following:

- No impacts of grades are reflected in the travel time estimates. The impacts of grades on M&L train performance are expected to be negligible. The impacts of grades on trains in the Highway Alignment have not been determined.
- Station dwell time would be a constant of 15 seconds plus 0.8 seconds per boarding and alighting passengers[2], and
- Comparative private auto speeds are based on year 2020 forecast highway LOS for New Hampshire[3] and a JEK survey of I-93 travel times using SmarTraveler Traveler Information Services for Massachusetts.[4]

Hours of Service and Frequency - The level of weekday service offered by rail alternatives was designed with the following considerations in mind:

Weekdays:

- The first inbound trip would arrive at North Station at approximately 6:45 am and the last outbound trip would depart North Station at approximately 11:00 pm,
- Peak service would operate on approximately half hour headways, and
- Off peak service would operate on hour headways.

Weekends:

- The first inbound trip would arrive at North Station at approximately 8:00 am and the last outbound trip would depart North Station at approximately 12:00 am,
- Direct service would operate on 90 minute headways, and
- Connecting service would meet all Lowell trains which operate on 120 minute headways.

Schedules – Train schedules were developed based on the following:

- Connecting services would provide five minute timed transfers at Anderson when possible.
- The minimum interval between trains on any line is five minutes, and

[2] Passenger forecasts were derived from Vanasse Hangen Brustlin, Inc. (2001). Appendix B. *Interstate 93 Improvements Salem to Manchester IM-IR-93-1(174)0, 10418-C: Salem to Manchester, New Hampshire*. Retrieved from http://www.nh.gov/dot/10418c/Rationale.htm
[3] Federal Highway Administration (2005). *I-93 Record of Decision*. Concord, New Hampshire.
[4] Travel times reported in Central Transportation Planning Staff's 2000, *Speeds and Travel Times on Limited-Access Highways in the Boston Metropolitan Region: 1999-2000*, were 19 minutes faster than the more recent JEK survey.

- Minimum turn time at a terminal is ten minutes.
- All trains would be stored and serviced overnight in or near Londonderry. Two trains each would be available for midday maintenance at the MBTA maintenance plant in Boston.

Figure 2: Speed Profile Highway Alignment from Boston to Londonderry

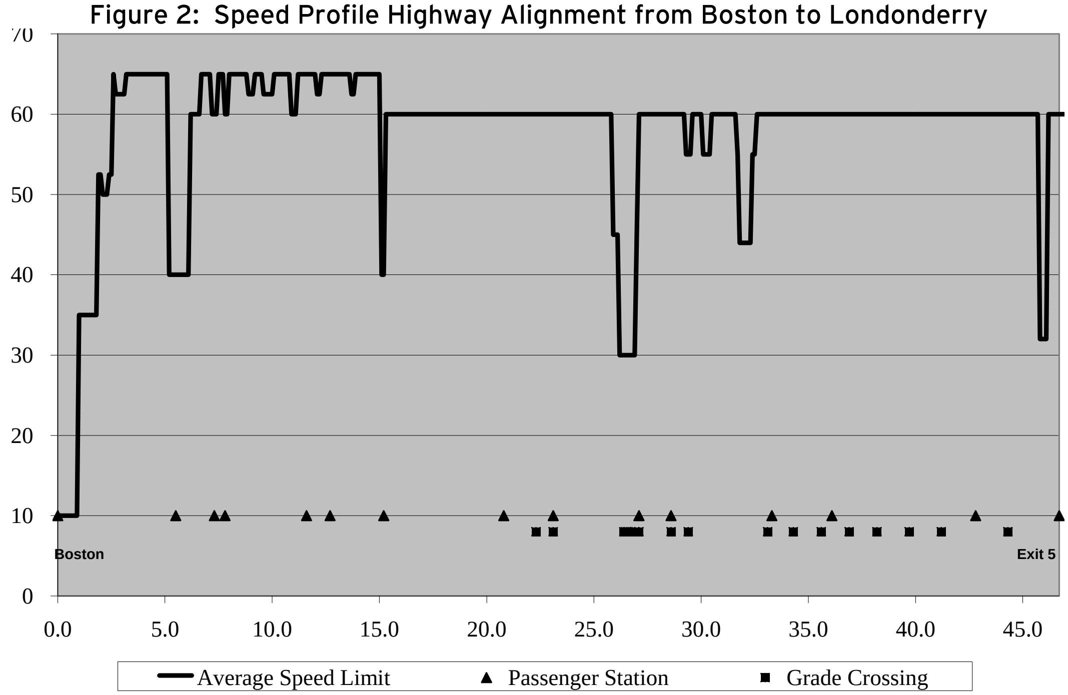
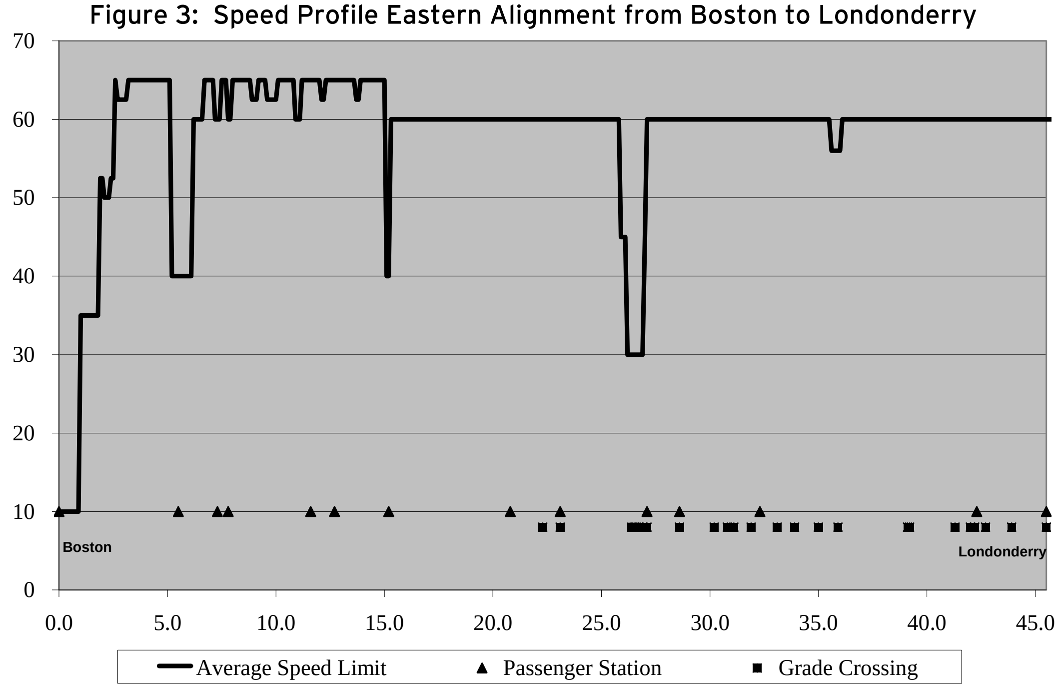


Figure 3: Speed Profile Eastern Alignment from Boston to Londonderry



Service Statistics

Tables 4 and 5 present service statistics on each of the four rail alternatives. All services offer five peak direction trips during each peak period

Table 4: Number of Weekday Trips and Average Headways by Time Period

		AM Peak (Inbound, Arriving Bos before 9 am)	AM Reverse Peak (Outbound, Departing Bos before 9 am)	Midday (Arriving or Departing Bos 9 am to 4 pm)	PM Peak (Outbound, Departing Bos 4 pm to 7 pm)	PM Reverse Peak (Inbound, Arriving Bos 4 pm to 7 pm)	Night (Arriving or Departin g Bos after 7 pm)	Total One-way Trips
HRB	Number of Trips	5	2	14	5	2	10	38
	Average Headway	0:30	1:16	1:00	0:33	0:58	0:56	
HRA	Number of Trips	5	3	14	5	3	8	38
	Average Headway	0:38	1:12	1:00	0:33	0:58	1:05	
ERB	Number of Trips	5	2	14	5	2	10	38
	Average Headway	0:30	1:15	1:00	0:32	0:55	0:56	
ERA	Number of Trips	5	3	14	5	3	8	38
	Average Headway	0:38	1:12	1:00	0:33	0:58	1:05	

Table 5: Weekday Service Statistics for Alternative Rail Services

	Peak Train Sets	Base Train Sets	Weekday Train Miles	Weekday Train Hours	Weekend Train Miles	Weekend Train Hours	Annual Train Miles	Annual Train Hours
HRB	5	3	1,775	54	1,121	35	574,036	17,661
HRA	4	2	1,343	41	544	31	400,911	13,709
ERB	5	3	1,725	54	1,121	35	561,489	17,517
ERA	4	2	1,293	40	544	31	388,364	13,485

HRB – The alternative providing direct service to Boston on the Highway Alignment would require five peak train sets, three of which would be required during the off-peak. The two train sets not used during the off-peak could be stored and serviced in Boston during the midday. By alternating the two train sets that are stored during the midday, all five train sets could be serviced in Boston facilities within three days.

Two passing sidings would be constructed on the portion of the alignment within I-93 in New Hampshire, including a siding near the State Line and a siding at the Derry/Exit 4 rail station. Thirteen meets would occur daily at the State Line siding.

To achieve the desired frequency, one minor change to existing service schedules was assumed. It was assumed that Lowell trip 354, which turns at Anderson station, could be operated by equipment from New Hampshire. This assumption was necessitated by the lack of available timeslots on the Lowell Line during this portion of the peak.

HRA – The alternative providing connecting service to Boston on the Highway Alignment would require four peak train sets, two of which would be required during the off-peak. The two train sets not used during the off-peak could be stored and serviced in Boston during the midday. These two train sets would each provide a direct trip into North Station during each peak period.

The entire portion of the Highway Alignment in New Hampshire would be double tracked north of the State Line. Greater scheduling flexibility is required to provide convenient connections with Lowell trains to Boston. Trains on the Haverhill line, which are not coordinated with Lowell line trains, constrain the connecting services. The current Haverhill schedule limits arrival and departure times at Anderson, especially during peak periods. Thirty-one of the 42 connecting trips provide five minute timed transfers to Lowell trains. Of the eleven remaining connections that are longer than five minutes, all are less than 15 minutes in length with seven connections longer than ten minutes (for details see Appendix).

Inspection of the connections schedule and stringlines of the HRA service indicates that it will be much more operationally difficult to manage than the HRB option. Potential conflicts with MBTA trains on the Lowell and Haverhill Lines and with Amtrak Downeaster trains, together with the need for timely connections at Anderson to provide quality service, will require a heightened degree of operational reliability that would be challenging to achieve.

ERB – Similar to HRB, the alternative providing direct service to Boston on the Eastern Alignment would require five peak train sets, three of which would be required during the off-peak. The two train sets not used during the off-peak would be stored and serviced in Boston during the midday.

This service would require passing sidings in approximately the same locations as ERB. Thirteen meets would occur daily at the State Line siding.

The same minor change to existing services assumed for the HRB alternative was assumed in the development of the ERB schedules.

ERA – The alternative providing connecting service to Boston on the Highway Alignment would require four peak train sets, two of which would be required during the off-peak. The two train sets not used during the off-peak would be stored and serviced in Boston during the midday. These two train sets would each provide a direct trip into North Station during each peak period.

Like HRA, the entire alignment north of the State Line, in this case the M&L, would be double-tracked to allow for greater flexibility in scheduling trains. Thirty-one of the 42 connecting trips provide five minute timed transfers to Lowell trains. Of the eleven remaining connections that are longer than five minutes, all are less than 15 minutes in length with seven connections longer than ten minutes (for details see Appendix).

The ERA option poses the same substantially inherent operational challenges to providing a reliable and attractive service that face the HRA option.

Potential Developments

An additional, prospective station site was identified during the train scheduling task. Virtually all off peak trains meet between milepost 30 and 32, five miles north of the Andover Street connection between the M&L and Haverhill Lines. Because of the potential for a train to be standing in the passing siding, a station at this location could take advantage of delays, allowing passengers to board or alight while waiting for the opposing train to pass. The siding would be between the proposed Methuen and Salem/Exit 2 stations. An ideal location for the additional station, in terms of train meets, would be halfway between the Methuen and Salem stations near milepost 31, approximately two miles from either station.

On the Highway alignment, milepost 31 would be approximately one-half mile north of Hampshire Road within the I-93 median, just north of the State Line. Construction of this station could include a park & ride lot for station access.

On the Eastern Alignment, milepost 31 would be near the intersection of Duffy Avenue and Kelly Road, approximately 0.75 miles north of the State Line.

As future operations planning and engineering is undertaken, it may be that schedules could be adjusted to shift this meet one mile south to the vicinity of the property occupied by the Massachusetts Society for the Prevention of Cruelty to Animals' Nevins Farm at Exit 48 on I-93 where Route 213 and I-93 intersect.

Weekday Schedules

This appendix documents conceptual schedules and stringlines of weekday service for the four rail alternatives.

HRB Schedules

Inbound Service

STATION	MP	302	202	502	304	204	504	352	506	206	306	208	308	508	680	310	212	5354	356	312	358	510	314	214	682	512	316	218	514	318	516	320	220
Cycle		B	A	N	B	A	K	B	L	A	B	A	B	D	E	B	A	M	B	B	B	N	B	A	E	D	B	A	M	B	N	B	A
Exit 5	46.7			5:32			6:02		6:22					7:01				7:27				8:39				9:38			10:40		11:39		
Exit 4	42.8			5:38			6:08		6:28					7:07				7:33				8:45				9:44			10:46		11:45		
Exit 3	36.1			5:46			6:16		6:36					7:15				7:41				8:53				9:52			10:54		11:53		
Exit 2	33.3			5:51			6:21		6:41					7:20				7:46				8:58				9:57			10:59		11:58		
Methuen	28.8			5:58			6:28		6:48					7:27				7:53				9:05				10:04			11:06		12:05		
Lawrence	27.1			6:02			6:32		6:52					7:31				7:57				9:09				10:08			11:10		12:09		
Andover	23.1		5:47	6:08		6:21	6:38		6:58	6:46		7:11		7:37			7:42	8:02				9:15		9:19		10:14		10:19	11:16		12:15		12:19
Ballardvale	20.8		5:51			6:25				6:50		7:15					7:46							9:23				10:23					12:23
Wilmington	15.2	5:51			6:34						7:13	7:26				8:03				8:41			9:31				10:31			11:31		12:31	
Anderson	12.7	5:55		6:21	6:38		6:51	6:58	7:11		7:17		7:38	7:50	8:01	8:08		8:15	8:30	8:45	9:15	9:28	9:35		10:04	10:27	10:35		11:29	11:35	12:28	12:35	
Winchester	7.8	6:02			6:46			7:07			7:25		7:46					8:24	8:38	8:52	9:23		9:42				10:42			11:42		12:42	
Wedgemere	7.3	6:04			6:49			7:09			7:28		7:49					8:26	8:40	8:54	9:26		9:44				10:44			11:44		12:44	
West Medford	5.5	6:08			6:53			7:13			7:32		7:53					8:30	8:44	8:58	9:30		9:48				10:48			11:48		12:48	
North Station	0.0	6:22	6:35	6:40	7:05	7:10	7:10	7:25	7:30	7:39	7:44	7:52	8:05	8:10	8:25	8:30	8:36	8:42	8:56	9:10	9:42	9:47	9:59	10:06	10:25	10:46	10:59	11:07	11:48	11:59	12:47	12:59	13:07

Inbound Service

STATION	MP	518	322	222	520	324	684	226	522	326	524	328	360	232	686	526	330	334	336	236	528	338	530	340	532	342	238	534	344	688	536	346	244
Cycle		D	B	A	M	B	E	A	N	B	D	B	B	A	E	M	B	B	B	A	N	B	D	B	M	B	A	N	B	E	D	B	A
Exit 5	46.7	12:38			13:40				14:40		15:40					16:39					18:01		18:35		19:40			20:37			21:32		
Exit 4	42.8	12:44			13:46				14:46		15:46					16:45					18:07		18:41		19:46			20:43			21:38		
Exit 3	36.1	12:52			13:54				14:54		15:54					16:53					18:15		18:49		19:54			20:51			21:46		
Exit 2	33.3	12:57			13:59				14:59		15:59					16:58					18:20		18:54		19:59			20:56			21:51		
Methuen	28.8	13:04			14:06				15:06		16:06					17:05					18:27		19:01		20:06			21:03			21:58		
Lawrence	27.1	13:08			14:10				15:10		16:10					17:09					18:31		19:05		20:10			21:07			22:02		
Andover	23.1			13:16	14:16			15:04	15:16		16:15			16:46						18:21	18:37		19:10		20:16		20:39	21:13			22:08		22:37
Ballardvale	20.8			13:24				15:08						16:50						18:25							20:43						22:41
Wilmington	15.2		13:31			14:31				15:31		16:31					17:26	18:01	18:31	18:35		19:06		19:41		20:46			21:46			22:51	
Anderson	12.7	13:24	13:35		14:29	14:35	14:54		15:29	15:35	16:27	16:35	16:55	17:00	17:05	17:25	17:30	18:05	18:35	18:40	18:51	19:10	19:23	19:45	20:29	20:50		21:26	21:50	22:14	22:21	22:55	
Winchester	7.8		13:42			14:42				15:42		16:42					17:37	18:12		18:47		19:17		19:52		20:57			21:57			23:02	
Wedgemere	7.3		13:44			14:44				15:44		16:44					17:39	18:14		18:49		19:19		19:54		20:59			21:59			23:04	
West Medford	5.5		13:48			14:48				15:48		16:48					17:43	18:19		18:53		19:23		19:58		21:03			22:03			23:08	
North Station	0.0	13:44	13:59	14:07	14:48	14:59	15:15	15:31	15:48	15:59	16:44	16:59	17:15	17:27	17:32	17:45	17:56	18:31	18:55	19:05	19:10	19:36	19:42	20:09	20:48	21:14	21:26	21:45	22:14	22:35	22:40	23:20	23:24

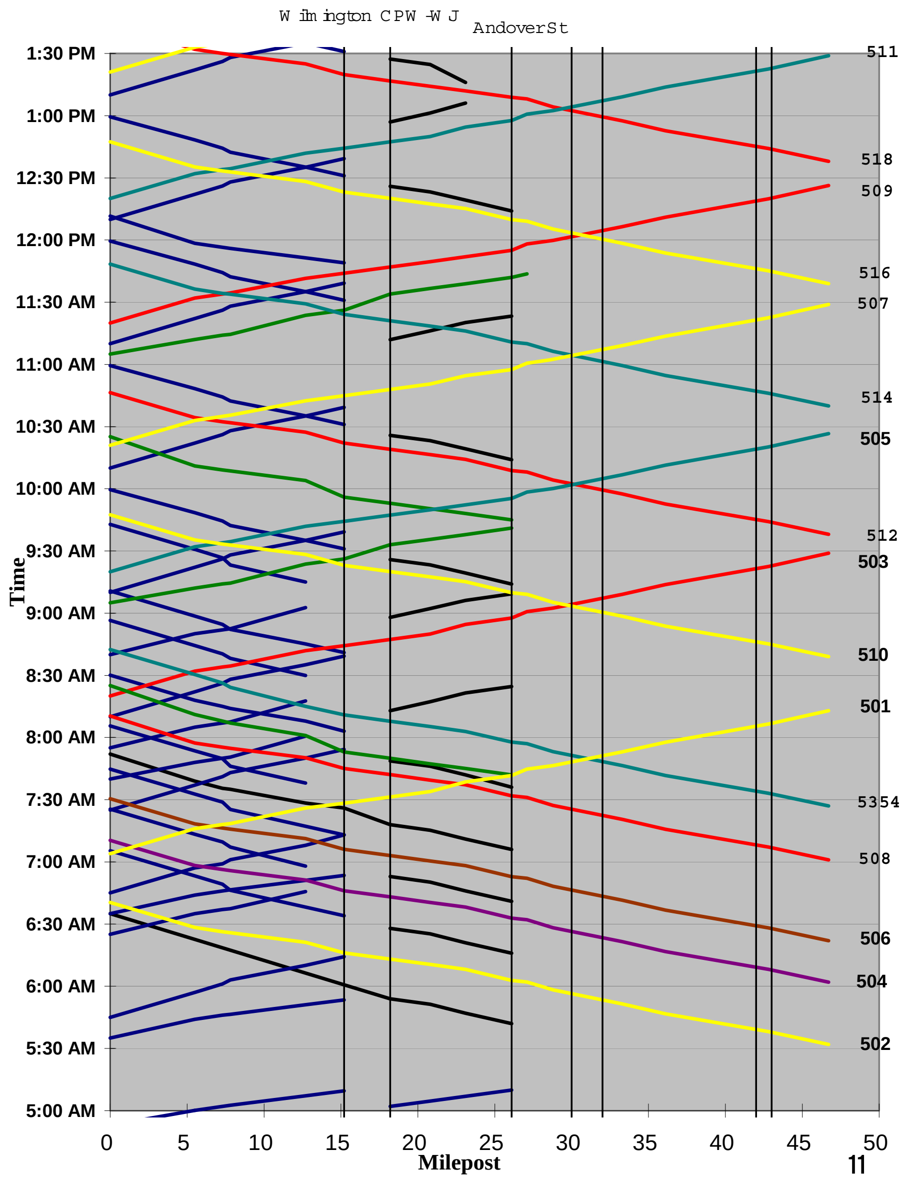
Outbound Service

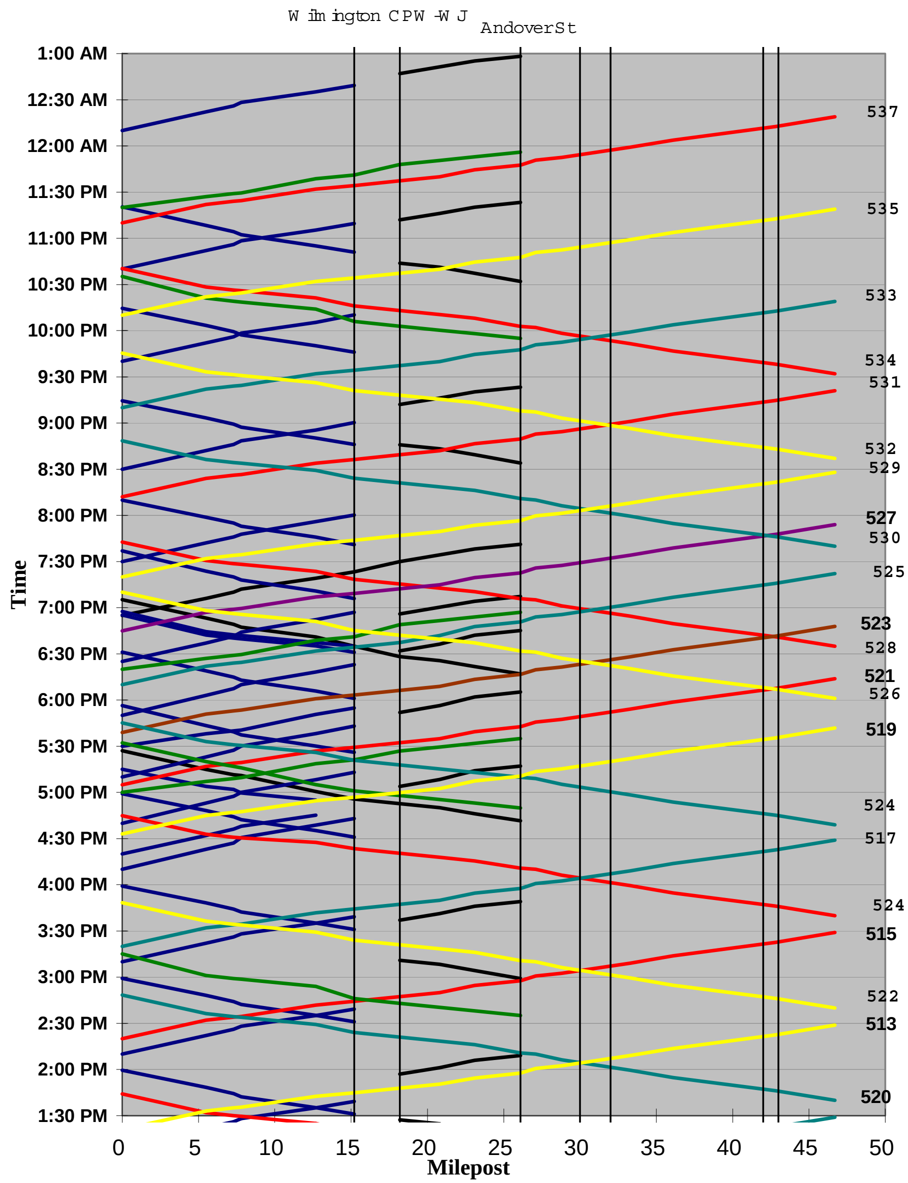
STATION	MP	301	351	305	501	307	205	353	355	309	503	209	357	681	311	505	315	507	213	683	317	509	319	511	215	321	513	217	323	515	223	325	517	327
Cycle		B	B	B	N	B	A	B	B	B	D	A	B	E	B	M	B	N	A	E	B	D	B	M	A	B	N	A	B	D	A	B	M	B
North Station	0	5:45	6:25	6:45	7:04	7:25	7:39	7:40	7:55	8:10	8:20	8:20	8:40	9:05	9:10	9:20	10:10	10:21	10:35	11:05	11:10	11:20	12:10	12:20	12:20	13:10	13:21	13:20	14:10	14:20	15:00	15:10	15:20	16:10
West Medford	5.5	5:57		6:57		7:37				8:22					9:22		10:22				11:22		12:22			13:22			14:22			15:22		16:23
Wedgemere	7.3	6:01				7:41				8:26					9:26		10:26				11:26		12:26			13:26			14:26			15:26		16:27
Winchester	7.8	6:03		7:01		7:43				8:28					9:28		10:28				11:28		12:28			13:28			14:28			15:28		16:30
Anderson	12.7	6:10	6:45	7:08	7:25	7:50		8:00	8:17	8:35	8:41		9:02	9:23	9:35	9:41	10:35	10:42		11:23	11:35	11:41	12:35	12:41		13:35	13:42		14:35	14:41		15:35	15:41	16:38
Wilmington	15.2	6:14		7:13		7:54				8:39					9:39		10:39				11:39		12:39			13:39			14:39			15:39		16:43
Ballardvale	20.8						8:17					9:02							11:16						13:01			14:01			15:41			
Andover	23.1				7:38		8:21				8:54	9:06						10:54	11:20					12:54	13:06		13:54	14:06		14:54	15:46		15:54	
Lawrence	27.1				7:44						9:00					9:58		11:00				11:58		13:00			14:00			15:00			16:00	
Methuen	28.8				7:46						9:02					10:00		11:02				11:59		13:02			14:02			15:02			16:02	
Exit 2	33.3				7:53						9:09					10:06		11:09				12:06		13:09			14:09			15:09			16:09	
Exit 3	36.1				7:57						9:13					10:11		11:13				12:11		13:13			14:13			15:13			16:13	
Exit 4	42.8				8:06						9:22					10:20		11:22				12:19		13:22			14:22			15:22			16:22	
Exit 5	46.7				8:12						9:28					10:26		11:28				12:26		13:28			14:28			15:28			16:28	

Outbound Service

STATION	MP	359	519	329	227	685	521	331	231	333	523	335	233	525	235	687	337	527	237	529	339	531	341	239	533	343	535	243	345	537	689	347	245
Cycle		B	N	B	A	E	D	B	A	B	L	B	A	M	A	E	B	K	A	N	B	D	B	A	M	B	N	A	B	D	E	B	A
North Station	0	16:20	16:33	16:40	16:45	17:00	17:05	17:10	17:15	17:30	17:39	17:50	17:52	18:10	18:15	18:20	18:25	18:45	18:55	19:20	19:30	20:12	20:30	20:34	21:10	21:40	22:10	22:35	22:40	23:10	23:20	0:10	0:10
West Medford	5.5	16:32		16:53				17:23				18:03					18:37		19:06		19:42		20:42			21:52			22:52			0:22	
Wedgemere	7.3	16:36		16:57				17:27				18:07					18:41		19:10		19:46		20:46			21:56			22:56			0:26	
Winchester	7.8	16:38		17:00				17:30				18:10					18:44		19:12		19:47		20:48			21:58			22:58			0:28	
Anderson	12.7	16:45	16:54	17:08		17:18	17:26	17:38		17:50	18:00	18:18		18:31		18:38	18:52	19:06	19:19	19:41	19:55	20:33	20:55		21:31	22:05	22:31		23:05	23:31	23:38	0:35	
Wilmington	15.2			17:13				17:43		17:54		18:23					18:57		19:23		20:00		21:00			22:10			23:09			0:39	
Ballardvale	20.8				17:08				17:56				18:36		19:00				19:34					21:16				23:16					0:51
Andover	23.1		17:07		17:14		17:39		18:02		18:13		18:42	18:47	19:04			19:19	19:38	19:53		20:46		21:20	21:44		22:44	23:20		23:44			0:55
Lawrence	27.1		17:13				17:45				18:19			18:53				19:25		19:59		20:52			21:50		22:50			23:50			
Methuen	28.8		17:15				17:47				18:21			18:55				19:27		20:01		20:54			21:52		22:52			23:52			
Exit 2	33.3		17:22				17:54				18:28			19:02				19:34		20:08		21:01			21:59		22:59			23:59			
Exit 3	36.1		17:26				17:58				18:32			19:06				19:38		20:12		21:05			22:03		23:03			0:03			
Exit 4	42.8		17:35				18:07				18:41			19:15				19:47		20:21		21:14			22:12		23:12			0:12			
Exit 5	46.7		17:41				18:13				18:47			19:22				19:53		20:27		21:20			22:18		23:18			0:18			

HRB Stringlines





HRA Schedules (Anderson connections longer than five minutes are highlighted)

Inbound Service

STATION	MP	5302	202	304	5304	204	352	206	5306	208	308	5308	680	310	212	354	5356	312	358	5314	214	682	5316	218	5318
Cycle		D	A	B	K	A	B	A	L	A	B	M	E	B	A	B	D	B	B	L	A	E	D	A	L
Exit 5	46.7	5:05			5:41				6:28			6:48					7:41			8:39			9:39		10:45
Exit 4	42.8	5:11			5:47				6:34			6:54					7:47			8:45			9:45		10:51
Exit 3	36.1	5:19			5:55				6:42			7:02					7:55			8:53			9:53		10:59
Exit 2	33.3	5:24			6:00				6:47			7:07					8:00			8:58			9:58		11:04
Methuen	28.6	5:31			6:07				6:54			7:14					8:07			9:05			10:05		11:11
Lawrence	27.1	5:35			6:11				6:58			7:18					8:11			9:09			10:09		11:15
Andover	23.1		5:47			6:21		6:46		7:11					7:42						9:19			10:19	
Ballardvale	20.8		5:51			6:25		6:50		7:15					7:46						9:23			10:23	
Wilmington	15.2			6:34						7:22				8:03											
Arrive Anderson	12.7	5:50			6:27				7:13			7:33	8:01				8:26			9:24		10:04	10:24		11:30
Depart Anderson	12.7	5:55		6:38			6:58		7:18		7:38		8:01	8:08		8:15	8:31	8:45	9:15	9:35		10:04	10:35		11:35
Winchester	7.8	6:02		6:46			7:07		7:26		7:46	7:40				8:24	8:39	8:52	9:23	9:42			10:42		11:42
Wedgemere	7.3	6:04		6:49			7:09		7:29		7:49	7:42				8:26	8:41	8:54	9:26	9:44			10:44		11:44
West Medford	5.5	6:08		6:53			7:13		7:33		7:53	7:45				8:30	8:45	8:58	9:30	9:48			10:48		11:48
North Station	0	6:22	6:35	7:05	6:47	7:10	7:25	7:39	7:45	7:52	8:05	7:57	8:25	8:30	8:36	8:42	8:57	9:10	9:42	9:59	10:06	10:25	10:59	11:07	11:59
																	0:38								

Inbound Service

STATION	MP	5320	220	5322	222	5324	684	226	5326	5328	360	232	686	330	5334	5336	236	338	5340	5342	238	688	5344	5346	244
Cycle		D	A	L	A	D	E	A	L	D	B	A	E	B	L	D	A	B	K	D	A	E	K	D	A
Exit 5	46.7	11:39		12:38		13:45			14:45	15:45					17:15	17:44			18:54	19:59			21:00	21:55	
Exit 4	42.8	11:45		12:44		13:51			14:51	15:51					17:21	17:50			19:00	20:05			21:06	22:01	
Exit 3	36.1	11:53		12:52		13:59			14:59	15:59					17:29	17:58			19:08	20:13			21:14	22:09	
Exit 2	33.3	11:58		12:57		14:04			15:04	16:04					17:34	18:03			19:13	20:18			21:19	22:14	
Methuen	28.6	12:05		13:04		14:11			15:11	16:11					17:41				19:20	20:25			21:26	22:21	
Lawrence	27.1	12:09		13:08		14:15			15:15	16:15					17:45				19:24	20:29			21:30	22:25	
Andover	23.1		12:19		13:16			15:04				16:46					18:21				20:39				22:37
Ballardvale	20.8		12:23		13:24			15:08				16:50					18:25				20:43				22:41
Wilmington	15.2																18:35	19:06							
Arrive Anderson	12.7	12:24		13:23		14:30	14:53		15:30	16:30		17:01	17:09		18:00	18:27	18:40	19:10	19:40	20:44		22:14	21:45	22:40	
Depart Anderson	12.7	12:35		13:35		14:35	14:53		15:35	16:35	16:55	17:01	17:09	17:30	18:05	18:35	18:40	19:10	19:45	20:50		22:14	21:50	22:55	
Winchester	7.8	12:42		13:42		14:42			15:42	16:42				17:37	18:12		18:47	19:17	19:52	20:57			21:57	23:02	
Wedgemere	7.3	12:44		13:44		14:43			15:43	16:43				17:39	18:14		18:49	19:19	19:54	20:59			21:59	23:04	
West Medford	5.5	12:48		13:48		14:48			15:48	16:48				17:43	18:17		18:53	19:23	19:58	21:03			22:03	23:08	
North Station	0	12:59	13:07	13:59	17:07	14:59	15:14	15:31	15:59	16:59	17:15	17:27	17:35	17:56	18:30	18:55	19:05	19:36	20:09	21:14	21:26	22:35	22:14	23:20	23:24

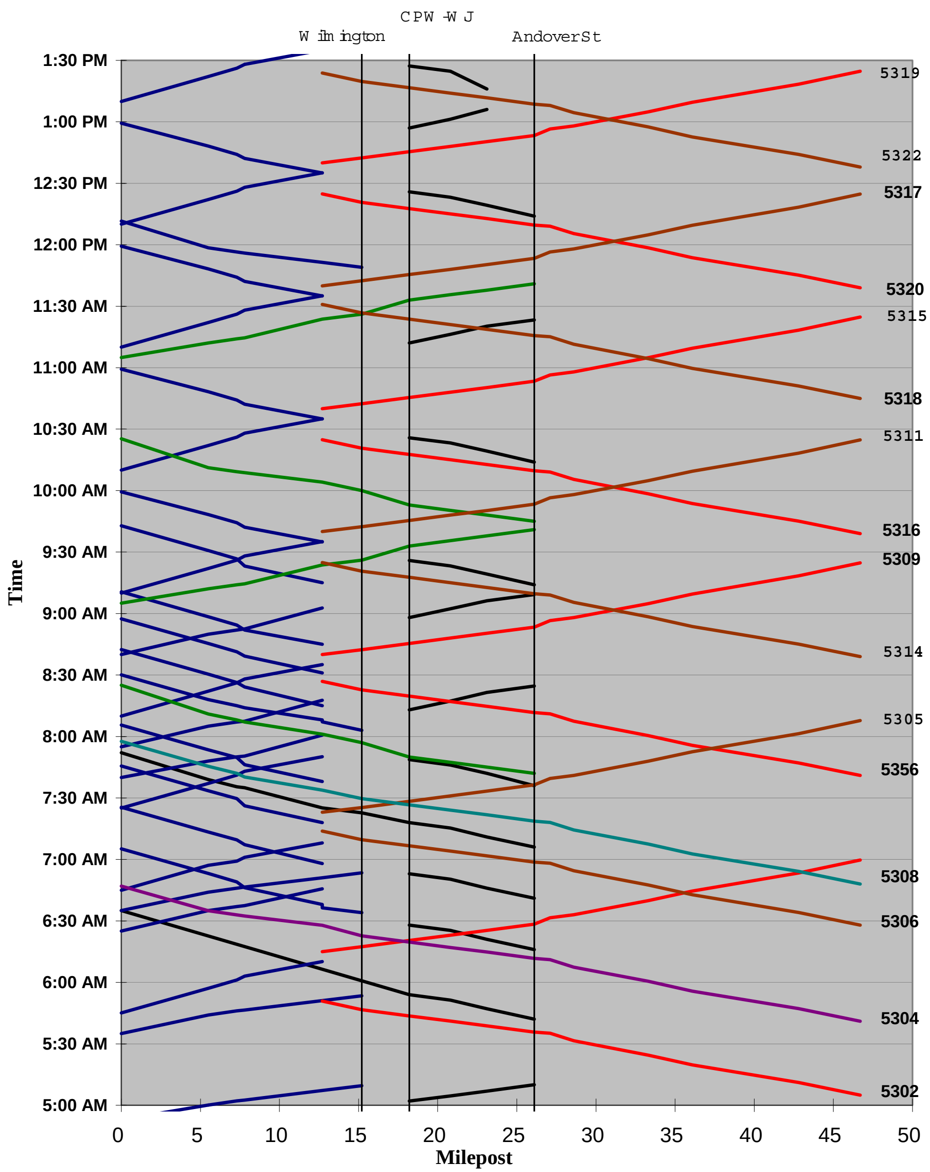
Outbound Service

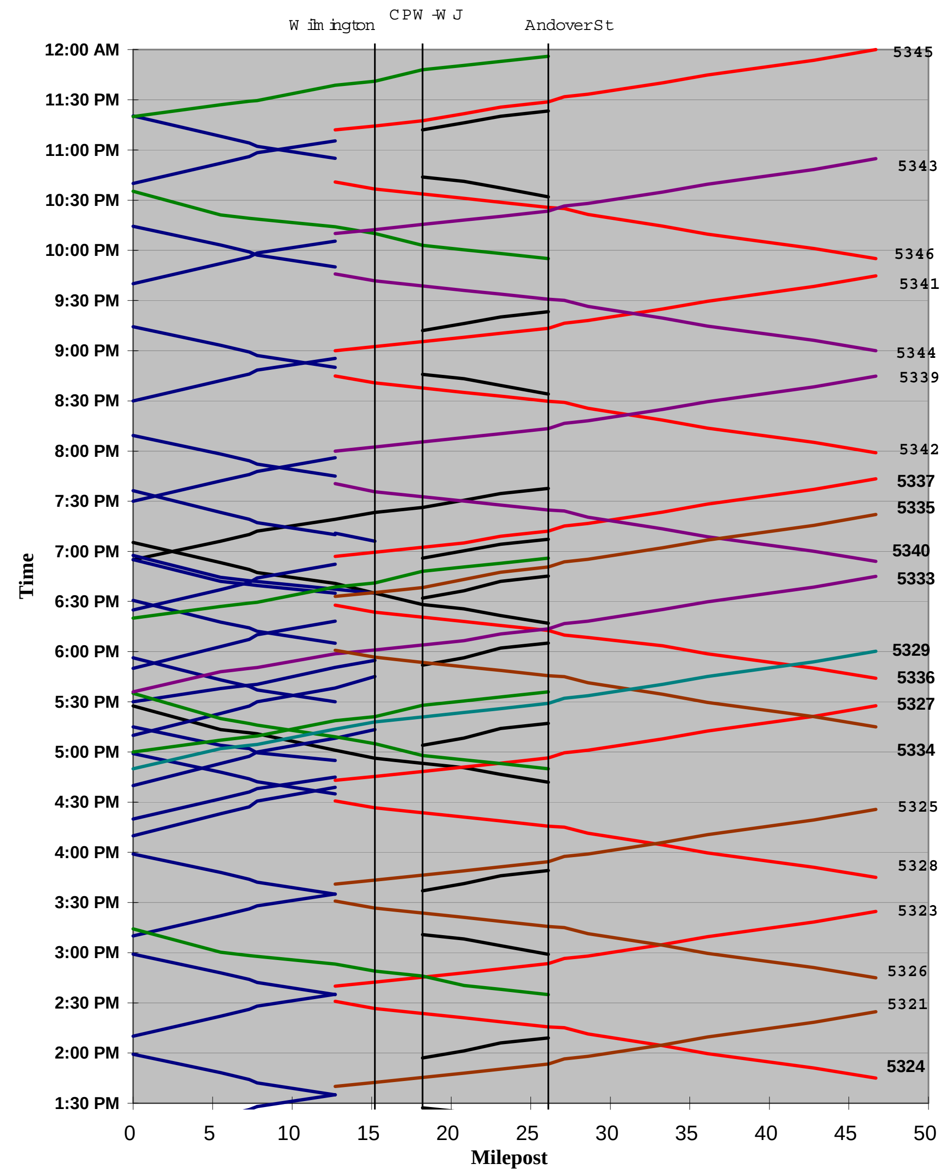
STATION	MP	5301	351	5305	307	205	353	355	5309	209	357	681	5311	5315	213	683	5317	5319	215	5321	217	5323	223	5325	5327
Cycle		D	B	L	B	A	B	B	D	A	B	E	L	D	A	E	L	D	A	L	A	D	A	L	D
North Station	0	5:45	6:25	6:45	7:25	7:39	7:40	7:55	8:10	8:20	8:40	9:05	9:10	10:10	10:35	11:05	11:10	12:10	12:20	13:10	13:20	14:10	15:00	15:10	16:10
West Medford	5.5	5:57		6:57	7:37				8:22				9:22	10:22			11:22	12:22		13:22		14:22		15:22	16:23
Wedgemere	7.3	6:01			7:41				8:26				9:26	10:26			11:26	12:26		13:26		14:26		15:26	16:27
Winchester	7.8	6:03		7:01	7:43				8:28				9:28	10:28			11:28	12:28		13:28		14:28		15:28	16:30
Arrive Anderson	12.7	6:10	6:45	7:08	7:50		8:00	8:17	8:35		9:02	9:23	9:35	10:35		11:23	11:35	12:35		13:35		14:35		15:35	16:38
Depart Anderson	12.7	6:15		7:23					8:40			9:23	9:40	10:40		11:23	11:40	12:40		13:40		14:40		15:41	16:43
Wilmington	15.2																								
Ballardvale	20.8					8:17				9:02					11:16				13:01		14:01		15:41		
Andover	23.1					8:21				9:06					11:20				13:06		14:06		15:46		
Lawrence	27.1	6:31		7:39					8:56				9:56	10:56			11:56	12:56		13:56		14:56		15:57	16:59
Methuen	28.6	6:33		7:41					8:58				9:58	10:58			11:58	12:58		13:58		14:58		15:59	17:01
Exit 2	33.3	6:39		7:47					9:04				10:04	11:04			12:04	13:04		14:04		15:04		16:05	17:07
Exit 3	36.1	6:44		7:52					9:09				10:09	11:09			12:09	13:09		14:09		15:09		16:10	17:12
Exit 4	42.8	6:53		8:01					9:18				10:18	11:18			12:18	13:18		14:18		15:18		16:19	17:21
Exit 5	46.7	6:59		8:07					9:24				10:24	11:24			12:24	13:24		14:24		15:24		16:25	17:27

Outbound Service

STATION	MP	359	329	5329	227	685	331	231	333	5333	5335	233	235	687	5337	237	5339	5341	239	5343	5345	243	689	347	245
Cycle		B	B	M	A	E	B	A	B	K	L	A	A	E	D	A	K	D	A	K	D	A	E	B	A
North Station	0	16:20	16:40	16:50	16:45	17:00	17:10	17:15	17:30	17:36	17:50	17:52	18:15	18:20	18:25	18:55	19:30	20:30	20:34	21:40	22:40	22:35	23:20	0:10	0:10
West Medford	5.5	16:32	16:53				17:23				18:03				18:37	19:06	19:42	20:42		21:52	22:52			0:22	
Wedgemere	7.3	16:36	16:57				17:27				18:07				18:41	19:10	19:46	20:46		21:56	22:56			0:26	
Winchester	7.8	16:38	17:00				17:30				18:10				18:44	19:12	19:47	20:48		21:58	22:58			0:28	
Arrive Anderson	12.7	16:45	17:08	17:13		17:18	17:38		17:50	17:58	18:18			18:38	18:52	19:19	19:55	20:55		22:05	23:05		23:38	0:35	
Depart Anderson	12.7					17:18					18:33			18:38	18:57	19:19	20:00	21:00		22:10	23:12		23:38		
Wilmington	15.2		17:13				17:45		17:54							19:23									
Ballardvale	20.8				17:08			17:56			18:43	18:36	19:00			19:30			21:16		23:21	23:16			0:51
Andover	23.1				17:14			18:02		18:10	18:47	18:42	19:04		19:08	19:34			21:20		23:25	23:20			0:55
Lawrence	27.1			17:32						18:16	18:53				19:15		20:16	21:16		22:26	23:31				
Methuen	28.6			17:33						18:18	18:55				19:16		20:18	21:18		22:28	23:33				
Exit 2	33.3			17:40						18:25	19:02				19:23		20:24	21:24		22:34	23:40				
Exit 3	36.1			17:45						18:29	19:06				19:28		20:29	21:29		22:39	23:44				
Exit 4	42.8			17:53						18:38	19:15				19:37		20:38	21:38		22:48	23:53				
Exit 5	46.7			18:00						18:45	19:22				19:43		20:44	21:44		22:54	0:00				

HRA Stringlines





ERB Schedules

Inbound Service

STATION	MP	302	202	502	304	204	504	352	506	206	306	208	308	508	680	310	212	5354	356	312	510	358	314	214	682	512	316	218	514	318	516	320	220
Cycle		B	A	N	B	A	K	B	L	A	B	A	B	D	E	B	A	M	B	B	N	B	B	A	E	D	B	A	M	B	N	B	A
Londonderry	45.4			5:35			6:05		6:25					7:04				7:30			8:25					9:42			10:46		11:42		
Derry	42.3			5:40			6:10		6:30					7:09				7:35			8:30					9:47			10:51		11:47		
Salem	32.3			5:52			6:22		6:42					7:21				7:47			8:42					9:59			11:03		11:59		
Methuen	28.8			5:58			6:28		6:48					7:27				7:53			8:48					10:05			11:09		12:05		
Lawrence	27.1			6:01			6:31		6:51					7:30				7:56			8:51					10:08			11:12		12:08		
Andover	23.1		5:47	6:08		6:21	6:38		6:58	6:46		7:11		7:37			7:42	8:02			8:57			9:19		10:15		10:19	11:19		12:15		12:19
Ballardvale	20.8		5:51			6:25				6:50		7:15					7:46							9:23				10:23					12:23
Wilmington	15.2	5:51			6:34						7:13	7:26				8:03				8:41			9:31				10:31			11:31		12:31	
Anderson	12.7	5:55		6:21	6:38		6:51	6:58	7:11		7:17		7:38	7:50	8:01	8:08		8:14	8:30	8:45	9:10	9:15	9:35		10:04	10:28	10:35		11:32	11:35	12:28	12:35	
Winchester	7.8	6:02			6:46			7:07			7:25		7:46					8:24	8:38	8:52		9:23	9:42				10:42			11:42		12:42	
Wedgemere	7.3	6:04			6:49			7:09			7:28		7:49					8:26	8:40	8:54		9:26	9:44				10:44			11:44		12:44	
West Medford	5.5	6:08			6:53			7:13			7:32		7:53					8:30	8:44	8:58		9:30	9:48				10:48			11:48		12:48	
North Station	0.0	6:22	6:35	6:40	7:05	7:10	7:10	7:25	7:30	7:39	7:44	7:52	8:05	8:10	8:25	8:30	8:36	8:42	8:56	9:10	9:30	9:42	9:59	10:06	10:25	10:47	10:59	11:07	11:51	11:59	12:47	12:59	13:07

Inbound Service

STATION	MP	518	322	222	520	324	684	226	522	326	524	328	360	232	686	526	330	334	336	236	528	338	530	340	532	342	238	534	344	688	536	346	244
Cycle		D	B	A	M	B	E	A	N	B	D	B	B	A	E	M	B	B	B	A	N	B	D	B	M	B	A	N	B	E	D	B	A
Londonderry	45.4	12:33			13:45				14:45		15:45					16:35					18:05		18:38		19:38			20:33			21:35		
Derry	42.3	12:38			13:50				14:50		15:50					16:40					18:10		18:43		19:43			20:38			21:40		
Salem	32.3	12:50			14:02				15:02		16:02					16:52					18:22		18:55		19:55			20:50			21:52		
Methuen	28.8	12:56			14:08				15:08		16:08					16:58					18:28		19:01		20:01			20:56			21:58		
Lawrence	27.1	12:59			14:11				15:11		16:11					17:01					18:31		19:04		20:04			20:59			22:01		
Andover	23.1	13:06		13:16	14:18			15:04	15:18		16:17			16:46		17:08				18:21	18:38		19:10		20:11		20:39	21:06			22:08		22:37
Ballardvale	20.8			13:24				15:08						16:50						18:25							20:43						22:41
Wilmington	15.2		13:31			14:31				15:31		16:31					17:26	18:01	18:31	18:35		19:06		19:41		20:46			21:46			22:51	
Anderson	12.7	13:19	13:35		14:31	14:35	14:54		15:31	15:35	16:29	16:35	16:55	17:00	17:05	17:21	17:30	18:05	18:35	18:40	18:51	19:10	19:23	19:45	20:24	20:50		21:19	21:50	22:14	22:21	22:55	
Winchester	7.8		13:42			14:42				15:42		16:42					17:37	18:12		18:47		19:17		19:52		20:57			21:57			23:02	
Wedgemere	7.3		13:44			14:44				15:44		16:44					17:39	18:14		18:49		19:19		19:54		20:59			21:59			23:04	
West Medford	5.5		13:48			14:48				15:48		16:48					17:43	18:19		18:53		19:23		19:58		21:03			22:03			23:08	
North Station	0.0	13:38	13:59	14:07	14:50	14:59	15:15	15:31	15:50	15:59	16:46	16:59	17:15	17:27	17:32	17:40	17:56	18:31	18:55	19:05	19:10	19:36	19:42	20:09	20:43	21:14	21:26	21:38	22:14	22:35	22:40	23:20	23:24

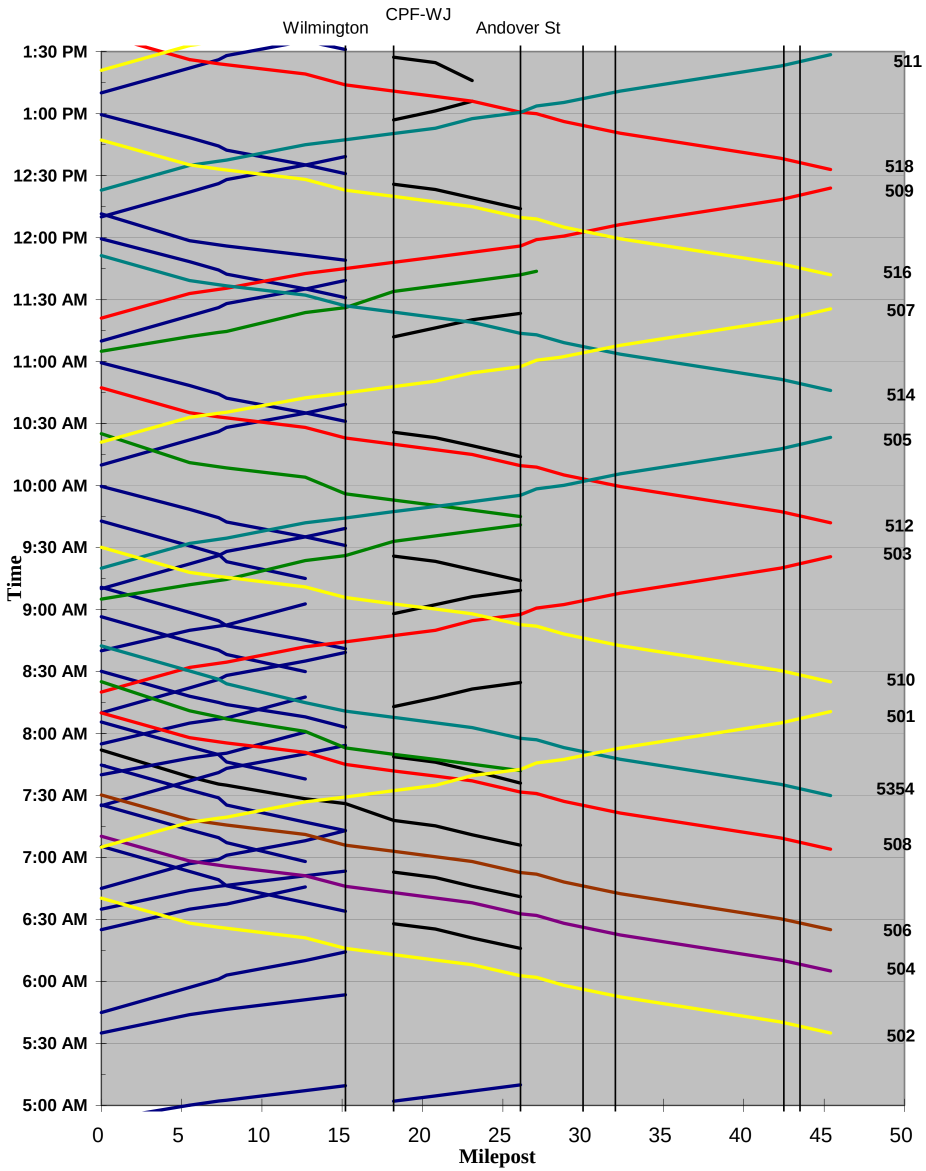
Outbound Service

STATION	MP	301	351	305	501	307	205	353	355	309	503	209	357	681	311	505	315	507	213	683	317	509	319	215	511	321	217	513	323	515	223	325	517	519
Cycle		B	B	B	N	B	A	B	B	B	D	A	B	E	B	M	B	N	A	E	B	D	B	A	M	B	A	N	B	D	A	B	M	N
North Station	0	5:45	6:25	6:45	7:05	7:25	7:39	7:40	7:55	8:10	8:20	8:20	8:40	9:05	9:10	9:20	10:10	10:21	10:35	11:05	11:10	11:21	12:10	12:20	12:23	13:10	13:20	13:21	14:10	14:20	15:00	15:10	15:20	16:30
West Medford	5.5	5:57		6:57		7:37				8:22					9:22		10:22				11:22		12:22			13:22			14:22			15:22		
Wedgemere	7.3	6:01				7:41				8:26					9:26		10:26				11:26		12:26			13:26			14:26			15:26		
Winchester	7.8	6:03		7:01		7:43				8:28					9:28		10:28				11:28		12:28			13:28			14:28			15:28		
Anderson	12.7	6:10	6:45	7:08	7:26	7:50		8:00	8:17	8:35	8:41		9:02	9:23	9:35	9:41	10:35	10:42		11:23	11:35	11:42	12:35		12:44	13:35		13:42	14:35	14:41		15:35	15:41	16:51
Wilmington	15.2	6:14		7:13		7:54				8:39					9:39		10:39				11:39		12:39			13:39			14:39			15:39		
Ballardvale	20.8						8:17					9:02							11:16					13:01			14:01				15:41			
Andover	23.1				7:39		8:21				8:54	9:06						10:54	11:20					13:06	12:57		14:06	13:54		14:54	15:46		15:54	17:03
Lawrence	27.1				7:45						9:00					9:58		11:00				11:59			13:03			14:00		15:00			16:00	17:09
Methuen	28.8				7:47						9:02					10:00		11:02				12:00			13:05			14:02		15:02			16:02	17:11
Salem	32.3				7:52						9:07					10:05		11:07				12:06			13:10			14:07		15:07			16:07	17:16
Derry	42.3				8:05						9:20					10:17		11:20				12:18			13:23			14:20		15:20			16:20	17:29
Londonderry	45.4				8:10						9:25					10:23		11:25				12:23			13:28			14:25		15:25			16:25	17:34

Outbound Service

STATION	MP	327	359	329	227	685	521	331	231	333	523	335	233	525	235	687	337	527	237	529	339	531	341	239	533	343	535	243	345	537	689	347	245
Cycle		B	B	B	A	E	D	B	A	B	L	B	A	M	A	E	B	K	A	N	B	D	B	A	M	B	N	A	B	D	E	B	A
North Station	0	16:10	16:20	16:40	16:45	17:00	17:05	17:10	17:15	17:30	17:40	17:50	17:52	18:10	18:15	18:20	18:25	18:40	18:55	19:10	19:30	20:10	20:30	20:34	21:10	21:40	22:10	22:35	22:40	23:10	23:20	0:10	0:10
West Medford	5.5	16:23	16:32	16:53				17:23				18:03					18:37		19:06		19:42		20:42			21:52			22:52			0:22	
Wedgemere	7.3	16:27	16:36	16:57				17:27				18:07					18:41		19:10		19:46		20:46			21:56			22:56			0:26	
Winchester	7.8	16:30	16:38	17:00				17:30				18:10					18:44		19:12		19:47		20:48			21:58			22:58			0:28	
Anderson	12.7	16:38	16:45	17:08		17:18	17:27	17:38		17:50	18:01	18:18		18:31		18:38	18:52	19:02	19:19	19:31	19:55	20:31	20:55		21:31	22:05	22:31		23:05	23:31	23:38	0:35	
Wilmington	15.2	16:43		17:13				17:43		17:54		18:23					18:57		19:23		20:00		21:00			22:10			23:09			0:39	
Ballardvale	20.8				17:08				17:56				18:36		19:00				19:34					21:16				23:16					0:51
Andover	23.1				17:14		17:40		18:02		18:14		18:42	18:47	19:04			19:15	19:38	19:43		20:44		21:20	21:44		22:44	23:20		23:44			0:55
Lawrence	27.1						17:46				18:20			18:53				19:21		19:49		20:50			21:50		22:50			23:50			
Methuen	28.8						17:48				18:22			18:55				19:22		19:51		20:52			21:52		22:52			23:52			
Salem	32.3						17:53				18:27			19:01				19:28		19:56		20:57			21:57		22:57			23:57			
Derry	42.3						18:06				18:40			19:13				19:40		20:09		21:10			22:10		23:10			0:10			
Londonderry	45.4						18:11				18:45			19:18				19:46		20:14		21:15			22:15		23:15			0:15			

ERB Stringlines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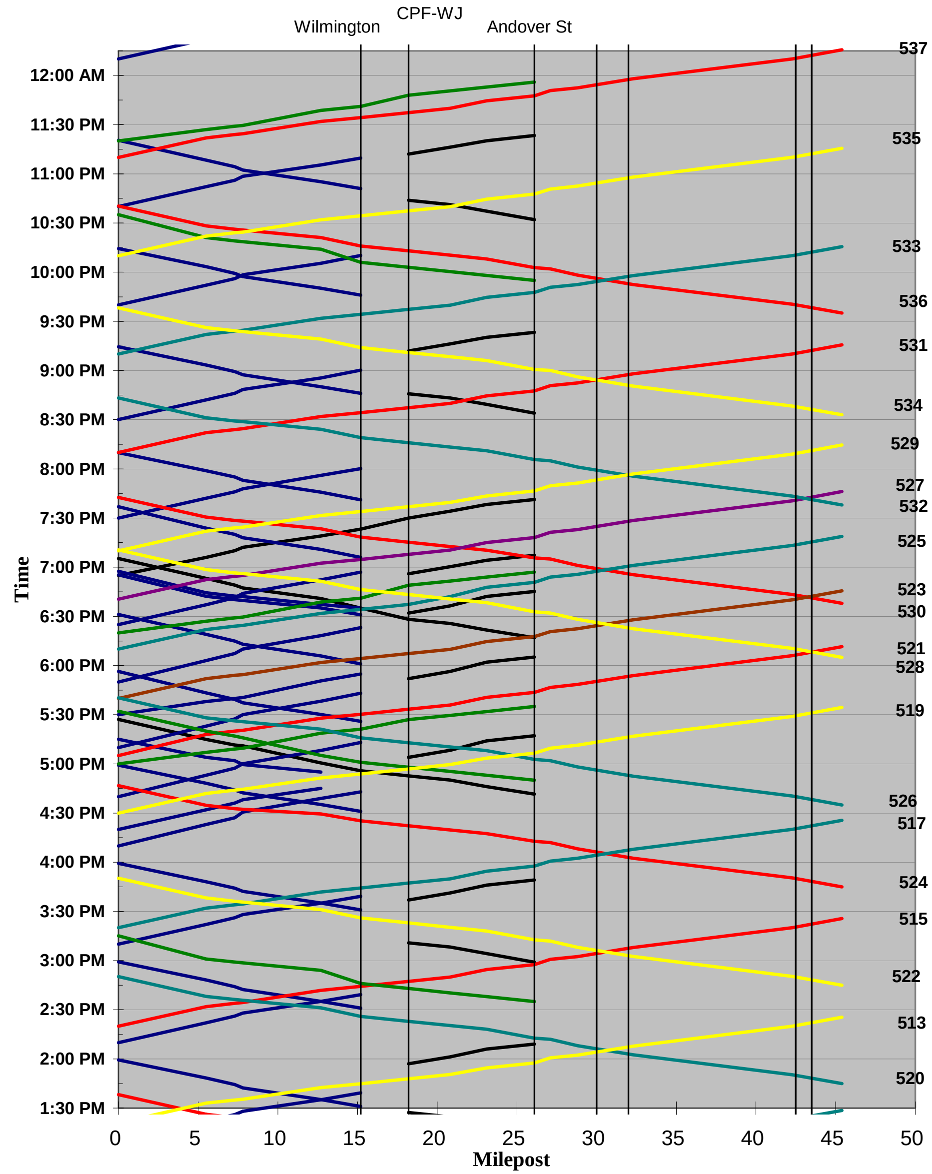
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ERA Schedules (Anderson connections longer than five minutes are highlighted)

Inbound Service

STATION	MP	5302	202	5304	304	204	352	206	5306	208	5308	308	680	310	212	354	5356	312	358	5314	214	682	5316	218	5318
Cycle		D	A	K	B	A	B	A	L	A	M	B	E	B	A	B	D	B	B	L	A	E	D	A	L
Londonderry	45.4	5:08		5:44					6:31		6:51						7:44			8:42			9:42		10:48
Derry	42.3	5:13		5:49					6:36		6:56						7:49			8:47			9:47		10:53
Salem	32.3	5:25		6:01					6:48		7:08						8:01			8:59			9:59		11:05
Methuen	28.6	5:31		6:07					6:54		7:14						8:07			9:05			10:05		11:11
Lawrence	27.1	5:34		6:10					6:57		7:17						8:10			9:08			10:08		11:14
Andover	23.1		5:47			6:21		6:46		7:11					7:42						9:19			10:19	
Ballardvale	20.8		5:51			6:25		6:50		7:15					7:46						9:23			10:23	
Wilmington	15.2				6:34					7:22				8:03											
Arrive Anderson	12.7	5:50		6:26					7:13		7:33		8:01				8:26			9:24		10:04	10:24		11:30
Depart Anderson	12.7	5:55			6:38		6:58		7:18			7:38	8:01	8:08		8:15	8:31	8:45	9:15	9:35		10:04	10:35		11:35
Winchester	7.8	6:02			6:46		7:07		7:26		7:39	7:46				8:24	8:39	8:52	9:23	9:42			10:42		11:42
Wedgemere	7.3	6:04			6:49		7:09		7:29		7:41	7:49				8:26	8:41	8:54	9:26	9:44			10:44		11:44
West Medford	5.5	6:08			6:53		7:13		7:33		7:45	7:53				8:30	8:45	8:58	9:30	9:48			10:48		11:48
North Station	0	6:22	6:35	6:45	7:05	7:10	7:25	7:39	7:45	7:52	7:58	8:05	8:25	8:30	8:36	8:42	8:57	9:10	9:42	9:59	10:06	10:25	10:59	11:07	11:59

Inbound Service

STATION	MP	5320	220	5322	222	5324	684	226	5326	5328	360	232	686	330	5334	5336	236	338	5340	5342	238	688	5344	5346	244
Cycle		D	A	L	A	D	E	A	L	D	B	A	E	B	L	D	A	B	K	D	A	E	K	D	A
Londonderry	45.4	11:42		12:41		13:48			14:48	15:48					17:18	17:47			18:57	20:02			21:03	22:00	
Derry	42.3	11:47		12:46		13:53			14:53	15:53					17:23	17:52			19:02	20:07			21:08	22:05	
Salem	32.3	11:59		12:58		14:05			15:05	16:05					17:35	18:04			19:14	20:19			21:20	22:17	
Methuen	28.6	12:05		13:04		14:11			15:11	16:11					17:41				19:20	20:25			21:26	22:23	
Lawrence	27.1	12:08		13:07		14:14			15:14	16:14					17:44				19:23	20:28			21:29	22:26	
Andover	23.1		12:19		13:16			15:04				16:46					18:21				20:39				22:37
Ballardvale	20.8		12:23		13:24			15:08				16:50					18:25				20:43				22:41
Wilmington	15.2																18:35	19:06							
Arrive Anderson	12.7	12:24		13:23		14:30	14:53		15:30	16:30		17:01	17:09		18:00	18:27	18:40	19:10	19:40	20:44		22:14	21:45	22:42	
Depart Anderson	12.7	12:35		13:35		14:35	14:53		15:35	16:35	16:55	17:01	17:09	17:30	18:05	18:35	18:40	19:10	19:45	20:50		22:14	21:50	22:55	
Winchester	7.8	12:42		13:42		14:42			15:42	16:42				17:37	18:12		18:47	19:17	19:52	20:57			21:57	23:02	
Wedgemere	7.3	12:44		13:44		14:43			15:43	16:43				17:39	18:14		18:49	19:19	19:54	20:59			21:59	23:04	
West Medford	5.5	12:48		13:48		14:48			15:48	16:48				17:43	18:17		18:53	19:23	19:58	21:03			22:03	23:08	
North Station	0	12:59	13:07	13:59	17:07	14:59	15:14	15:31	15:59	16:59	17:15	17:27	17:35	17:56	18:30	18:55	19:05	19:36	20:09	21:14	21:26	22:35	22:14	23:20	23:24

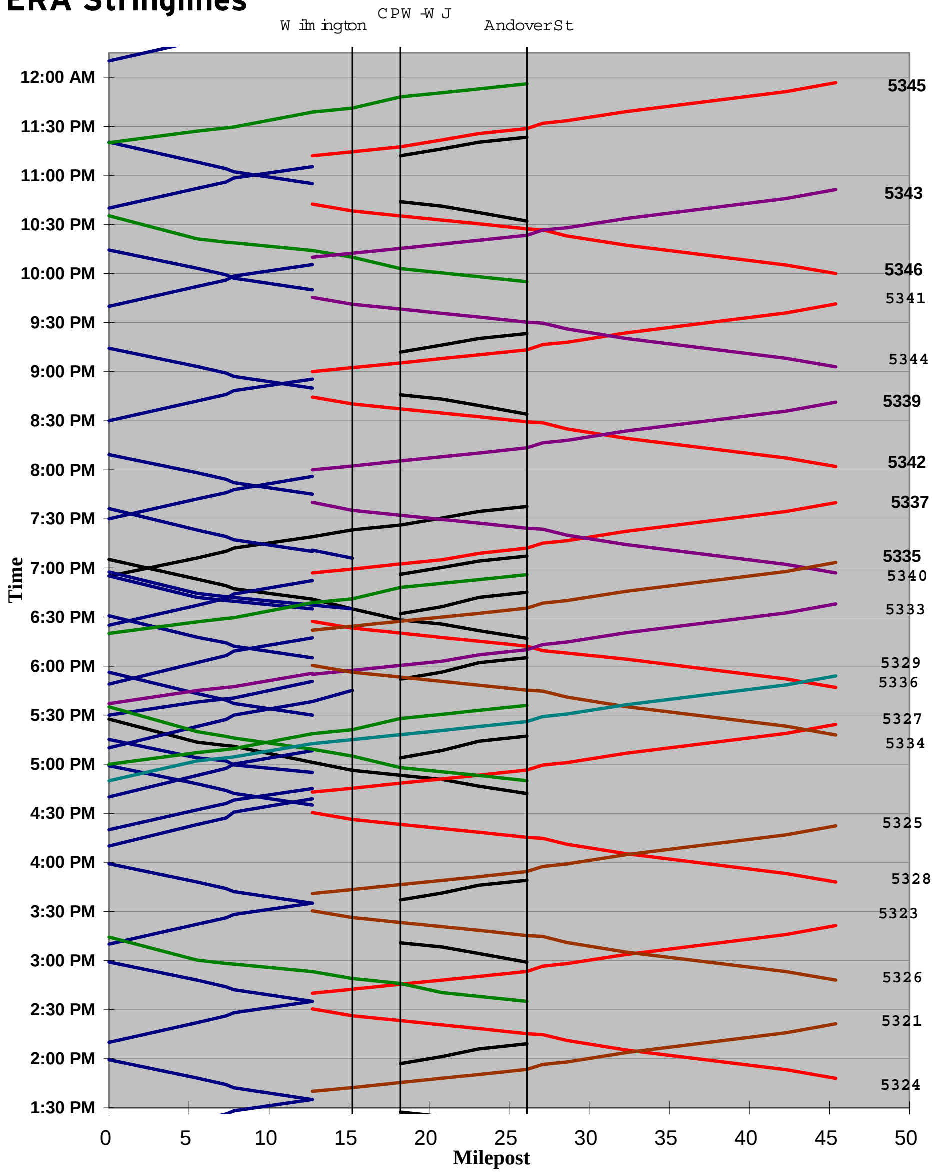
Outbound Service

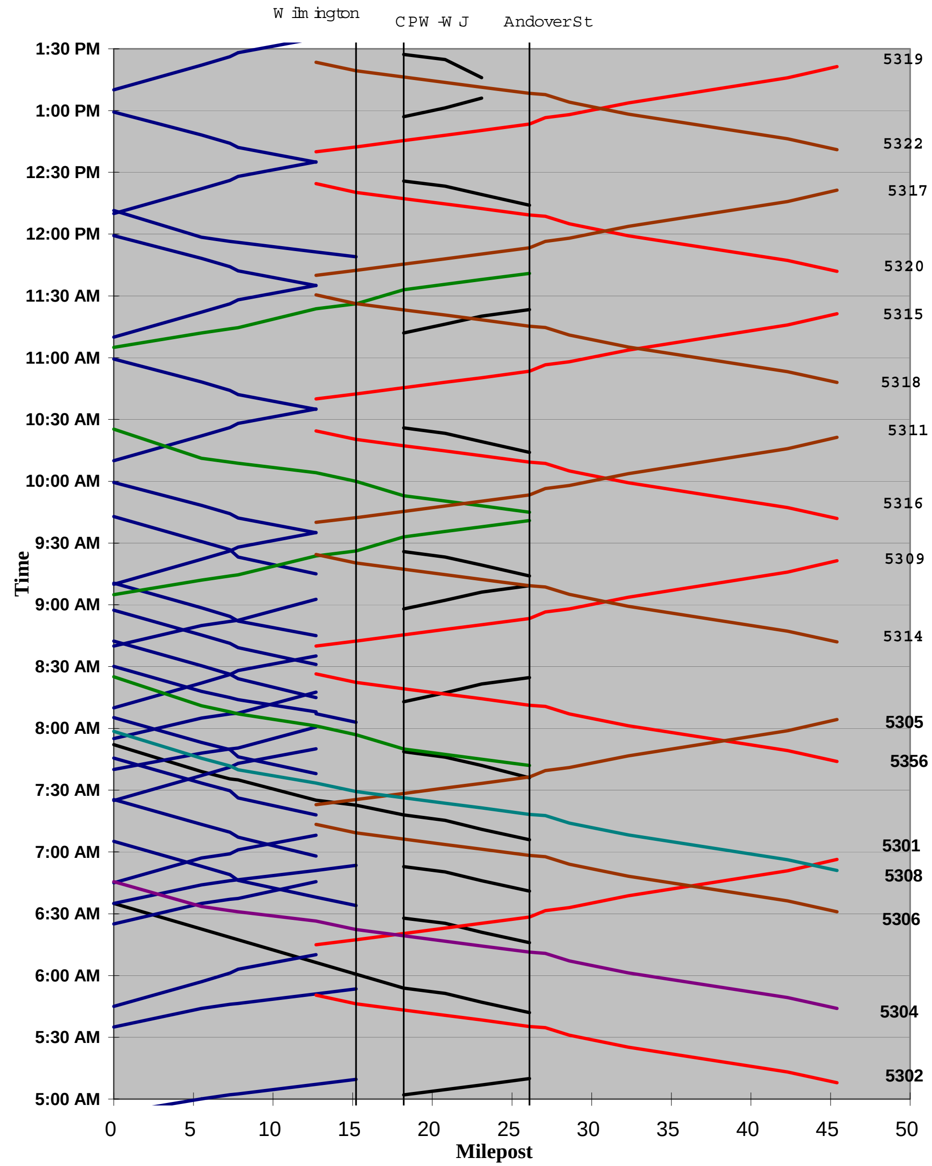
STATION	MP	5301	351	5305	307	205	353	355	5309	209	357	681	5311	5315	213	683	5317	5319	215	5321	217	5323	223	5325	5327
Cycle		D	B	L	B	A	B	B	D	A	B	E	L	D	A	E	L	D	A	L	A	D	A	L	D
North Station	0	5:45	6:25	6:45	7:25	7:39	7:40	7:55	8:10	8:20	8:40	9:05	9:10	10:10	10:35	11:05	11:10	12:10	12:20	13:10	13:20	14:10	15:00	15:10	16:10
West Medford	5.5	5:57		6:57	7:37				8:22				9:22	10:22			11:22	12:22		13:22		14:22		15:22	16:23
Wedgemere	7.3	6:01			7:41				8:26				9:26	10:26			11:26	12:26		13:26		14:26		15:26	16:27
Winchester	7.8	6:03		7:01	7:43				8:28				9:28	10:28			11:28	12:28		13:28		14:28		15:28	16:30
Arrive Anderson	12.7	6:10	6:45	7:08	7:50		8:00	8:17	8:35		9:02	9:23	9:35	10:35		11:23	11:35	12:35		13:35		14:35		15:35	16:38
Depart Anderson	12.7	6:15		7:23					8:40			9:23	9:40	10:40		11:23	11:40	12:40		13:40		14:40		15:41	16:43
Wilmington	15.2																								
Ballardvale	20.8					8:17				9:02					11:16				13:01		14:01		15:41		
Andover	23.1					8:21				9:06					11:20				13:06		14:06		15:46		
Lawrence	27.1	6:31		7:39					8:56				9:56	10:56			11:56	12:56		13:56		14:56		15:57	16:59
Methuen	28.6	6:33		7:41					8:58				9:58	10:58			11:58	12:58		13:58		14:58		15:59	17:01
Salem	32.3	6:38		7:46					9:03				10:03	11:03			12:03	13:03		14:03		15:03		16:04	17:06
Derry	42.3	6:50		7:58					9:15				10:15	11:15			12:15	13:15		14:15		15:15		16:16	17:18
Londonderry	45.4	6:56		8:04					9:21				10:21	11:21			12:21	13:21		14:21		15:21		16:22	17:24

Outbound Service

STATION	MP	359	329	5329	227	685	331	231	333	5333	5335	233	235	687	5337	237	5339	5341	239	5343	5345	689	243	347	245
Cycle		B	B	M	A	E	B	A	B	K	L	A	A	E	D	A	K	D	A	K	D	E	A	B	A
North Station	0	16:20	16:40	16:50	16:45	17:00	17:10	17:15	17:30	17:37	17:49	17:52	18:15	18:20	18:25	18:55	19:30	20:30	20:34	21:40	22:40	23:20	22:35	0:10	0:10
West Medford	5.5	16:32	16:53				17:23				18:02				18:37	19:06	19:42	20:42		21:52	22:52			0:22	
Wedgemere	7.3	16:36	16:57				17:27				18:06				18:41	19:10	19:46	20:46		21:56	22:56			0:26	
Winchester	7.8	16:38	17:00				17:30				18:09				18:44	19:12	19:47	20:48		21:58	22:58			0:28	
Arrive Anderson	12.7	16:45	17:08	17:12		17:18	17:38		17:50	17:55	18:17			18:38	18:52	19:19	19:55	20:55		22:05	23:05	23:38		0:35	
Depart Anderson	12.7					17:18					18:22			18:38	18:57	19:19	20:00	21:00		22:10	23:12	23:38			
Wilmington	15.2						17:45									19:23									
Ballardvale	20.8				17:08			17:56				18:36	19:00			19:30			21:16		23:21		23:16		0:51
Andover	23.1				17:14			18:02		18:06		18:42	19:04		19:08	19:34			21:20		23:25		23:20		0:55
Lawrence	27.1			17:29						18:13	18:38				19:15		20:16	21:16		22:26	23:31				
Methuen	28.6			17:30						18:14	18:40				19:16		20:18	21:18		22:28	23:33				
Salem	32.3			17:36						18:20	18:45				19:22		20:23	21:23		22:33	23:39				
Derry	42.3			17:48						18:32	18:57				19:34		20:35	21:35		22:45	23:51				
Londonderry	45.4			17:54						18:38	19:03				19:40		20:41	21:41		22:51	23:56				

ERA Stringlines





Date **September 24, 2007**

To David Nelson

From Tara Blakey

Subject NH I-93 Transit Investment: Developing Preliminary Alternatives

cc: Dennis Coffey, John Weston, Ken Kinney

The Record of Decision (ROD) for New Hampshire's I-93, Salem to Manchester, project includes a commitment to a Transit Investment Study for the corridor. Review of the ROD revealed the requirements of the Transit Investment Study to be evaluation of the long term rail and transit needs for the corridor and consideration of a rail station at the Manchester Airport.

Eight preliminary alternatives are being developed for the Transit Investment Study. This memo includes a rough description of each preliminary alternative, and a list of information needed for further development of the alternatives.

Rail Alternatives

Two rail alignments and four rail alternatives will be evaluated:

- Using the Manchester and Lawrence (M&L)
  - To Boston
  - To Anderson Transportation Center
- Within the Transit Reservation (I93 median)
  - To Boston
  - To Anderson Transportation Center

The only historic rail alignment connecting the study corridor with downtown Manchester was the M&L. Extension of the Manchester Airport's east-west runway, however, was developed over the M&L right of way so that there is no longer an uninterrupted rail route from the study corridor to Manchester. For this reason, it was assumed that the origin for all rail alternatives would be in the vicinity of Exit 5 on I-93 in New Hampshire.

To be in accordance with the ROD it will be necessary to evaluate a rail station at the Manchester Airport, two and a half miles east of Exit 5. In this case, the Airport station would be the origin of rail service. It is expected that a large capital investment would be necessary for convenient airport access by rail since the airport's 1,500 foot wide runway lies between the truncated M&L and the concourses.

Both alignments will use the M&L to access the MBTA commuter rail network in Massachusetts. The services will operate on the MBTA's Haverill Line, Wildcat Branch, and Lowell line for access to Boston or the Anderson Transportation Center. Besides New Hampshire stations, station stops would be implemented in Methuen and Lawrence to compensate for the impacts of rail restoration in these communities. All new trains would call on Anderson. Trains may also make stops in Andover and on the Lowell line as indicated to facilitate service integration.

Table 1: Preliminary Rail Transit Alternatives

Alternative	Stations	Route		Service
ER1 Rail to Boston on M&L	Online Stations : Exit 5, Derry, Rockingham Park, Methuen, Lawrence,	NH I-93 Exit 5 – Lawrence	M&L	Each train would stop at all M&L stations and some existing stations en route to Anderson.
		Lawrence – Wilmington Jct	Haverhill Line	
		Wilmington Jct - Wilmington	Wildcat Branch	
		Wilmington - Boston	Lowell Line	
ER2 Rail to Anderson Transportation Center on M&L	Online Stations : Exit 5, Derry, Rockingham Park, Methuen, Lawrence,	NH I-93 Exit 5 – Lawrence	M&L	Each train would stop at all M&L stations and some existing stations en route to Anderson. At Anderson, travelers would be offered convenient transfers to Boston rail service and to bus shuttles to nearby employment sites.
		Lawrence – Wilmington Jct	Haverhill Line	
		Wilmington Jct - Wilmington	Wildcat Branch	
		Wilmington – Anderson RTC	Lowell Line	
HR1 Rail to Boston in Transit Reservation	Online Stations : Exit 5, Exit 4, Exit 3, Exit 2, Methuen, Lawrence,	NH I-93 Exit 5 – Exit 1	NH I93 transit reservation	Each train would stop at all M&L stations and some existing stations en route to Anderson.
		Exit 1 – Lawrence	M&L	
		Lawrence – Wilmington Jct	Haverhill Line	
		Wilmington Jct - Wilmington	Wildcat Branch	
		Wilmington - Boston	Lowell Line	
HR2 Rail to Anderson Transportation Center in Transit Reservation	Online Stations : Exit 5, Exit 4, Exit 3, Exit 2, Methuen, Lawrence,	NH I-93 Exit 5 – Exit 1	NH I93 transit reservation	Each train would stop at all M&L stations and some existing stations en route to Anderson. At Anderson, travelers would be offered convenient transfers to Boston rail service and to bus shuttles to nearby employment sites.
		Exit 1 – Lawrence	M&L	
		Lawrence – Wilmington Jct	Haverhill Line	
		Wilmington Jct - Wilmington	Wildcat Branch	
		Wilmington – Anderson RTC	Lowell Line	

As defined in the New Hampshire DOT I-93 Improvements Manchester-Salem Rail Design Guidelines, the transit reservation is being designed for light rail operations. Assuming the Rail Design Guidelines can be revisited, the rail alternatives described above would employ conventional commuter rail network rollingstock for the following reasons:

- 50 mph maximum light rail speeds are not competitive with auto travel, and
- light rail vehicles are not compatible with the regional rail network (for one seat ride to Boston).

To ensure that conventional commuter rail equipment can be integrated into the transit reservation, a review of the reservation's curvature and gradients would be necessary to determine if 80 mph maximum allowable speeds could be achieved in the highway median.

Information Needed for Further Development

– Curvature and gradient along the planned transit reservation

Bus Alternatives

Two bus alignments and four bus alternatives will be evaluated:

- Within I-93 HOV Lanes and Shoulders
  - To Boston
  - To Anderson Transportation Center
- Within the Transit Reservation (I93 median)
  - To Boston
  - To Anderson Transportation Center

Bus service within the HOV lanes and shoulders would pick-up and drop-off passengers at offline stations including Granite Street in Manchester and at the Park & Ride lots at I-93 exits 5, 4, 3, and 2 in New Hampshire. Since travel times increase significantly with each offline station served (time to exit and return to I-93), it was assumed that each bus would serve only one station and would travel directly between that Park & Ride station and Boston (or Anderson). The bus serving the Manchester station would use I-293 to travel between Manchester and I-93. Once on I-93 buses would travel in the planned HOV lane in New Hampshire. South of the New Hampshire – Massachusetts state line, buses would travel in the highway shoulder to avoid congestion in the general purpose lanes. For service to Boston, buses would enter Massachusetts's HOV lane near exit 30.

Bus service within the transit reservation would originate in Manchester and use I-293 to travel between Manchester and I-93. Buses would enter the transit reservation once on I-93, north of Exit 5. Stations (at exits 5, 4, 3, and 2) would be located within the transit reservation so that vertical passenger circulation (similar to that required for the HR alternatives) would be necessary for station access from Park & Ride lots. Since buses would not need to exit I-93 to pick-up passengers, each bus could serve every station without unacceptable increases in travel time. South of the New Hampshire – Massachusetts state line, buses would travel in the highway shoulder to avoid congestion in the general purpose lanes. For service to Boston, buses would enter Massachusetts's HOV lane near exit 30.

Table 2: Preliminary Bus Transit Alternatives

Alternative	Stations	Route		Service
HB1 Bus to Boston in HOV	Offline Stations : Manchester, Exit 5, Exit 4, Exit 3, Exit 2	Manchester - I-93	293 GP lane	Each bus would serve one offline Park & Ride station before expressing to Boston. For off-peak service, buses may serve more than one station.
		293 - I93 NH Exit 5	I93 GP lane	
		Exit 5 - NH/MA State Border	NH I-93 HOV lane	
		NH/MA State Border – MA Exit 30	MA I93 shoulder	
		MA Exit 30 - Boston	MA I93 HOV lane	
HB2 Bus to Boston in Transit Reservation	Offline stations : Manchester Online stations : Exit 5, Exit 4, Exit 3, Exit 2	Manchester - I-93	293 general purpose (GP) lane	Each bus would begin in Manchester and stop at each online station en route to Boston.
		293 - I93 NH Exit 5	I93 GP lane	
		NH Exit 5 – NH/MA State Border	NH I93 transit reservation	
		NH/MA State Border – MA Exit 30	MA I93 shoulder	
		MA Exit 30 - Boston	MA I93 HOV lane	
HB3 Bus to Anderson Transportation Center in HOV	Offline Stations : Manchester, Exit 5, Exit 4, Exit 3, Exit 2	Manchester - I-93	293 GP lane	Each bus would serve one Park & Ride station before expressing to the Anderson RTC. For off-peak service, buses may serve more than one station. At Anderson, travelers would be offered convenient transfers to Boston rail service and to bus shuttles to nearby employment sites.
		293 - I93 NH Exit 5	I93 GP lane	
		293 - I93 NH Exit 5	I93 GP lane	
		Exit 5 - NH/MA State Border	NH I-93 HOV lane	
		NH/MA State Border – Anderson RTC	MA I93 shoulder	
HB4 Bus to Anderson Transportation Center in Transit Reservation	Offline stations : Manchester Online stations : Exit 5, Exit 4, Exit 3, Exit 2	Manchester - I-93	293 GP	Each bus would begin in Manchester and stop at each online station en route to Anderson. At Anderson, travelers would be offered convenient transfers to Boston rail service and to bus shuttles to nearby employment sites.
		293 - I93 NH Exit 5	I93 GP lane	
		NH Exit 5 – NH/MA State Border	NH I93 transit reservation	
		NH/MA State Border – Anderson RTC	MA I93 shoulder	

Shoulder operations have been reviewed with some Massachusetts officials with agreement that there are no physical obstacles to bus shoulder by-pass operations along the Massachusetts portion of the route and a willingness to explore possible bus shoulder operations along I-93. Private bus operators have not yet had the opportunity to offer opinions on shoulder operation options.

It may be possible to reduce running times by operating buses in the shoulder on I-293 and on I-93 north of the transit reservation or HOV lane.

New Hampshire's plans for an HOV lane on I-93 remain uncertain. Shoulder running would be a viable alternative to HOV operations if New Hampshire does not decide to construct a HOV lane. Depending on future congestion levels, buses operating in the shoulder may not be significantly slower than buses operating in HOV lanes.

Information Needed for Further Development

- Buses to operate on shoulder of I-293 and I-93 north of exit 5?
- Assume a HOV lane for 2030 operations?

Hours of Service

It is proposed that, where possible, services would operate with:

- Peak service frequency of 30 minutes
- Weekday offpeak service frequency of 60 minutes
- Saturday service frequency of 90 minutes.
- Sunday service frequency of 180 minutes.

See Table 3 for conceptual hours of operation by day type.

Table 3
Conceptual Service Schedules

Weekdays	
Arrivals in Boston	Departures from Boston
6:45 AM	7:00 AM
7:15 AM	8:00 AM
7:45 AM	9:00 AM
8:15 AM	10:00 AM
8:45 AM	11:00 AM
9:45 AM	12:00 PM
10:45 AM	1:00 PM
11:45 AM	2:00 PM
12:45 PM	3:00 PM
1:45 PM	4:00 PM
2:45 PM	4:30 PM
3:45 PM	5:00 PM
4:45 PM	5:30 PM
5:45 PM	6:00 PM
6:45 PM	7:00 PM
7:45 PM	8:00 PM
8:45 PM	9:00 PM
9:45 PM	10:00 PM
10:45 PM	11:00 PM
Daily RTs =	19

Saturdays	
Arrivals in Boston	Departures from Boston
7:45 AM	8:00 AM
9:15 AM	9:30 AM
10:45 AM	11:00 AM
12:15 PM	12:30 PM
1:45 PM	2:00 PM
3:15 PM	3:30 PM
4:45 PM	5:00 PM
6:15 PM	6:30 PM
7:45 PM	8:00 PM
9:15 PM	9:30 PM
10:45 PM	11:30 PM
Daily RTs =	11

Sundays and Holidays	
Arrivals in Boston	Departures from Boston
7:45 AM	8:00 AM
10:45 AM	11:00 AM
1:45 PM	2:00 PM
4:45 PM	5:00 PM
7:45 PM	8:00 PM
10:45 PM	11:00 PM
Daily RTs =	6

Evaluation

The study team will recommend four to six of the eight preliminary alternatives for further study so that evaluation resources can be focused on the most attractive alternatives. The recommendation will be based on an evaluation of:

- Order of Magnitude Costs
- Travel Times
- Service Headways

APPENDIX D
MANCHESTER AIRPORT EXTENSION ALTERNATIVE

Manchester/Airport Extension Alternative

The Manchester/Airport Extension Alternative incorporated all the same assumptions service plans as the M&L Alternative with the addition of two stations. These include a station at the Manchester-Boston Regional Airport and one in downtown Manchester. All other service parameters remained unchanged.

Airport Passenger Transit Ridership Model

The travel demand model developed to support the analysis of transit service alternatives is a typical "four-step" travel demand forecast model, which predicts trip generation, trip distribution, trip mode choice, and trip assignment for "typical weekday" travel. The model does not forecast travel demand associated with special generators such as airports. The trips associated with airport travel are different than typical weekday travel in their generation, timing, distribution and mode choice due to the constraints associated with the limited number of airport locations, airline schedules, baggage, and other factors.

The extension of the M&L to Manchester and the Airport required development of a model for the Manchester-Boston Regional Airport "special generator". While the corridor model captures the effect of this airport station location on workers traveling to and from airport work destinations, as well as workers using the airport station to commute to other locations in the corridor, it was necessary to develop a separate "off-model" approach to forecasting the use of the airport station by airport travelers.

A simplified version of the four-step approach was implemented in a spreadsheet. The trip generation was based on estimates of year 2000 daily trips associated with the Manchester airport provided by the Southern New Hampshire Planning Commission, and on an assumed annual growth rate of 2.8% provided by the Manchester Airport. SNHPC assumes approximately 13,300 daily airport passenger trips in 2000, which increase to 30,500 daily airport trips in 2030. It was then determined how many of those daily airport passenger trips could be served by the proposed rail service (identified as possible transit trips). This was done through an analysis of airport passenger travel time of day and the travel origins and destinations (within New England) of airport passengers. Airport passenger time of day analysis was based on the airport arrival and departure information included in Figure 1.

From the identification of the Possible Transit Trips, an assumed transit "mode share" was identified that is typical of airport passengers. The assumed transit mode share of 1% to 2% was based on a review of mode shares observed at other US airports with comparable transit services.

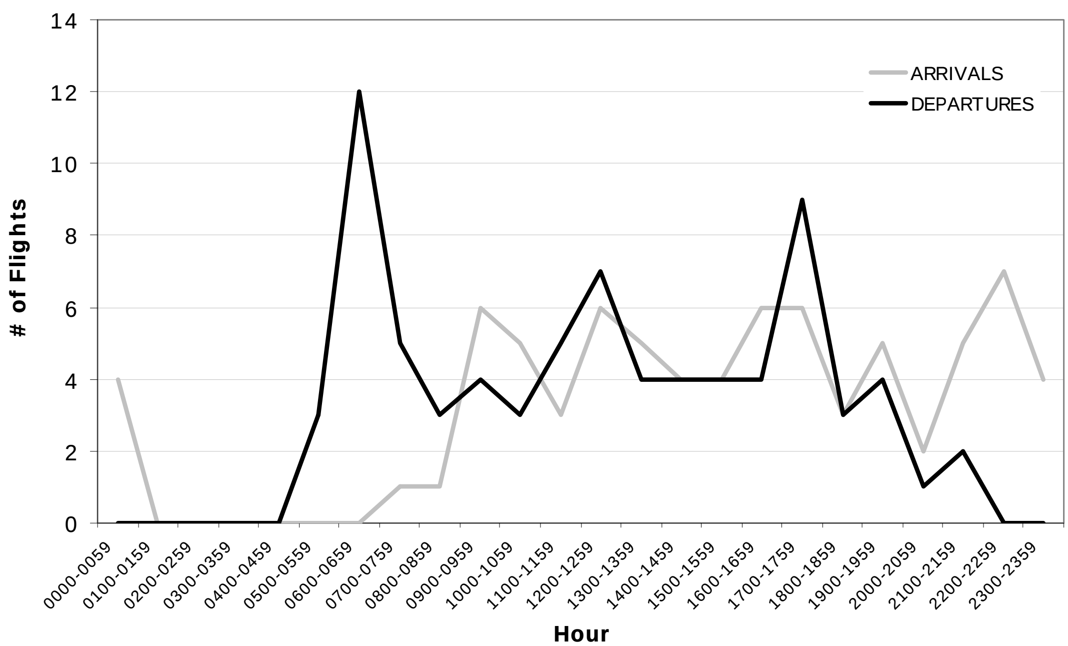
Table 1 shows the result of this analysis, with a forecast of 170-330 air passenger trips in 2030 to and from the Manchester-Boston Regional Airport using the proposed rail transit services.

Table 4. Manchester Air Passenger Trips Using Transit

	Total Trips	Possible Transit	Transit Trips
Year 2030 Daily Trips	30,500	17,000	170-330

The estimated airport passenger transit ridership is based on the existing distribution of ground access trips that are currently experienced at the airport. It is highly likely that with the implementation of rail service, the volumes of airport passengers that would use the airport from areas that could be served by the service could increase. The extent of that increase would be determined by numerous factors including but not limited to, the draw of airlines serving Manchester-Boston vs. other nearby airports (namely Boston's Logan International), ease of access to the airports within the region, and the potential for travel packages to utilize the rail service for travel bookings. Due to the variability of future conditions that could be experienced at the Manchester-Boston the ridership estimates were based on the existing conditions and did not take into account the potential market changes at the airport.

Figure 1. Manchester-Boston Regional Airport Flight Arrival and Departure Distribution



Source: Manchester Airport Authority

APPENDIX E
LAND USE

I-93 Transit Investment Study: A National Review of Transit Supportive Land Use Practices and an Analysis of New Hampshire and Massachusetts Land Use Regulations

August 10, 2007

Introduction

This technical memorandum summarizes our review and assessment of the zoning ordinances and, where applicable, comprehensive plans for New Hampshire and Massachusetts towns and cities in the I-93 Transit Investment Study Area. It does not address other ordinances. Its primary purpose is to assess whether the existing regulations and strategies promote or impede opportunities to support future transit systems through the implementation of various transit-related land use policies and strategies.

This memo is organized in two sections. The first is broken into nine subsections, each of which describes the role of a specific zoning and / or land use planning technique in implementing transit-supportive land use strategies. This includes a discussion of such approaches as station area zoning, density, mix of uses, and parking standards. Within each subsection is a summary of successful national models, based on our knowledge and research of transit-oriented development (TOD) zoning strategies and techniques, and general best practices. The second section assesses the degree to which each jurisdiction's zoning ordinances utilize these strategies and, as appropriate, identifies opportunities to facilitate transit-oriented development.

National Review of Land Use Planning Techniques and Strategies

1. Station Area Zoning

The first, fundamental step towards facilitating transit-supportive land use is to ensure that zoning ordinances allow the creation of zones with land uses and densities that make possible the implementation of TODs. Zoning codes can achieve this through a variety of methods that generally fall into three principal categories: Euclidean base zoning, an overlay zone, or a floating zone.

Euclidean, or traditional, zoning separates land uses and usually contains explicit regulations such as bulk and height controls. Development projects that meet all regulations may be developed as-of-right.

Overlay zones, by contrast, are created to control land use for a purpose that does not coincide with existing zoning; these could include protecting the environment or preserving historic sites. The overlay zone, as its name implies, is placed on the zoning map over a base Euclidean zone. The overlay modifies, eliminates and / or adds regulations to the base zone. Land within the overlay is subject to the rules both of the overlay and the base zone. Overlays effectively provide land use control without increasing the complexity of existing regulations.

Floating zones contain criteria establishing the location of the zoning district, but the zone is not mapped until an application for development that fulfills all of the regulations is approved. This approach allows jurisdictions to avoid a mapping controversy until specific projects are submitted. This approach also provides time for the developer or TOD proponents to conduct community outreach and build support for the proposed project.

Some jurisdictions have found that generic overlays are too blunt a tool to facilitate the fine-grained TOD development they envisioned, and have replaced them with station-specific base zones. This approach has proven to be more effective, planners say, because it allows the jurisdiction to tailor the zoning to station areas and create market-responsive bonuses and performance standards. Finally, although an overlay district is a flexible tool, it should be mapped with some care. Noncontiguous land mapped within the same overlay district should share characteristics that qualify it for special treatment and distinguish it from other land.

Form-based zoning codes are a newly emerging technique for simplifying the development process and allowing the flexibility that helps to facilitate TODs. Form-based codes place emphasis on building form as opposed to land use, setting requirements for structure types and characteristics such as setback, building height and floor area ratio (FAR). A building is permitted anywhere within the zone regardless of use, as long as it conforms to these requirements. The intent of a form-based code is to encourage use diversity among visually compatible structures. Very few jurisdictions have chosen to use this zoning approach: California is the only state that has adopted enabling legislation.[1] Based on performance, it may become a useful tool in encouraging a diversity of uses and in alleviating developer concerns about delays in the permitting process.

National Models

Seattle, WA undertook a Station Area Planning program in 1998 to focus on future development around stations that were proposed in Sound Transit's 1999 adopted alignment. Station Area Overlay legislation was passed by the City Council in 2001. This created districts that prohibited auto-oriented uses (drive-in

[1] Tomabari, Edward A. "Smart Growth, Smart Choices Series: Mixed-Use Development," (National Association of Home Builders, January 2005).

businesses and vehicle repair facilities) and revised parking standards within a quarter-mile of proposed light rail stations to preserve future TOD opportunity areas. Overlay districts include the following characteristics:

- Residential uses at street-level are prohibited along principal pedestrian streets.
- Specific activities are excluded, including drive-in businesses and industrial uses.
- Flexible parking standards are encouraged, and design standards call for parking to be placed at the rear or side lot lines of a structure.
- Nonconforming uses cannot be expanded by more than 20 percent of the existing gross floor area of an existing use.

Portland, OR created interim development standards to prevent undesirable land uses from being developed before station area plans were enacted. In 2004, the City created Light Rail Transit Station overlay zones that contain very detailed requirements on site design and location of uses. The requirements were designed to encourage a mix of residential, commercial and employment uses within the zones.

Minneapolis, MN is currently amending its comprehensive plan to designate the areas around each of the six neighborhood stations on the Hiawatha Corridor light rail system as transit station areas. This process is occurring in two stages. The first stage establishes pedestrian overlay zones in the station areas and creates additional regulations and incentives for development in these areas. The second will result in recommendations for changes to the "primary" zoning districts.

Best Practices

- Overlay districts can be an effective interim measure to control undesired land uses and preserve TOD opportunity areas while station area plans are being completed. A base zone can replace the overlay when station area planning is completed.
- Overlay districts are effective when applying design standards or other general guidelines to areas throughout the jurisdiction, such as around station areas.
- Base zones are generally the most effective method for controlling land uses.

- A floating zone can be used to enact a TOD ordinance to avoid mapping controversies. It should contain very specific location criteria and provide the opportunity for public input during the planning process, not during rezoning or approval.

2. District Boundaries

The boundaries of TOD zones are generally defined by the distance a pedestrian is willing to walk in ten minutes. This distance is typically a quarter- to a half-mile around a transit station, although some jurisdictions have chosen TOD boundaries based on their community's unique geographic characteristics.

While many jurisdictions set boundaries on a straight-line radius from the transit station to the district edge, the distance along city streets more accurately measures "walkability" when adjoining streets are not connected, the topography is severe, or physical features intervene. In environments where bicycling is common and / or encouraged, a bicycle travelshed two miles from the transit station also would have implications for land use.

In order to achieve the greatest density of transit, employment, and retail uses, jurisdictions require the most intense development to locate adjacent to transit stations. Some jurisdictions further refine this approach by allowing medium intensity uses to locate between a quarter-mile and half-mile of the station. Such a gradation of intensity helps to mitigate the impact of the highest intensity uses on areas outside of the transit station zone and is similar to the village development pattern that is common in New Hampshire. In addition, some jurisdictions have enacted buffer zones or height planes, in which the maximum permitted building height decreases for parcels approaching the edge of the transit zone.

National Models

Lakewood, CO passed legislation in February 2007 creating Transit Mixed-Use (TMU) districts in the station areas surrounding four planned stations on the West Corridor of the new light rail line stretching from Golden, CO into downtown Denver. The TMUs are designed to encourage development that has a sufficient density of both residents and employees and appropriate mix of uses to support the light rail line. The Sheridan Boulevard Station will be approximately 90 acres, and will contain five sub-areas that allow a mixture of commercial and residential uses and an 800-space parking structure.

Best Practices

- Transit station zones are typically mapped within a quarter- to half-mile from stations.

- Some jurisdictions have created location criteria to help determine which adjacent properties could be included in the transit zone once it is mapped and rezoning requests are filed. These criteria relate to land use characteristics and conditions that are transit-supportive.

3. Mix of Uses

The creation of a mixed-use commercial core that includes residential uses is the key land use planning action in creating a transit-supportive environment. While this concept is sometimes presented as "new" by planners, it is actually a return to the traditional development patterns of New England communities. This type of development should be built within the TOD boundary at a density that supports transit. The percentage of retail, office and residential uses generally varies based on station / neighborhood types and market demand. Convenient transit that is accessible to retail, housing and employment can reduce traffic congestion during peak hours by shifting local driving trips from arterials to walking trips within the TOD. Eventually, less road capacity will be needed if the mix of uses helps to diminish peak travel demand.

Mixed uses are integral to the creation of TODs from a transit ridership, traffic management, land use efficiency and neighborhood vitality perspective. Customers are more willing to commute by transit if convenience shops and other daily supportive services (drycleaners, day care, banks) are located near stations. TODs promote balanced, bi-directional traffic flows and allow for more efficient trip consolidation. If space is divided among office, commercial and residential uses, trips can be more balanced through the day and week. This mix of uses also creates opportunities for improved land use efficiency: nighttime theatergoers and daytime office workers, for example, can share parking in the same facility. These types of purpose and spatial efficiencies can help to reduce the scale of suburban activity centers. Finally, mixed uses increase neighborhood vitality and improve the opportunities for social interaction.

Determining the type of transit station can provide a context in which to identify appropriate land uses. Regional transit stations in mature areas (such as stations in downtowns and edge cities) will serve the most users and are most suitable for high intensity employment, residential and retail uses. Developing areas designated as regional growth centers, including the areas surrounding highway interchanges, also can be zoned for high intensity uses.

Neighborhood and community stations in either mature or developing areas can serve and support low intensity commercial uses and lower residential densities. Neighborhood TODs also provide an opportunity for affordable housing because land prices in these areas generally will be less costly than more intense station areas, enabling developers to build housing units at a lower cost while meeting state and local affordable housing goals.

Regional and district TODs generally will have larger core areas (i.e., the transit station and the immediate surroundings around which the district is developed) than community and neighborhood stations. Larger mixed-use cores often include supermarkets, professional offices, restaurants, service and entertainment uses, comparison retail and employment-intensive office and light industrial uses. The size and location of the core commercial area will reflect market demand as well as proximity to transit. In all areas, upper floor office and residential uses help to create a 24-hour environment and generate volumes of shoppers to support retail uses.

In mature areas, station area planning should identify existing uses that fit the concept of TOD, as well as transit-supportive uses that are missing from the land use pattern. Site improvements may be needed at some properties, which many jurisdictions address through design guidelines. In addition, infill sites should be identified so the density and intensity of the neighborhood can be increased, if necessary, to support development patterns that meet that mobility needs of the community.

Uses that rely on automobile and truck traffic are not appropriate in TOD areas, although some jurisdictions allow drive-throughs and other auto-dependent uses to remain in order to avoid the issue of nonconforming uses. This, however, is not a best practice. Such uses should be deemed legally nonconforming uses. Uses that are not appropriate for TODs and have been prohibited by jurisdictions include service stations, car washes, outdoor and mini storage facilities, motels, and car repair facilities.

Different uses are appropriate in different types of transit station areas. The appendix contains a table of recommended transit-supportive uses.

National Models

San Diego, CA's TOD Design Guidelines encourage the development of village greens and public plazas around transit stops and core commercial area to serve as public activity centers. The guidelines also encourage the City's Park and Recreation Department to allow TODs to meet the City's park standards through the use of small and frequent parks and plazas.

Gresham, OR created four zones for the area surrounding a light rail station. Each zone encourages a minimum amount of a certain type of development, but allows for a mix of other types of development, subject to development standards. This plan allows for a mix of uses within a broader development context.

Seattle, WA prohibits manufacturing uses in TODs because such uses generally have few employees per acre. However, **San Diego's** TOD Design Guidelines say that light industrial uses with low employment densities can be appropriate in some TODs, provided they are located outside of the mixed-use core and are compatible with other TOD uses.

Tacoma, WA utilizes "mixed-use districts" to encourage development tailored to each center's residential, commercial, or industrial character. These districts replace the zoning code entirely and are combined with additional design and engineering guidelines.

Best Practices

- Regional transit stations in mature areas serve the most users and are most suitable for high intensity employment, residential and, retail uses. Developing areas, specifically the southern region of New Hampshire, can best guide the development which will accompany projected population growth rates through areas zoned for higher-intensity use.

- Regional and district station areas generally will have larger core areas than community and neighborhood station areas. Larger mixed-use cores often include supermarkets, professional offices, restaurants, service and entertainment uses, while neighborhood and community stations can serve and support low intensity commercial uses and lower residential densities.

- Different uses are appropriate in different types of transit station areas. In mature, regional station areas, entertainment centers, offices, and high-end retail are appropriate, while in developing neighborhood areas, mixed-use residential, and small convenience retail should be permitted.

4. Development Density and Intensity

The economic viability of transit systems is tied to their ability to attract riders. Numerous studies have identified a positive link between ridership and the density and intensity of development around transit stations. Reid Ewing's 1997 survey of 11 TOD design guidelines across the United States concluded that a residential density threshold of 7 units per acre (basic bus service), 15 units per acre (premium bus service) and 20 to 30 units per acre (for rail services) were most common.[2] These numbers are not relevant to specific sites or corridors, but represent common density thresholds.

Because density is central to the application of TOD principles, jurisdictions should define density precisely and apply the definition within the zoning regulations. Residential density can be measured several ways: as *gross density*, which includes all uses, streets and open space and is usually measured in persons per square mile; *net density*, which includes residential and associated uses and open space and is expressed in dwelling units per acre; and *net-net density*, which includes only residential development on site and exclude streets, higher uses, public parks and undevelopable spaces, and is also measured in dwelling units per acre. The effects of using gross versus net-net density are dramatic, as the net-net densities can generate yields twice as high as the gross density measure.

Most areas are not built at this density or intensity. A single-use subdivision of single-family detached homes, for example, typically is built at a net density of one to eight units per acre, or three to eight units per acre if clustered. Houses built at zero lot lines can reach five to 10 units per net acre, while townhouses typically are eight to 16 units per net acre. By contrast, garden apartments typically include 16 to 40 units per net acre, while mid-rise and high-rise apartment buildings can range from 30 to as many as 300 units per net acre.

Employment density also has been shown to be more influential than residential density at generating transit ridership. Suggested densities for employment and commercial centers vary from .35 to 2.0 FAR, depending on the presence of residential uses and structured parking facilities. A national study of transit ridership patterns found that downtown densities of 100 workers per gross acre translates, on average, into 300 boardings per day for suburban light-rail stations that are surrounded by low-density (five persons per acre) residences 20 miles outside of a downtown.[3]

The level of transit service and the resulting level of pedestrian traffic will determine to a large degree the intensity of uses that can be supported in the station area. TODs with high levels of transit service are most appropriate for intense uses; TODs with less frequent service generally can support lower use

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[2] Ewing, Reid. *Transportation and Land Use Innovations.* Chicago: Planners Press, 1997.
[3] Parsons Brinckerhoff Quade & Douglass, Inc., R. Cervero, Howard/Stein-Hudson Associates, and J. Zupan. "Regional Transit Corridors: The Land Use Connection," *TCRP Project H-1*. Washington, D.C.: Transportation Research Board, National Research Council, 1995.

intensities.[4] Densities also may be determined by considering the costs of transit operations. Transit providers may work with jurisdictions to determine the density needed to support transit by calculating the number of trips per acre of developed land.[5]

National Models

San Diego encourages developers to mix building types to create a transit-supportive housing density that is compatible with surrounding neighborhoods. San Diego's TOD Design Guidelines recommend average minimum densities of 12 to 25 dwelling units per net acre in TOD areas. The City determined that single-family detached housing could be built at 12 to 17 units per acre on small lots, with ancillary units (or "granny flats") on some lots.

San Diego has also established minimum and maximum intensities for office development, which vary depending on whether a site has structured parking (see Table 1 below). The City strongly urges office developers to build structured parking and allows maximum FAR for office uses to be increased if recommended in a transit station area or community plan. However, the maximum allowed without structured parking implies that parking requirements would be reduced or a portion would be provided offsite.

Table 1: City of San Diego's Minimum and Maximum Floor Area Ratios for Office Uses in TOD Zones

Without structured parking		With structured parking	
Minimum	**Maximum**	**Minimum**	**Maximum**
0.35	0.6	0.5	Set by community plans
0.35	0.6	0.5	

Source: City of San Diego Transit Oriented Development Design Guidelines

A study in **Washington State** stated that employment uses require at least 50 employees per acre to support transit service. This is, however, an employment density more typical of suburban areas than of dense transit districts. Office uses typically provide 250 square feet of space per employee. A center

[4] Morris, Marya. "Creating Transit-Supportive Land-Use Regulations." Chicago, IL: American Planning Association, *Planning Advisory Service* (1996): 41.
[5] White, S. Mark. "The Zoning and Real Estate Implications of Transit-Oriented Development," *TCRP J-5, Topic 3-03*, Washington, D.C.: Transportation Research Board, National Research Council, September 1997 draft: 2.

employing 50 workers per acre, then, would encompass 10,000 square feet, or an FAR of 0.29 (see Table 2).[6] Increasing the FAR to 0.35 and even to 0.50 would yield 61 and 87 employees per acre, respectively.

Table 2: The Relationship Between Employment Density and Floor Area Ratio

Employees per acre	Floor Area Ratio
50	0.29
61	0.35
87	0.50

Source: HNTB

Compare these figures to the densities required to support transit in Table 3 and it is clear that the employment density required of transit should be higher than typical suburban standards.

Table 3: Residential and Employment Density Required to Support Transit Service

	Intermediate Service Local Bus	Frequent Local Bus	Light Rail	Rapid Transit
Dwelling Units per acre	7[a]	15[b]	9[c]	12[d]
Residents per acre	18	38	23	30
Employees per acre	20	75	125+	

[a] Average: Varies as function of downtown size and distance to downtown.
[b] Average density over a two square mile tributary area
[c] Average density for a corridor of 25 to 100 square miles to downtowns of 20 to 30 million square feet of nonresidential floor space
[d] Average density for a corridor of 100 to 150 square miles to downtowns larger than 50 million square feet of nonresidential floor space

Source: Residential Densities: Regional Plan Association, 1976; Colman, 1976;
Employment Densities, Ewing, 1996; Frank and Pivo, 1994.
Cited in the course manual of the National Transit Institute's Training Course for Coordinating Transportation and Land Use, p. 2.37, 2001.

Huntersville, NC (located 12 miles north of Charlotte) has prepared a TOD plan and neo-traditional zoning code in response to explosive growth over the past 15 years. The TOD-R district promotes residential growth with compatible commercial uses within a half-mile of rapid transit stations; the TOD-

[6] Morris, p. 41.

E district allows high-density office employment with FARs between 0.5 and 1.5. Additionally, sites within a quarter-mile of a proposed transit stop are not restricted as to housing type. This decision is an attempt to avoid the political controversy that often accompanies attempts to allow multi-family rezoning.

Mountain View, CA replaced an older shopping center that was adjacent to a commuter rail station with 400 housing units by increasing the density and using transit-supportive design guidelines. Net residential density for single-family homes is 12 units per acre, townhouses and rowhouses are 30 units per acre, and apartments are 50 units per acre. Average density is 22 units per acre, and all units are within walking distance of the transit station.

Denver, CO's transit-mixed use zoning district allows FARs of up to five to one and reduces parking requirements by 25 percent. In order to qualify for this zoning, sites must be at least 12 acres and within walking distance of a transit station.

Best Practices

Density is more important than mix of uses in influencing transit ridership. Residential and employment areas adjacent to transit station areas should be planned and zoned accordingly.

A mix of residential building types (small lot single-family detached and attached housing, garden apartments and multi-family developments) should be permitted in TOD zones to create density sufficient to support transit.

The difference between gross and net densities should be defined in the zoning regulations, and the distinction should be used explicitly.

Employment densities of between 75 and 125 (or more) workers per acre are needed to support rapid/mass transit along corridors.

5. Regulatory and Policy Incentives

Most jurisdictions have found that land use regulations and design standards are only partially successful in creating the type of mixed-use, pedestrian-friendly, transit-oriented district they have envisioned. Numerous studies have concluded that public-sector policies and incentives are essential in overcoming the institutional constraints that can prevent successful TODs. Where "sticks" have limited utility, "carrots" can help. Carrots are incentives in the form of density or other bonuses, reductions or waivers of fees, land cost write-downs, and fast track permitting to counterbalance any increased development burden as a result of TOD requirements. In addition to incentives, developers value regulatory clarity and stability. Clear TOD policy support and direction from the local government will encourage developers to move non-traditional projects forward. This support can come in the form of a consolidated permit review process for projects in the TOD district, a centralized and easily accessible development code database, or flexibility through the permit review process.

The most common incentives used in TOD are density bonuses and relaxed parking standards. Density bonuses allow developers to construct more units on a site than would be allowed under existing regulations in exchange for helping a jurisdiction achieve public policy goals. These goals should be reflected in the city or town's comprehensive plan. The most common use of density bonuses is to create dwelling units in market-rate developments that are available to low- and moderate-income households at below-market price points. Except in areas with buoyant real-estate markets and perhaps limited land, developers may not be interested in density bonuses. Many suburban developers do not believe the market will support maximum densities allowed under standard base zoning, much less bonuses. There are exceptions where bonuses can be used to leverage TODs: usually very strong real estate markets with a huge demand to build as much commercial space as possible. Relaxed parking standards are another common TOD development incentive. Parking requirements are often based on the assumption that developers are constructing in a typical suburban, car-oriented environment, and will provide surface or structured parking for their developments. Reduced parking standards recognize that densities are higher, alternative transit is readily available, and car use is discouraged in TODs. In addition to supporting a pedestrian-oriented environment, reduced parking requirements typically decrease construction budgets, thereby making new development more financially attractive. Parking reductions can still meet the need of customers traveling to and from their destinations by car, but does so in non-conventional ways, for example shared parking facilities and use of municipal lots.

Developers often cite land assembly and packaging as being the most effective development incentive because TOD sites are often infill development created from smaller, irregular parcels that are owned by multiple entities. Developers of greenfield sites would not have to contend with the burden of land assembly. By pre-assembling and packaging infill sites for development, a municipality is helping to neutralize one of the challenges associated with TOD development.

Creating zoning incentives essentially involves four steps: establishing the purpose(s) of the incentives, selecting the amenities, determining what bonuses will be granted, and administering the program.

Once a jurisdiction has developed the purposes of the incentive program, based on the goals of the comprehensive plan, the policies should be articulated in the statements of legislative intent, together with the other statements of purpose for the TOD zone. The next step is to select the amenities: these could include affordable housing, preservation of historic resources, or the retention of existing open space. Zoning incentives are legally justified on either the "traditional externalities analysis" of the local government's police power or on the aspect of the police power that empowers local governments to protect the public welfare. Incentives for public plazas and arcades have been justified on the basis of the "traditional externalities analysis," where a rational nexus between the incentive and the public benefit resulting from the granting of the incentive must be shown.

When administering bonus programs, local governments must decide whether to grant bonuses as-of-right or use a discretionary process. Most jurisdictions do both. Even in cities where bonuses are granted as-of-right, the site review process provides the local government with an opportunity to shape the details of amenities. Even well crafted incentives are difficult to implement. Ambiguities in design guidelines make it important that the administrative procedure for granting incentives be as explicit as possible so the public receives the benefit proportionate to the bonuses provided.

National Models

Somerville, MA leveraged the extension of the MBTA's Red Line through Davis Square to reinvigorate a commercial and residential area that has fallen into decline during the 1960s and '70s. Through planning and land assembly, the City integrated existing structures with the redevelopment of over 170,000 square feet of office and retail space and new multi-family housing. The City designated a redevelopment area within the square that allowed for property acquisition and clearance, infrastructure improvements, and some public control over private development within the area. The City also worked with state and federal agencies to package grants to finance civic improvements, including streetscapes, public art, and park renovations.

Density bonuses in **Montgomery County, MD** have been used near the Bethesda and Silver Spring stations to alleviate developers of the cost burden associated with the inclusionary housing ordinance that requires affordable housing unit set-asides. The inclusion of this housing in office developments has helped to create a 24-hour live / work district.

Atlanta's Lindbergh City Center occupies 51 acres surrounding MARTA's Lindbergh subway and bus station. The 4.8 million square feet of development is made up of 2.7 million square feet of office space, 330,000 square feet of retail space, over 500 apartments, more than 350 condos and a 190-room hotel. The master plan for the TOD envisions a development of medium- and high-rise structures with decked parking centered on the Lindbergh station.

San Jose, Orlando and Portland have enacted variable impact fees for mixed-use projects, using a sliding scale to reduce the fees required of developers to reflect the reduced number of trips generated by mixed-use projects. Without these reductions, impact fees would have rendered proposed TOD projects financially infeasible.

Best Practices

- Incentives must be relevant to the development context to be effective. Density bonuses will not be effective where density is not controlled. In these areas, expedited permit tracking or tax write-downs may be more appropriate.

- Jurisdictions must decide whether to grant incentives as-of-right or through a discretionary process. Most local governments do both. Even in places where an as-of-right system is used, local governments can exert some control over the amenity through the site review process.

- Density bonuses are most effective in areas with buoyant real-estate markets and limited land.

- Other incentives used to leverage TODs include land-cost write-downs in return for equity participation, local grants, and tax abatement.

6. Design Guidelines

Transit-supportive urban design guidelines are used to both encourage and facilitate transit usage. Guidelines address building design, pedestrian orientation, landscaping, site design, and development scale. They are usually implemented in conjunction with zoning requirements, and, unlike zoning codes, allow for flexibility in the project review process. Rather than prescribing the method to achieve a development goal, design guidelines state the goal and provide multiple methods for achieving it. Zoning codes allow for TOD land uses, but design guidelines shape the appearance and experience of the TOD's built environment.

Design rules usually are advisory guidelines, not standards. Mandating design elements and improvements adds to the cost of development projects and can make them less appealing to developers. Therefore, most jurisdictions use incentives instead of standards to entice developers to build amenities.

The decision to make design guidelines mandatory rather than advisory often depends on the regulatory context. In highly regulated environments mandatory standards may be effective; where the environment is lax, strict guidelines will reduce the attractiveness of the TOD. Some jurisdictions also have required certain design elements that support bicycle, pedestrian and transit uses, but these requirements are few. Often, design is best treated as a negotiable item as part of the development process.

An important dimension of promoting design is creating the kinds of amenities that will make the densities necessary to support transit more acceptable to potential transit riders. Research shows that good quality design and site improvements can "soften" perceptions of density.

National Models

Many excellent TOD design guidelines, including the TTA guidebook for the **Raleigh-Durham area of North Carolina**, have been written and are worth considering. An overview on "Pedestrian and Transit-Friendly Design," prepared for the Florida Department of Transportation by Reid Ewing, lists several "essential" design elements for TOD:

- Medium- to high-densities
- Mix of land uses
- Short- to medium-length blocks
- Transit routes every half-mile
- Two- or four-lane streets (with rare exceptions)
- Continuous sidewalks wide enough for couples
- Safe crossings
- Appropriate buffering from traffic
- Street-oriented buildings

- Comfortable and safe places to walk.[7]

San Diego's *Transit-Oriented Development Design Guidelines* is another good source. The design principles within it are to be applied in the zoning ordinance when station area plans are drafted. For example:

> Buildings must be of a sufficient intensity and density to create safe and active streets enhanced by a sense of enclosure and visual interest, and to support transit. Orienting buildings to public streets will encourage walking by providing easy pedestrian connections, by bringing activities and visually interesting features closer to the street, and by providing safety through watchful eyes and activity day and night. Moderate to high intensities and densities also support frequent and convenient transit service; and retail centers can provide a greater variety of goods and services if more residents and employees are within close proximity. (*City of San Diego TOD Design Guidelines*)

Somerville, MA created a Design Review Overlay District in the Davis Square neighborhood to help ensure that redevelopment and new construction fits within the context of the existing environment and encourages pedestrian activity.

Implementing TOD design guidelines can generate institutional conflicts within local government. Many transit-supportive design manuals call for generous turning radii at street intersections to allow buses to negotiate turns. Such designs are generally at odds with the minimalist street designs advanced by neo-traditionalists and TOD advocates. Neo-traditionalists practice the New Urbanist style of planning, which advocates for denser, pedestrian-friendly, mixed-use communities that reduce reliance on automobile use. In the case of proposed TODs in **California, Oregon and Virginia**, developers have been caught in a crossfire between traffic engineers and fire marshals who complained that planned streets were too narrow (for safety and liability reasons) and neo-traditional planners who insisted they were too wide (and thus auto-centric). Insurance underwriters also have a potential voice in TOD outcomes. A proposal to increase density bonuses by 25 percent around several **Los Angeles** Metrorail stations would have increased the fire code rating, which forced the City to back away from a TOD proposal.

[7] Ewing, Reid. *Pedestrian- and Transit-Friendly Design: A Primer for Smart Growth*. Washington, D.C.: Smart Growth Network, 1999.

Best Practices

- Many jurisdictions enact design guidelines in TOD zones to encourage good design. These guidelines, which are usually advisory, are contained within the TOD zoning ordinance. Other jurisdictions apply general design guidelines (guidelines that also can be applied outside of TOD areas), often through an overlay district.

- Mandating design elements and improvements adds to the cost of development projects and makes them less appealing to developers. Therefore, most jurisdictions use incentives instead of standards to entice developers to build amenities. However, in heavily regulated environments, mandatory standards are feasible.

- Selecting relevant amenities is an important part of promoting good design. Good design and site improvements "soften" perceptions of density.

7. Provisions Friendly to Bicyclists and Pedestrians

The success of a TOD largely depends on getting people out of their cars and onto their feet or bicycles. One way to achieve this modal shift is to provide a vibrant, safe, and interesting environment through which to walk or bicycle. Though this created environment is often an outgrowth of the design process described above, it can be augmented to specifically enhance the pedestrian experience through landscaping, street furniture, and pedestrian-friendly street-level business activities. Bike racks, showers, and designated bike lanes are useful in encouraging bicycle ridership.

Street design should reflect the prioritization of pedestrians and bicyclists over single occupancy vehicles (SOVs). For urbanized areas, this can be achieved through grid patterns of street networks, block lengths no longer than 400 feet, well-defined and enforced pedestrian crossings, and traffic calming techniques.

National Models

Zoning provisions requiring showering facilities have been recommended in **Atlanta's** Lindbergh Station District zone and similar guidelines have been enacted in **Mountain View, CA** to serve workers commuting to their jobs on bicycles.

Somerville, MA provides extensive bike storage facilities at the Davis Square stop on the Red Line, and has used traffic calming techniques, including pedestrian safety islands, brick crosswalks, and pedestrian signalization, to reduce the speed of traffic flow and increase pedestrian safety.

Atlanta's Lindbergh Transit Station zone also contains specific design standards for public sidewalks, requiring a minimum width of 15 feet and creating space for street furniture, trees, signage and other facilities without obstructing pedestrian access.

Columbus, OH's TOD overlay zone requires bicycle parking facilities be installed within 50 feet of building entrances of all new office and multi-family structures.

Best Practice

- Zoning provisions requiring showers, bicycle parking, minimum sidewalk widths, and other amenities for bicyclists, pedestrians and transit users should be enacted to create a more pleasant built environment.

8. Parking

Managing the supply of and demand for parking is one of the fundamental challenges of a successful TOD. Plentiful parking encourages the use of single occupancy vehicles (SOV) over mass transportation alternatives. Studies have found that office buildings with similar designs, tenants, and transit service generated less SOV trips when parking is restricted.[8] TODs strive to balance the demands of motorists with the needs of pedestrians, bicyclists and transit users. Several zoning tools have been developed to manage parking within TODs, including parking minimums and maximums, shared parking, offsite parking allowances, and the use of on-street parking.

Parking lots and structures consume land that could be used more efficiently and productively.[9] Many jurisdictions attempt to return parking lots to a higher use by reducing parking requirements. Even in places where parking standards are reduced, fluctuations in demand can leave many spaces empty. Shared or joint use parking is a zoning requirement that addresses this situation. Adjacent or nearby uses can share parking spaces, whether in a shared parking lot or a larger parking structure serving many uses. Shared parking is especially effective when the uses' peak periods of parking demand are staggered. Transit stations and entertainment complexes create a natural shared-parking arrangement because their demands for parking complement each other over a 24-hour period.

Several jurisdictions allow uses within TODs to satisfy a portion of their parking requirements with on-street parking. Installing short-term parking meters with high rates for long-term parking is a common

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[8] Alverson, K. "An Evaluation of the Effectiveness of Transportation Demand Management Programs in Downtown Bellevue." Master's degree thesis. University of Washington. 1991.

adjunct to this policy, so customer turnover and high yields from street parking are realized. Mandatory employee off-site parking for commercial uses is another strategy. Some jurisdictions also have created employee-cashout programs that encourage employees to use transit by adding to their wages the employer's equivalent cost of providing a parking space.

The amount of parking that will be required at each transit station typically is a function of its proximity to the Central Business District (CBD). Stations at the end of a transit line will serve the largest commutershed and require the most parking. Because demand at these stations is high, parking maximums should be greater than at station areas closer to the CBD, where transit users can choose among stations and where the potential time saved by taking transit instead of driving is less. Parking maximums can be reduced incrementally based on a station's proximity to the CBD.

National Models

Denver, CO does not impose parking requirements in the downtown commercial core, but has created requirements for residential mixed-use and TOD zones: 2 spaces per 1,000 square feet of office space, 3.3 spaces per 1,000 square feet of retail space, and 1 to 2 spaces per housing unit, depending on the number of bedrooms. Developers can apply for a 50 percent reduction in the requirement if the required parking is close to transit and is shared among uses.

Portland, OR has adopted parking maximums in several of its TOD zones, including the Cascade Station / Portland International Center Plan District, where maximums have been enacted for properties adjacent to a light rail line.

San Diego, CA recommends parking reductions of 2 – 15 percent for different types of land uses in the City's urban TODs. The Metropolitan Transit Development Board (MTDB) entered into a license agreement for parking with a theater owner to share the transit agency parking lot at Grossmont Station. To use the parking lot, the theater pays MTDB under terms of an annual lease. Theatergoers can use the parking lot at all hours, subject to the same limitations of trolley patrons (for example, no parking over 24 hours). San Diego also allows retail, office and public uses to count on-street spaces adjacent to their properties as part of their required allotment.

Best Practices

[9] Morris, p. 15.

- Many jurisdictions have reduced the parking required of land uses in TOD zones through parking maximums, shared parking, offsite parking, and on-street parking. These reductions usually are expressed in a percentage reduction from the standard required in the jurisdiction's parking regulations.

- Parking standards should be reviewed every few years to determine if they are effective.

- Shared or joint use parking can be used where fluctuations in parking demand leaves many spaces empty during parts of the day.

- Several jurisdictions allow uses within TODs to satisfy a portion of their parking requirements with on-street parking. Retail, office and public uses to count on-street spaces adjacent to their properties as part of a required allotment.

- Stations at the end of a transit line serve the largest commutershed and require the most parking. Because demand at these stations is high, parking maximums should be greater than at station areas closer to the CBD.

- Many municipalities have established parking authorities to fund and build public parking structures at TODs. This allows jurisdictions to manage the supply of parking where parking standards are reduced.

9. Housing affordability

TODs provide a unique opportunity for increased affordable housing opportunities in both existing and new housing stock. Housing that is located adjacent to mass transportation minimizes transportation costs in relation to total household budget. New higher-density construction in TODs provides an opportunity for municipalities to incentivize developers to include a percentage of affordable units. Mixed-income housing is desirable because it provides the range of housing types and price points that allow for the population mix necessary to sustain a diverse, vibrant community.

The zoning tools used to encourage the development of affordable housing include density bonuses, maximum set-aside provisions, and waiving or relaxing certain zoning regulations. These tools are used to implement "inclusionary zoning," which either requires the inclusion of affordable housing in new construction, or creates special incentives to encourage it. It is important to note that New Hampshire state law does not allow for inclusionary zoning to be made mandatory; it must be a voluntary incentive.

Mandatory inclusionary zoning is legal in Massachusetts. A 1999 Massachusetts Housing Partnership Fund study found that more than 100 municipalities (out of 351) in Massachusetts have some form of inclusionary zoning.[10] New Hampshire's only state statute regarding affordability requires that manufactured housing is provided for in local zoning codes.[11]

Massachusetts' Chapter 40B of the General Laws allows non-profits or other eligible entities to seek local approval for affordable housing without regard to zoning or other locally-adopted land use controls if less than 10 percent of the municipality's housing stock is subsidized. The intent of the statute, which is essentially a statewide inclusionary zoning law, is to increase the supply and improve the distribution of low- and moderate-income housing through the state. While New Hampshire's state legislature does not allow for mandatory inclusionary zoning, the frequency of southern New Hampshire localities adopting voluntary affordability zoning codes is comparable to Massachusetts.[12]

Jurisdictions without explicit provisions for affordable housing in their TOD zones may address the issue through general housing policies and inclusionary zoning. California, Maryland, Connecticut, New Hampshire, New York and Virginia have enacted legislation to enable or require local governments to adopt inclusionary zoning provisions for affordable housing, and New Jersey, Oregon and Florida have statewide policies and / or programs.[13]

Location Efficient Mortgages (LEMs) are another tool that promotes mixed-use development. These mortgages reduce the qualifying income amounts for residents of dense, mixed-use settings that are well-served by transit. This qualifying income reduction is allowed in order to account for the tendency of these households to own fewer cars (and therefore, have lower travel expenses), thus providing them with a larger share of their income for housing consumption.

Some jurisdictions also have enacted variable impact fees for TOD projects, using a sliding scale to reduce the fees required of developers to reflect the reduced number of trips generated by mixed-use projects.

[10] Philip B. Herr and Associates. "Zoning for Housing Affordability." Boston, MA: Massachusetts Housing Partnership Fund, 2000.
[11] State of New Hampshire, Revised Statutes Annotated, Title LXIV, Chapter 674, Section 32.
[12] Herr, Philip B. "Zoning for Affordability in Massachusetts: An Overview." National Housing Conference Affordable Housing Policy Review: Inclusionary Zoning: Lessons Learned in Massachusetts, 2002. 2 (1): 4.
[13] Morris, p. 29.

National Models

All units in **Renton, WA's** Overlake Station qualify as affordable housing. The joint development project of King County, the King County Housing Authority and a private developer utilizes tax-exempt financing and federal housing tax credits to provide units to households earning 60 percent of the county's median income ($35,000 to $40,000 per year). Each unit also will receive a bus pass as an incentive to use transit and reduce automobile congestion in the area.

Los Angeles County provides a density bonus, subject to the planning director's review, of up to 50 percent if at least 33 percent of the total dwelling units in a development are provided for lower-income households, or at least 50 percent of the units are provided for qualified senior citizens. To obtain the bonus, the developer must record covenants to ensure that lower-income households and / or senior citizens will occupy the bonus units for 30 years.

Atlanta, GA's Lindbergh Transit Station Area district includes an incentive for affordable housing. It allows developers to increase the floor area of residential uses to two times the gross lot area, from a base of 1.0 for nonresidential uses, 0.696 for residential uses, and 1.696 for mixed-use projects, if at least 20 percent of the units (for sale or rent) are affordable. The Atlanta City Council has defined the price of low-income units at 1.5 times the city's median family income and the rent of low-income units at 60 percent of fair market rent. Developers must agree to keep the units affordable for at least 20 years.

Montgomery County, MD's Moderately Priced Dwelling Unit Law has been effective at providing affordable housing for many years. It is a mandatory program requiring that 12.5 – 15 percent of all housing units in developments of 50 units or more be priced affordably. In exchange, the developer may build up to 22 percent more units than the zoning would otherwise permit. Moderate income households (earning 65 percent or less of the county median income) may purchase or rent housing at a below-market rate. Moreover, one-third of the rental units are set aside for low-income households, defined as households at or below 80 percent of the county's median income. Units must be integrated architecturally and spatially into the development.

Charlotte, NC's transit station area joint development policies, adopted in 2003, encourage banks to offer LEMs for home or condo buyers near transit stops.

Best Practices

- A few jurisdictions, such as Los Angeles County and the City of Atlanta, have included affordable housing density bonuses among their TOD zoning provisions. However, these jurisdictions are the exception, not the rule. Most local governments address affordable housing through general policies that apply in residential areas, including TODs.

- Jurisdictions without explicit provisions for affordable housing in their TOD zones may address the issue through general housing policies and inclusionary zoning requirements. The zoning tools used to require or encourage the development of affordable housing include density bonuses, maximum set-aside provisions, and waiving or relaxing certain zoning regulations.

- Mandatory set-asides require that residential projects of a certain size or larger include a percentage of units for low- and moderate-income households. Some density bonuses are combined with mandatory set-arises to offset the developer's costs of providing the lower income units.

Appendix

Evaluation of the Transit Supportiveness of Selected Land Uses			
	Group		
Use Classification	**1**[14]	**2**[15]	**3**[16]
Residential Uses			
Single-family residential[17]			
Lots greater than 5,000 square feet	-	x	-
Lots 5,000 square feet or less	x	-	-
Multifamily residential	x	-	-
Elderly residential	x	-	-
Public and Semipublic Uses			
Cemeteries	-	-	x
Clubs and lodges	-	x	-
Convalescent facilities	-	-	x
Cultural institutions	x	-	-
Day care, general	x	-	-
Government offices	x	-	-
Hospitals medical offices	x	-	-

[14] Group 1 = Transit Supportive
[15] Group 2 = May be transit supportive with appropriate development standards
[16] Group 3 = Not transit supportive
[17] Small lots or attached single-family housing is transit supportive.

Evaluation of the Transit Supportiveness of Selected Land Uses			
Park and recreation facilities[18]	-	x	-
Public safety facilities	-	x	-
Residential care	-	x	-
Schools, colleges and adult education	x		-
Commercial uses			
Ambulance services	-	-	x
Animal sales and services	-	x	-
Animal boarding	-	-	x
Banks and savings and loans	x	-	-
with drive up service	x	-	-
Building materials and service	-	x	-
Commercial recreation and entertainment[19]	-	x	-
Eating and drinking establishments	x	-	-
fast food or take out	-	x	-
with drive through service	-	x	-
Bar and tavern	x	-	-
Food and beverage sales	-	x	-
Funeral and investment services	-	-	x
Laboratories[20]	-	x	-
Maintenance and repair services[21]	-	x	-
Nurseries, commercial	-	-	x
Offices, business and professional	x	-	-

[18] Small parks are transit supportive; large facilities such as golf courses and multiple playing fields are not.
[19] Indoor uses such as cinemas and theaters are transit supportive.
[20] Small-scale facilities such as medical labs are transit supportive.
[21] Neighborhood-oriented businesses are transit supportive.

Evaluation of the Transit Supportiveness of Selected Land Uses			
Personal improvement services	-	x	-
Personal services	x	-	-
Research and development services	-	x	-
Retail services	x	-	-
Volume discount retail	-	x	-
Travel services	x	-	-
Vehicle equipment sales and service[22]	-	-	x
Automobile rentals	-	-	x
Automobile washing	-	-	x
Commercial parking garage[23]	-	-	x
Commercial surface parking	-	-	x
Service stations	-	x	-
with convenience retail	-	-	x
Vehicle equipment repair	-	-	x
Vehicle equipment sales/rental	-	-	x
Vehicle storage	-	-	x
Visitor accommodations	-	x	-
Hotels	x	-	-
Bed and breakfast inns	x	-	-
Motels	-	x	-
Industrial uses			
Includes truck stops, manufactured home sales, cold storage plants, junk yards and solid waste transfer stations	-	-	x

[22] Vehicle sales and service can be transit supportive if on site storage of vehicles is limited.
[23] Garages can be transit supportive if active, nonparking uses are located at street level

Evaluation of the Transit Supportiveness of Selected Land Uses			
Light industrial/employment	-	x	-

Source: Adapted from Planning and Design for Transit, Tri-Met, March 1993
Cited in *Creating Transit-Supportive Land-Use Regulations*, Planning Advisory Service Report 468, 1996.

Analysis of Existing Zoning Ordinances and Recommendations

Bedford, NH

Bedford Zoning Policies

Station area zoning

Bedford's Zoning Ordinance maps the town into ten base districts, three overlay districts, and one performance zone. The F.E. Everett Turnpike (I-293) and Daniel Webster Highway (Route 3) run along the Town's eastern border with Manchester, and are intersected by Route 101, which is the main east-west arterial. Route 101 merges with and becomes part of I-293 at this juncture. The prospective rail transit line runs along the western border of Manchester, directly across the Merrimack River from the convergence of these major roads and highways. The performance district (PD) has been mapped to cover approximately 75 percent of the eastern border area of Bedford. The purpose of this district, and all districts that use performance standards, is to discourage the separation of land uses by utilizing a more flexible land use planning tool that measures the quantifiable impacts of each development. In order to develop in the Route 101 performance district, the developer must receive Planning Board approval by demonstrating that the proposed project meets all of the performance standards outlined in the Zoning Ordinance. These requirements include dimensional, parking, environmental, signage, lighting and landscaping standards. This type of land use planning tool allows for greater development flexibility while maintaining the Town's overall design and usage controls. The Zoning Ordinance indicates that in 1997 Bedford chose to delete multiple residential dwellings from the list of permitted uses in the Route 101 PD. While a number of other transit-supportive uses are allowed, such as personal service establishments, banks, day care facilities, restaurants, and professional offices, the absence of residential uses will prevent this district from achieving a fully transit-supportive level of development. Without residential uses, the district will not be able to sustain a vibrant, pedestrian-friendly, 24-hour neighborhood.

Areas zoned for Apartment Residential are located on the western edges of the Route 101 PD, but are too far from the potential rail transit corridor to be considered transit-supportive. Additionally, the height and density requirements on these multi-family dwelling units are too restrictive to permit the level of residential development required for a TOD. The Residential Agricultural, Civic Institutional, and General Residential districts that abut the Route 101 PD strictly separate residential from all other uses. In order to facilitate mixed-use, transit-oriented development, the Town may want to consider revising the Route 101 PD to include multi-family residential at the transit-supportive levels of density outlined in the first half of this memo, or creating a TOD overlay district that allows dense, mixed-use development that is targeted to within a half-mile radius of a potential transit station.

District boundaries

The Zoning Ordinance does not identify specific TOD Zoning Districts; therefore, there are no defining parameters for district size or boundaries.

Mix of uses

Bedford's Zoning Ordinance strictly separates residential uses, with the exception of elderly housing, from all other uses in each of the base and overlay districts. The Route 101 PD, which most closely functions as a TOD district, offers the greatest variety of commercial, industrial, institutional, agricultural, and industrial uses, but does not permit any residential uses. In order to leverage the greatest economic development potential from a potential transit station, as well as capitalize on the opportunity to diversify Bedford's housing stock and provide greater access to affordable housing opportunities, the Town may want to consider permitting denser, multi-family housing either in the recommended TOD overlay zone or within the Route 101 PD.

Development density and intensity

The greatest density of development is permitted in the far eastern portion of Bedford and in selected areas along the Route 101 corridor. The balance of the Town is zoned Residential Agricultural, which restricts uses to single-family, cluster, and elderly housing units, some institutional uses, and agricultural uses. Lots in this district must be at least 1.5 acres, with sizable frontage and setback requirements. The most densely zoned residential district is the Residential Apartment zone, which permits minimum lot sizes of just under one acre and a maximum of 12 dwelling units per development, with a maximum of two bedrooms per unit, in a building no taller than 35 feet. This level of residential density is not supportive of a wide variety of household types, especially young families with children, nor is it supportive of a potential mass transit system. While permitted cluster developments allow for smaller dwelling units, they do not allow for a greater density of these units on a lot. The Town may consider allowing greater residential density within existing districts, particularly the Residential Apartment zone or within the recommended TOD overlay zone.

Allowed commercial and industrial densities, even in the Route 101 PD, are not great enough to adequately support a TOD. Restrictions on building heights, minimum lot sizes, and frontage requirements guide development in a pattern that is not pedestrian-friendly. The Town may want to consider increasing density and reducing frontage and setback requirements both in existing districts as well as the recommended TOD overlay.

Regulatory and policy incentives

Bedford's existing regulatory and policy incentives are currently restricted to the Route 101 PD. Bonus dimensional standards have been developed in an effort to manage access to and from parcels located on the Route 101 corridor. In exchange for deeding land that is within 50 feet of the centerline of Route 101, deeding land for a shared access driveway, or deeding land for use as future service roads, a developer can increase the percentage of allowed impervious surface by a pre-determined formula. Reductions in setbacks and minimum lot areas are also available. While these incentives function to make commercial and industrial development denser within the PD, the Town may want to consider strengthening the incentives for dense, mixed-use development. Specifically, the Town may consider streamlining the permitting process, providing density bonuses, increasing the allowed minimum densities in residential zones, reducing parking requirements, or assisting developers with land assembly.

Design guidelines

The Historic District of Bedford has the Town's strictest design guidelines: they evaluate, among other things, a proposed project's compatibility, scale and size, project impact, stylistic features, and historical, architectural, or cultural value. While some other districts have general design guidelines, the Town may want to consider a similar design review process for the Route 101 PD or the recommended TOD overlay. Mandatory design guidelines may serve to stifle development, but the provision of design suggestions and assistance with project design review may help to guide future development in a way that is aesthetically pleasing and sensitive to context.

Provisions friendly to bicyclists and pedestrians

The Zoning Ordinance includes one provision that is designed to encourage bicyclists and pedestrians: the Route 101 PD performance standards "encourage a pedestrian-friendly environment through the inclusion of sidewalks, barrier-free street crossings, mass transit shelters, public benches, and bicycle racks." The Land Development Control Regulations specify that pedestrian access to all non-residential or multi-family structures must be provided via sidewalks that are consistent with ADA regulations. When non-residential or multi-family developments are sited on public streets with sidewalks, on-site walkways must be constructed in order to provide pedestrian access to the development.

In order to support transit-oriented development, as well as increase mobility options for seniors and young people, provide recreational opportunities, and reduce congestion, the Town may want to consider creating a network for pedestrian and bicycle paths. These paths could serve as connectors from the residential, western half of the Town to the denser, commercially-oriented eastern half.

Parking

Bedford's Zoning Ordinance requires two parking spaces per single- and two-family dwelling unit, two spaces (one of which must be covered) for multi-family dwellings, and one space per 250 square feet of gross floor area in professional office areas. The only parking-based incentive offered in the Zoning Ordinance is within the Route 101 PD: side and rear lot landscaping requirements are eliminated when a development utilizes shared access and interconnected parking. The City may want to consider reducing parking requirements, especially for multi-family dwelling units, in order to encourage developers to construct denser developments.

Housing affordability

With the exception of a 25 percent affordable unit requirement for elderly housing developments, the Town of Bedford does not provide any incentives for the creation of affordable housing units. The vast majority (83 percent) of Bedford's housing stock is single-family dwelling units; the remaining 17 percent is multi-family units. There are no manufactured housing units. The requirement that multi-family dwelling units cannot have more than two bedrooms effectively prevents families with more than one child from living in rental housing in Bedford. This extremely narrow choice of housing stock will limit the ability of young families, seniors, and low- to moderate-income households to either remain in or move into Bedford. As population rates continue to grow across New Hampshire, development pressure and Bedford's existing land use regulations will force the type of large lot, single-family home construction that encourages sprawl and traffic congestion. Bedford should consider allowing for higher density, multi-family residential developments in the Route 101 PD, and consider allowing additionally density bonuses for the provision of affordable units.

Derry, NH

Derry Zoning Policies

Station area zoning

Both I-93 and the prospective rail line pass through the southwestern quadrant of the Town, which is the site of the downtown area and the densest levels of development. The rail line is almost immediately bordered on the west by I-93 and on the east by Route 28, another major north-south arterial. Route 102, which serves as Derry's main street in the downtown, intersects with both Route 28 and the rail line, passing just north of I-93 before reaching Derry's western border with Londonderry. This quadrant also contains each of the Town's 21 zoning districts, one of which is an overlay (Traditional Business Overlay) and one of which is floating (Neighborhood Commercial District). The Central Business District (CBD) zone is essentially a mixed-use district designed to protect existing residential, historical, traditional commercial, and cultural uses. In addition to retail, commercial, and supportive services, this district allows single-family and multi-family (up to four dwelling units) residential uses. The Traditional Business overlay district (TBOD) is another mixed-use district, designed to allow uses that will complement existing historical, residential, commercial, and cultural uses. The district allows the development of multi-family residential in conjunction with non-residential uses, specifying that the residential units are not permitted on the ground floor.

While the Zoning Ordinance does not create a TOD district, the CBD and TBOD largely function as mixed-use, transit-supportive districts. The City may want to consider increasing allowed density to transit-supportive levels in these districts and creating a TOD overlay district to target mixed-use development with a half-mile radius of a potential transit station.

District boundaries

The Zoning Ordinance does not identify specific TOD Zoning Districts; therefore, there are no defining parameters for district size or boundaries.

Mix of uses

In the fall of 2000, new zoning regulations allowing mixed uses, a broader range of retail uses and dimensions that were patterned after traditional downtown development were adopted. The mix of uses allowed across a range of zoning districts, specifically the CBD and TBOD, can be characterized as transit-supportive. The City may consider allowing for limited commercial, retail, office, and supportive service uses in the Multifamily Residential district. As discussed in the first half of this memo, the City would more successfully leverage economic development from a mass transit system if a mix of uses is allowed within a half-mile radius of a station. This change would be effective because of existing residential density and the fact that this district is already located within the main transportation corridor (between Route 28 and I-93).

The 2003 Master Plan recommends a revision of the Zoning Code to encourage housing for Derry's senior citizen population in or near the downtown. The Independent Adult Community overlay district allows senior citizen-designated housing developments in the Medium Density Residential, Low Medium Density Residential, Low Density Residential, and Office / Research and Development districts. In order to implement the recommendations of the Master Plan and allow for the broadest range of housing options near prospective transit station sites, the City may want to consider allowing senior housing in districts that currently allow for any residential use. This would increase the mobility options of the senior citizens, as they could live closer to the downtown core in denser housing developments.

Development density and intensity

Derry's Zoning Ordinance uses minimum lot areas to define density rather than dwelling units per acre (residential) or FAR (non-residential). The CBD, which allows a maximum of 18 dwelling units per acre, is the exception. There are a range of residential zoning districts to create gradations in density and development intensity, from the Low Density district, which requires single-family homes on three acre lots, to the Multifamily Residential district which requires 3,630 square feet of lot area per dwelling unit. This highest level of allowed density approaches the amount necessary to support a mass transit system, but the Town may want to consider further increasing it to fully transit-supportive levels. One way to achieve this is through increasing building height allowances: in the densest residential district, the MFR, buildings cannot exceed 60 feet. The Town may want to consider increasing this so that, while maintaining sensitivity to the context of surrounding buildings and existing neighborhood character, a greater density of multifamily units can be constructed.

Setbacks and frontage requirements are appropriate in all districts, and transit-supportive in the CBD and TBOD. The Town may want to consider reducing minimum lot sizes in the Office / Medical / Business and Commercial districts; smaller lots will create a more pedestrian-friendly, transit-supportive landscape.

Regulatory and policy incentives

The Ordinance does not currently allow for any regulatory or policy incentives. The Town may want to consider implementing incentives to encourage future development that is consistent with the recommendations of the Master Plan. For example, the Plan recommends the creation of more housing for seniors closer to the downtown. After making this allowable within the Zoning Ordinance, the Town may want to create a density bonus system or offer streamlined permitting and expedited review in order to encourage development. The Plan also recommends improving the landscaping of downtown businesses. In order to encourage this, the Town may offer parking requirement reductions in return for an increase in square footage of landscaped lot frontage. There are a number of incentives that Derry can explore using in order to achieve its land use planning goals.

Design guidelines

Because one of the goals of the CBD is to allow development that would not have a severe impact on existing historical, residential, traditional commercial, or cultural uses, the Planning Board has been authorized to adopt architectural design regulations for the district. The Office / Business district also outlines design guidelines that encourage new construction to blend in with the existing residential character of the district. While other districts require general site plan reviews, the Town may want to consider adopting a stricter design guideline and review process for all the districts in the downtown area. This will allow the Town to ensure that all future development is visually compatible and incorporates design elements that are transit-supportive.

Provisions friendly to bicyclists and pedestrians

The 2003 Derry Master Plan states the Derry residents can "now get downtown without having to use our cars, either biking through the interlacing Pathways trail system or by taking the bus or jitney shuttle that circulates throughout the community. It's much easier to bike and walk among Downtown stores now that through traffic on Broadway [Route 102] has been reduced and diverted to other routes."[24] The plan does, however, recommend increased public investment in streetscape improvements and the creation of incentives to encourage downtown businesses to improve landscaping. These two new initiatives would complement the work that has already been undertaken to improve the pedestrian experience. The Town

[24] Town of Derry 2003 Master Plan, "The Town We Want: Vision of Future Derry."

may also want to consider whether the provision of street furniture and bike racks in the CBD and TBOD might further enhance the pedestrian and biking experience.

Parking

The 2003 Derry Master Plan recommends several innovative approaches to addressing inadequate parking, including revising site plan review requirements to encourage shared parking, Town acquisition of several parcels in the downtown in order to provide additional parking, and considering the possibility of an "access fee" in-lieu of on-site parking provisions. In addition to considering these recommendations, the Town may evaluate expanding the CBD district requirement specifying that parking should be located at the rear of the building to other downtown districts. This will create a more inviting environment for pedestrians by encouraging human-scale development that directly abuts walkways.

Housing affordability

Derry's housing stock is fairly evenly divided between single-family (51 percent) and multi-family (45 percent) dwelling units. The Master Plan states that there are ample opportunities for affordable homes, including senior-oriented housing complexes, in Derry. In 2000, 4.5 percent of the total housing stock (455 units) was assisted units of affordable housing. These units include both family and senior citizen households. Between 1970 and 1990, the Master Plan notes that Derry's senior citizen population grew by 75 percent. As the baby boomer generation ages, this percentage can be expected to quickly increase.

Derry does not currently offer incentives for the creation of affordable housing units. In order to accommodate projected growth rates and provide an even wider choice of housing stock, the Town may want to consider offering density bonuses or other regulatory incentives to encourage development in targeted areas. These incentives should be directed towards zones which allow for multi-family residential and are close to shopping, employment, recreation, and transportation opportunities.

Hudson, NH

Hudson Zoning Policies

Station area zoning

Hudson's Zoning Code identifies seven districts: the majority of the Town is mapped as one of the two General districts. These General districts are designed to "allow natural constraints, such as infrastructure development and market forces, to determine the most appropriate use of land," so they permit almost all uses which are allowed in the other five districts. The code specifies that these two districts are intended to eventually become absorbed in either existing or newly created districts. The majority of Hudson's densest development occurs along its western border, immediately adjacent to the existing rail line. Each type of zoning district is present along this border.

The Town's Master Plan, a draft revision of which is currently available, recommends maintaining the existing balance of single-family, two-family, and multi-family housing units. It also encourages the development of alternative transportation systems. In order to achieve both of these planning goals, the Town should consider implementing a TOD overlay district to allow for higher residential densities and mixed uses within a half-mile radius of any proposed transit station. This would accommodate Hudson's population growth rates and facilitate economic development, while at the same time discouraging sprawl by patterning development in the traditional New England style.

District boundaries

The Zoning Code does not identify specific TOD Zoning Districts; therefore, there are no defining parameters for district size or boundaries.

Mix of uses

There is no defined mixed-use district, but, with the exception of the Industrial district, some form of residential use is permitted in all districts. Multi-family housing is only permitted in the Business district. However, commercial and retail uses are not permitted in the Residential R-1 and R-2 districts. The Town Residence district, which is intended to encourage denser residential developments, does not allow for a number of supportive commercial and retail uses. This separation of uses does not create an environment in which the type of mixed-use, dense development that supports transit ridership could be successfully created.

Hudson's mostly densely developed area, its downtown core, is immediately across the Merrimack River from Nashua's downtown. Other areas along the border do not have this land use coordination: Nashua's commercial and multi-family region along its southeastern border is directly across from a large recreational and single-family zone in Hudson. Directly north of these parcels, Hudson's industrially developed area abuts single-family homes in Nashua. In order to most effectively leverage development from any mass transit system, Nashua and Hudson should collaborate to synchronize future transit-supportive, mixed-use development.

Development density and intensity

Hudson's Zoning Code encourages the development of low-density, single- or two-family homes. Density requirements are expressed in minimum lot areas rather than dwelling units per acre (residential) or FAR (non-residential). These densities are decreased if town water and sewer service is not present. Large minimum lot areas, in combination with sizable frontage requirements, will function to encourage a pattern of sprawling residential development. This pattern of development is not transit-supportive, and is at odds with the recommendation of the Master Plan to "create strong, viable local neighborhoods with a range of facilities on hand so that people can drive shorter distances to where they want to go and make more trips by foot, bicycle, or public transportation."

A Growth Management plan, added to the zoning code in 2001, requires that a building certificate be obtained by a developer in advance of receiving a building permit. These certificates are required for new construction on lots of record established after November 3, 2000. Subdivisions approved by the Planning Board are guaranteed a minimum certificate allocation, the amount of which is outlined in the Zoning Code. The remaining annually-allocated certificates are then awarded to applicants on a first-come, first-serve basis.

The Town may want to consider allowing residential densities in the recommended TOD overlay district to approach the levels outlined in the first half of this memo. Similarly, the Town should consider allowing supportive as-of-right commercial and retail uses on the street-level of multi-family developments in this district. Reduced lot and frontage requirements would allow denser, more pedestrian-friendly development.

Regulatory policies and incentives

Hudson's Zoning Code allows for a reduction of the minimum frontage and lot size requirements for mixed-use or dual use on a lot. The requirements are calculated under existing guidelines for the principle use with the most frontage, but each additional use is calculated at half of its typical value. These reductions are allowed based on special exception.

The Code does not provide incentives for increased density; it is not clear that, based on Hudson's market, this form of incentive would be the most effective in encouraging transit-supportive development. The Town may want to consider offering parking reductions or flexibility for multi-family developments or commercial and retail establishments in the recommended TOD overlay zone. Additionally, the Town may want to consider reducing or waiving impact fees for residential developments within the proposed TOD overlay district.

Design guidelines

Hudson requires that the Planning Board review and approve site plans for all developments that are new or a change of use, excepting one- and two-family residential construction. As part of this review process, the Town recommends that, where practical, non-residential developers should consult the design standards set forth in the August 2000 "Non-Residential Development: Community Character Guidelines," as prepared by the Nashua Regional Planning Commission. In addition to this recommendation, the Town may want to consider adopting a stricter design guideline and review process for all the districts in the downtown area and in the proposed TOD overlay district. This will allow the Town to ensure that all future development is visually compatible and incorporates design elements that are transit-supportive.

Provisions friendly to bicyclists and pedestrians

Hudson's Master Plan recommends a well-connected, interesting pedestrian network that includes access to schools, shopping, and recreation. With the assistance of the Nashua Regional Planning Commission, the Master Plan outlines a highly detailed potential bicycle and pedestrian network. The creation of this network would be an excellent step towards creating an alternative transportation system for the Town, and would function as a good partner with any future mass transit systems.

The zoning code requires that sidewalks, where necessary, be four feet wide. The Master Plan recommends that this be increased to five feet in order to comply with Americans' with Disabilities Act guidelines.

Parking

Hudson's Zoning Code requires that residential developments provide two parking spaces per unit, retail business and personal service establishments provide one space per 200 square feet of gross leasable area, and industrial areas provide one space per 600 square feet of gross floor space or 0.75 spaces per employee of the combined staff of the two largest shifts. All parking must be provided on the same lot as the use it is serving.

The large number of on-site spaces required could function to discourage denser development, and the abundance of free parking encourages people into single occupancy vehicles. Parking reductions for higher-density developments and allowances for shared parking could supply adequate parking facilities while reducing the impact of parking lots and structures on the built environment.

Housing affordability

Two-thirds of Hudson's existing housing stock is single-family. Demographics trends reveal decreasing household sizes, while, at the same time, increasing population rates for the entire southern New Hampshire region. The combination of these three factors will result in increasing housing costs per capita, which means that young families, lower-income households, and elderly residents will be priced out of the market. Communities that have homogenous housing stock or household types lack the social and economic diversity necessary to sustain themselves and grow efficiently.

Currently, Hudson does not offer any incentives for the creation of affordable housing. The Town does offer lot size and parking reductions for developments designated for senior citizens. The Master Plan recommends that affordable housing, especially for very low-income and elderly residents, should be located within walking distance of essential services, retail, and medical facilities. This recommendation could serve as the basis for the creation of an affordable housing density bonus within targeted zones throughout the Town.

Litchfield, NH

Litchfield Zoning Policies

Station area zoning

The Town of Litchfield is a predominantly rural and agricultural community, but it is surrounded by some of the most urban cities and towns in New Hampshire: Merrimack, Nashua, and Manchester. The prospective western alignment of the rail transit line runs just across the far side of its western border with Merrimack. Just inside the western border of Litchfield, Route 3A mirrors the route of the rail line through Merrimack; Route 102 slices through the southeastern corner of Litchfield. The Town is mapped into four base zoning districts: Commercial, Commercial Industrial, Residential, and Transition. The Zoning Ordinance further breaks these districts down by geographical location: Highway Commercial, Southwestern Commercial, Northern Commercial, Southern Commercial / Industrial, and Northern Commercial / Industrial. There is no mixed-use district. The northern and southern portions of the Town have the greatest diversity of zoning districts and highest levels of development.

The 2002 Master Plan recommends the creation of a town center zoning district in order to allow increased density and a mix of permissible uses. Despite the fact that the rail line does not extend into Litchfield itself, the Town may want to consider establishing a mixed-use, TOD town center district to guide development in the area nearest any potential transit stations in Merrimack. This could be accomplished either through an overlay district or through the creation of a new base district.

District boundaries

The Zoning Ordinance does not identify specific TOD Zoning Districts; therefore, there are no defining parameters for district size or boundaries.

Mix of uses

The Southwestern Commercial district allows for the development of one residential unit in conjunction with a commercial use, provided that the minimum lot size is one acre. Transitional districts offer the same opportunity for commercial / residential development, as well as permitting single and duplex residences that have been occupied since March 14, 1989, and the combination of two or more principle uses on the same parcel without subdivision. Both the Northern and Southern Commercial / Industrial districts also allow for the use of two or more principles uses on the same lot. Currently, true mixed-use development that includes residential units is not allowed. The recommended TOD overlay district is the mechanism that would combine commercial, retail, and supportive services with residential uses in order to create vibrant, self-supporting 24-hour neighborhoods.

Development density and intensity

The 2002 Master Plan recognizes that in order to preserve Litchfield's rural and agricultural character, it must partner with municipalities across the region in planning for future land use. Locally, the Plan calls for the creation of a diversity of zoning districts to broaden the tax base, preserve rural and agricultural land, and discourage scattered development. The density of development is going to be somewhat constrained by the absence of a public sewer system. The Town can leverage this constraint to achieve community land use and planning goals by making geographically targeted infrastructure investment decisions.

Local zoning does not currently permit the as-of-right creation of multi-family housing greater than two attached units. The density for existing multi-family residential developments is somewhat high, the highest being eight units per acre, considering that none are served by public sewer. The minimum residential density for single-family homes is one dwelling unit per acre and 1.5 acres for duplexes and two-family developments.

In an effort to maintain Litchfield's annual growth rate at regionally comparable levels, the Town approved a Residential Growth Management Ordinance in 2000. The Ordinance establishes a residential housing growth target based on the average annual percentage increase in building permits issued in the five adjacent municipalities over the past preceding six years. This ordinance is set to expire on May 1, 2008, unless renewed. The Town also adopted the Housing for Older Persons Ordinance in 2001, which allows for the development of duplexes that are restricted to residents aged 55 and over.

In the Commercial, Commercial / Industrial, and Transitional districts, the minimum lot size is one acre, although final lot sizes are at the discretion of the Planning Board, based on, among other things, sewage disposal requirements and soil types. Minimum frontages for these lots range from 150 feet up to 500 feet. These large frontage requirements create an extremely auto-dependent landscape that is unfriendly to pedestrians. Should the Town decide to create the recommended town center or TOD district, these frontages and lot size requirements, in addition to setbacks, should be greatly reduced. Walkable, vibrant, mixed-use districts require human-scale development.

Regulatory and policy incentives

The 2002 Master Plan encourages the creation of a Transfer of Development Rights program (TDR) as a mechanism to target growth to areas with supportive infrastructure while preserving existing open space. The Plan suggests that the density credits generated through this program be directed towards the creation of a village-scale, mixed-use development.

The Town currently offers up to a 25 percent density bonus in the Housing for Older Persons overlay district, which is awarded at the Planning Board's discretion. The Town may also want to consider creating a system of incentives to encourage targeted denser developments that are sensitive to the community's rural and agricultural aesthetic. These could include the suggested TDR program, streamlined permitting, density bonuses, or impact fee reductions or waivers.

Design guidelines

The Zoning Ordinance provides only very general site plan review requirements. The 2002 Master Plan advocates discouraging strip-style development through design standards that support the desired types of commercial site development. Design guidelines in residential and mixed-use areas could be an important planning tool as future development pressures encourage sprawling, disjointed development. Design guidelines offer a mechanism to encourage developments that are complementary to the rural and agricultural aesthetic of the community.

Provisions friendly to bicyclists and pedestrians

The 2002 Master Plan includes the preservation of road capacity through coordinated land use and transportation as one of its transportation goals. The Town's recognition of the importance of land use decisions in transportation planning is further reflected in the stated goal of encouraging land use patterns that make transportation alternatives viable. Specifically, the Plan calls for the expansion of the bicycle and pedestrian trail on "both new and existing roadways and aggressively seek protection of historic transportation right-of-ways for future use when connections can be made."

The Zoning Ordinance does not currently offer any requirements that are sensitive to the needs of bicyclists or pedestrians. In order to support transit-oriented development, as well as increase mobility options for seniors and young people, provide recreational opportunities, and reduce congestion, the Town may want to consider enhancing the network for pedestrian and bicycle paths. These paths could serve as connectors from the residential portions of the town to the northern and southern commercial districts, as well as any potential transit station which may be developed in Merrimack.

Parking

There are no parking minimums or maximums outlined in Litchfield's Zoning Ordinance. The Town may want to consider establishing requirements in Commercial, Commercial Industrial, and Transition districts as a means of controlling traffic and encouraging alternate forms of transportation. As discussed in the first half of this memo, abundant parking encourages travel by single occupancy vehicle and often results in a sprawling, pedestrian-unfriendly environment. The Town may want to consider instituting parking requirements now in advance of future population growth and increased vehicular traffic.

Housing affordability

Litchfield's Zoning Ordinance does not currently permit the creation of as-of-right multi-family housing. In 2005, 81 percent of Litchfield's housing stock was single-family housing and 15 percent was multi-family. The Master Plan states that Litchfield has been turned into a bedroom community over the previous 40 years. The Plan claims that "the high cost of housing and limited housing opportunities may influence the high incidence of elderly residents moving out of the community later in life. Another change already underway is the larger numbers of children entering the school system each year."

The Town adopted a Housing for Older Persons ordinance in March 2001, which is designed to encourage development of housing alternatives with supportive facilities and services for senior citizens. While a density bonus is available in these developments, it is not in exchange for a percentage of affordable units. The Town may want to consider requiring the construction of affordable units in order to receive a density bonus.

Should the Town create a sewer system that allows higher density development, the Town may want to consider targeting development to growth corridors and offering density bonuses in exchange for the provision of affordable units for residents of all ages.

Londonderry, NH

Londonderry Zoning Policies

Station area zoning

Londonderry is mapped into nine base zoning districts (two residential, four commercial, two industrial, and one airport) and five overlay districts. There is no transit-oriented development overlay district. I-93 is the major north-south transportation corridor, and Routes 28 and 102 are the major east-west arterials running through Londonderry. Route 28 intersects I-93 at Exit 5, and Route 102 intersects at Exit 4; Route 28 runs nearly parallel to the prospective rail transit corridor. These points of intersection are all potential sites for a mass transit station.

The Exit 5 area is zoned to allow for a mix of uses that are supported by the Route 28 Performance Overlay District (POD). This POD, and a similar district mapped along Route 102, was created to utilize performance standards and incentives to facilitate land use patterns that are supportive of existing and future development along both routes. The western portion of Route 102 continues to be residential and low-density, while the portion approaching I-93 becomes higher-density commercial. The Route 102 POD is currently mapped to transition between these two areas of different development patterns. While these two districts most closely approximate a transit-oriented development district, they do not allow the residential development that would facilitate a mixed-use community. The Town may want to consider implementing a TOD overlay district to allow for higher residential densities and mixed uses within a half-mile radius of any proposed transit station.

District boundaries

The Zoning Ordinance does not identify specific TOD Zoning Districts; therefore, there are no defining parameters for district size or boundaries.

Mix of uses

Until the 1960s, Londonderry was a largely agricultural community. While the Town is still noted for its orchards, a majority of the Town (approximately 58 percent) is zoned residential. In order to retain this agricultural and rural aesthetic, the Town should consider targeting growth to corridors where it already exists and the Town's existing infrastructure can support it. This would mean allowing for a mix of commercial, residential, retail, and office space along the rail corridor and at Exits 4 and 5 on I-93. While multi-family uses are permitted on parcels adjacent to these corridors, in order to leverage the economic development associated with mixed-use development, they need to be permitted on parcels directly abutting these corridors. Similarly, the Town may want to consider allowing some multi-family residential developments at targeted locations within existing commercial districts.

Development density and intensity

Londonderry's 2004 Master Plan identifies a number of environmental constraints, including the Musquash conservation area, Scobie Pond, and Little Cohas Brook, which, when combined with minimal infrastructure, limit the amount of development which can occur in parts of northern and western Londonderry. The Plan identifies I-93's exits 4 and 5 as concentrations of dense commercial and retail development.

While the Master Plan identifies the desire of residents to maintain lower-density housing stock that fits in the context of existing residential development, the expansion of I-93 and possibility of a mass transit system, coupled with high rates of population growth, means that targeted, higher-density housing developments should be considered. The Master Plan identifies that there is very little land remaining in the highest-density R-3 districts for additional development.[25] Denser developments along existing transportation corridors would provide additional housing opportunities for future growth without encouraging a pattern of sprawl development.

The Zoning Ordinance specifies that no more than 24 dwelling units may be constructed per lot. The Town's Residential Development Phasing policy applies to all developments of 15 dwelling units / lots or more; developments are restricted to the construction of between 15 and 48 units per year, based on the type and location of construction. The Growth Management section of the Zoning Ordinance provides that residential development shall not exceed a 2 percent increase in Londonderry's housing stock over the preceding calendar year. These types of land use tools are meant to control and guide growth, but may create a barrier to higher-density, transit-supportive developments in areas within a half-mile radius of a transit station.

Regulatory policies and incentives

[25] Town of Londonderry Master Plan, 2004, p. 3 – 8.

The Route 102 POD allows dimensional incentive bonus standards, including reductions in minimum lot area and frontages, an impervious surface bonus (which allows for a greater percentage of the lot to be covered by an impervious surface), and a reduction in front setback requirements. These bonuses are awarded for projects that choose to voluntarily develop their properties in a way that is most compatible with the stated goals and objectives of the district and the Master Plan. Within this district an individual commercial building cannot have a building footprint larger than 12,500 square feet, but may be granted an incentive bonus to a building footprint not larger than 25,000 square feet if the proposed parking for the commercial use will be limited to the rear and side of the structure, the parking area for the building is interconnected with an adjoining lot, or provisions are made to allow for connection of parking lots in the future, and the access for the building is shared with one or more other lots.

The Route 28 POD offers only an impervious surface bonus.

Outside of these two zoning districts, the Zoning Ordinance does not specify any regulatory policies or incentives that would encourage transit-supportive development. The Town may want to consider offering parking reductions or flexibility for multi-family developments or commercial and retail establishments in the recommended TOD overlay zone. Increased as-of-right density and assistance with land assembly would further facilitate transit-supportive development in appropriate areas.

Design guidelines

Londonderry does not have strict requirements for design guidelines outlined in its Zoning Ordinance. Only one district's regulations makes mention of design guidelines: the Planning Board requires a rendering of proposed buildings within Commercial zones. The Town may want to consider implementing design guidelines in the PODs and multi-family residential areas in order to create visual continuity in new developments.

Provisions friendly to bicyclists and pedestrians

The 2004 Master Plan recommends the creation of a prioritized trail plan that would link trails and pathways throughout the commercial district, residential neighborhoods, and parks of Londonderry. The Plan specifically targets the town center area as being particularly unfriendly to pedestrians: "…the entire town center is extremely difficult to navigate by foot. There are almost no pedestrian amenities such as sidewalks, crosswalks, and signage and there is a perceived shortage of nearby parking."[26]

[26] Town of Londonderry Master Plan, 2004, p. 4 – 5.

The most densely developed commercial and retail areas, along Exits 4 and 5, are currently designed to be accessed by vehicles entering or exiting I-93. This type of auto-dependent design is not pedestrian-friendly and provides a barrier to transit-supportive land use. In order to address this and similar situations, the Town should consider creating a comprehensive bicycle and pedestrian network to facilitate the mobility of both the youth and senior citizen populations.

Parking

Londonderry's Zoning Ordinance requires that two parking spaces be provided for every single- and two-family unit, and that 2.5 spaces be provided for every multi-family dwelling unit. Professional and business offices must provide 4.5 parking spaces per 1,000 square feet of gross floor area. These are fairly high parking requirements, which may make it more difficult for developers to utilize parcels to their highest and best use. The Zoning Ordinance allows for coordinated or joint parking design in the Route 102 POD, but it does not specify that this would be a reduction in the parking requirement. The Town should consider allowing for reductions in the baseline parking requirements, as well as reductions based on shared parking facilities.

Housing affordability

The majority (70 percent) of the Town's housing stock is detached single-family homes, and the majority of all housing units (86 percent) have been built since 1970. The master planning process found that "many residents lamented the fact that their children, upon their return to Londonderry following college, could not find nearby affordable housing."[27] Londonderry's Zoning Ordinance does not currently allow any incentives for the construction of affordable housing units. The Town may consider providing incentives for the construction of housing that is affordable to low- to moderate-income households, particularly in multi-family housing developments. Specifically, this could be achieved through density bonuses in return for the provision of affordable units or a reduction or waiver of impact fees.

Manchester, NH

[27] Town of Londonderry Master Plan, 2004, p. 4 – 45.

Manchester Zoning Policies

Station area zoning

Each of the three corridors being considered for a prospective transit line passes through Manchester. The City is mapped into 16 base zones (six residential, three business, two mixed-use, four industrial / institutional, and one conservation) and ten overlay districts. This variety of zones provides a good framework for implementing the dense, mixed-use development that is necessary to support a mass transit station.

Specifically, the Redevelopment district is designed to "provide a transitional mixed-use district that facilitates the redevelopment of areas lying between the Central Business District and the residential multifamily districts." Drawn around both prospective rail corridors, this district provides flexible opportunities for a mixture of commercial, industrial, and residential uses. The Amoskeag Millyard Mixed-Use district is across the Merrimack River from the Central Business District and is designed to allow the adaptive re-use of former mill buildings and to allow for special planning and design issues associated with pedestrian linkages to the downtown. This district also contains two overlay districts: the Amoskeag Millyard Historic (AMH) district overlay and the Amoskeag Corporation Housing Historic (ACHH) district overlay. The ACHH is designed to protect and leverage the opportunities that this area presents, including the "retention of the architectural and historical values characteristic of this complex, and the presence of valuable resources for present and future housing and office needs."

These districts, which are abutted by the dense Urban Multifamily district, indicate that the City is working to encourage dense, mixed-use development. While these base and overlay districts represent a sensitivity to existing buildings and physical infrastructure, the City may want to consider the creation of a true TOD overlay zone in anticipation of future mass transit station(s). This designation would enable the City to target even denser, multi-use developments to within a half-mile radius of a transit station, which could be designed to complement the existing network of base and overlay districts.

District boundaries

The Zoning Ordinance does not identify specific TOD Zoning Districts; therefore, there are no defining parameters for district size or boundaries.

Mix of uses

The Zoning Ordinance allows for a good mix of residential, commercial, retail, and support services within the Redevelopment and Amoskeag Millyard Mixed-Use districts. The City may want to consider allowing for a similar mix of retail and support service uses in the Urban Multifamily district, thereby allowing residents to fulfill errands for daily needs within their own neighborhoods. The recommended TOD district overlay would also provide the opportunity for a transit-supportive mixture of uses. Overall, the multitude of uses allowed within several zones provides a good opportunity for the targeted, mixed-use development that is necessary to implement transit-supportive land use policies and regulations.

Development density and intensity

The 2006 Manchester Downtown Strategic Plan recommends the site at the intersection of Elm and Auburn Streets, which is currently an industrial building, for a multi-modal transit center. This could either be planned for mixed-use or as part of a larger-transit supportive mixed-use development that is designed to encourage pedestrian usage, trip consolidation, and a vibrant, 24-hour neighborhood.

Manchester allows for its tallest as-of-right development in the C-2 district (10 stories) and densest as-of-right development in the Amoskeag Millyard Mixed-Use district (FAR of 6.0). Generally, the minimum lot sizes and setback requirements for the R-2 and R-3 districts are supportive of denser, urban development. In order to facilitate even denser residential development, the City may want to consider allowing for density bonuses in return for the provision of affordable housing. The Strategic Plan also references a number of surface parking lots which negatively affect the pedestrian scale of the landscape and provide an opportunity for redevelopment. The City should consider reducing its downtown parking requirements (discussed below) and working to assemble and package these parcels for redevelopment.

Regulatory and policy incentives

The Zoning Code offers a density bonus for the provision of multifamily dwelling units for the elderly: increased building height to 100 feet, increased density to 80 dwelling units per acre, and a FAR of one in the R-3 district. The City may want to consider expanding density bonus provisions to include affordable housing. Considering that Manchester is already largely developed, the City may encourage infill development be assessing the inventory of City-owned land and working with developers to assemble parcels of vacant and underutilized land for redevelopment.

Design guidelines

The only references to design guidelines in Manchester's Zoning Ordinance occur in reference to the Arena overlay and Amoskeag Millyard Historic district. The City may want to consider expanding this design review process to cover all zoning districts that are mapped in the Central Business Area so that the City may guide visually cohesive, transit-supportive building and environment design.

Provisions friendly to bicyclists and pedestrians

According to the 2006 Manchester Downtown Strategic Plan, the City has an inconsistent pedestrian environment: "Some parts of the City have well-maintained sidewalks and curbs with decorative light fixtures and street trees while other parts have so many curb cuts that the sidewalks are non-existent."[28] The Plan comments, though, that the expansion of I-293, which runs along the Merrimack River, provides an opportunity to plan for increased pedestrian access and amenities at key points along the river.

As discussed above, the Amoskeag Millyard Mixed-Use district is designed to allow the adaptive re-use of former mill buildings and to facilitate special planning and design issues associated with pedestrian linkages to the downtown. This effort could serve as a template for pedestrian planning activities outside of this district. As part of its ongoing effort to update the 1993 Master Plan, the City may consider undertaking a survey of existing sidewalks and bike trails to determine if existing networks could be upgraded or new linkages created.

Parking

Developments within the Amoskeag Millyard Mixed-Use (AMMU) and Arena overlay districts are not required to conform to the parking requirements outlined in the Zoning Ordinance. Developers must, however, submit a parking plan to the Planning Board for their approval. In the AMMU, parking requirements may be modified based on the unique characteristics of the individual structure or use and the characteristics of mixed uses which operate at different hours of the day. The parking plan should explain how the expected parking demand can be accommodated through on-site surface parking, public parking available in on-street spaces, or in parking garages / lots. The Ordinance further allows proximity to mass transit to be considered when calculating parking requirements.

The Downtown Strategic Plan also indicates that surface parking dominates the environment in the Mill District, surrounding historic buildings and limiting pedestrian access to the waterfront.[29] Surface parking lots should be kept to a minimum and, when necessary, placed behind buildings or converted into aesthetically pleasing, structured parking facilities on smaller parcels.

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[28] Manchester Downtown Strategic Plan, April 2006, p. 23.
[29] Manchester Downtown Strategic Plan, April 2006, p. 23.

In order to more fully create a transit-supportive, pedestrian-friendly environment, the City may consider implementing a parking plan process similar to the one currently used in the AMMU for zones throughout the Central Business District.

Housing affordability

Approximately 37 percent of Manchester's housing stock is single-family; 63 percent is multi-family. While residents have a number of housing stock types to choose from, Manchester, like the entire southern region of New Hampshire, must increase housing production to keep up with population growth and reduced household sizes. The 2006 Manchester Strategic Downtown Plan finds that housing density is lower and housing values are lower within a one-mile radius of downtown; both density and value increase outside of a three-mile radius.[30] This indicates that there is ample opportunity to construct downtown dwelling units at all price points, from affordable studio, one- and two-bedroom apartments, to luxury condos for empty-nesters. This mixture of housing stock would provide the diversity of household incomes and types that is necessary to create a mixed-use, transit-oriented development.

Manchester's Zoning Ordinance does not currently allow any incentives for the construction of affordable housing units. The City may consider incentiving affordable housing production for low- to moderate-income households, particularly in multi-family housing developments. Specifically, this could be achieved through density bonuses in return for the provision of affordable units, or a streamlined permitting process for developments that include affordable housing.

Merrimack, NH

Merrimack Zoning Policies

Station area zoning

Merrimack utilizes Euclidian zoning with a designated Elderly Overlay District (EOD), multiple Planned Residential Districts (PRDs), and a Town Center District (TCD). The rail corridor is located almost exclusively within an R Residential District and I-1 Industrial Districts, and is immediately adjacent to both Limited and General Commercial Districts (C-1 and C-2). The rail line also passes though the EOD, two PRDs, and the TCD.

The residential density in the rail corridor, which is subject to the R-4 zoning classification, requires a minimum lot size of 40,000 square feet (.91 acres) for a single family home, 80,000 square feet for two-family residences (1.83 acres), and multi-family housing at a density of 12,500 square feet per unit. The

EOD allows densities at more than twice this amount (up to 8 units per acre). The PRD District also permits higher densities (eight units per acre for elderly, six units per acre non-elderly) and requires a commercial component.

The southern portion of the rail corridor passes through an I-1 District, which is one of the largest contiguous industrially-zoned areas in the region. In addition to industrial uses, various support uses (restaurants and day care) and planned unit developments (higher density residential and compatible non-residential uses) are permitted in the district. In total, Merrimack can support an additional 4,600,000 square feet of commercial and industrial floor area.

Because of the large percentage of existing non-conforming uses in the Town Center, redevelopment would be encouraged by relaxing zoning restrictions for non-conforming buildings and sites. While the 2002 Master Plan Update indicates that no additional local growth control or regulation is necessary, a number of vacant parcels provide an opportunity to encourage denser, transit-supportive land uses. The Town may consider a TOD overlay district to allow for higher residential densities and mixed uses within a half-mile radius of any proposed transit station.

District boundaries

The Zoning Code does not identify specific TOD Zoning Districts; therefore, there are no defining parameters for district size or boundaries.

Mix of uses

Merrimack's Zoning Code does not identify a true mixed-use zone. I-1 and I-2 Districts, however, allow a number of transit-supportive uses by right (restaurants, banks, hotel) and allow the residential density of the EOD and planned unit developments through a Conditional Use Permit. Similarly, C-1 and C-2 districts allow residential uses (other than planned unit developments) when granted by the Zoning Board of Adjustment (ZBA). While this is de-facto mixed use, the additional burden of applying for an extra permit or applying to the ZBA may discourage mixed-use developments in these districts. The creation of an as-of-right mixed-use overlay district would streamline the development process and provide regulatory clarity. This would be especially useful along the southern portion of the rail line, where large tracts of land zoned I-1 are currently occupied by employers such as Fidelity Investments, and would provide an ideal opportunity to create a 24-hour, mixed-use TOD.

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[30] Manchester Downtown Strategic Plan, April 2006, p. 10.

Development density and intensity

The Zoning Code expresses residential densities in lot size and dwelling unit per acre and commercial / industrial density in lot size alone. Planned unit developments (PUDs), the EOD, and the R-4 District offer the opportunity for the densest residential developments. Most of these districts are located in the far eastern portion of Merrimack, between the Everett Turnpike and the Merrimack River, immediately abutting the rail line. Cluster development is permitted in any residential districts other than R-1, which provides another opportunity for denser residential development. Side yard and frontage requirements constrain development density. Because industrial and commercial uses are governed by lot size rather than maximum gross floor area, density bonuses will be ineffectual as an incentive for denser development.

In order to successfully leverage full development potential from a transit station, residential densities within a half-mile of the station should be increased to the transit-supportive levels outlined in the first half of this memo. The maximum allowable as-of-right residential density of 8 units per acre is not sufficient for a TOD. Increased density could be accomplished through a TOD overlay zone.

Regulatory and policy incentives

The Zoning Code does not provide incentives for increased density. As discussed above, the creation of a TOD overlay zone would provide the opportunity to streamline the permitting process by removing the necessity for Conditional Use Permits and appearances before the ZBA. A reduction in residential and commercial parking requirements in a TOD overlay zone would provide a further incentive for denser development.

Design guidelines

The 2002 Master Plan Update addressed aesthetic concerns in the TCD: "the extent of existing development, much of which is uncoordinated, unattractive and incompatible with the human scale, limits the ability of the Town to create a new more aesthetically pleasing environment." The Town's Subdivision Regulations (April 2007) include a building design section, which outlines design requirements for PRDs, C and I Districts for any buildings requiring site plan approval from the Planning Board. The Town may want to consider adopting a stricter design guideline and review process for all the districts in the downtown area. This will allow the Town to ensure that all future development is visually compatible and incorporates design elements that are transit-supportive.

Provisions friendly to bicyclists and pedestrians

The 2002 Master Plan Update recommends an expansion of the existing bicycle network and the implementation of traffic calming techniques to improve bicycle and pedestrian safety. Sidewalks, where required, must be five feet wide. There are no bicycle facility requirements. In order to support transit-oriented development, as well as increase mobility options for seniors and young people, provide recreational opportunities, and reduce congestion, the Town may want to consider creating a network for pedestrian and bicycle paths. Additionally, the Town may want to consider implementing the traffic calming techniques, particularly in the Commercial districts that are adjacent to the F.E. Everett Turnpike.

Parking

The only mention of parking in the Zoning Code directs that off-street parking shall be provided for all uses and developments proposed as required by the Planning Board in accordance with the State's RSA 674:43. The subdivision regulations outline parking requirements by land usage: single-family homes must provide two spaces, two-family homes must provide four spaces, multi-family residential developments must provide one space per dwelling unit plus one space per bedroom, offices must provide one space per 200 square feet of gross floor area, and industrial establishments must provide two spaces per three employees. There are currently no provisions in the Zoning Code or Site Plan Review guidelines for parking reductions.

Housing affordability

The 2002 Master Plan Update found that "Merrimack's overall pattern of residential development has provided for a wide range of housing alternatives to meet the needs of a diversity of families and individuals." No affordable housing provisions are specified in the zoning code. While the Master Plan indicates that the Town does not currently need an increased supply of affordable housing, Merrimack may want to have provisions and incentives in place to manage the expected future population growth rates in a manner that encourages and supports a variety of household types and income levels.

Nashua, NH

Nashua Zoning Policies

Station area zoning

Nashua utilizes both Euclidian zoning and overlay districts to map the city into 15 base zones, six overlay districts, and three special districts. A special Transit-Oriented Development district is created in the Zoning Code, but does not currently appear on the zoning map. Through this mixture of zones, overlays, and special districts, the Code currently provides a number of tools for encouraging transit-supportive development. The rail corridor passes through General Industrial Districts (GI), Urban Residence Districts (RA, RB), Suburban Residence Districts (R9), and a General Business District (GB).

Specific transit-supportive zones and districts include the Mixed Use overlay district (MU), Flexible Use district (FU), and Transit-Oriented Development district (TOD). MU districts are "established from time to time" to "enable in-fill development to occur in a manner that will be compatible with the surrounding site environment and neighborhood" to ensure that "private development and rehabilitation will be compatible and coordinated with public improvement and investment." FU districts permit multiple, coordinated uses in an integrated concept development plan while providing for open space, wetland protection, and recreation. The TOD district encourages a mixture of residential, commercial, and employment opportunities in a more intensely built-up environment that is pedestrian-oriented and transit-supportive.

District boundaries

The TOD District is not currently defined; the Board of Aldermen, upon recommendation by the Planning Board, will define the area where it finds that the land area will support transit usage because of, among other factors, an existing or proposed development. The area, once defined, would be restricted to a half-mile radius of the transit station.

Mix of uses

Nashua's Code includes one defined mixed-use district, and several that function as mixed-use districts. The Mixed Use overlay district (MU) allows, in addition to uses permitted by the underlying district, residential, community facility, agricultural, retail, service, commercial and accessory uses. The Flexible Use district (FU) allows for a range of uses, including single-family residential, mixed-use village area (which includes elderly housing, retail, personal service, and professional and business offices), accessory uses, and a few conditional uses. The Downtown districts (D-1 and D-3) also allow for a mix of uses, including accessory dwelling units, elderly housing, multi-family dwellings, commercial, recreation and entertainment. The TOD District allows uses defined in the R-C (Urban Residential) and D zoning districts.

The diversity of zoning, overlay, and special districts and the multitude of uses they allow provide a good opportunity for the fine-grained, mixed-use development that is necessary for the implementation of transit-supportive land use.

Development density and intensity

According to the Nashua 2000 Master Plan, the City is almost entirely built out. The Code clearly defines density levels for all zoning districts, and also defines the level of density that the City has found sufficient to support transit ridership: 16 – 40 dwellings units per acre and FARs ranging from 2.5 to 6.0. In general, permitted densities, setbacks, minimum lot areas, and required frontages are conducive to denser, urban development. The code specifically allows the Administrative Officer to reduce a district's setback requirement for the development of infill lots. Densities can be further increased through the series of density bonus incentives that the City offers, the details of which will be discussed in the following section.

Regulatory and policy incentives

The Code provides a number of incentives, including increased density, permit streamlining, parking reductions, and fee waivers. Planned Residential Developments (PRDs) offer a variety of incentives in exchange for a density bonus of .025 bonus units per acre on 10 – 25 acre tracts, to a maximum of .5 dwelling units per acre on tracts exceeding 25 acres. These incentives include the provision of plantings along existing natural landscape buffers, 250 square feet per unit of developed active recreation facilities, or a privately-operated day nursey or kindergarten for 12 or more children. Conservation Subdivisions offer bonuses of .10 to .25 dwelling units per acre for tracts smaller than ten acres for the same incentives offered to PRDs. Density bonuses are also available to incentivize the creation of affordable housing units, the details of which are discussed in the "housing affordability" section below.

Permit streamlining is offered under the Code's inclusionary zoning section: if a rezoning is required for a dwelling unit, the applicant can file a combined site planning and rezoning request.

The Code allows a reduction in parking requirements for mixed-use developments. The reduction is calculated through a formula that weights the types of uses and time of day.

Impact fees are waived for elderly and low- to moderate-income housing units.

Nashua currently offers an array of regulatory and policy incentives to encourage denser, more affordable development. Because the City has been largely built out, it may also want to consider assembling and packaging infill lots for developers in order to facilitate the redevelopment process. As discussed in the first half of this memo, developers have cited this regulatory incentive as adding value and making redevelopment possible on parcels where it might have been deemed too difficult otherwise.

Design guidelines

Nashua's code requires site plan review for non-residential uses or multi-family dwellings of four or more units. Approval criteria includes the requirement that the proposed use should co-exist with surrounding uses and the development must maintain the unique aesthetic, architectural, and visual character of nearby buildings. Site and subdivision guidelines also have general guidelines regarding building appearance.

Within the FU district, the Code requires that all structures within the mixed-use village area reflect the guidelines outlined in "Hall's Corner Architectural Design Review, Procedure and Guidelines." In exchange for more flexible zoning, Planned Residential Developments establish higher standards of building design than in typical residential developments. The Downtown Districts are subject to design requirements that mandate traditional storefronts oriented towards Main Street.

Provisions friendly to bicyclists and pedestrians

Nashua's 2000 Master Plan recognizes that existing development patterns are primarily geared towards auto dependency. The Zoning Code states that the street system should be designed to respect the function of streets as the "shared domain of drivers, pedestrians, and bicyclists." Sidewalks, where required, must be at least five feet in width; if a bike lane in included, the sidewalk must be at least ten feet wide. The Code recognizes the importance of sideways in increasing the mobility of seniors by stating that the use of walkways, trails and natural walking paths shall be an integral part of the design of any elderly housing development. Developers, when approved by the Planning Board, may choose to pay a fee in-lieu of constructing a required sidewalk. The revenue may be solely used for the construction of new sidewalks in the area of the City where the sidewalk would have been constructed.

Parking

The Code requires that off-street parking by provided for any new structure, enlargement, or new land use. The spaces must be provided on the same lot as the principle use, or the Planning Board may approve a parking lot no more than 300 feet from the lot line of the use the parking is serving. The Planning Board may also allow the substitution of municipal lot spaces for the off-street parking requirement, as long as they are located within 1,000 feet of the building. Two or more buildings may also provide required parking in a combined facility, at the discretion of the Administrative Officer.

The Code allows for parking reductions through a defined formula that weights uses and the time of day. This reduction is available for office / industrial, retail, hotel, restaurant and entertainment / commercial uses.

Housing affordability

While the majority of Nashua's housing stock is multi-family, most of the new construction since the 1980s has been single-family. The City understands that a diversity of housing stock types and price points are necessary to accommodate the demographic trends towards older and smaller households.

Voluntary inclusionary zoning is expressly allowed under New Hampshire state law. Nashua has identified a critical shortage in affordable housing and responded by providing incentives for the increased construction of affordable units through the provision of streamlined permitting and density bonuses. The zoning code defines low-income households as earning no more than 50 percent of the area median income (AMI); moderate-income households earn between 50 – 80 percent of the AMI. In order to be considered an affordable dwelling unit, these households may spend no more than 30 percent of household income on rental housing plus utilities, or 33 percent for owner-occupied housing.

The Code provides permit streamlining for developers of affordable housing by allowing the combination of the site plan and rezoning applications. Available density bonuses range from 15 – 30 percent, based on affordable set-asides of 2 – 20 percent. These units must remain affordable for 20 – 30 years, depending on the type of unit. The highest rates of bonus are available in the TOD district zoning classification. Alternately, the ordinance allows developers to pay a fee equal to the dwelling unit construction cost into a housing trust fund as means of compliance. These policy decisions indicate the City's commitment to implementing planning principles that align with the techniques of transit-oriented development.

Salem, NH

Salem Zoning Policies

Station area zoning

Salem is divided into 12 zoning districts (three residential, one recreational, six commercial / industrial, one rural, and one Town Center) and one Seniors Housing overlay district. The I-93 corridor and Route 28 / rail corridor are parallel, at one point within a half-mile of each other. The ongoing expansion of I-93 will decrease this separation while increasing traffic capacity. Expanded capacity will provide opportunities for economic development and growth in this entire corridor. Planning land use to complement a future mass transit system will allow for economic expansion while at the same time diminishing the impact of vehicular traffic on main arterials.

The commercial and industrial zones are concentrated in the areas between these two corridors: the Mall at Rockingham Park is directly north of Rockingham Park Boulevard, which connects I-93 to Route 28. The I-93 and Route 28 corridors pass through the majority of zoning districts in Salem, none of which allow an opportunity for the dense, mixed-use developments that would be transit-supportive. Because of the close proximity of the two corridors, however, it may be possible to leverage the existing residential, commercial, and industrial development and associated traffic to support a mass transit system. Specifically, multi-unit developments should be permitted as-of-right in commercial districts, the Limited Community Shopping Village District, and the Town Center District. Rather than modifying existing base zones, Salem may want to consider creating a TOD overlay district that would encompass the half-mile radius of a proposed transit station.

District boundaries

The Zoning Ordinance does not identify specific TOD Zoning Districts; therefore, there are no defining parameters for district size or boundaries.

Mix of uses

Salem's Zoning Ordinance allows for mixed-use in a variety of its districts, including the Garden Apartment R-A district, Business Office (BO) districts, Commercial-Industrial (CI) districts, Limited Community Shopping Village (LCSV) district, and Town Center (TC) district. While the BO, LCSV, and TC districts allow for residential uses, they are restricted to one- and / or two-family dwellings, which do not allow for densities that would approach a transit-supportive level. CI districts allow for a variety of commercial and personal service uses, but no residential.

The corridor between I-93 and Route 28 is the most heavily developed and intensely zoned region in Salem. Greater spatial and usage efficiencies could be gained by combining abutting complementary uses: for instance, a multi-unit residential unit could be located on the upper floors of a bank and drycleaner, which is adjacent to a grocery store and an office building that has a café at street-level. Currently, this type of mixed-use, residential development is not possible. The recommended TOD overlay district is the mechanism that would combine commercial, retail, and supportive services with residential uses in order to create vibrant, self-supporting 24-hour neighborhoods.

Development density and intensity

Salem's Zoning Ordinance does not currently allow high-density, mixed-use development. In the Residential district, single-family housing, which represents the majority of Salem's housing stock, must be on lots of at least 25,000 square feet; two-family developments must be on lots of at least 37,500 square feet. In the Rural district, the minimum lot size for a single-family home is 87,120 square feet, and 174,340 square feet for two-family dwellings. Large portions of the land on the western edge of the I-93 corridor are ideal for higher-density development, but are zoned Rural. The only district that allows above a two-family dwelling unit is the Seniors Housing overlay district, which permits densities of up to eight units per acre. These density levels begin to approach the residential densities needed to support a mass transit system, as outlined in the first half of this memo.

The majority of developments cannot be more than two and one-half stories tall and have maximum lot coverage ratios of 25 – 50 percent. This, in combination with generous setback requirements, results in smaller, less dense developments. In order to increase the density of developments to a transit-supportive level, Salem may want to consider increasing as-of-right density for new construction within a half-mile radius of proposed mass transit stations. This would include increasing allowable building height and reducing setback and frontage requirements.

Regulatory and policy incentives

Salem's Zoning Ordinance provides a density bonus in exchange for open space preservation. In Residential and Rural districts, this means that a development of at least 40 acres may be awarded a density bonus of up to 20 percent of the as-of-right density if at least 50 percent of the lot is reserved as open space.

The Seniors Housing Overlay district allows a density bonus of up to 10 percent for all projects over ten acres that restrict the age of all occupants to 62 and older. This additional density is a bonus on top of the increased density allowed because the housing development is designated for senior citizens age 55 and over.

With the exception of these two density bonuses, the Zoning Ordinance does not allow for any regulatory or policy incentives. Salem may want to consider whether density bonuses within the Town Center or Limited Commercial Shopping districts may be effective in steering denser development into areas that have the infrastructure to support it. Other incentives to consider implementing include streamlined permitting and reduced parking requirements.

Design guidelines

As outlined in the Site Plan Regulations, Salem's design guidelines are fairly general; the most specific regulate the Town Center district. Within this district, the Zoning Ordinance outlines such design elements as massing and style, façade elements, door and window openings, and materials are specified. The Town may want to consider expanding these design requirements into the Limited Community Shopping Village and proposed TOD overlay districts in order to guide pedestrian-friendly, human-scaled development.

Provisions friendly to bicyclists and pedestrians

Salem's Master Plan calls for a reduction in the need for roadway construction through the development of viable alternatives that reduce the dependence on the automobile as the only mode of travel. Salem's Zoning Ordinance does not currently require nor offer any incentives for the development of a bicycle or pedestrian network. In order to reserve open space, reduce local traffic congestion, and improve air quality, the Town may want to consider designing a network that would allow people to bike or walk into the corridor between Route 28 and I-93. This network could also be used by commuters seeking an alternate method for accessing a mass transit station.

Parking

Off-street parking requirements are outlined in the Zoning ordinance: two spaces per dwelling unit in single-family dwellings and apartments, one space per unit in housing for the elderly, and one space per 300 square feet of gross floor area for office and business uses. These requirements are fairly high, and the Ordinance does not provide any options for reducing these requirements through shared parking or the use of municipal lots. It will be difficult for developers to achieve higher levels of density without a baseline reduction in the parking requirement or the opportunity for reductions.

Housing affordability

Salem's Zoning Ordinance includes an article outlining the opportunity for density bonuses for the provision of affordable housing units. Units are to be affordable for households making 50 to 100 percent of the area median income. Neither the Zoning Ordinance nor the Site Plan Regulations outline the exact amount of the density bonus available, other than to state that such density will be awarded by the Planning Board, density shall not be more than 50 percent greater than allowed in underlying zone on the basis of four bedrooms per single family, and that not more than 40 affordable units will be allowed on a single tract. The Master Plan states that, at the time of its writing, the affordable housing ordinance had been applied only twice since its adoption.

The Seniors Housing overlay district specifies that at least ten percent of the total dwelling units in all projects shall be dedicated as affordable to low- and moderate-income households (those making less than 80 percent of the area median income).

The need for affordable housing is going to continue to grow across the southern New Hampshire region. In order to proactively address the housing needs of its current and future residents, Salem may want to consider clarifying and streamlining the affordable housing ordinance in order to ease the development process. Also, the Town may want to revise the Zoning Ordinance to allow for more multi-family housing developments in selected areas in order to increase the variety of the housing stock and allow more affordable housing opportunities for young people, senior citizens, and lower-income residents.

Windham, NH

Windham Zoning Policies

Station area zoning

Windham's Zoning Ordinance maps the Town into 12 primary districts (three residential, seven business uses, one rural, and one historic) plus four overlay districts (aquifer protection, open space residential, elderly housing, and Route 28 access management). While no TOD district has been explicitly created, three districts (Neighborhood Business District (NB), Gateway Commercial (GC), and Village Center District (VC)) are supportive of denser, multi-use development. The existing rail corridor runs through a residential and a rural zone along the western border of the Town, while I-93 passes through the center of Town and immediately abuts almost every type of zoning district. While the land use surrounding the I-93 corridor is already the densest and most diverse in the Town, a TOD overlay district for future use along the rail corridor would provide the Town with an effective tool for proactively guiding future growth.

The NB district allows for businesses that provide goods and services for residents of the area. While residential uses are not allowed in the district itself, it does provide the types of services that would support denser, pedestrian-friendly residential developments. The VC district is located along Route 111, between I-93 and the rail line, and has the high-density, mixed-use characteristics of TOD, including parking requirement reductions, no setback requirements, and no minimum lot sizes. The GC district is designed to encourage high-quality commercial development along the I-93 corridor at Exit 3. While its density requirements and performance standards are similar to a TOD, residential uses, which are the key to a true TOD, are not allowed under the current zoning ordinance.

District boundaries

The Zoning Ordinance does not identify specific TOD Zoning Districts; therefore, there are no defining parameters for district size or boundaries.

Mix of uses

Windham's 2005 Master Plan makes clear that the retention of the community's rural usages and aesthetic is a planning and land use goal of the Town. The Plan acknowledges that the construction of I-93 brought unexpected growth, which changed Windham's historically rural pattern of development. The expansion of I-93 that is currently underway and a potential mass transit system will provide opportunities for economic development and population growth, but requires proactive planning actions in order to direct development in a way that complements, rather than challenges, the community vision established in the Master Plan. One way to accomplish this is to create higher-density, mixed-use development in specific districts, so as to alleviate sprawl and congestion in the community as a whole.

Windham's Code currently allows for a mix of commercial and retail opportunities in the mixed-use districts above; the Code specifically encourages them in the GC district. In order to be fully transit-supportive, however, each of these districts should also allow for higher-density multi-family residential developments. The VC district currently allows for up to 20 percent residential development and most closely approximates a TOD. Even the districts that do not allow for any residential uses, such as the Professional, Business and Technology district, abut residential areas. If a comprehensive pedestrian and bicycle network was created to connect these zones, as described below, these forms of alternative transportation could reduce congestion on the I-93 and main arterial corridors. Additionally, economic development opportunities would be created for existing commercial and retail uses adjacent to this network.

Existing mixed-use districts have been located in the I-93 corridor to support the vehicular traffic associated with the highway. With slight modifications to permitted uses, including the inclusion of higher-density residential, this corridor would be supportive of a mass transit system in the I-93 right-of-way. This diversity and density of uses is not currently allowed along the existing rail corridor. In order to fully capitalize on a potential rail transit station, the Town should consider creating a TOD overlay zone that extends in a half-mile radius from the station and allows for mixed commercial, retail and residential uses. Because this radius would pass through abutting municipalities, Windham should reach out to their neighbors and craft a micro-regional planning effort to ensure that neighboring development plans are coordinated and mutually supportive.

Development density and intensity

Windham uses soil-based lot sizing to determine minimum lot areas for development. Minimum lot sizes are 50,000 square feet with 30,000 square feet of contiguous area, excepting the VC district and Open Space Residential zones. In both the GC district and VC district, there are no setback requirements, which is conducive to the denser, urban development that encourages pedestrian, street-level activity.

The Master Plan states that the average single-family lot size in 1998 was 1.1 acres: single-family homes are 92 percent of Windham's housing stock. This density of residential development encourages sprawl, increases reliance on single occupancy vehicles, and is not conducive to transit-supportive development. The Open Space residential district offers an opportunity to create denser residential development in an effort to conserve open space. The numbers of lots allowed are the same as under a traditional subdivision, but developers are given dimensional flexibility in exchange for setting aside 65 percent of the total area for open space. The Residence B district allows for the densest residential development, up to six units of per multi-family building, but is only mapped in three small areas throughout the town. As discussed above, denser, multi-family development should be permitted in the GC district, VC district, and NB district, and should be permitted in the recommended TOD overlay.

Regulatory and policy incentives

Windham currently offers four incentives to increase density in designated elderly housing developments. These incentives include up to a 20 percent density bonus in return for the provision of 25 percent of rental units for the elderly, up to a 50 percent density bonus for elderly units constructed in conjunction with a local, state or federal program designed to create affordable housing units for senior citizens, up to a 15 percent density bonus if at least 50 percent of the units are handicapped accessible, and up to a 15 percent density bonus for the provision of significant and substantial on-site recreational and / or common facilities.

The Village Center, Gateway Commercial, and Professional, Business and Technology districts offer options for shared or reduced parking requirements, based on demonstration to the Planning Board that shared parking will be maximized by complementary uses.

Because one of the stated land use goals of the town is to protect the rural landscape, the Town may want to consider implementing a transfer of development rights (TDR) system. TDRs allow areas that choose not to develop to the highest allowed density (rural areas) to "transfer" or sell their development capacity to areas (such as downtown) where such increased density is desirable. Typically, this mechanism is used to control the location of population growth, and allows rural landowners to capture the market value of their property without selling it, changing its use, and subdividing it. TDR programs have been used by multiple municipalities around the country, including Vermont, Pennsylvania, and New Jersey, for decades.

Design guidelines

Site plan review is required for any new use or change in use, excepting one- and two-family structures. The Site Plan Regulations provide guidelines for building design and appearance, with a separate section specifying additional requirements for the TC district.

Provisions friendly to bicyclists and pedestrians

The Code requires that the GC district provide pedestrian and bicycle access and circulation as an integral element of the design of any site. The Planning Board may require the extension of bicycle and pedestrian access to property lines, and the interconnection of access ways to adjacent parcels. This is a TOD-supportive requirement, but is limited to a relatively small area within Windham. The Town may want to consider extending this bicycle and pedestrian network so that residents have the opportunity to bike or walk along one continuous path from residential areas to business and commercial districts. This would create recreational opportunities, reduce congestion, and provide increased mobility options to the elderly and non-vehicle owning populations.

Parking

Off-street parking requirements are specified in the Code: one space must be provided per dwelling unit, one space per 250 square feet of gross floor area for business, professional, and administrative offices, and one space per 200 square feet of gross floor area in retail and service establishments. As discussed above, the Village Center, Gateway Commercial, and Professional, Business and Technology districts offer options for shared or reduced parking requirements, based on demonstration to the Planning Board that shared parking will be maximized by complementary uses. The Town may also consider allowing adjacent municipal lot spaces to be counted towards off-street parking requirements.

Housing affordability

Windham's only affordable housing bonuses are those in the Elderly Housing Overlay District, which is discussed above. While these policies are important in creating affordable housing opportunities for senior citizens in Windham, the Town may consider incentiving affordable housing production for low- to moderate-income households, particularly in multi-family housing developments. Specifically, this could be achieved through density bonuses in return for the provision of affordable units, or a streamlined permitting process for developments that include affordable housing. Because the vast majority of Windham's housing stock is single-family homes, in the future the Town may want to consider partnering with banks to offer location efficient mortgages for homes located near planned mass transit stations.

Andover, MA

Andover Zoning Policies

Station area zoning

Andover is mapped into 11 base zoning districts (four residential, three business, one mixed-use, three industrial) and two overlay districts (flood hazard and watershed protection). A number of highways and large arterials crisscross the Town: I-93, Route 28, and the existing commuter rail line are the main north-south connectors, while I-495 runs east-west along the northern edge of Andover's border. Andover currently has two commuter rail stations: Andover station in the downtown core and the Ballardvale station along the Town's southern border. I-93 and the rail line converge just past the edge of Andover's southern border in an area known as the Lowell Junction.

Zoned for industrial uses, the Lowell Junction area is home to facilities owned by Gillette / Proctor & Gamble, Wyeth BioPharma, Charles River Labs, and AGFA Films, among other companies. Approximately 6,000 workers travel to work daily in the Lowell Junction area. Despite this high concentration of employment, the Town has been unsuccessfully in their multi-decade effort to construct a new interchange from I-93 to provide better and more direct access to this area. Several existing business are unable to expand within the Lowell Junction because of poor highway access. An estimated 11,575 new jobs could be created if the existing vacant commercial and industrial land is fully developed.[31] Following a joint effort by Andover, Tewskbury and Wilmington, the Merrimack Valley Planning Commission undertook an "Interstate 93 Corridor Study" during 2001 – 2003 to evaluate, among other things, the feasibility of widening I-93 and adding a new interchange at this location. After determining that construction was feasible, MassHighway and the Federal Highway Administration (FWHA) requested a stand-alone document outlining alternatives for a new interchange. This report, "The Route I-93 / Lowell Junction Interchange Justification Study" (IJR), has been submitted to Massachusetts' Executive Office of Transportation for ultimate submittal to the FWHA. This marks the first step towards receiving FWHA approval for the interchange. Should this project receive all approvals and proceed, it will present an overwhelming opportunity to fully tap the development potential of this area.

The Merrimack Valley Economic Development Council released a whitepaper supporting the construction of a new interchange at the Junction, developed together with a new multi-modal transportation center along the Haverhill commuter rail line. The Council argues that a major multi-modal transit center located at the Junction would connect the development with residents of Lawrence, Haverhill and Bradford, where approximately 20,738 people live within a 10-minute walk to transit.[32] Furthermore, according to the Council, there are over 1,000 units of housing currently being planned or under construction within walking distance to stations in Lawrence, Haverhill, Bradford, and Andover.[33] All of these units would be connected to the Junction via rail.

The Ballardvale commuter rail station is located in an area that is zoned General Business, Single Residence A, and Industrial G. A strip of parcels zoned Single Residence C buffers this area from the Industrial A designation of the Lowell Junction area. The downtown Andover station is located within the Mixed-Use district, and is immediately surrounded by General Business, Industrial G, and Single Residential A zones.

Both of these stations, particularly the downtown station, allow for a mix of uses in the area immediately surrounding the station. Neither of these stations, though, is located in or near zones that allow multi-family residential dwelling units. In order to capitalize on the Junction area's vast development opportunities, the Town should consider creating a TOD overlay district that allows a mix of multi-family dwelling units with commercial, retail, and supportive personal services within a half-mile radius of each station. This would increase transit ridership and provide the Town with additional economic development opportunities. The Tri-Town Planning Coalition, which represents officials from Andover, Tewksbury, and Wilmington, have released a vision for the area that does not include the creation of housing within the core of the new development. This decision will result in the creation of a new office

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[31] Merrimack Valley Economic Development Council, "The Junction / Route 93 Development Area: Our Opportunity for Smart Growth and Regional Economic Development in the Merrimack Valley and Northeastern Massachusetts."
[32] Ibid.

and retail development, but may stunt the potential of this development to become a true mixed-use, 24-hour community. This vision will allow the Tri-Town Planning Coalition to achieve its stated goal of expanding the tax base for each community. The Coalition may consider expanding its vision to include a residential component in an effort to reach the housing goals of the three communities.

District boundaries

The Zoning Bylaws does not identify specific TOD Zoning Districts; therefore, there are no defining parameters for district size or boundaries.

Mix of uses

The 1992 Andover Master Plan identifies a goal of creating more mixed-use development, particularly in areas that are transitioning from obsolete and inappropriate uses. The Plan recommends identifying incentives and guidelines that could be used to encourage developers to create mixed-use developments in older historical industrial districts. The Zoning Bylaws have created a development mechanism called Planned Development – Mixed Uses to allow for the redevelopment, conversion, or expansion of existing structures to include a mixture of multi-family dwelling units with business uses. A Mixed-Use district has been created in the downtown core to facilitate development that incorporates a mix of uses, but prohibits residential uses other than single-family detached dwellings. In order to create a residential population to support both the businesses in the Mixed-Use district and increase transit ridership numbers, the Town may want to consider revising the Code to allow multi-family residential within the Mixed-Use district, or create the recommended TOD overlay district. The Town may also want to consider evaluating whether any older, obsolete industrial structures located near the rail stations could be further incentived to encourage redevelopment as a Mixed-Use Planned Development.

Development density and intensity

Andover's Zoning Bylaws express density in minimum lot areas, minimum yard depths, and maximum heights. The Single Residence C district requires a minimum lot size of approximately one acre, while the Apartment district must fulfill the requirements of the adjoining Single Residence district, although the development must provide at least 3,500 square feet per unit. No more than 12 dwelling units are allowed in any one building in the Apartment district, and buildings cannot be over three stories. This density could be increased to better facilitate TOD, increase activity in the station areas, and reduce the number of vehicles contributing to traffic congestion.

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[33] Ibid.

Regulatory and policy incentives

While the Zoning Ordinance contains mandatory affordable housing construction requirements (discussed below), the Town may consider providing density bonuses in exchange for the voluntary provision of affordable units. By providing this opportunity, the Town could target the incentives to areas near transit stations, thereby increasing density while generating ridership. The Town also provides a number of incentives for reduced parking requirements in the General Business district. The Town may want to consider expanding these incentives to other downtown districts, including the Mixed-Use district.

Design guidelines

The 1992 Master Plan recommended extending the mandatory Design Advisory Group project review to commercial and industrial projects outside of the General Business district. Specifically, the Town may consider creating a design guideline process for the Mixed-Use and recommended TOD overlay districts in order to encourage uniform, cohesive development that creates a pedestrian-friendly, human-scale environment.

Provisions friendly to bicyclists and pedestrians

The 1992 Master Plan recommended the creation of a bicycle-friendly transportation system that encourages frequent use by commuters, students, and residents. The Zoning Bylaws now include a section designed to ensure public safety by reducing the interaction of pedestrians, bicyclists, runners and recreational users with automotive traffic, reducing reliance on autos for local trips, reducing the impact of heavy traffic volumes on local roads, and encouraging linkages between neighborhoods. The Bylaws state that the goal of the Town is to "promote, whenever possible in the development process, provision for pedestrian and bicycle paths connecting residential housing, adjacent neighborhoods, school, recreational sites, open space, downtown services, places of work or any other connections which will provide safe, efficient, alternative ways of transportation and encourage a greater sense of community." As the Lowell Junction interchange project moves forward, the Town should incorporate pedestrian and bicycle linkages throughout the area to increase mobility options.

Parking

The Zoning Bylaws offer parking requirement reductions for Industrial districts, based on evidence that special circumstances have reduced the need for parking. A number of reductions are also available in the General Business district: shared parking facilities may be used if up to 50 percent of the spaces serving a building may used jointly for other uses not normally open or used during similar hours or remote parking is used by the employees and / or clientele of a commercial use. A 15 percent reduction is available if direct pedestrian access to abutting commercial areas is provided through improved pathways, stairway access, or other improvements.

Housing affordability

The 1992 Master Plan recommends promoting the development and maintenance of a variety of housing types available at all price points. The Plan specifically encourages the adaptive reuse of existing buildings, including former industrial sites, for residential use, the establishment of a Housing Trust Fund, zoning incentives to encourage the construction of affordable housing, and the development of lower density, scattered site affordable units.

The Zoning Bylaws now incorporate a number of both mandatory and voluntary opportunities to provide affordable housing units. In an effort to provide more affordable housing opportunities to seniors, 15 percent of the units developed in senior citizen assisted living facilities must be set aside as affordable for low-, moderate-, or upper-moderate-income seniors. The Bylaws also specify two types of Planned Developments that may be permitted: a Planned Development – Multifamily Dwelling (PD-MD) for the conversion of existing non-residential structures to multi-family dwelling units, or a Planned Development – Mixed Use (PD-MU) for the combination of multi-family dwelling units with business uses. In order to gain approval for proposed projects with more than three dwelling units, 15 percent of the residential units must be set aside for affordable units subsidized by either state or federal funds. Dimensional special permits for the construction of subsidized affordable housing are also available. These are designed to encourage the use of nonconforming lots for the construction of affordable housing.

In addition to existing incentives, the Town may consider offering streamlined permitting for affordable housing developers or working with banks to provide Location Efficient Mortgages to homebuyers purchasing property near a mass transit station.

Lawrence, MA

Lawrence Zoning Policies

Station area zoning

The City of Lawrence is mapped into thirteen zoning districts (three business, three industrial, three residential, and four highway / open space / water) and two overlay districts (Riviviendo Gateway and Planned Industrial). The City is divided into northern and southern halves by the Merrimack River.

Route 28, known as Broadway, and Winthrop Avenue are the main north-south arterials; I-495 runs along the eastern border of the City and has two interchanges in Lawrence. The existing Lawrence MBTA commuter rail station is located on the Haverhill Line. This line runs north from Boston until it reaches the southern edge of the Merrimack River, at which point to curves east and crosses Lawrence's border with North Andover. Lawrence is the station where the proposed eastern alignment of the rail corridor would meet with the existing Haverhill MBTA line and continue on the existing route down to Boston's North Station.

The station is located in an area that is zoned General Industrial (I2). This district allows for office, restaurant, and retail uses that are considered transit-supportive, but it does not allow residential uses, with the exception of multi-family developments by a special permit. The area is immediately abutted by a Secondary Business district, which is similar in permitted uses to I2, and Residential (R3/R4) districts, which permit the densest residential development. While these surrounding districts are within a half-mile of the station, the City may still want to consider creating a TOD overlay zone to allow for a specific mixed-use, high-density residential and commercial zone in the area immediately surrounding the station. The creation of such a district would also allow the City to offer incentives for transit-supportive development and allow the creation of design guidelines.

District boundaries

The Zoning Ordinance does not identify specific TOD Zoning Districts; therefore, there are no defining parameters for district size or boundaries.

Mix of uses

Lawrence's Zoning Ordinance contains both Mixed Use and Planned Development designations. Planned Unit Developments are defined as mixed-use developments of two or more buildings or structures on a lot that is the lesser of a minimum of 60,000 square feet or five times the minimum lot size of the base zoning district. The development mixture is residential, open space, commercial, industrial, or other uses which, when combined with the variety of building types, is "sufficiently advantageous" to receive special permission for development. Mixed use developments are similarly defined, but apply to only a single building, as opposed to two or more.

As stated above, the existing station is located in an I2 Industrial zone, which allows for some mixed-uses, although multi-family residential is allowed only by special permit. Multi-family housing is not allowed as-of-right in any zoning district: it is only available through a special permit and site plan review process.

The Zoning Ordinance specifies that mixed uses are allowed in the Business districts, but prohibited in all residential districts. This separation of uses is not particularly transit-supportive. In order to leverage the greatest economic development potential from a transit station, as well as capitalize on the opportunity to diversify Lawrence's housing stock and provide greater access to affordable housing opportunities, the City may want to consider permitting denser, multi-family housing as part of mixed-use development in the recommended TOD overlay zone.

Specifically, the 2000 U.S. Census reveals that while owner-occupied housing units account for only 32.2 percent of the total housing stock, the vacancy rate for these units was at only one percent. This extremely low vacancy rate indicates that there is demand for more homeownership opportunities than what is currently provided. The City may want to consider the possibility of incentiving the creation of for-sale condominium units in the recommended TOD overlay zone. The Monarch on the Merrimack, slated to open in October 2007, is a residential reuse of the former Wood Worsted Mill. This new loft-style condominium development is located adjacent to the Lawrence commuter rail station, and exemplifies how adaptive reuse and infill development can be useful in creating transit-supportive development in older urban areas. This type of residential development is key to revitalizing an area, but it is one component of what must be a larger, comprehensive effort to create a mixed-use, high-density, pedestrian-friendly neighborhood. Retail, office, and supportive services should be allowed at street-level on the streets within a half-mile of the commuter station.

Development density and intensity

The residential zones in the area surrounding the station are R2/R2A and R3/R4: these are the densest residential districts. The R4 zone requires a 5,000 square foot lot area, 2,500 square feet of lot area per dwelling unit, minimum frontages of 50 feet, and a maximum height of six stories / 70 feet. The majority of the parcels in the adjacent residential zones are developed, which reduces the opportunity for new, higher-density construction. The I2 and B2 districts allow multi-family residential (by special permit), and the parcels in these districts provide the greatest opportunity for infill and redevelopment. Redevelopment and new construction may be further facilitated, however, if multi-family uses are allowed as-of-right within the recommended TOD zone, subject to TOD design guidelines.

Regulatory and policy incentives

Based on the success of the Monarch on the Merrimack and similar developments, private developers could become more interested in redeveloping adjacent underutilized mills and vacant lots. This market demand could provide the City with an opportunity to create a system of incentives for developers in exchange for the provision of amenities in the public way surrounding their developments. Currently, the City does not offer any development incentives in the Zoning Ordinance. The City's Department of Community Development offers assistance programs for businesses, including the Brownfields Cleanup Incentives program and the Gateway Project. This Project is located within Lawrence's U.S. Department of Housing and Urban Development-designated Renewal Community Area, which offers businesses access to special tax incentives. This program utilizes private and public investments to revitalize the City's downtown residential, commercial and industrial centers.

In addition to these and other existing programs, the City may want to consider additional incentives. These could include Location Efficient Mortgages, which could be especially useful as Lawrence tries to increase its homeownership rate, land cost write-downs, and fast track permitting. While the private market for new housing units may be on the upswing in Lawrence, as evidenced by the Monarch on the Merrimack, the City will be instrumental in creating an environment that facilitates and sustains new and infill development.

Design guidelines

The site plan review guidelines, as currently outlined in the Zoning Ordinance, do not address the aesthetic elements of construction, which is an essential part of creating a transit-supportive environment. The recommended TOD overlay district would provide an opportunity for the City to create a series of design guidelines to encourage new and infill redevelopment that is sensitive to context, human-scaled, and transit-supportive. Mandatory design guidelines may serve to stifle development, but the provision of design suggestions and assistance with project design review may help to guide future development in a way that is aesthetically pleasing.

Provisions friendly to bicyclists and pedestrians

Lawrence's zoning ordinance does not require any provisions for bicyclists or pedestrians, although the site plan review process requires that proposed sidewalks and other amenities will provide maximum pedestrian and bicyclist safety and access. The station area is separated from surrounding residential and business areas by the track itself. This creates an unfriendly environment for pedestrians, and does not encourage passengers to arrive at the station on foot or by bike. The City could incentivize developers in the recommended TOD overlay to improve pedestrian linkages around the station area. This would be especially helpful in the area around the Parker Street underpass between Market and Merrimack Streets. A large percentage of the frontages on Parker and Market Streets are surface parking lots, which are not conducive to creating a pedestrian-friendly environment. Increased landscaping, the provision of street furniture and bike racks, and the creation of bike lanes would create an environment that would encourage pedestrian and bike use.

Parking

Lawrence's Zoning Ordinance requires that general office uses provide three parking spaces per 1,000 square feet of gross floor area and residential uses provide one parking space per one bedroom apartment and two spaces for all other types of dwelling units. These are comparatively high parking requirements, but the Ordinance does provide the opportunity to qualify for parking reductions. Planned Unit Developments and Mixed Use developments may be allowed to utilize shared parking by special permit if the developer can demonstrate that the mix of uses has different peak hours or days of demand.

The Ordinance also outlines two parking management plans that could qualify developers for a parking reduction: Parking Management Program "A" and Parking Management Program "B." Under "A", reserved parking for carpools is provided, a ride-share match-up bulletin board that also shows public transit schedules is provided on-site, an annual promotion is undertaken with the State ride-sharing program, a transportation coordinator is appointed, and an annual activity report is provided. Plan "B" includes all of the activities of "A", plus subsidizes either monthly parking charges at public transit facilities, provides vanpool passes to employees for $15 per month, or provides employee shuttle bus service. While there are some exceptions to these plans, they are a good step towards creating flexible parking requirements. As the City looks to encourage infill development, it may want to consider requirements that on-site parking be placed at the rear of the building, so as to encourage minimal lot setbacks and a pedestrian-friendly environment.

Housing affordability

As discussed above, 2000 U.S. Census data indicates that the demand for owner-occupied units is greater than the supply. Lawrence's demographic characteristics illustrate the need for a greater supply of affordable housing: households are larger than the state average (2.9 versus 2.51), median household income in 1999 was only 45 percent of the statewide median ($27,983 versus $50,502), and the percentage of persons living below poverty in 1999 was over two and one-half times greater than the statewide figure (24.3 percent versus 9.3 percent). Also, the percentage of foreign-born persons living in Lawrence in 2000 was approximately two and one-half times the statewide figure (30.6 percent versus 12.2 percent). This demographic profile demonstrates a pressing need for affordable housing. While the Lawrence Housing Authority and the City's Department of Community Development are working towards the creation of affordable housing opportunities, the City may also want to investigate increasing unit production by leveraging the emerging trend of loft redevelopment of mill facilities. The City could require developers to provide either a percentage of their units as affordable to low- and moderate-income households or pay a payment into an affordable housing trust fund for the creation of affordable units throughout the City.

The City could also provide both provide both market-rate and affordable homeownership opportunities to the residents of Lawrence through incentive packages for developers and Location Efficient Mortgages for buyers. It is especially important for low-income households to have the opportunity to live near mass transportation: increased mobility options reduce dependence on costly private vehicle ownership.

Methuen, MA

Methuen Zoning Policies

Station area zoning

Two of the prospective mass transit corridors pass through the City of Methuen: I-93 runs through the western half of the town and the potential eastern alignment rail corridor runs just east of I-93, paralleling Route 28. I-495 passes through the eastern half of the City, connected to I-93 by the east-west Route 213. There are not currently any MBTA commuter rail stations in Methuen. The rail line passes through the existing downtown, which is defined in the draft Master Plan as the Gaunt Square area, bounded by Broadway, Hampshire, and Osgood Streets. The City is mapped into 15 base districts (two conservation, seven residential, four business, one industrial, one hospital) and two overlay districts (major industrial and Ashford School Re-Use). There is no mixed-use district, but the Central Business District (CBD), which the rail line runs adjacent to, is intended to be "a place of diversity and a mixture of uses." Despite this intent, the Zoning Ordinance allows multi-family residential uses only through a special permit in the CBD, thereby greatly reducing the district's functionality as a true mixed-use zone.

The City of Methuen updated the 1986 Master Plan in 2007, an action that was undertaken because of residents' concerns regarding the pattern of development that is occurring in their community. Specifically, "traffic congestion is increasing; environmentally sensitive lands and rural areas are being proposed for residential developments; housing growth without balanced economic development is shifting property tax burdens on residents; housing is becoming less affordable; and the maintenance and upgrading of public facilities is increasingly difficult to finance…" These are all concerns that can at least be partially addressed through the decision to implement higher density, transit-supportive land use policies. Indeed, the Master Plan references the desire of Methuen's residents to have "smaller-scale, more unique stores and restaurants" than the existing downtown provides.

According to the Master Plan, the City owns 424 vacant parcels of land. While a number of these are either abutting existing municipal buildings or undeveloped due to environmental constraints or conservation, the balance represent a valuable opportunity to provide development assistance (through packaging and assembly) and development control (through deed restrictions). Additionally, the City may want to consider creating a TOD overlay zone near the prospective rail station in order to allow as-of-right mixed-use, higher-density development. Based on the recommendations of the Master Plan, the City may also want to consider implementing similar mixed-use development along major vehicle corridors, such as Routes 213 and 113.

District boundaries

The Zoning Ordinance does not identify specific TOD Zoning Districts; therefore, there are no defining parameters for district size or boundaries.

Mix of uses

One land use goal outlined in the Master Plan is to "support a mix of land uses to provide more options for residents to work and live in." Mixed-use developments are not currently allowed in any district, including the CBD, as-of-right; in the Limited Business (BL) and CBD districts, mixed-uses are allowed with a special permit. The Master Plan recommends allowing residential densities of up to 12 units per acre in the CBD. Currently, when permitted, these developments must follow the density requirements of the underlying zone.

The Code does not allow any retail, service or office uses in any of the residential districts. Only Planned Unit Developments are allowed to include up to three convenience commercial establishments per 100 dwelling units. This separation of uses is not conducive to the mixture of residential, commercial, office, and supportive services that are necessary to sustain a 24-hour, transit-oriented development. The City may want to consider implementing the recommendations of the Master Plan by allowing for residential densities of up to 12 dwelling units per acre in the CBD and in the recommended TOD overlay district.

Development density and intensity

Dimensional requirements outlined in the Zoning Ordinance define minimum lot sizes ranging from 8,000 square feet (Residential, RG and MA) up to lots over 130,000 square feet (Limited Business, certain developments in the multi-family districts). The maximum as-of-right density for any residential development is six units per acre, and the maximum height limit for any building is four stories; this does not approach the transit-supportive levels of density outlined in the first half of this memo. Minimum frontages and front- and side-yard setbacks encourage auto-dependency and strip-style development.

The Master Plan identifies new subdivisions and Chapter 40B developments (subsidized low- and moderate-income housing) on the City's east and wide sides as contributing to traffic congestion on collector streets. According to the Master Plan, 71 percent of all residential acreage is single-family, and 73.4 percent of residential development is on lots of a half-acre or less. There are two multi-family zoning districts in Methuen: MA and MB. Both allow multi-family developments by special permit only. MA requires three acre lots with a permitted density up to two dwelling units per acre. The MB district requires a one acre minimum lot and a maximum density of four dwelling units per acre. The Master Plan also comments that recent construction of senior citizen-restricted housing and 40B developments have been "cause for concern among residents," and raised questions about appropriate residential densities and usages.

Planned Unit Developments (PUDs) are allowed by the City as a means for promoting the efficient use of land. Although increased density is not permitted, with the exception of the affordable housing density bonus (described below), a 30 percent open space requirement ensures that the development will make more efficient use of the minimum 10 acre lot requirement. Mixed-use developments in the CBD and BL districts have no required minimum setbacks, but frontages that range from 80 to 100 feet are too large to encourage fine-grained, pedestrian-oriented development.

In order to allow for residential growth while addressing the concerns of residents discussed above, the City may want to consider targeting increased residential development, including affordable units, to the CBD and the recommended TOD overlay district. The City may also want to consider making multi-family developments as-of-right in the multi-family and CBD districts. The extra regulatory burden of applying for a special permit may be functioning to discourage developers from applying. The Master Plan also discusses the possibility of implementing a Transfer of Development Rights (TDR) program in order encourage the preservation of existing farm and open space. The development rights generated could be directed to areas where the City would like to generate density.

Regulatory and policy incentives

The City does not offer any regulatory or policy incentives other than an affordable housing density bonus and parking reductions (described below). The City may want to consider offering streamlined permitting for mixed-use developments or residential developments that include an affordable housing component.

Design guidelines

The City has general site plan review guidelines, but does not have design guidelines to encourage uniform, cohesive development that creates a pedestrian-friendly, human-scale environment. The City may want to consider creating voluntary design guidelines for the CBD and the recommended TOD overlay district in order to encourage uniform, cohesive development that creates a pedestrian-friendly, human-scale environment.

Provisions friendly to bicyclists and pedestrians

The Master Plan references the City's "limited and unpredictable placement of sidewalks." The Plan comments that sidewalks are in some of the older neighborhoods of Methuen, but are missing from connector corridors. The City has no existing citywide trail network, there are infrequent bicycle racks, no designated bike lanes, and children are not allowed to ride bicycles to school. The Plan recommends the creation of a city-wide bike and pedestrian plan to "create a system of off-road paths, lanes, and trails that connect destinations and provide desirable recreation opportunities." In order to support transit-oriented development, as well as increase mobility options for seniors and young people, provide recreational opportunities, and reduce congestion, the City way want to consider implementing the recommendations of the Master Plan.

Parking

Currently, the City requires two parking spaces for one- and two-family homes, two spaces for multi-family units, one space per 300 square feet for office, and one space per 250 square feet plus one space per two employees on maximum shift for retail uses. The City offers several options for reducing the parking requirement. The Special Permit Granting Authority may allow off-site parking on another lot if the use the parking is serving is not more than 200 feet from the lot. In the CBD, off-site parking is allowed within 500 feet of the principle business, and the Community Development Board may reduce the parking requirement by up to 50 percent if it is demonstrated that it is infeasible to create the required amount. Joint parking lots are available when it can be demonstrated that the combined parking needs of all uses sharing the lot will be sufficiently staggered through the day and night to meet the normal requirement for each use. In addition to this diverse array of parking reduction opportunities, but the City may want to also consider allowing parking reductions for housing developments that contain affordable units.

Housing affordability

According to the Master Plan, only 9.2 percent of the City's housing stock is subsidized with State or Federal funds, which means that developers can use Chapter 40B to bypass local zoning laws to create affordable housing units. In order to address this affordable dwelling unit shortage, the Plan goes on to recommend that the City institute a mandatory inclusionary zoning ordinance on all new residential subdivisions, especially in rural areas. The requirement would be on a sliding scale dependent on development size; the minimum affordable unit contribution would be one unit, the maximum would be six units.

The City already offers an affordable housing density bonus in multi-family developments. Four of the multi-family development types (multi-family, attached dwelling, planned unit development, and mixed-use development) allow up to 100 percent density bonuses for affordable housing; this is awarded at the discretion of the special permit granting authority. Developers must provide at least 10 percent of the units as affordable to households up to 80 percent of the area median income. The units are deed restricted in order to retain affordability through ownership changes. The Community Development Board may allow developers to pay a fee-in-lieu of constructing affordable units within developments: the amount of this fee is determined by the Board, and paid into a City-administered Affordable Housing Fund. The combination of proposed mandatory affordable requirements and voluntary incentive bonuses should be effective in helping Methuen to designate 10 percent of its housing stock as subsidized affordable. The City may also want to consider requiring affordable housing units be constructed in the recommended TOD overlay zone.

Tewksbury, MA

Tewksbury Zoning Policies

Station area zoning

Tewksbury is mapped into 12 base districts and six overlay districts. The existing Lowell line of the MBTA commuter rail slices through the western edge of the City in an area that is zoned Heavy Industrial. I-495 passes through the northwestern edge of Tewksbury, intersecting with Route 28. Route 28, also known as Main Street, is almost entirely bordered by the City's only commercially-zoned parcels. I-93 runs through the easternmost points of Tewksbury, in the area that is known as Lowell Junction. This area, as discussed in both the Andover and Wilmington sections, represents a huge industrial and commercial development opportunity.

The Merrimack Valley Economic Development Council released a whitepaper supporting the construction of a new I-93 interchange at the Junction, developed together with a new multi-modal transportation center along the Haverhill commuter rail line. In this paper, the Council states that the Town of Tewksbury rezoned land west of I-93 to allow Mills Corporation to construct a new regional, retail shopping center on the west side of I-93 when the proposed Lowell Junction interchange is constructed.[34] This area is now covered by the Highway Corridor Overlay District (HCOD) which is designed to, among other things, facilitate integrated physical design and to encourage interaction among activities located within the overlay district. This overlay specifies performance standards, which were created to establish a mechanism to both facilitate and control development.

The Council recommends a major multi-modal transit center located at the Junction, and argues that it would connect the development with residents of Lawrence, Haverhill and Bradford, where approximately 20,738 people live within a 10-minute walk to transit.[35] Furthermore, according to the Council, there are over 1,000 units of housing currently being planned or under construction within walking distance to stations in Lawrence, Haverhill, Bradford, and Andover.[36] These would all be directly linked to the Junction via train.

55 percent of Tewksbury's employment consists of retail and service jobs, and 18 percent manufacturing. Since 1995, Tewksbury has absorbed higher rates of employment and business growth than either Andover or Wilmington.[37] It is especially important, then, for Tewksbury to have an appropriate transit-supportive station area zoning plan in place to leverage the greatest possible amount of development from the new Lowell Junction interchange. The City may to consider creating a TOD overlay zone, in addition to the HCOD, in order to permit higher-density residential in a targeted area around the proposed interchange. While the area is surrounded by the Residential zone, the permitted density in this zone is not high enough to take full advantage of the development potential presented by the Junction interchange. The Tri-Town Planning Coalition, which represents officials from Andover, Tewksbury, and Wilmington, have released a vision for the area that does not include the creation of housing within the core of the new development. This decision will result in the creation of a new office and retail development, but may stunt the potential of this development to become a true mixed-use, 24-hour

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[34] Merrimack Valley Economic Development Council, "The Junction / Route 93 Development Area: Our Opportunity for Smart Growth and Regional Economic Development in the Merrimack Valley and Northeastern Massachusetts."
[35] Ibid.
[36] Ibid.

community. The existing vision will allow the Tri-Town Planning Coalition to achieve its stated goal of expanding the tax base for each community. The Coalition may consider expanding its vision to include a residential component in an effort to reach the housing goals of the three communities.

District Boundaries

The Zoning Bylaws does not identify specific TOD Zoning Districts; therefore, there are no defining parameters for district size or boundaries.

Mix of uses

Tewksbury's Zoning Bylaws do not contain a specific mixed-use district. The existing districts tend to be fairly strict in usage separation: Commercial districts only allow single-family or elderly housing by special permit, and the Residential districts do not allow for any commercial or retail uses. The major transportation intersections, including the I-495 and Route 38 interchange, are located in areas that permit only limited amounts of residential development. As discussed above, the HCOD overlay, which is located in the Junction area, does not allow for any residential uses. The Town should proactively plan for TOD-style land use in the Junction area. This could be accomplished by implementing a TOD overlay district to allow for higher residential densities and mixed uses within a half-mile radius of any proposed transit station or new interchange.

Development density and intensity

According to the Merrimack Valley Economic Development Council, after accounting for natural constrains, land along the west side of I-93 in all three communities could support about 1.85 million square feet of office, retail and industrial space and several hundred units of housing.[38] Tewksbury should conduct an evaluation of its existing Zoning Bylaws to see if existing zones are mapped in order to best facilitate and encourage this development.

The Zoning Bylaws provide a number of different high-density residential development options. Multi-family dwellings are only allowed in the Multiple Family district by special permit from the Planning Board. No more than 100 units are allowed, and commercial and industrial uses are prohibited. The maximum height of the building is 35 feet, and there cannot be more than seven units per acre, or three bedrooms per unit, or 14 bedrooms per acre. Multi-family dwelling units for people over age 55 are authorized by special permit in both the Multiple Family Residential district and the Commercial district.

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[37] Ibid.
[38] Ibid.

No more than 150 units are allowed, and no more than seven units or 14 bedrooms per acre are permitted.

The Multiple Family Dwellings in the Senior Village District / 55 (SVD/55) is an overlay district designed to allow senior citizen-designated housing in multi-family buildings zoned at higher densities than permitted in the base district. It is located at the junction of Andover and North Streets in an area whose base zone is Residential. A Senior Village Development is allowed by special permit, must be at least five contiguous acres, not taller than 2.5 stories, and no more than seven units per acre.

The Community Development District (CDD) is designed to provide an alternative to residential, institutional and public elderly housing in Tewksbury. A Community Development Project (CDP) is allowed by in the CDD subject to site plan review by the Planning Board. Each CDP must be sited on at least 12 acres, have no more than six dwelling units per acre, nor more than 2 bedrooms per unit to a maximum of 12 bedrooms per acre. 65 percent of the units per dwelling acre must be devoted to Independent Living Facility, and 35 percent must be used for Assisted Living / Long Term Care Facility.

While these districts provide a variety of options for constructing residential development, the densities that they generate are not sufficient to support a mass transit system. The Town may want to consider allowing increased residential densities in targeted areas around the Town: in existing Multi-Family districts along the Route 38 corridor or in the recommended TOD overlay in the Junction area. Currently, all multi-family residential development requires a special permit. In order to encourage development, the Town may consider streamlining the permitting process by allowing these developments as-of-right in targeted areas.

Regulatory and policy incentives

Tewksbury currently offer two density bonus incentives. One that is offered, the Historic Preservation Incentive, is designed to provide incentives and permit flexibility in the preservation of historic buildings. This incentive allows developers to receive a “one for one” density bonus for dwelling units constructed in an SVD / 55 development: for every one historic housing unit, the developer receives one bonus SVD / 55 dwelling unit. These units are not subject to the affordable housing requirements described below.

The Open Space Residential Design Special Permit (OSRD) is designed to encourage the preservation of open space by allowing greater design flexibility in residential developments. OSRDs are permitted in R40, R80 and Farming districts, and offer one additional market-rate dwelling unit in exchange for an affordable housing unit, up to a maximum 15 percent increase in allowed density. For each additional 10 percent of the site set aside as open space, a density bonus of five percent is awarded. This bonus cannot exceed 25 percent of the allowed density.

Because so much of the residential development in Tewksbury requires a Special Permit, the Town may want to consider converting a number of uses to as-of-right and control development through stricter design guidelines or performance standards. Additionally, the Town may want to consider reducing the parking requirements in targeted areas in order to encourage denser development and transit ridership.

Design guidelines

The OSRD district has the strictest design review process; the remaining districts are subject to relatively general design requirements. The Town may want to consider implementing stricter architectural design guidelines in the HCOD and multi-family residential areas in order to create visual continuity in new developments.

Provisions friendly to bicyclists and pedestrians

The Zoning Bylaws require sidewalks where necessary for safe pedestrian access and circulation, but do not outline any requirements for bicycle path provisions. In order to support transit-oriented development, as well as increase mobility options for seniors and young people, provide recreational opportunities, and reduce congestion, the Town may want to consider creating a network for pedestrian and bicycle paths. These paths could serve as connectors from the residential areas of Town to the Lowell Junction development area and increase opportunities for the use of alternative forms of transportation.

Parking

Tewksbury's Zoning Bylaws require three spaces per single-family dwelling unit, two spaces per multi-family dwelling units, one per 200 square feet of a personal service establishment, and one per 300 square feet of gross floor area for business and office uses. The Zoning Bylaws allow the Planning Board to reduce the number of parking spaces required by no more than 30 percent through the issuance of a special permit. This reduction is awarded based on documentation verifying the "special nature or use of a building." Because Tewksbury's parking requirements are comparatively high, the Town may want to consider shared parking or reduced parking requirements, particularly in the HCOD and the recommended TOD overlay district.

Housing affordability

Tewksbury requires the inclusion of affordable units in a number of different zoning districts. The Town requires that a Multiple Unit Development which receives a special permit must provide at least 15 percent of the units to households earning 80 percent of the area median income. An application for an Open Space Residential Design Special Permit will require that at least ten percent of the total units be put aside for households earning up to 80 percent of the area median income. Construction of affordable units may be waived if the developer makes an equivalent fee-in-lieu-of-units payment to the Town of Tewksbury for disbursement to the Affordable Housing Trust Fund. This Fund is available for use by the Local Housing Partnership to create affordable housing either through the purchase of land or units, or the development of new or rehabbed dwelling units.

The Bylaws also require that the ratio of three-bedroom market-rate units to three-three bedroom affordable units must be one to one in both Multiple Family and Multiple Dwelling for Persons Over 55 districts. This is important, as low-income households with children often have difficulty in finding a dwelling unit which is large enough to accommodate a family with multiple children. An application for an SVD / 55 development must include an affordable component which is determined by a sliding scale based on density.

In addition to developer-subsidized units, the Bylaws allow for the construction of cluster developments. These developments do not increase allowed density, but provide a diversity of dwelling unit sizes and price points. This diversity is important in providing housing opportunities that are affordable to all of Tewksbury's current and future residents.

Wilmington, MA

Wilmington Zoning Policies

Station area zoning

The Town of Wilmington is mapped into 12 zoning districts (five residential, three business, two industrial, and two conservation). Each of the three prospective mass transit corridors passes through Wilmington. Two MBTA commuter rail lines (Haverhill and Lowell) run on parallel north-south tracks through the Town; there are two existing commuter rail stations (North Wilmington and Wilmington), and the Anderson Regional Transportation Center is just across Wilmington's southern border. The only two areas zoned for the Central Business District (CBD) are immediately adjacent to the two commuter rail stations, and the General Business (GB) districts are located around the stations and along the main arterials leading to the stations. I-93 passes through the northeastern portion of the Town and is bordered by General Industrial (GI) and Residential (R) districts.

The CBD, GB, GI, and R districts each have strictly defined separations of usage: no residential uses are allowed in the GI district, and only certain types of residential are allowed by special permit in the CBD and GB districts. No business uses are allowed in any of the residential districts. In order to discourage the type of auto-centric sprawl development that the residents expressed disapproval of during the Master Planning process, the Town may want to consider creating a TOD overlay district that allows for a mix of residential, retail, and business uses within in a half-mile radius of both the existing commuter rail stations and the area known as the Lowell Junction Development Area.

Wilmington, like Andover and Tewksbury, is also directly affected by the proposed construction of a new I-93 interchange at the Lowell Junction Development Area. The Merrimack Valley Economic Development Council released a whitepaper supporting the construction of a new interchange at the Junction, developed together with a new multi-modal transportation center along the Haverhill commuter rail line. A major multi-modal transit center located at the Junction would connect the development with residents of Lawrence, Haverhill and Bradford, where approximately 20,738 people live within a 10-minute walk to transit.[39] Furthermore, according to the Council, there are over 1,000 units of housing currently being planned or under construction within walking distance to stations in Lawrence, Haverhill, Bradford, and Andover.[40] All of these units would be connected to the Junction via rail.

Currently, the northern tip of Wilmington, which is the area adjacent to the Lowell Junction area, is zoned GI and R. The Town may wish to continue coordinated planning efforts with Andover and Tewksbury to ensure that regional planning strategies are in place in order to best facilitate spatially-efficient, transit-supportive development in the Junction area. The Tri-Town Planning Coalition, which represents officials from Andover, Tewksbury, and Wilmington, have released a vision for the area that does not include the creation of housing within the core of the new development. This decision will result in the creation of a new office and retail development, but may stunt the potential of this development to become a true mixed-use, 24-hour community. This vision will allow the Tri-Town Planning Coalition to achieve its stated goal of expanding the tax base for each community. The Coalition may consider expanding its vision to include a residential component in an effort to achieve the housing goals of the three communities.

District Boundaries

[39] Ibid.
[40] Ibid.

The Zoning Bylaws does not identify specific TOD Zoning Districts; therefore, there are no defining parameters for district size or boundaries.

Mix of uses

The Town of Wilmington Master Plan 2001 states that while four industrial centers (Southeastern Wilmington, East Wilmington, Northeastern Wilmington, and the center of town) have emerged in Wilmington, a strong town center never emerged. The Plan attributes this failure to a lack of planning policies that promoted the development of attractive mixed-use districts: specifically, a zoning bylaw requiring 125 foot lot frontages in commercial districts encouraged auto-oriented strip developments along state highways.

The Neighborhood Business district (NB) allows for less intense uses than in the General Business district, and permits single-family dwelling units and accessory apartments. Smaller required frontages and lot sizes contribute to a denser, more residential character.

The Master Plan explains the importance of mixed-use centers in increasing economic activity, reducing automobile dependency, and fostering social interaction, and recommends that the Town consider reducing the General Business districts in order to focus activity in designated activity centers. These recommended activity centers would follow TOD planning principles of mixed-use, pedestrian-oriented development, and are specifically recommended in the Town Center.

Multi-family residential uses are permitted in the Central Business District by special permit from the Planning Board, but must be located above the ground floor in existing structures. For new, entirely residential multi-family construction in the CBD, the building must be on a lot of at least 25,000 square feet, be no more than 40 feet tall, and a density of one unit per 4,000 square feet of lot with no more than 12 units per structure.

Conservation Subdivisions, when 50 units or larger, may apply to the Planning Board to include no more than 1,000 square feet of convenience retail primarily targeted to the residents of the surrounding neighborhood. The area around the North Wilmington MBTA station also includes some mixed commercial development. Because the Town lacks a true mixed-use district, the Town may want to consider mapping the recommended TOD overlay district around existing commuter rail stations and the proposed Junction interchange.

Development density and intensity

The 2001 Master Plan states that recent residential development is the result of the subdivision of farms and forests, which has "changed the character of the formerly open spaces and unpopulated roadways."

Planned Residential Developments (PRDs) are designed to protect opening space by promoting dense development on compact sites. The minimum lot size is eight acres, and the maximum density is three units per acre. As of the 2001 writing of the Master Plan, there were no existing PRDs. This may be because they can only be created in response to a specific proposal from a developer and are classified as a rezoning, which requires a two-thirds majority of the votes in a Town Meeting for approval. The requirements of this process function as a strong disincentive to developers, thereby encouraging a pattern of sprawling, subdivision development. Conservation subdivisions are allowed in an effort to provide a development design that facilitates the preservation of open space by encouraging a more compact form of residential development.

The General Business district (GB) is the Town's main commercial district designation. The Master Plan characterizes these districts as accommodating the type of strip-mall development disliked by the residents of Wilmington. Buildings are set back from the street, only cover a small percentage of the lot, and are usually surrounded by parking. Because of this auto-centric design, buildings are not pedestrian-friendly and encourage traffic congestion. The Town may wish to encourage more pedestrian-friendly, transit-supportive development through the recommended TOD overlay district, or by increasing both the density and variety of allowed uses in the GB and GI districts.

Regulatory and policy incentives

The 2001 Master Plan comments that in the absence of higher-density zoning or incentives to develop at natural activity centers, like the CBD or Perry's Corner, developers choose to develop along roadways with fewer spatial constraints. The lack of development incentives offered by the Town, then, is directly encouraging the type of strip-mall development and sprawl that the Town is trying to avoid.

In order to protect the existing open space in Wilmington and encourage a denser pattern of commercial development, the Town may want to consider assembling and packaging smaller, infill parcels of vacant or under-utilized land for developers.

Design guidelines

The Zoning Bylaws offer only general regulations for site design standards and site plan review, which prohibits the Town from guiding new development in a manner than it is both aesthetically pleasing and pedestrian-oriented. The Town may want to consider TOD design guidelines like those used in San

Diego (discussed in the first half of this memo) in order to guide transit-supportive development in the recommended TOD overlay zone.

Provisions friendly to bicyclists and pedestrians

The 2001 Master Plan claims that existing pedestrian and bicycle facilities are inadequate, and recommends that the Town "invest in sidewalks, pathways, and other pedestrian connections that will link residential neighborhoods to school, activity centers, and employment areas."

The Zoning Bylaws state that Conservation Subdivisions shall provide walkways and bicycle paths to link residences with parking areas, open spaces, and recreation facilities, including links to off-site land uses (schools, recreation facilities, neighborhood activity centers) and existing or proposed bicycle trail networks.

Parking

The Zoning Bylaws require two parking spaces per dwelling unit, one space per 250 square feet of gross floor area in retail and service businesses, and one space per 300 square feet of gross floor area for business and professional uses. The Bylaws allow for shared parking facilities: when any land or building is used by two or more distinguishable purposes, the parking requirement is determined based on a calculation that factors in type of land usage and the time of day.

The Bylaws also offer reduced parking requirements for the CBD: retail and service businesses are required to provide one space per 400 square feet of gross floor area, and offices must provide one space per 500 square feet of gross floor area. These standards are further relaxed to 600 and 750 square feet (respectively) if the use is within 600 feet of a public parking lot of at least 60 spaces, of which at least two-thirds is two-hour parking.

Conservation Subdivisions also have reduced parking requirements if located within a half-mile of an MBTA commuter rail stations: instead of two spaces per dwelling unit, the developer must provide 1.5 off-street spaces.

The Board of Appeals may issue a special permit to allow reductions in parking requirements based on a demonstration that a proposed change in use of a building or new construction, which normally would result in a higher parking requirement, would not adversely affect the neighborhood if kept at the current levels.

While the Town currently offers a variety of parking incentives, it may want to consider proactively planning a strategy to avoid parking congestion that could occur due to increased vehicular traffic resulting from the proposed interchange in the Lowell Junction area. These strategies could be a combination of shared parking, parking requirement reductions, and parking maximums.

Housing affordability

The Over 55 Housing district contains a density bonus for the inclusion of affordable units: the total number of allowable units may be increased by 25 percent if at least 25 percent of the total number of units will be set aside as affordable. The for-sale units will be subject to contractual agreements that restrict occupancy and resale prices, thereby ensuring their long-term affordability. Additionally, the Town must be granted the right of first refusal for all affordable units that are being sold, and at least 70% of the affordable units must be initially offered to Wilmington residents.

The 2001 Master Plan recognizes that households located near mass transit stations typically save money by foregoing car ownership. In order to encourage this lifestyle choice, the Town may want to partner with banks to provide Location Efficient Mortgages for households located near either the Wilmington or North Wilmington commuter rail stations, as well as any future residential developments in the Lowell Junction Development Area.

Woburn, MA

Woburn Zoning Policies

Station area zoning

The City of Woburn is mapped into 15 base districts (four residential, four business, three industrial, two mixed-use, one office, and one open space) and two overlay districts (office park and Woburn Loop Bikeway / Greenway Overlay District). The existing commuter rail line has two stations in Woburn: Anderson Regional Transportation Center and Mishawum. The Anderson station was opened in 2001 as a multi-modal connection center servicing the Amtrak Downeaster service to Portland, Maine, the MBTA commuter rail service from Lowell into North Station, the Logan Express bus shuttle to Logan Airport in Boston, the Manchester Shuttle bus to New Hampshire's Manchester airport, the MetroNorth Shuttle which provides bus service to locations in Woburn, Burlington, and the Lahey Clinic, bicycle parking, and a 2,000 space parking lot. The Mishawum commuter rail station is located adjacent to I-95 / Route 128. I-93 briefly passes through the southeastern border of the City. The traditional downtown is located close to the geographical center of Woburn, which is not near any of these major transportation corridors. The rail line passes through mainly industrial districts and borders on some of the lowest density residential districts. While both of these stations are well-established and well-used by commuters, the City may want to investigate the possibility of creating a TOD that allows higher-density, multi-family residential and other mixed-uses within a half-mile radius of both stations. Currently, the mixed-use districts are located in the downtown core.

District boundaries

The Zoning Ordinance does not identify specific TOD Zoning Districts; therefore, there are no defining parameters for district size or boundaries.

Mix of uses

As discussed above, the Industrial and Office Space districts through which the rail line passes do not allow the mix of residential, commercial, retail, offer and supportive services that are essential to creating a TOD. The existing Mixed-Use districts currently allow for the highest density apartment developments, but should broaden the variety of commercial, retail, office, and supportive services that are allowed to operate. These districts are located in the downtown area, which, as discussed above, is removed from both of the commuter rail stations. The Industrial and Office Park districts that currently surround the stations do not allow for any residential uses and have a limited number of commercial and retail services. In order to diversify the mix of uses within a half-mile radius of the stations, the City should consider implementing the recommended TOD overlay zone.

Development density and intensity

Woburn's least dense residential zoning districts require at least a 12,000 square foot lot for detached single-family construction. This small lot size, in combination with comparatively small frontage and setback requirements, encourages a moderately dense development pattern. The first unit of an apartment development requires a 12,000 square foot lot, with 4,000 square feet for each additional unit. Apartment buildings can reach a maximum height of seven stories. This type of multi-family residential is restricted to the R-4 and Mixed-Use districts, neither of which is mapped near the commuter rail stations. This type and density of use should be permitted in the recommended TOD overlay zone to increase ridership and provide a wider variety of housing opportunities for Woburn's residents.

Regulatory and policy incentives

The Zoning Ordinance currently allows for a density bonus in cluster developments: while the general requirements state that allowed density should reflect the normal zoning requirements of the underlying district, the developer can apply for up to a 15 percent density bonus for the provision of community amenities. These include providing public access to open space for recreation, deeding land to the City for conservation, a matching of extra market-rate units with an equal number of units to be available at construction cost to the City of Woburn Housing Authority, creating a variety of price points and differently sized units to permit purchase by a broader market, or planning to include units especially suited to seniors.

This incentive, along with available parking reductions described below, are the only two regulatory or policy incentives provided for in Woburn's Code. The City may want to consider offering streamlined permitting or flexibility for multi-family developments or commercial and retail establishments in the recommended TOD overlay zone. Increased as-of-right density and assistance with land assembly would further facilitate transit-supportive development in appropriate areas.

Design guidelines

Woburn's Zoning Ordinance does not currently outline any requirements for a design review process. In order to create a more transit-supportive, pedestrian-friendly environment, the City may want to consider providing developers with voluntary designs in the Downtown Business, Neighborhood Business, and Mixed-Use districts. Also, design guidelines should be included in the creation of the recommended TOD overlay district.

Provisions friendly to bicyclists and pedestrians

The Woburn Loop Bikeway / Greenway Overlay District was created as a mechanism to encourage the redevelopment of abandoned or underutilized commercial and industrial sites. The overlay, which is drawn over the General Industrial district, permits a variety of residential uses and incorporates the Woburn Loop Bikeway / Greenway Project (WLBGP). The WLBGP is the alternative transportation corridor construction project that is proposed for the former railroad right-of-way known as the Woburn Loop. The Woburn Redevelopment Authority identifies the right-of-way as running approximately .8 miles through the center of Woburn's South End, which is the area of the City with the greatest percentage of low- and moderate-income households. The WLBGP will serve as an innovative tool to facilitate new housing and economic development opportunities in this under-utilized and blighted corridor. As the planning process for this project moves forward, the City may want to consider evaluating potential bicycle and pedestrian paths extending from the WLBGP area into surrounding neighborhoods, including the Anderson Regional Transportation Center.

Parking

Woburn requires two parking spaces per dwelling unit in all residential districts, one per 200 square feet of ground floor retail or service establishment, one per 350 square feet for the same uses above or below the ground floor, and one 350 square feet of floor area in office or professional buildings. A reduction in the number of off-street parking spaces required in the Mixed-Use districts are available through a special permit, given that the hours of parking needs for individual uses are sufficiently staggered throughout a 24-hour period. Additionally, a special permit may issued to allow off-site parking that is within 500 feet of the use it is servicing. The City may want to consider reducing residential parking requirements in the existing residential districts, as well as the recommended TOD district.

Housing affordability

Woburn's only incentive for the production of affordable housing is available in cluster developments, as described above. In order to accommodate projected growth rates and provide an even wider choice of housing stock, the Town may want to consider offering density bonuses or other regulatory incentives to encourage development in targeted areas. These incentives should be directed towards zones which allow for multi-family residential and are close to shopping, employment, recreation, and transportation opportunities. Specifically, the City may want to consider targeting affordable housing development to the area surrounding the Anderson station: easy access to multiple modes of public transit would increase a household's budget for housing and food by eliminating the financial burden of owning a car.

The Woburn Redevelopment Authority has converted vacant and underutilized space to residential use in three Woburn Square buildings. This is being funded in part through grants from the Housing Development Support Program (HDSP), administered by the Massachusetts Department of Housing and Community Development. The Pilgrim Square project restored the first floor of an abandoned building in Woburn Square for retail uses, while the upper two floors each contain two one-bedroom residential units. All four of the units will be rented to low- to moderate-income households. The 414 Main Street Redevelopment Project retained ground floor retail space and created three one-bedroom residential units on the second floor of the building. The Moore & Parker Redevelopment Project is currently in the design phase. It is slated to include ground floor retail and five one-bedroom units to be constructed on the upper two floors. The rent established for all units will be affordable to households at 65 percent of the area median income. These efforts represent an innovative and effective way to rehab vacant buildings while encouraging retail and affordable rental housing opportunities.

APPENDIX F
PUBLIC INVOLVEMENT PLAN

NEWS RELEASE

STATE OF NEW HAMPSHIRE, DEPARTMENT OF TRANSPORTATION
Charles P. O'Leary, Commissioner

For Immediate Release
October 29, 2007

Contacts: Ram Maddali
NHDOT Planning Bureau
(603) 271-6581
Paul Nelson
Massachusetts Executive
Office of Transportation
(617) 973-7479

PUBLIC MEETINGS SCHEDULED FOR I-93 TRANSIT STUDY

DISCUSSING OPTIONS FOR BOSTON - MANCHESTER CORRIDOR

The New Hampshire Department of Transportation (NHDOT) and Massachusetts Executive Office of Transportation (MA EOT) will hold two public meetings to review findings of the I-93 Transit Investment Study. The purpose of these meetings is to hear ideas and suggestions from the general public in both states that will help to inform the development of the strategic plan.

The two-year study has identified possible transit service opportunities within the I-93 Corridor between Boston, Massachusetts and Manchester, New Hampshire. The study team has analyzed a range of alternatives, including rail, bus, and ride-sharing. The study has reviewed local land use policies that impact on growth in the region and the potential for transit-friendly land use.

The public meetings will be held on the following dates:

- Tuesday, November 27, 2007 from 6:00 PM – 8:00 PM at Memorial Hall Library, 3 Main Street, Andover, Massachusetts, and
- Wednesday, November 28, 2007 from 6:00 PM – 8:00 PM at Salem High School, 44 Geremonty Drive, Salem, New Hampshire.

Potential transit alternatives will be presented and discussed at both of the public meetings. Conceptual station area land use alternatives will also be presented as examples of how transit use may be encouraged. The presentation material will be identical at each of the meetings. Study information can also be viewed and comments can be submitted on the project website at www.i93transit.org.

Directions to Memorial Hall Library in Andover can be found at http://www.mhl.org/about/visit/directions.htm?section=3.2. Directions to Salem High School can be found at http://www.salemschooldistrictnh.com/schools/shs/directions.htm. For further information on the I-93 Transit Investment Study, visit the web site or contact Ram Maddali, Bureau of Planning and Community Assistance, New Hampshire Department of Transportation, email: rmaddali@dot.state.nh.us.

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I-93 Transit Investment Study
Public Involvement Plan
November 10, 2006

Purpose

The I-93 Transit Investment Study will identify a long-term vision of transit investments that are needed and feasible to accommodate future travel demand in the I-93 corridor from Boston to Manchester, New Hampshire. The study will also determine when and how those investments should be implemented. The study will include three phases. Phase 1 will include the developing of the Purpose and Need statement, setting goals and objectives, identifying issues, developing and implementing a Public Involvement Plan, collecting and analyzing data, and developing the initial alternatives. Phase 2 will include refining alternatives, developing draft recommendations, and developing the travel demand model and alternative analysis. Phase 3 will include developing and presenting a strategic plan.

This Public Involvement Plan outlines how New Hampshire Department of Transportation (NHDOT), in cooperation with Massachusetts Executive Office of Transportation, and the project team will inform and seek input from the communities, residents, and traveling public. Many approaches will be used to let people know what is happening throughout the study and there will be numerous opportunities for discussion and comment. Public opinion and comments will be documented and considered in the development of recommendations for transit alternatives.

Public Participation Principles

The public involvement plan has been developed to support civic engagement in the study by emphasizing the following principles:

- <u>The public shall have adequate access to information</u>: A record of all public, Stakeholder Committee, and Technical Advisory Committee (TAC) meetings will be kept. Technical documents will be placed in locations available to the public.

- <u>The public shall have clarity in the information presented to them</u>: Technical information and regulatory procedures will be presented in terms that are understandable to the public.

- <u>The public shall be able to engage with a responsive and timely project study team</u>: The public, Stakeholder Committee, and TAC will receive sufficient notice of meetings, which will be scheduled at a time and place that is convenient and comfortable. Ample time to review any materials will also be provided. All public questions and inquiries will be answered in a timely manner.

- <u>The public shall be able to participate in a process that is well coordinated</u>: Good coordination, communication, and collaboration among all concerned agencies and community organizations will be critical to providing the public with the most current and correct information and the overall success of the project.

Key Elements of Plan

The Public Involvement Plan has a number of elements to inform and involve the public in a meaningful way. The study team will be accessible to the public, share information in a complete and understandable manner and record and responds to public comments and concerns. Key elements of the Plan include:

1. Technical Advisory Committee

Staff from the following governments and agencies will be identified to serve on the Technical Advisory Committee:

- NHDOT
- Massachusetts Executive Office of Transportation
- Federal Highway Administration
- Federal Transit Administration
- Rockingham Planning Commission
- Southern New Hampshire Planning Commission
- Nashua Regional Planning Commission
- Northern Middlesex Council of Governments
- Boston Metropolitan Planning Organization
- Merrimack Valley Regional Planning Commission
- Merrimack Valley Regional Transportation Authority
- Massachusetts Highway Department
- Massachusetts Bay Transportation Authority
- U.S. Environmental Protection Agency
- Other potential relevant local, state, or federal agencies and transportation providers

The TAC will provide oversight, direction, and review for the study.

The project study team will take a collaborative approach with the TAC. It will fully share study documents as they are developed. Materials will be sent to the committee in advance of the meeting to allow adequate time for review. TAC members will be asked to bring concerns and insights for discussion by the committee and project study team. Alternatives and impacts will be examined as the study progresses. TAC members will also be asked to assist the project study team in conducting outreach by identifying issues, information resources, key individuals, and public, and committee meeting locations.

The TAC will meet every other month or as needed during the course of the study. The meetings will be linked to project milestones. Some meetings will include agenda items or breakout sessions on topics that may require more specificity and discussion. Such topics include transportation modeling and the federal New Starts program.

2. Stakeholder Committee

The Stakeholder Committee membership will be broader than that of the TAC. In addition to government and agency staff, the Stakeholder Committee will include members of businesses, interest groups, and the public who lives and travels the I-93 Corridor. Examples of groups represented on the Stakeholders Committee include:

- Concord 2020
- Greater Manchester Chamber of Commerce (Metro Center)
- NH Railroad Revitalization Association
- Boston - Manchester Regional Airport
- Association for Public Transportation
- New England Council
- Intercity bus trade association
- Railroads and freight interest groups

The Stakeholder Committee will provide input to the project study, including the vetting of early alternatives analysis. The committee will have discussions related to specific topics as well as at major project milestones. Specific topics for meetings (or breakout sessions for meetings) will likely include transportation modeling and the federal New Starts program. These meetings are intended to be attended by a consistent group of people, a committee. The Stakeholder Committee will meet approximately three times or as needed during the course of the study. The project team will coordinate the efforts of the Stakeholder Committee with the input and assistance [efforts] of the TAC.

3. Public Meetings

The project team will hold five (5) public meetings during the course of the study. The first two meetings will be held in Phase 1. One meeting will be held in Massachusetts and the other will be held in New Hampshire. The project team will present information developed thus far and will review the work planned for phases two and three of the project. Two (2) public meetings will occur in Phase 2 of the study to present the preliminary alternatives analysis and recommend alternatives for further evaluation. One meeting in Phase 2 will be held in Massachusetts and the other will be held in New Hampshire. Finally, one public meeting will occur in Phase 3 of the study. This meeting will allow the public to review information and comment on the strategic plan.

The format for the public meetings will allow for public review of documents, opportunities for one-on-one discussion with members of the project study team. A short, informal presentation followed by a question and answer period can be conducted if attendees are interested. If attendees are not interested in viewing a presentation, they can simply ask the staff one-on-one questions. There will be display materials that are graphically rich, written in clear language, and easy for the public to understand at the meetings. Display materials may include such things as maps, timelines, and/or visualization tools where feasible within the project budget.

4. Website

Project websites are an effective way to support public participation efforts for transportation projects. A project website, www.i93transit.org, will be developed at the beginning of the project. This site will:

- Follow the progress of the study,
- Advertise meetings,
- Provide links to other area organizations and studies,
- Provide access to minutes of meetings and documents,
- Provide monthly project updates, and
- Allow people to make comments and ask questions.

Additional Elements of Plan

The project study team will also utilize other means and methods to inform and involve the public. These additional elements include:

- Project Newsletters / Fact Sheets: The project team will prepare and mail project updates over the course of the project. If there are no substantial updates in a quarter, the product will be a fact sheet. The fact sheet may cover a significant process, technology, or study area that is critical to the study's completion.
- Media – Outreach: The project study team will reach out to the media in advance of public meetings to provide notice of the upcoming meetings. A press kit will be provided to the media for each public meeting to provide background material and status of the study as well as information on how to reach key contact people associated with the study.

- Focused Stakeholder Meetings: The project study team will contact and meet with interested parties collectively or individually as appropriate during Phase 1. Interested parties may include representatives of government agencies, interest groups, and businesses, as well as the public.
- Community Events and Meetings: Members of the team may reach out to people by going to where groups are already gathered and distributing information on the study. For example, team members may attend events such as town or county fairs and set up a kiosk and/or hand out newsletters and fact sheets. Other events team members may also attend / participate in include Community Technical Assistance Conferences and Chamber of Conference meetings. Public radio is another means to disseminate information about the project.

Timeframe

- The TAC will meet every other month as needed during the course of the study. The meetings will be linked to project milestones.
- The Stakeholder Committee will meet approximately three times over the course of the study as needed during the course of the study. The meetings related to specific topics as well as be linked to project milestones.
- Two public meetings are scheduled for February / March 2006 and two are scheduled for September / October 2007. One final public meeting is scheduled for January 2008.
- There will be approximately twenty focused stakeholder meetings during Phase 1 of the project study.
- Materials to review for meetings will be posted to the project website ahead of the meeting.
- Reports on public meetings will be posted within 2 weeks after the meetings have been held.
- Newsletters / project updated will be prepared and mailed quarterly, totaling 6-8 updates per year.

I-93 Transit Investment Study – Meetings Summary

Project Kick-Off Meeting Tuesday, August 1, 2006 10:00 AM Nashua Regional Planning Commission
Technical Advisory Committee Meeting Tuesday, September 19, 2006 10:00 AM Nashua Regional Planning Commission
Technical Advisory Committee Meeting Tuesday, November 7, 2006 10:00 AM Nashua Regional Planning Commission
Technical Advisory Committee Meeting Summary Thursday, February 15, 2007 1:00 PM Massachusetts Executive Office of Transportation
Technical Advisory Committee Meeting Summary Thursday, June 21, 2007 1:00 PM Merrimack Valley Planning Commission
Technical Advisory Committee Meeting Summary Thursday, September 27, 2007 1:00 PM New Hampshire Department of Transportation
Technical Advisory Committee Meeting Summary Wednesday, March 26, 2008 2:30 PM Massachusetts Executive Office of Transportation, Boston

Technical Advisory Committee Meeting Summary Thursday, June 12, 2007 8:30 AM Salem Town Hall
Technical Advisory Committee Meeting Summary Tuesday, August 26, 2007 9:00 AM Southern New Hampshire Planning Commission
Stakeholder Group Meeting Summary Wednesday, March 28, 2007 5:00 PM Sal's Riverwalk Conference Center 354 Merrimack Street, Lawrence, Massachusetts
I-93 Transit Investment Study Public Meeting Summary of Comments April 10, 2007 Methuen City Hall, Methuen, MA
I-93 Transit Investment Study Public Meeting Summary of Comments April 11, 2007 Derry Municipal Center, Derry, NH
I-93 Transit Investment Study Summary of Comments November 27, 2007 Andover Public Library, Andover, MA
I-93 Transit Investment Study Summary of Comments November 28, 2007 Salem High School, Salem, NH

I-93 Transit Investment Study Public Meeting – October 1, 2008, 6 p.m. Manchester City Hall Manchester, NH
I-93 Transit Investment Study Public Meeting – October 2, 2008, 6 p.m. Methuen City Hall Methuen, MA

I-93 Transit Investment Study

Project Kick-Off Meeting
Tuesday, August 1, 2006
10:00 AM

Nashua Regional Planning Commission

Attendance

People who signed in:

Andrew Motter	Federal Transit Administration (FTA) Region 1
Camille Pattison	Nashua Regional Planning Commission (NRPC)
Steve Williams	NRPC
Lynn Ahlgren	Massachusetts Executive Office of Transportation (EOT)
Stephen Woelfel	EOT – Transit Planning
Rosemary Monahan	U.S. Environmental Protection Agency (U.S. EPA)
Cliff Sinnott	Rockingham Planning Commission
Chris Curry	Northern Middlesex Council of Governments (NMCOG)
Paul Hajec	NMCOG
Arthur Cunningham	Conservation Law Foundation
Bill O'Donnell	Federal Highway Administration (FHWA) – New Hampshire
Kit Morgan	New Hampshire Department of Transportation (NHDOT)
Ram Maddali	NHDOT
David Preece	Southern New Hampshire Planning Commission (SNHPC)
Tim White	SNHPC
Tony Komornick	Merrimack Valley Planning Commission (MVPC)
Bill Cass	NHDOT

Consultant Staff:

Ken Kinney	HNTB Corporation
Marcy Miller	Fitzgerald & Halliday, Inc.
Dennis Coffey	HNTB Corporation
Joe Castiglione	Parsons Brinckerhoff (PBC)

Welcome and Introduction of Consultant

Ram Maddali welcomed everyone to the I-93 Transit Investment Study kick-off meeting. He started by thanking everyone for attending and asked that everyone introduce themselves to the group. After introductions, Mr. Maddali provided copies of the scope to those who did not have them. He then turned the meeting over to Ken Kinney, who gave a presentation on the project study approach, work plan, and schedule.

Study Approach, Work Plan, and Schedule

Mr. Kinney began his presentation by discussing the team structure. He identified the different consultants working on the project team and what their roles are. HNTB will primarily be responsible for project management, project administration, agency coordination, and the alternatives analysis. Parsons Brinkerhoff will primarily be responsible for the regional model, ridership forecasts and transit analysis. Fitzgerald & Halliday will be responsible for community outreach, project communications, and agency coordination. Edwards and Kelcey will be responsible for transit alternatives and corridor analysis.

Mr. Kinney next addressed the topic of the decision-making process and committee roles. He discussed the management committee, which will include Massachusetts EOT and NHDOT. He described the role of the Technical Advisory Committee (TAC), which is to provide oversight, direction, and review. Most of the representatives that are attending today's meeting will be on the TAC, and will meet approximately every other month, or as needed. The Stakeholder Committee will provide input to the process. Rosemary Monahan from U.S. EPA stated that she liked this description of committee roles better than what is listed in the scope. There is too much overlap between the two committees as it is listed in the scope. Another suggestion was that Barbara Lucas from Metropolitan Area Planning Commission should be asked to participate on the TAC.

Andrew Motter from FTA asked how the public meetings would fit into the committee processes. The team stated that they would go through this in detail when discussing the public involvement process. There were concerns about how this process will coincide with the Community Technical Assistance Program (CTAP) process as some projects from CTAP may become part of this process and vice versa. Mr. Motter questioned whether people in CTAP are considered stakeholders. Most agreed that the answer was yes because the members of CTAP live in the corridor.

The next item that Mr. Kinney addressed was key issues. He stated that there are no favored corridors and that all have significant strengths and weaknesses. Another key issue will be the definition of the study area. Joe Castiglione from Parsons Brinckerhoff discussed this further stating that the model would need to be expanded to Concord, NH. This will require the team to gather data from the regional planning agencies.

Mr. Kinney then provided a brief description of the study scope. Meeting participants had copies of the scope. Mr. Kinney discussed the three different phases of the project and what will occur in each Phase. Phase 1 will include the developing of the Purpose and Need statement, setting goals and objectives, identifying issues, developing and implementing a Public Involvement Plan, collecting and analyzing data, and developing the initial alternatives. Phase 2 will include refining alternatives, developing draft recommendations, and developing the travel demand model and alternative analysis. Phase 3 will include developing and presenting a strategic plan. He stated that the financial analysis will be a critical issue and will be addressed in Phase 3. Mr. Kinney stated that the team is interested in tapping into the expertise of this group as many of them have worked on other local reports. Rosemary Monahan agreed that this group will be able to make suggestions as to who would be interested in individual meetings with the project team. Mr. Kinney wrapped up this discussion with the initial tasks that the team will get started on. These are to review existing studies, evaluate existing data, research legal policies, develop outreach plan, develop a project website, conduct stakeholder meetings, identify the initial alternatives, and develop the baseline land use report and TDF.

There was a concern about the lack of track capacity for additional passenger rail services at North Station. Mr. Kinney responded that the team does not plan on doing a computer based capacity analysis of the station but will qualitatively look at this if it is a deciding factor.

Public Involvement Plan

Marcy Miller introduced herself and stated that Fitzgerald & Halliday will develop a Public Involvement Plan over the next month. Ms. Miller went over items that the plan will likely include.

The plan will include public meetings. There will be two meetings early in the project study. One of these Phase 1 meetings will be in New Hampshire and one will be in Massachusetts. The other two meetings will occur later in the project, during Phase 3. The plan will also include the development of a website. The website will include background materials on the study and links to other reports and documents. The website will also include a meetings calendar, agendas, and meeting summaries, as well as a place for viewers to submit comments on the study. The study team will also produce quarterly newsletters or fact sheets. There will likely be between six and eight newsletters produced over the course of the study.

The team is also thinking of and taking suggestions on other means to gather input on the study. Ms. Miller suggested a number of non traditional methods that could be used including town/county fairs, chamber meetings, kiosks, and public radio. Meeting attendees offered a few other suggestions including:

- Presenting to the State legislature in the Spring,
- Handing out flyers at the dump on a Saturday,
- Use local/regional public and commercial radio
- Parallel efforts with the I-93 CTAP

Finally, Ms. Miller suggested that the team will work closely with the Technical Advisory Committee and the Stakeholder Committee. The members of these committees could act as ambassadors, relaying information to-and-from their respective organizations.

Suggested Next Meeting Date

The group agreed that Tuesday morning is a good day to have meetings. Participants agreed that NRPC was a good central location, though others offered to host a future meeting. Tony Komornick from MVPC offered to host a future meeting. The group tentatively scheduled the next meeting date for September 19, 2006. There was a request to discuss how land use assumptions are going to be made and evaluated at this meeting. Joe Castiglione from Parsons Brinckerhoff indicated that this will be part of the sensitivity testing, but could be discussed further at the September meeting.

I-93 Transit Investment Study

Technical Advisory Committee Meeting
Tuesday, September 19, 2006
10:00 AM

Nashua Regional Planning Commission

Attendance

People who signed in:

Andrew Motter	Federal Transit Administration (FTA) Region 1
Steve Williams	Nashua Regional Planning Commission (NRPC)
Lynn Ahlgren	Massachusetts Executive Office of Transportation (EOT)
Stephen Woelfel	EOT – Transit Planning
Cliff Sinnott	Rockingham Planning Commission
Chris Curry	Northern Middlesex Council of Governments (NMCOG)
Paul Hajec	NMCOG
Tom Irwin	Conservation Law Foundation
Bill O'Donnell	Federal Highway Administration (FHWA) – New Hampshire
Kit Morgan	New Hampshire Department of Transportation (NHDOT)
Ram Maddali	NHDOT
Matt Caron	Southern New Hampshire Planning Commission (SNHPC)
Tim White	SNHPC
Bill Cass	NHDOT
Jim Gallagher	Metropolitan Area Planning Commission

Consultant Staff:

Ken Kinney	HNTB Corporation
Marcy Miller	Fitzgerald & Halliday, Inc.
Ken Livingston	Fitzgerald & Halliday, Inc.
Dennis Coffey	HNTB Corporation
Joe Castiglione	Parsons Brinckerhoff (PB)
John Weston	PB
David Nelson	Edwards & Kelsey (E& K)
Yawa Duse-Anthony	E& K
Essek Petrie	HNTB

Welcome and Introduction of Consultant

Ken Kinney welcomed everyone and asked that each individual introduce him or herself. He proceeded to review the agenda for the meeting and the proposed final products of the study. He asked the project team members to provide brief overviews of progress on initial study tasks.

Initial Study Tasks

Essek Petrie, of HNTB, gave an overview of the review of existing condition reports and studies. HNTB is in the process of collecting and synthesizing the reports and has a good start on the population and employment data for the region. He presented the bibliography that lists and provides links to many of these existing reports.

Joe Castiglione, of PB, then gave a review of the model development to date. The Team will expand the Nashua model, which was developed for the Boston to Nashua Commuter Rail Study. Mr. Castiglione discussed geographic challenges of identifying potential ridership. He discussed user benefits measures. While identification of user benefit are not a required component of this initial study, Joe suggested it may be in the best interest of the Study, should the selected transit project become a candidate for New Starts funds. The Team will also be reviewing the New Hampshire DOT statewide transportation model over the next few weeks. This model will be evaluated to see if the level of detail and coverage is sufficient for this Study or if additional zonal detail information will be required.

Marcy Miller, of FHI, provided a review of the public involvement efforts thus far. The Draft Public Involvement Plan is currently being reviewed by the Management Committee. Ms. Miller went over the purpose of the plan as well as items that the plan includes. The plan includes four major guidelines which should be adhered with throughout the Study. They include:

- access to information,
- clarity in information,
- a responsive and timely project team, and
- a well coordinated process.

Ms. Miller proceeded to describe the components of the plan. The major components include the TAC, Stakeholders Committee, public meetings, and website. She stated that there will be two meetings early in the study. One of these Phase 1 meetings will be in New Hampshire and one will be in Massachusetts. Two additional meetings will occur later in the project, during Phase 3. A member of the TAC questioned when the first public meetings would be held. The team responded dates would be determined in the coming weeks as the overall study schedule is finalized by the Management Team. FHI has developed a draft project website, which is currently under review by the Management Committee. The website includes background materials on the study, links to other reports and documents, agendas, and meeting summaries, as well as a place for viewers to submit comments on the study.

Ms. Miller discussed other public involvement mechanisms and their timelines that the team will use over the course of the study. These include fact sheets, media outreach, focused stakeholder meetings, and community events. The study team will soon begin producing the first quarterly fact sheet. There will be between six and eight newsletters produced over the course of the study.

Stakeholders Meetings

Ken Kinney provided a summary of the individual stakeholder meetings held to date. He specifically spoke of meetings the team had with Manchester and Windham. Manchester appears to be supportive of transit oriented development and supports developing at the high land use densities that can support transit. Mr. Kinney noted that there was a general interest and excitement among the towns at the opportunities rail service could provide and a concern that towns would be at a disadvantage if they miss out on the opportunity for commuter rail or similar "high service transit" options. There was also interest to tap into the Boston and Manchester airport travelers.

Windham described traffic as being a major issue. They have a large number of residents commuting into Boston and surrounding towns. They view their town center plan as fairly dense and do not believe there would be local support for increasing those densities to the level that are traditionally associated with transit. Staff also noted that part of the Manchester and Lawrence (M & L) Rail right-of-way was paved as a bike trail. The town intends to use this right-of-way for transit at some point and does not see a problem with the two modes sharing the right-of-way, or perhaps replacing the bike trail entirely with transit. Windham has an understanding of growth impacts on I-93 and of the potential local costs to address those impacts. They plan to participate in the December 2nd CTAP conference.

Conceptual Transit Alternatives

David Nelson, from E & K, discussed previous work completed on transit corridor alignments, including the Manchester and Lawrence, Nashua, I-93 Corridor, North Station access, 128/495 distribution, and Manchester airport. He discussed in more detail three potential rail corridor alignments. The Eastern corridor would go from Manchester to Lawrence on the abandoned Manchester and Lawrence branch (M&L), where it connects with the existing MBTA Haverhill Line to MBTA Wildcat Branch to MBTA Lowell Line to North Station. The Highway corridor would use the I-93 right-of-way south from Exit 5 to a point near Rockaway Park, where it would connect to the M&L and reaching North Station on the same alignments as the previous option. The Western corridor would go from Manchester to Lowell on the B&M New Hampshire Main Line. From Lowell to North Station, it would use the existing MBTA Lowell Line. He discussed the services with each of these corridors and the potential travel times. Study team members and some TAC members noted that the projected travel times would not be acceptable to the public, especially if they have to change modes to complete their trips.

David and Ken also discussed the challenge of radial trips and the problems of dealing with them, especially in the I-495 and Rt. 128 regions. Other issues discussed included:

- The potential to toll POV's or SOV's using the transit lanes to help subsidize the transit service.
- The need for a 1000-foot long tunnel (estimated cost $1000 per foot) under the extended east-west runway at Manchester Airport or the placement of a station at the south end of the north-south runway with use of the vehicular tunnel in that area. These are serious logistic problems to providing reasonable access to the terminal.

The Purpose and Need Statement will be important in defining alternatives and eventually a preferred alternative.

Next Steps and Meeting Dates

The group tentatively scheduled two meeting dates in November, the 7th and the 28th. The team will review existing studies and reports by then and will have gathered more data for the model. The team intends to have the first fact sheet available for distribution at the CTAP conference. The meetings will be at 10:00 AM. The location is to be determined.

I-93 Transit Investment Study

Technical Advisory Committee Meeting
Tuesday, November 7, 2006
10:00 AM

Nashua Regional Planning Commission

<u>Attendance</u>

People who signed in:

Steve Williams	Nashua Regional Planning Commission (NRPC)
Lynn Ahlgren	Massachusetts Executive Office of Transportation (EOT)
Paul Hajec	Northern Middlesex Council of Governments
Bill O’Donnell	Federal Highway Administration (FHWA) – New Hampshire
Kit Morgan	New Hampshire Department of Transportation (NHDOT)
Ram Maddali	NHDOT
Matt Caron	Southern New Hampshire Planning Commission (SNHPC)
Tim White	SNHPC
Anthony Komornick	Merrimack Valley Planning Commission
Rosemary Monahan	U.S. Environmental Protection Agency

Consultant Staff:

Ken Kinney	HNTB Corporation
Marcy Miller	Fitzgerald & Halliday, Inc.
Dennis Coffey	HNTB Corporation
Ron O’Blenis	Parsons Brinckerhoff (PB)
Essek Petrie	HNTB

Welcome and Introduction of Consultant

Ken Kinney welcomed everyone and asked that each individual introduce him or herself. He reviewed the agenda for the meeting. He distributed a draft schedule to the TAC for their review and comment. The schedule will be on the agenda at the January meeting when more time would be allotted to discussion. In the meantime TAC members should provide comments via e-mail to the project team. He stated that the draft schedule would also be reviewed, and possibly revised, by the management committee before the January TAC meeting.

Initial Study Tasks

Ken asked the project team members to provide brief overviews of progress on initial study tasks.

Marcy Miller, of FHI, provided a review of the public involvement efforts that have occurred since September. FHI has completed two press releases, one for the project launch and one for the website launch. Both releases are with the state Departments of Transportation. FHI has also completed a draft fact sheet. This has been reviewed by the Management Team. Some edits still need to be made related to formatting. However, the fact sheet should be available to be distributed at the December 2 CTAP Conference. Marcy stated that FHI had a conference call with staff at NHDOT to discuss some unresolved comments on the Draft Public Participation Plan. The Plan will be revised to reflect these changes. Lastly, Marcy reviewed the website format and asked for comments on this format. Ram Maddali, of NHDOT, suggested that FHI review the welcome to see that the language was consistent with changes made to the fact sheet and other documents. There was a question about whether it is necessary to have Ram's contact email as well as the comment form. After some discussion, most agreed that this was helpful if someone wanted to send an attachment or wanted to e-mail the project manager specifically. It was noted that the illustration on the opening page was not applicable – a new illustration will be used.

Ron O'Blenis, of PB, provided an update of the model development efforts. The Team is expanding the Nashua model, which was developed for the Boston to Nashua Commuter Rail Study. They expect to wrap up this effort in January after which the model will be used to evaluate various alternatives. There were no comments or questions on this effort.

Essek Petrie, of HNTB, stated that they are in the process of analyzing MBTA commuter rail line boardings on the Haverhill and Lowell lines. They will soon look at these trends and relate them to I-93 travel and the land use in the corridor. He provided information on land use and land use policies in the communities along potential transit corridors. He presented population and employment estimates for the present and future (2030). There were some questions as to what the sources were. Essek stated that the estimates were a compilation of CPTS, MVPC, NMCOG, and NHDOT estimates. There were some concerns among TAC members because of differing views of expected relationships between jobs and households future projections. It was suggested that the study team also consider CTPT estimates.

Essek discussed the zoning and land use policies for each of the communities on the two rail corridors (the western corridor – the current Lowell line, and the M&L branch). Ram asked if this level of detailed analysis was going to be done for every community in the study area. Essek replied that it will be done only for those communities located directly on a transit line. The analyses for other communities in the study area would be less detailed. It was mentioned that the population densities for Salem, Derry, Atkinson, and Windham seemed much too high. Ram questioned whether it would be beneficial if Essek provided a table that included the source data to the TAC members. The consensus was that this would be helpful and Essek said that he would provide this information.

Ram questioned if there are population and employment criteria for New Starts funding. Ken Kinney answered that no there are no fixed requirements. He stated that at some point in this project study, there would be a session or agenda topic on New Starts funding.

Essek continued through each of the communities along the transit corridors. Communities discussed included Lowell, Chelmsford, Tyngsboro, Nashua, Merrimack, Bedford, Manchester, Hooksett, Bow, Concord, Lawrence, Methuen, Salem, Windham, Derry, and Londonderry. He discussed the percentage and type of housing in each community, as well as the physical and institutional potential for transit oriented development. There was a question if any of these communities have changed their zoning as a result of this study

Rosemary Monahan questioned the analyses in Bow and Concord and whether it was useful to consider stations in these communities also. After considerable discussion, it was agreed upon that the intent of the project was to look at these towns as market areas for the Manchester station (the end of the line). Increasing the study area to include stations in these towns would require an expansion in the model further north of Concord, which is not part of this study.

Stakeholders Meetings

Ken Kinney provided a summary of the on-going stakeholder meetings. He specifically spoke of meetings the team had with Derry and the Manchester - Boston Regional Airport. Some of the points that were raised in the Derry meeting included:

- Derry is becoming a suburb of greater Boston. Thirty-five percent of Derry residents commute to Massachusetts, many to the 495/128 corridor.
- There is an identified need to provide more information to elected planning board members about TOD concepts.
- There is support for rail, except probably from some adjacent property owners.

Points raised in the Manchester – Boston Regional Airport meeting included:

- The airport and Southwest Airlines support rail service to the airport.
- Twenty percent of the airport's passengers are from Massachusetts.
- There are serious challenges to development of an airport station.
- Off-site airport station has potential (but travelers want transit service to get then "to" their destination, not near it.)

TAC Member Comments

- Rosemary Monahan noted the recently published Harvard study (Taubmann Center – graduate student report) of commuter rail and land use impacts. (This study will be included on the project web site.)
- Steve Williams noted that characteristics of commuter rail services vary with distance – the currently planned Nashua service extension is about 10 miles from the existing terminus. Manchester is an additional 19 miles, and Concord would add another 20 miles. The typical "acceptable" commuter rail time is 1 hour.
- RE use of the M&L branch – Bill O'Donnell noted that the new Lawrence inter-modal center would require backtracking – however, it was agreed that any service on the M&L could skip Lawrence.

Next Steps and Meeting Dates

Ken Kinney and Ram Madalli noted that the next meeting will be held in mid-January at a location in Massachusetts. The exact meeting date in not known yet. Web site and e-mail notices will be sent to all.

I-93 Transit Investment Study

Technical Advisory Committee Meeting Summary
Thursday, February 15, 2007
1:00 PM

Massachusetts Executive Office of Transportation

Attendance

TAC members who signed in:

Lynn Ahlgren	Massachusetts Executive Office of Transportation (EOT)
Paul Hajec	Northern Middlesex Council of Governments
Bill O'Donnell	Federal Highway Administration (FHWA) – New Hampshire
Kit Morgan	New Hampshire Department of Transportation (NHDOT)
Ram Maddali	NHDOT
Bill Cass	NHDOT
Matt Caron	Southern New Hampshire Planning Commission
Anthony Komornick	Merrimack Valley Planning Commission
Rosemary Monahan	U.S. Environmental Protection Agency
Andrew Motter	Federal Transit Administration – Region 1
Cliff Sinnott	Rockingham Planning Commission
Dennis DiZoglio	Merrimack Valley Planning Commission
Jim Gallagher	Metropolitan Area Planning Council
Bruce Kaplan	Boston Metropolitan Planning Organization - Central Transportation Planning Staff

Other attendees:

Former.Mass. State Rep. John A Businger	National Corridors Initiative
Tom Irwin	Conservation Law Foundation
Arthur B. Cunningham	Sierra Club

Consultant staff:

Ken Kinney	HNTB Corporation
Marcy Miller	Fitzgerald & Halliday, Inc.
Dennis Coffey	HNTB Corporation
Addie Kim	HNTB Corporation
John Weston	Parsons Brinckerhoff (PB)
David Nelson	Edwards & Kelsey (E& K)
Yawa Duse-Anthony	E& K

Welcome and Introductions

Lynn Ahlgren welcomed everyone and asked that each individual introduce him or herself. Ken Kinney reviewed the agenda for the meeting. The three items to be discussed include the draft purpose and need statement, initial transit alternatives, and the upcoming public meetings.

Purpose and Need

Ken Kinney used power point slides to show the framework and selected text of the draft purpose and need statement. Comments and questions related to the draft purpose statement included:

- There was a question regarding the geographic locus of the mobility improvements. Ken replied that generally, improvements are intended to address longer distance work trips originating in the northern portion of the study area that are destined for the southern portion of the study area.
- There was a question about whether or not the term "employment centers" include those not in the central Boston area, such as those along 128 or 495. Ken noted that these areas would certainly be included, though Boston is considered to be the major destination for this study in order for any proposed transit service to have enough riders to be cost effective. Boston is still has the most concentrated density of jobs in the region.
- There was considerable discussion as to how narrow the focus should be on the I-93 corridor, with some indicating that the study may be shifting from its original target.
- There was a suggestion that the purpose statement be tied more closely to the original mandate that included phrases such as reduce pollution, reduce congestion, etc. Reference was made to the bi-state MOU that defined the overall purpose of the cooperative effort.
- There should be clear language about promoting transit supported land use.
- The phrase "establishing additional transportation modes" should be changed to "enhancing existing or establishing additional transportation modes."
- The phrase "increase mobility options" should be changed to "research / identify future transit options."
- Purpose and need should not be focused exclusively on Boston based trips, but rather the larger metro area needs to be served. Ken Kinney and David Nelson commented that transit systems require density (of people and jobs) to work effectively, but that a system may also serve the more dispersed sectors as long as there is a base of support for the main line operation.
- Simply stated, the study should evaluate and determine future transit investments to meet mobility needs of residents in the region.[Bill Cass]

Ken reviewed the draft need statements and the goals and objectives with the TAC. One comment related to the goals and objectives was that there was too much overlap in the goals and objectives, causing confusion. Ken next reviewed the evaluation criteria, where there were now three new evaluation measures. They were land use/development impacts, environmental impacts, and public support. Comments and questions related to the evaluation criteria included:

- A concern that user cost is already reflected in ridership. Ken agreed that user cost should probably be removed from the list. [slide 11].
- A question whether cost benefit would be included in user benefit. [Yes]
- A question about cost effectiveness vs. user benefit was raised – and discussed.

Ken then led a discussion of the problem statement – with many good points contributed by the TAC members, including:

- It was noted the 5 points (slide 6) identify different aspects of the overall problem – the lack of mobility options in the study area.
- The goals and objectives seem to be redundant – overlap.
- References to New Hampshire should also generally include Massachusetts.

A discussion of evaluation criteria led to inclusion of additional criteria:

- Public support to provide funding, and resolution of other public concerns (NIMBY issues)
- Operating and maintenance costs must also be included in evaluation of alternatives and determination of cost-benefit factor. Baseline is no-build alternative.

A discussion ensued regarding farebox recovery ratios – with the finding that MBTA commuter rail fare box recovery runs in the 36 – 40 % range.

It is noteworthy that the current transit share of trips from New Hampshire to the "inner core" of Boston is 11% - a very healthy share of the market considering the lack of "convenient" transit options. This is based on the 2000 Census "journey to work" data. It was noted that the viability of transit services is based on the worth of the effort to the consumer – they will make the effort if the overall service meets basic mobility needs, is safe and consistent.

Ken next reviewed the existing conditions in the study area, including highway volumes and existing transit service. TAC members stated that the Office on Energy and Planning released new 2030 population forecasts in January 2007.

Several technical comments were made and noted, especially concerning presentation options for data (i.e, numbers vs percentages, graphs for some data, and putting all the data into the study context). The Team will make changes consistent with these suggestions.

Ken suggested that all additional comments on the purpose and need statement and existing conditions should be submitted to Dennis Coffey by February 23, 2007.

Initial Alternatives

David Nelson, from E & K, discussed in detail three potential rail corridor alignments. The Eastern corridor would make use of the abandoned Manchester and Lawrence branch (M&L), connecting with the existing MBTA Haverhill Line to North Station. The Highway corridor would use the proposed transit reservation within the I-93 right-of-way south from Exit 5 to a point near Rockingham Park, where it could connect to the M&L and on to North Station. The Western corridor would go from Manchester to Lowell on the B&M New Hampshire Main Line. From Lowell to North Station, it would use the existing MBTA Lowell Line. He discussed the potential services on each of these corridors and the estimated travel times.

Study team members and some TAC members noted that the projected travel times would not be acceptable to the public, especially if they have to change modes to complete their trips. David acknowledged that the alternatives with the longer travel times would likely get eliminated very early on in the process, but to be fair, they must be considered initially.

Concern was expressed that downtown Manchester or the Manchester Airport needed to be the northern terminus of the service to encourage reverse commute ridership.

Questions and comments were raised about the need for double tracking of the MBTA line between Lawrence and Reading, potential speed restrictions on the M&L branch (due to local concerns) and the need for the northern terminus to be Manchester (or at least the airport). TAC members discussed short segments that could serve as initial or start up segments of the full length as well as mixed services (e.g., bus and rail). The importance of the Manchester airport was discussed.

Three of the alternative routes involve transfers (from one vehicle to another at some point in the route) thus suggesting the "transfer penalty" will impact ridership. This is true, but may also offer a range of equipment and technology options to address during the next pahse of alternatives analysis. A brief discussion of "DMU" rail technology and "BRT" bus services helped to provide some context of these options. The team will also review the recent TCRP study that evaluates the use of highway shoulders for bus services. Massachusetts has been using their shoulders to accommodate their traffic volumes for several years.

It was also noted that the planning horizon for the study is 2030 – so that the strategic plan will be based on assumptions of what conditions will be at that time (population, land use, roadway conditions, etc.). Interim steps (minimum operating segments) will also be a part of the strategic planning process.

Public Meetings

Marcy Miller stated that the team is starting to prepare for the two upcoming public meetings by creating a brochure, press packet, a second fact sheet, and a letter to the editor of the Union Leader, and other local media. The two public meetings, one in New Hampshire and one in Massachusetts, are going to be held in late-March or early-April. Meeting locations under consideration include the Windham Town Hall and the Methuen City Hall. Topics covered at the meetings would include the purpose and need and the initial transit alternatives, including suggestions that the TAC members had regarding these elements. An "Open House" concept meeting is planned, with a brief presentation and time for more one on one interaction with team members. The team will coordinate with CTAP to perhaps piggyback onto one of their already scheduled meeting efforts.

TAC members suggested that the first Stakeholder Meeting be held before the public meetings. Ram Maddali suggested sending an email out to the TAC requesting the name of a representative from each agency in the Public Involvement Plan who would participate on the Stakeholder Committee. Marcy asked if there is a preferred location for the Stakeholder Committee meeting, and Merrimack Valley Planning Commission Conference Room was suggested. Again, this meeting will also be coordinated with the CTAP process.

I-93 Transit Investment Study

Technical Advisory Committee Meeting Summary
Thursday, June 21, 2007
1:00 PM

Merrimack Valley Planning Commission

Attendance

TAC members who signed in:

Lynn Ahlgren	Massachusetts Executive Office of Transportation
Bill O'Donnell	Federal Highway Administration (FHWA) – New Hampshire
Kit Morgan	New Hampshire Department of Transportation (NHDOT)
Ram Maddali	NHDOT
Matt Caron	Southern New Hampshire Planning Commission (SNHPC)
Tim White	SNHPC
Steve Williams	Nashua Regional Planning Commission
Dennis DiZoglio	Merrimack Valley Planning Commission (MVPC)
Anthony Komornick	MVPC
Betsy Goodrich	MVPC
Andrew Motter	Federal Transit Administration (FTA) – Region 1
Matthew Moran	FTA
Cliff Sinnott	Rockingham Planning Commission

Consultant staff:

Ken Kinney	HNTB Corporation
Marcy Miller	Fitzgerald & Halliday, Inc.
Dennis Coffey	HNTB Corporation
David Nelson	Edwards & Kelsey (E& K)
Yawa Duse-Anthony	E& K
Joe Castiglione	Parsons Brinckerhoff

Welcome and Introductions

Dennis DiZoglio welcomed everyone to Haverhill and MVPC. Ken Kinney provided an additional welcome and reviewed the agenda for the meeting. The three items to be discussed include the recommended eight tier one alternatives, suburban transit connectivity, and alternative analysis next steps. These eight will be analyzed and reduced to four tier 2 alternatives.

Eight Tier One Alternatives

Initial Alternatives

David Nelson presented 15 alternatives on three potential corridor alignments to the TAC at the February 2007 meeting. He reviewed the three alignments, the Eastern corridor, Western corridor, and Highway corridor, as well as the two modes of transit improvements, rail and bus rapid transit service. David described the baseline as improvements that will be completed in concert with the I-93 highway expansion project. These baseline improvements include enhanced bus service from Exit 4 in Derry, and the planned bus services from Exit 5 in Londonderry and Exit 2 in Salem, and the purchase of 14 commuter coaches by NHDOT.

David noted that the original 15 alternatives have been narrowed to eight alternatives based on the preliminary evaluation criteria. First, the three alternatives on the Western corridor have been eliminated. These alternatives do not serve the I-93 travel market and thus the benefit to I-93 congestion would be minimal. While improvements in the western corridor could provide benefits to communities on that corridor, and certainly has independent utility, they simply would not address the purpose and need of this study. There was a concern that this corridor (and any potential improvements) could eventually compete with I-93 improvements. Ken Kinney suggested that policy makers can take the cost-effectiveness information from this study and compare it with other corridor improvement information. There was also an issue with the point in the presentation that there is a "small Manchester to Massachusetts market." It was agreed that this statement was stated poorly and would not be used as part of the reasoning for eliminating these alternatives.

David noted that the rail alternatives have been shortened from Manchester CBD because of the high capital cost to restore ROW across the airport. The cost of a tunnel under the runway would be significant. However, airport shuttle service will be examined as part of the alternatives assessment. There were concerns about this modification among TAC members. The airport, a few stated, was an important destination. There was also a concern that this modification presumes that any future service will be rail. Ken stated that all alternatives can support rail service, though even without this modification, the rail would not reach directly below the terminal. There would have to be a shuttle. There was a suggestion to look at alternative rail right-of-way. David stated that we did explore the power line right-of-way but this was deemed infeasible because route passes through the Mall of New Hampshire parking lot. David stated that service to the airport would largely serve non-residential travel rather than residential travel. People who would use this service most are non residents flying into Manchester who plan to visit Boston or elsewhere in the region.

It was noted by several members that the Concord / Bow region is interested in connecting into this system in Manchester. We should be sure to not take any actions which will foreclose these northern travel markets connecting in. Ken stated that we can provide costs of what it would take for these northern markets to connect in.

David noted that the Andover and Lawrence transfer options have also been eliminated because Lawrence is constrained from an operational feasibility perspective and Andover has weaker service characteristics and connectivity compared with the Anderson Regional Transportation

Center. David stated that trains will still stop in elsewhere Lawrence because there are significant populations that need to be served and Lawrence is becoming more of a travel destination.

David summarized the eight tier one alternatives that remain. There are four rail alternatives that remain, two on the Eastern corridor (one providing service to Boston and one providing service to Anderson) and two on the Highway corridor (one providing service to Boston and one providing service to Anderson). There was a question about potential station locations. There were concerns that if there was a problem somewhere (e.g. Derry) could the service stop there? David stated that the strategic study can include a cost differential of truncating the line at various locations.

In addition, there are four bus alternatives, two shoulder alternatives (one providing service to Boston and one providing service to Anderson) and two dedicated lane alternatives(one providing service to Boston and one providing service to Anderson). On the Boston service rail alternatives there was a question of why the Haverhill Branch could not be use instead of the Wildcat Branch. The Haverhill Branch has only a single track and many stops and thus would have longer travel times end to end. There were questions about the median vs. shoulder lane travel in the highway alignment, including questions about where stations would be placed in the median alignment. David stated that this is an issue that would have to be addressed.

The Team discussed bus bypass shoulders. Under this concept transit vehicles could use highway shoulders to bypass congestion thereby increasing reliability and providing travel time savings for transit service. Yawa Duse-Anthony said there are several areas in North America that utilize this approach. The project team is preparing materials documenting this research including best practices such as driver education and proper signage. David presented Smart Traveler data illustrating potential time savings using bus bypass shoulders. David also described High Occupancy Toll (HOT) lanes and their advantages (they come with a revenue stream).

Suburban Transit Connectivity

The team and TAC members reviewed a range of options, including employer based shuttles, low cost, or no cost shuttles (through TMAs) and airport shuttle services. David noted that all alternatives can be modeled with and without a high quality transit connection at Andover and/or Anderson.

General Discussion

Key areas of concern of TAC members included**:**

Need for a logical northern terminus (i.e, airport or downtown Manchester)
Need more definition of the “transit reservation” in the I-93 highway corridor – can it be used for busway/shoulder lanes and /or HOT lanes? Where is it?
What happens in Massachusetts? What is schedule for I-93 improvements in Mass.?
Shuttles and TMAs – many experiments have failed – need to better understand why.

Need facts on distribution of employment centers and other demographics.

Next Steps

Ken described the next steps for the project team. They are to:

- Develop operating plans for Tier 1 alternatives
- Identify station locations
- Finalize evaluation measures for Tier 2 evaluation
- Employ evaluation measures
- Present findings to Stakeholders
- Prepare full evaluation of Tier 2 alternatives (ridership, costs, etc.)

Ken stated that at the next meeting, the TAC would discuss various operating plans and three station area concept plans. These plans will likely be in Salem, Derry, and one on the highway alignment. The next meeting was tentatively set for the afternoon of August 16, 2007. The location will be determined.

I-93 Transit Investment Study

Technical Advisory Committee Meeting Summary
Thursday, September 27, 2007
1:00 PM

New Hampshire Department of Transportation

Attendance

TAC members who signed in:

Lynn Ahlgren	Massachusetts Executive Office of Transportation (EOT)
Bill O'Donnell	Federal Highway Administration (FHWA) – New Hampshire
Ram Maddali	New Hampshire Department of Transportation (NHDOT)
Matt Caron	Southern New Hampshire Planning Commission (SNHPC)
Steve Williams	Nashua Regional Planning Commission
Dennis DiZoglio	Merrimack Valley Planning Commission (MVPC)
Anthony Komornick	MVPC
Cliff Sinnott	Rockingham Planning Commission
Peter Stamnas	NHDOT
Bill Cass	NHDOT
Chris Curry	Northern Middlesex Council of Governments
Paul Foundoukis	FHWA
David Preece	SNHPC
Paul Nelson	Massachusetts EOT
Rosemary Monahan	U.S. Environmental Protection Agency

Other attendees:

Rodrigo Marion	Central New Hampshire Planning Commission (CNHRPC)
Nick Alexander	CNHRPC
Catherine Corkery	NH Sierra Club
Tom Irwin	Conservation Law Foundation

Consultant staff:

Ken Kinney	HNTB Corporation
Julia Suprock	HNTB Corporation
Marcy Miller	Fitzgerald & Halliday, Inc.
David Nelson	Edwards & Kelsey (E& K)
John Weston	PB Americas, Inc.

Welcome and Introductions

Ram Maddali welcomed everyone to Concord, New Hampshire and New Hampshire Department of Transportation (NHDOT). He asked that everyone introduce him or herself. He next asked if we could move the modeling discussion up in front of the first item on the agenda. There were no objections, and John Weston proceeded with the modeling discussion.

Model Preview

John Weston first explained that the project team is developing a travel demand model because the Federal Transit Administration (FTA) requires a cost per user benefit, which is essentially travel time savings. The travel demand model is a four step process. The model predicts reaction of travel based on changes in the transportation system, prices (fuel costs, parking costs), and future population and employment. The model will also produce ridership forecasts and FTA user benefit measures.

The SUMMIT travel demand model is currently being utilized to estimate travel times. The model uses a combination of the Mass State Model, NH State Model and the CTPS Model. While the model will be calibrated to the 2000 Census information and utilize the official MPO approved projections for 2030, there are two other actions that will be taken related to the population and employment projections. First, the model results will test sensitivity of growth by incorporating the projections developed by the Delphi panel. Second, the population and employment forecasts will be coordinated with the station area planning work also occurring in the study. It was noted that the station area sensitivity forecasts will be a redistribution of projected population and employment, where the Delphi panel sensitivity will incorporate additional growth.

There was a comment that the model area should be expanded on the east side (to Route 125). John stated that he believed that there was not a significant amount of travel in the corridor generated from that area, but that he would check on that. There was a question on the population forecasts and what was in the current model. John stated that what is in the current model is the MPO approved forecasts, but that the team was also planning to perform the two tests described earlier. Rosemary Monahan stated that the Delphi panel estimates are based on highway improvements only and not additional transit improvements. It may be worth noting this.

Operating Plans

Ken Kinney stated that for the operating plans, the team wanted to focus on the concepts and get concurrence from the TAC that these are the operating plans that the team should move forward with in more detail. David Nelson, from E & K last presented four rail alternatives and four bus alternatives on two corridor alignments to the TAC at the June 2007 meeting. He quickly reviewed the two alignments, the Eastern corridor and Highway corridor alignment, as well as the two modes of transit improvements, rail and bus transit service. David stated that the team is still trying to find a way to get the rail alternatives past the airport to downtown Manchester.

David reviewed the proposed operating plans for the rail alignments in more detail, including the five proposed stations for the eastern rail alignment and the six proposed stations for the highway rail alignment. He discussed service schedule and number of trains that could operate per day on weekdays as well as on weekends and holidays.

David next discussed buses and the shoulder bus alternative. He stated that buses traveling on shoulders is the best way to get an increased capacity, especially for the short-term timeframe. Operating plans, including bus headways was discussed in detail. For the shoulder bus service alternatives, there would be five terminals along I-93 and each would have express peak service to one station in Boston. Midday trips may be coupled together to reduce costs.

There was a question on whether it made sense for these buses to make stops at other locations, such as Andover, before reaching Boston. David stated that these other destinations before Boston often have free parking, and transit service to these locations has not been successful in the past. In addition, each of the terminal location can fill the buses by going to Boston alone, so it does not make sense to stop to pick up more passengers or drop off the few that may want to get off in Andover. David reminded the group that the goal was to provide successful transit service and essentially gain as high as ridership as possible. Ken Kinney also suggested that in the detailed operation plans for the buses, it may make sense to assume that there is some sort of successful connective services in the destination locations.

David questioned NHDOT on their intent to build one lane as a high-occupancy vehicle (HOV) lane in the I-93 corridor. Bill Cass clarified that the plan was to build four general purpose lanes, one of which <u>could</u> be converted to a HOV lane at a later date. So for the purpose of this study, the team should assume four general purpose lanes.

There was a concern that downtown Boston would not be able to accept additional buses. David stated that he did not think this was an issue. New Hampshire buses could be allowed stop on the streets, instead of dropping everyone off at South Station.

David also addressed the preliminary operating plans, including hours of operation and headways, for bus rapid transit (BRT) service. There would be five stations, and buses would stop at all stations. There was a question about the length of the walk from the middle of a park-n-ride lot to a station. David said that it would likely be a couple hundred yards and pedestrian improvements to the lot would likely be necessary. Another TAC member questioned where the BRT would travel in Massachusetts. David answered that the buses would travel in the shoulders.

Ken Kinney questioned the TAC on whether there were any objections to the preliminary approach to developing the operating plans. There was a concern about connecting the rail service to downtown Manchester and including this analysis in the model. John Weston acknowledged this concern and said the team would consider it. However, an issue with including this in the analysis at this time is that is will greatly reduce the cost-benefit of the analysis. An additional major capital cost could likely prove to make the project not cost-effective.

Land Use Policy Report

Ken Kinney introduced Julia Suprock from HNTB Corporation. Julia presented her analysis so far on the land use policy report. In addition, she would also give this presentation at the CTAP Conference on Saturday.
She first reviewed different Transit Oriented Development (TOD) tools. She stated that there were two kinds of TOD, bus and rail, with 91% of all TOD development occurring around or near rail stations. She also reviewed two different examples of TOD development, an urban example in Somerville, MA, and a more rural example in Wisconsin.

Julia next presented focused on six of the communities that were studied for this analysis: Derry, Londonderry, Manchester, Salem, Windham, and Methuen. She outlined land use trends, existing practices that each community encouraged, and opportunities to implement the use of additional TOD tools.

There was a comment that it would be beneficial to the more rural communities to include density transfer as a TOD tool. Julia stated that this would be incorporated into the policy report.

Conceptual Station Area Planning

Ken Kinney stated that station area concepts are underway. These initial concepts have been drafted and are presented along the back wall today. He asked that TAC members review these and provide comments as they would also be presented to the communities at the CTAP conference.

Public Meeting Planning

Marcy Miller, from Fitzgerald & Halliday, Inc., stated that it was time to start planning for our next round of public meetings. The team had much information to present that has been gathered since last April. She stated that the team was hoping to host two public meetings (one in each state) the week of November 26th. Any suggestions for locations for the meetings will be appreciated. It was suggested that Salem would be a good location for the New Hampshire meeting, perhaps at Salem High School. In addition, the team is also looking to plan a Stakeholders group meeting in the beginning of December.

Next TAC Meeting

The next TAC meeting will be scheduled for November 15, 2007. Ken stated that one item he would like to discuss at the meeting is the Manchester & Lawrence rail line, and its physical and financial feasibility.

I-93 Transit Investment Study

Technical Advisory Committee Meeting Summary
Wednesday, March 26, 2008
2:30 PM

Massachusetts Executive Office of Transportation, Boston

Attendance

TAC members who signed in:

Ram Maddali	New Hampshire Department of Transportation (NHDOT)
Matt Caron	Southern New Hampshire Planning Commission (SNHPC)
Steve Williams	Nashua Regional Planning Commission
Rosemary Monahan	U. S. Environmental Protection Agency
Paul Nelson	Massachusetts EOT
Kit Morgan	NHDOT
Peter Butler	FTA – Region 1
Barbara Lucas	MAPC (Boston MPO)
Cliff Sinnott	Rockingham Planning Commission (RPC)
David Preese	Southern New Hampshire Planning Commission

In attendance via teleconference:

Ken Cervenka	FTA Office of Planning and Environment
Alex Eckmann	Federal Transit Administration

Other attendees:

Stanley Wood	Mass Highway (Highway Operations)
David Carney	Bus operations, MBTA
Lisa -	MBTA
Tom Irwin	Conservation Law Foundation

Consultant staff

Ken Kinney	HNTB Corporation
Dennis Coffey	HNTB Corporation
Jill Barrett	Fitzgerald & Halliday, Inc.
John Weston	PB Americas, Inc.

Welcome and Introductions:

Paul Nelson welcomed everyone to Massachusetts Executive Office of Transportation. TAC members introduced themselves. Ken asked that the committee discuss the New Hampshire Capital Corridor before beginning with the items on the TAC agenda.

Capitol Corridor

Steve Williams, Executive Director of the Nashua Regional Planning Commission conveyed concerns by leaders in Southern New Hampshire that the Capitol Rail Corridor is not included in the I-93 Transit Investment Study. This corridor is defined as passenger rail service from Boston, MA through Nashua, NH to Manchester, NH with eventual service to Concord, NH. Steve passed out a resolution from Senator Peter Hoe Burling, Chair of the New Hampshire Rail Transit Authority, citing the Capital Corridor as the number one priority for rail in the state. The Rail Transit Authority recommended that the rail corridor be put back into the I-93 Transit Investment study as an alternative. Recently New Hampshire DOT received a letter from the Mayor of Manchester expressing concern that the Capital Corridor was not under consideration in the study. David Preese reinforced the message from the Manchester region.

TAC members reviewed the reason why the Capital Corridor was not included as an alternative in the I-93 Transit Investment Study. Dennis Coffey noted that the study team has found, and the TAC concurred, that while some commuters from the I-93 study area may use this route, it would not serve the majority of people living in the I-93 corridor and therefore would not address the purpose and need of the study. The study team and the TAC have consistently noted the independent utility of this route. TAC members noted that there is no conflict between the study and the goal of the state in pursuing the Capital Corridor as a priority project.

Ram Maddali of NHDOT acknowledged the importance of developing the Capital Corridor. He said this rail line is farther along in development than the M & L line and the state is supportive of efforts to move forward. The project is in the Long Range Transportation Plans of both regions and about $31M in funding has been identified for the Capital Corridor. After considering and evaluating the concerns of Manchester officials and the New Hampshire Rail Transit Authority, it was agreed that the Capital Corridor line will not be added to the I-93 TIS as an alternative, as originally discussed at the November 15, 2007 TAC meeting. But the TAC did agree that the strategic implementation plan should affirm the importance of the Capital Corridor to the state as a significant transportation alternative.

Modeling

There was extensive discussion about the January 29, 2008 memo on modeling prepared by PB Americas, Inc. (PB). John Weston of PB explained the need to use a hybrid model using both the CTPS model (Boston MPO Model maintained by the Central Transportation Planning Staff) and the Massachusetts Statewide Model, which includes most of the Southern New Hampshire study area, as well as Massachusetts. Ken Cervenka of the FTA Office of Planning and Environment had submitted comments on many technical aspects of the analysis and Barbara Lucas of MAPC had additional concerns about the modeling. Barbara noted that the newly amended Regional in the near future transportation plan includes a different demographic set than was used in the current model. It was decided that due to the technical nature of the comments there would be a separate discussion of these issues and John will report back to the TAC with a report on that technical meeting.

John Weston noted that the study team would also conduct two types of sensitivity analysis – one utilizing the Delphi model and another that would deal with TOD development.

There was much discussion about the various types of information used in the model that could affect results. Barbara Lucas asked how the 1991 household survey on mode choice translates into census demand. Was a ½ mile walking radius from a transit used? (Yes) Was there any sensitivity to the cost of parking? (No – there is too much variety and complexity). Barbara noted that the supply of parking might become more of a constraint in Boston as more garages are slated to be torn down. Is the model calibrated in a way that can respond to fluctuations in the price of fuel? (Yes, for sensitivity analysis runs).

David Preese noted the proposed alternatives only go as far as Exit 5. Why not Exit 6? Also, concerning the airport – did we consider impact of the new airport connector road (from Everett Turnpike?)?

Parking Costs

Ken Kinney said he would distribute the parking memo to the TAC after the sensitivity runs are completed.

Bus on Shoulders

John Weston reviewed two buses on shoulders programs (Minneapolis and Ottawa) that were evaluated. The Minneapolis program has a 10 mph differential between speeds on general-purpose travel lanes and the shoulder up to a maximum of 35 mph. The Ottawa program provides a 12’ lane and allows a maximum speed of 100 kilometers (62.5 mph). If the Minneapolis program were applied on the I-93 corridor it would result in only a 1-2 minute travel time savings whereas the total time saved for a commuter in New Hampshire using the Ottawa program would be 20-25 minutes. John Weston examined the potential to expand the shoulder and its related costs to various segments of the corridor as follows:

1. New Hampshire: Widen 10’ shoulder by 2’ - $25 million
2. State line to Route 125 (No. Andover) – 10’ shoulder currently in use during peak periods. Another 2’ needs to be added.

3. Route 125 to West Street in Redding – requires 5'widening of shoulder on average - $7-10 million
4. West Street to I-95 interchange: proposed project underway there could incorporate shoulder widening
5. Stoneham to Mystic River – Needs a lot of work because there are built in drainage features and the pavement base is not thick enough. Shoulder and structure must be completely rebuilt - $25 million
6. South of Mystic River to exit 31 -
7. At exit 31 there is an HOV lane southbound so there would be no benefit to having bus on shoulders and northbound the highway is on an elevated structure that would be too expensive to widen.

John Weston reported all bridges have a 64' span between abutments so there would be no need to widen any structures. Costs for this program would also need to include bus maintenance facilities, the purchase of buses and bus shelters. John said the buses would start in a town center, proceed to the nearest Park & Ride and then run express.

Stan Wood of Mass Highway said he thought there would be significant cost to widening I-93 in the northern part of the corridor, if the highway had to be widened towards the median because of drainage. Also, further south along the interstate there would be considerable costs to moving guardrails and signs, accommodating an acceleration/deceleration lane and building pull out areas for breakdowns. TAC members also asked about operational issues for vehicles moving from the shoulder to the HOV lane.
TAC members also noted that along with the NH bus operations, there are other busses that might use the system – MBTA, Massport (Logan Express), MVRTA.

The study team will review these issues with MassHighway. Ken Kinney noted that there are many policy issues to be addressed related to this alternative.

Massachusetts Legislative Briefing

Dennis Coffey and Ken Kinney reported on the briefing at the State House on the I-93 Transit Investment Study organized by State Senator Steven Baddour. Four state legislators for the I-93 corridor area, approximately 10 legislative staff members and 20 commuters and Under Secretary of Transportation Wendy Stern attended the briefing. The commuters were supportive of transit in general, particularly the bus on shoulders program, and cited the need for more parking at transit stations.

M&L Line

Ken Kinney reported on the physical evaluation of the M&L Line between Lawrence MA and Manchester NH. The NHDOT owns most of the Right of Way (ROW). Presently there are two bike paths on the M&L ROW, a number of existing agreements to use the ROW that can be terminated for transit use and other physical encroachments by property owners that have not been permitted. Ken reported that it appears to be physically feasible to build single lane track with passing sidings at selected locations.

Ken reported that the study team has explored how to reconnect the M&L line from Exit 5 to downtown Manchester via the Manchester Airport. The consultant team developed a route from exit 5, tunneling under the runway and driveway between the airport terminal and parking garage, creating an underground station within the airport, and connecting back to the M&L and on into downtown Manchester. Establishing a connection from exit 5 to downtown Manchester would be very expensive ($230 million), especially as compared to the cost of rail improvements from North Station to Exit 5 ($200 million). Also the airport manager believes from a regulatory point of view, given security concerns at airports, approval of a tunnel would be extremely difficult to obtain.

TAC members noted that there are a number of at-grade crossings of the M&L – and these would present safety challenges. Ken Kinney noted that the estimates include federally approved grade crossing traffic warning systems.

Next Steps

Ken Kinney reported that the project team is in the process of completing the following:

1. <u>Environmental Review</u> – not a formal "EA", but rather an identification of important issues that would be explored in the next phase.
2. <u>Ridership forecasts</u> – the one remaining data gap – these will be used to conduct the final alternatives analysis and sensitivity analysis. The Study Team will provide a written response to the remaining model questions following the technical conference call.
3. <u>Bus on Shoulder memo</u>. Will review and revise information related to this alternative, and explore with MHD operational issues.
4. <u>Parking costs memo</u>. Will examine the cost assumptions used in the model – this will be an appendix to the model memo.

In late April the Team will meet for two workshops to review both the ridership forecasts and the framework for the Strategic Implementation plan (tentatively April 28, 29).

The next TAC meeting is targeted for the week of May 19th (either Wednesday or Thursday (Subsequently this meeting is being proposed the week of June 9th).

I-93 Transit Investment Study

Technical Advisory Committee Meeting Summary
Thursday, June 12, 2007
8:30 AM

Salem Town Hall

<u>Attendance</u>

TAC members who signed in:

Ram Maddali	New Hampshire Department of Transportation (NHDOT)
Kit Morgan	NHDOT
Matt Caron	Southern New Hampshire Planning Commission (SNHPC)
Rosemary Monahan	U.S. Environmental Protection Agency (EPA)
Carl Deloi	EPA
Rodrigo Marion	Central New Hampshire Regional Planning Commission

Other attendees:

Tom Irwin	Conservation Law Foundation

Consultant staff:

Ken Kinney	HNTB Corporation
Dennis Coffey	HNTB Corporation
Marcy Miller	Fitzgerald & Halliday, Inc.
David Nelson	Jacobs
John Weston	Parsons Brinckerhoff

Welcome and Introductions

Ken Kinney welcomed everyone and described the meeting's agenda. He stated that John Weston would first present information on the ridership results from the modeling. Ken would then address the key findings and action strategies based on the ridership results and other study findings.

Ridership

John first discussed the estimated average daily inbound boardings (2030) for the no build, M & L commuter rail, and bus on shoulders alternatives. He stated that the no build alternative includes the bus service that is planned as part of the highway widening. John highlighted that ridership is greater in Massachusetts than in New Hampshire. In 2030, there are projected to be about 500 boardings per day at New Hampshire stations and 1,400 boardings per day in

Lawrence for commuter rail. Many of these 1,400 boardings in Lawrence are new boardings. The bus on shoulders boardings are comparable. Here, he highlighted the 2,500 boardings at Methuen.

In addition, John discussed an extension of M&L service from Exit 5 to the airport and downtown Manchester. This alignment would increase ridership by about 600 boardings per day.

John next discussed the results of two different sensitivity analyses, one for gas prices and another for transit oriented development. For the gas price sensitivity analysis, John doubled the gas prices. The result was that the transit ridership rose by 12-15 percent and vehicle miles of travel and congestion were lower. He noted that he did not adjust the transit fares, and that the results were somewhat skewed. In addition, he stated that this analysis will be updated based on recent gas price increases. There was a question regarding the projections used. John stated that the model used the required, statewide projections.

The transit oriented development sensitivity analysis was based on sample plans for potential infill and transit oriented development. For example, a redevelopment of Rockingham led to an increase in ridership of 15 percent at that station. He noted that this cannot be included in the model. This is a possibility after January 2009, as the evaluation criteria for these types of projects may change.

Key Findings

Ken next presented the key findings. He stated that ridership on the M & L commuter rail alternative and the bus on shoulders alternative are essentially equivalent. He noted that the bus on shoulders is basically a park & ride-based strategy, but will retain service to town centers. He continued that the ridership to the airport would be low (390-560 boardings per day), but realistic. Given the cost of this alternative, this is not a viable alternative. Extending the M & L from Exit 5 through the airport to downtown Manchester adds about 700 boardings per day, about an 8 percent increase.

Another key finding is that a high percentage of the rail benefits accrue to Massachusetts residents, as 67 percent of southbound boardings are at Massachusetts stations. No alternatives would divert enough traffic from I-93 to affect the level of service on the highway.

While the boardings for the commuter rail and bus on shoulders alternatives are equivalent, the capital, operating, and maintenance costs for the rail alternative are greater. For example the capital costs are $200 million for the rail and $80 million for the bus on shoulders alternatives. However, the land use impacts are higher for the bus on shoulders alternative. There are no fatal flaws for either build alternative at this point in the study process. It is recommended that both build alternatives continued to be analyzed.

Action Strategies

Implementation recommendations in the Strategic Plan include:

- Implement bus on shoulders in phases as this provides the greatest cost benefit,
- Actively preserve the M & L right-of-way for future transit from Exit 5 to the state line,
- Develop bi-state agreements for both build alternatives,
- Establish a timeline for M & L decisions, and
- Pursue federal funding.

There was a question as to whether there has ever been a New Starts project with two state sponsors. Kit Morgan stated that he was unsure and would research this.

Next TAC Meeting

There will be one more TAC meeting, likely in August, before the study concludes in September.

I-93 Transit Investment Study

Technical Advisory Committee Meeting Summary
Tuesday, August 26, 2007
9:00 AM

Southern New Hampshire Planning Commission

<u>Attendance</u>

TAC members who signed in:

Kit Morgan	New Hampshire Department of Transportation (NHDOT)
Paul Nelson	Massachusetts Executive Office of Transportation
Matt Caron	Southern New Hampshire Planning Commission (SNHPC)
Rosemary Monahan	U.S. Environmental Protection Agency (EPA)
Carl Dierker	EPA
Steve Williams	Nashua Regional Planning Commission
Tony Komornick	Merrimack Valley Planning Commission
Bill Jannell	NHDOT
Cliff Sinnott	Rockingham Planning Commission
Tim White	Southern New Hampshire Planning Commission
Chris Curry	Northern Middlesex Council of Governments
Dennis DiZoglio	Merrimack Valley Planning Commission
Bill Gordon	Federal Transit Administration

Other attendees:

Tom Irwin	Conservation Law Foundation
Dan O'Neil	City of Manchester
Peter Griffin	New Hampshire Railroad Revitalization Association

Consultant staff:

Ken Kinney	HNTB Corporation
Dennis Coffey	HNTB Corporation
Marcy Miller	Fitzgerald & Halliday, Inc.
David Nelson	Jacobs
John Weston	Parsons Brinckerhoff

Welcome and Introductions

Tim White from Southern New Hampshire Planning Commission welcomed everyone. Ken Kinney asked for self introductions and reviewed the meeting's agenda. He stated that the focus of the meeting was to go over draft recommendations that collectively make up the draft

Strategic Implementation Plan (SIP). The focus will be on the recommended alternatives, their benefits, distribution of benefits, and how the project will be funded.

Key Findings

Ken reviewed the costs of M&L and bus on shoulders alternatives. Besides the cost, a major difference is their effect on land use. M&L has more positive impact on land use, promoting denser development, especially around stations. This has not typically been associated with bus service. The total capital cost for M&L rail service is $197M, while bus on shoulders is $80M. The federal share of M&L rail service construction is $98.5M, while bus on shoulders transit construction is $40M. After annual non federal funding and annual operations and maintenance, the states and locals would need to provide $6.3 million per year for M&L service, and nothing for bus on shoulders service.

There was a question whether bus on shoulders would originate in downtown areas. Ken answered that yes, it would.

David Nelson reviewed bus on shoulders services in Twin Cities, MN and Ottawa, CAN. He noted that bus on shoulders has also recently been implemented in Atlanta, GA and Seattle, WA. There have not been any major safety issues in these areas.

John Weston discussed ridership forecasts for 2030 inbound boardings. Both alternatives generate same number of riders, however, distribution is different. Bus on shoulders picks up commuters from downtown Manchester for example. M&L has additional stations in MA. Added service to these stations picks up additional riders. The no build is an estimate for ridership for planned and committed commuter bus service. From Methuen, bus on shoulders service is faster than M&L rail service because the trains stop at locations in Lawrence and Andover. In addition, the bus on shoulders will circulate in downtown Boston, while rail will end at North Station. There was a question whether the ridership forecasts are constrained by parking. They are not.

John addressed sensitivity analysis regarding the effect of high gas prices, transit oriented development, and the Delphi panel projections. For the gas price sensitivity analysis, John doubled the gas prices. The result was that the transit ridership rose 20 percent in the northern portion of the corridor, and decreased as the commuting distance to Boston decreased. Transit oriented developments with heavy populations also increased the ridership.

There was a question whether ridership figures reflect reverse commute. John answered that the numbers do include some percentage for non-work trips, or non-commuter use. Forecasting the reverse commute for 2030 is more difficult, and he did not find a significant amount of reverse commute in 2030. There really is very little reverse commute in the model. There was a question if the Lawrence numbers included new riders only or all riders. This number is mostly additional riders. In addition, the model did not indicate a significant decrease at Lawrence.

Regarding the Delphi panel estimates, the differences in estimates were not uniform. Some stations have major increases, while some have decreases. This is primarily because the additional jobs in Southern New Hampshire weaken the attractiveness of working in Boston.

Thus, the pattern of where people were going changed. There was about 10-15 percent difference overall. There was a question whether the three test runs were cumulative? John stated that they are not purely additive because this is only a share model, not a change in travel model. There was a question about fares. John stated that he used MBTA 2000 fare structure because the model is calibrated to this. He also used the same fare for bus and rail, although bus fare is currently higher. Because fares are set in policy decision, he did not want to set them too high and mask demand.

Ken stated that ridership for the two alternatives are equivalent. However, the bus on shoulders ridership from town centers is low; it is essentially a park & ride strategy. In addition, extending M&L service from Exit 5 through the airport to downtown Manchester adds only about 700 boardings, an increase of eight percent, while doubling the cost. The alternative did not attract many airport users.

Ken stated that neither the rail nor the bus alternatives served I-495 or Route 128 corridors very well. A high percentage of rail benefits accrue to MA residents. 67% of all southbound boardings are at MA stations. Neither alternative will divert enough traffic from I-93 to alter the level of service.

The bus on shoulders alternative will have a 12-foot shoulder, like the Ottawa model. John discussed the five different phases of bus on shoulder implementation plan. The first area of construction would be between Medford and Woburn. While the improvements would not be completed for more than 20 years, the congestion relief would begin early when the southern portion of the corridor is constructed. This is where the congestion is the highest. There were concerns that the bus on shoulders alternative will take longer and cost more than expected. In addition, there were concerns about the vehicles already driving on shoulders in Massachusetts. There are discussion about widening the highway on inside, and take the general purpose traffic off the shoulders. Regarding the I-93 widening project in New Hampshire, the designs will accommodate the wider shoulder. They are looking to build the base to accommodate this.

There was a question about 4(f) problems in the area of Middlesex Fells. There is enough space within the existing ROW to shift lanes toward the center. The cost is high here to address the drainage improvements.

There was a question if Phase 2 was in the Massachusetts State Transportation Improvement Plan. Reportedly it is not. The bus on shoulder strategy will require a strong commitment from Massachusetts. They are interested in listening, but have not made a commitment yet.

Study Team Recommendations

Ken presented the key recommendations. SIP recommendations include:

- Begin phased implementation of Manchester to Boston bus on shoulder transit services,
- Preserve Manchester & Lawrence (M&L) right-of-way for future transit use,
- Pursue bi-state agreements for transit service.

Ken noted that the states have already begun to pursue bi-state agreements. The study team anticipates that at some future time (possibly after 2030 horizon year) the conditions will support implementation of rail service on the M& L corridor. The next steps in the project development include completion of a bi-state transit agreement, setting up a transit funding task force (possibly a legislative study committee), and beginning the process of funding and conducting and Environmental Assessment for the BOS alternative. Finally, the team recommended preventing future encroachments in the M&L corridor.

There are concerns about the rail alternative's effect on bicycle paths, safety (at grade crossings), and noise. There was a suggestion to coordinate with communities who have bicycle and pedestrian trails in M&L rail corridor. This should be reflected as a next step.

It was noted that this is very thorough study. Kit Morgan agreed that these recommendations are the correct next steps. Begin discussions with departments on moving forward. Paul Nelson stated that Massachusetts EOT is interested in cooperating with NH on next steps.

Ken thanked everyone for participating in the TAC and encouraged additional comments to be sent to him. The final report will be available for distribution in fall 2008. Public meetings will be conducted on October 1st and 2nd.

I-93 Transit Investment Study

Stakeholder Group Meeting Summary
Wednesday, March 28, 2007
5:00 PM

Sal's Riverwalk Conference Center
354 Merrimack Street, Lawrence, Massachusetts

Attendees:

Lynn Ahlgren	Massachusetts Executive Office of Transportation (EOT)
Bill O'Donnell	Federal Highway Administration (FHWA) – New Hampshire
Kit Morgan	New Hampshire Department of Transportation (NHDOT)
Ram Maddali	NHDOT
Bill Cass	NHDOT
Tom Irwin	Conservation Law Foundation
Arthur B. Cunningham	Sierra Club
Robert Halpin	Merrimack Valley Economic Development Council, Inc.
Leigh Levine	Federal Highway Administration – New Hampshire
Linda Bonetti	Merrimack Chamber of Commerce
Michael Bonetti	Merrimack Chamber of Commerce
Andrea Leary	Merrimack Valley Transportation Management Association
Sydney Culliford	Pan Am Railways
Roger Bergeron	Pan Am Railways
Jim Jalbert	C & J Trailways
Stan Franzeen	Junction Transportation Management Organization
Donna Morris	Greater Salem Chamber of Commerce
George Fredette	Greater Salem Chamber of Commerce
Bill Scott	Town of Salem
Mike Fitzgerald	New Hampshire Department of Environmental Services
Dan O'Neil	City of Manchester / Southern New Hampshire Planning Commission
Paul Materazzo	Town of Andover
Peter Griffin	New Hampshire Railroad Revitalization Association
Joe Bevilacqua	Merrimack Valley Chamber of Commerce
Harry Blunt	Concord Trailways

Consultant staff:

Ken Kinney	HNTB Corporation
Marcy Miller	Fitzgerald & Halliday, Inc.
Dennis Coffey	HNTB Corporation
Essek Petrie	HNTB Corporation
Ken Livingston	Fitzgerald & Halliday, Inc.

Welcome and Introductions

Lynn Ahlgren welcomed everyone and introduced the study and the project team. Ken Kinney, Project Manager, reviewed the agenda for the meeting. The items to be discussed included the purpose and objectives of the study, demographics and potential transit alternatives, and land use/transit-oriented development. Ken then provided a brief update of the study, describing each of the three phases of the project.
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Ken noted that this study was not looking at rail options only. The alternatives analysis will include bus, express bus, and rail transit. He reviewed the study area as well as the purpose and the objective of the study. He noted that the study is focused on north-south markets for transit improvements in the study area.

The presentation covered demographic, population and employment changes in the region over the past 20+ years. Forecasts were presented through the planning year target of 2030. He then focused on the transit improvements that could be feasible to assist meeting the mobility needs of the growing population in the region. There are three types of systems that could be used in the region: push-pull commuter trains; diesel multiple units; and bus rapid transit.

Ken discussed in detail three potential transit corridor alignments. The Eastern corridor would make use of the abandoned Manchester and Lawrence branch (M&L), connecting with the existing MBTA Haverhill Line to North Station. The Highway corridor would use the proposed transit reservation within the I-93 right-of-way south from Exit 5 to a point near Rockingham Park, where it could connect to the M&L and on to North Station. The Western corridor would go from Manchester to Lowell on the B&M New Hampshire Main Line. From Lowell to North Station, it would use the existing MBTA Lowell Line. Potential services, transfer points, and travel times on each of these corridors were discussed.

Ken stated that though the M & L may have the best alignment location, it may have a high cost because the route is not in service at this time. On the other hand, the western route rail is currently in service, but the location may not best meet the needs of the I-93 corridor residents. Finally, three of the alternative routes involve transfers (from one vehicle to another at some point in the route) and that factor will have an impact on ridership.

Ken discussed supportive local government land use policies that would allow for market-based transit oriented development. Ken discussed what transit oriented development could look like in New Hampshire and provided comparison examples across the United States. He went through land uses and the potential for such development in Manchester, Derry, Londonderry, Windham, and Salem.

After the presentation there was a question and answer period. These comments include:

- There was a question whether the rail service would be express service and where the stops would be. Ken answered that it would likely be an express type service with strategic stops that have yet to be identified.

- There was a comment about the need to double track the rail line. Ken answered that the consultant team was aware of this and it will be addressed.
- There was a comment about the importance of coordinating with Manchester Airport. Ken answered that the team has and continues to coordinate with the airport and that the airport is supportive of bringing transit into the corridor.
- There was a question on whether Methuen has a good location for a station and transit oriented development. Ken noted that the City of Methuen is interested in TOD, is exploring a range of options, and is involved with the I-93 study process.
- There was a comment about the importance of this study and the multimodal transportation opportunities that could evolve and that it should not be wasted.
- There was a comment that Boston was more than an employment location. There are also hospitals, sports, etc. Should consider this and that some may be making a reverse commute.
- There was a comment stating that Derry and Salem both have town centers for potential stations (along the M&L branch).
- There was a question / comment on the cost of the I-93 highway corridor alignment for light-rail development. Ken noted that this would likely be the most expensive option because of the cost for the infrastructure in the median. The differences between light rail and other transit alternatives were discussed.
- There was a suggestion to look at a new rail stop and Park & Ride at Lowell Junction.
- There were questions about the cost of the transit alternatives. Ken stated that this was something that he did discuss with the NH state legislature. The state will have to develop a non-federal funding strategy to provide a local share of capital costs and to meet ongoing O&M costs.
- There was a comment that I-93 northbound is at its busiest on Friday evenings with travelers heading up to the Lakes Region for the weekend. Not sure if New Hampshire is ready for this kind of impact to the Lakes Region.
- There were comments on packaging transit oriented development for the towns. They need to know that it is coming and they can use tools such as transfer of development rights to encourage growth around the stations.
- There was a question on the population projections used. Did the team use delphi estimates? It was noted that land use policy changes could increase development which could increase ridership. Ken answered that he agrees with this statement, however, the team could only use officially adopted population and employment estimates provided by the two states.
- The comment was made that the widened I-93 will reach a point of saturation (congestion) in the future – and that this study should identify (and explore) interim steps that could slow the process of congestion – and the study should further consider the impacts of vacation-tourism travel demands (including north of Concord).
- There was a comment that many residents commute from Manchester into the Merrimack Valley, and the study should consider their needs also. The Merrimack Valley needs to be able to attract skilled workers as well. Ken acknowledged the problem with serving scattered employment locations with a fixed transit route. He suggested bus rapid transit and employer based transportation as feasible options in this scenario.
- There was discussion about bus rapid transit and transit station locations (at Exit 5) and how this would meet needs of residents of the City of Manchester.

- A question was raised about transit and TOD – which comes first? Ken replied that there can be TOD type development without transit being in place.
- There was a question about whether there has been a comparative analysis of the cost between bus and rail. Ken indicated that bus rapid transit was generally less expensive for capital costs, though that cost depends on whether or not an exclusive new right of way is constructed. The operating costs per passenger are similar. Ken said the study team would examine these numbers.
- There was a question how the state would be able to get federal funding as those resources are diminishing. It was also noted that private bus carriers are operating in this market, without subsidy – and are providing a good service and are profitable companies (as compared to the Downeaster service).
- There was a comment that a study objective should be to minimize the environmental impacts of transportation as the highway Environmental Impact Statement was the driver for the study.
- There was a comment to highlight the other benefits of transit such as sleeping or reading while traveling.
- There was a question as to what goes into ridership factors. Ken answered that parking, driving costs, travel time, and transfers go into ridership factors.
- There was a comment on taking out existing travel lanes and its effect on air quality.
- There was question on the application process for the FTA New Starts program. Ken that the study would produce an adequate cost-benefit analysis though additional work would be needed including a detailed financial plan. Ken provided more details about the federal New Starts program.
- There was a question about the possibility of using the rail line for freight also. Dennis Coffey discussed this possibility, saying that the most likely place for rail growth and investment is in intermodal transfer areas.
- There was a question whether the study would look at peak hour road pricing. There was a comment to contact the Boston Chamber of Commerce as they are looking at congestion pricing. It was also noted that many commuter s do not realize their true costs in commuting by automobile – many costs are hidden, or blended.
- There was a comment that this project is on the radar of agencies in Washington, DC.
- It was noted that the New England states are losing workers and residents due to congestion, costs of commuting and costs of housing – states and region must collaborate.

Bill Cass and Ram Maddali thanked the many attendees for their participation. The team closed the meeting by announcing the upcoming public meetings on April 10th and 11th.

I-93 Transit Investment Study Public Meeting
Summary of Comments

April 10, 2007
Methuen City Hall, Methuen, MA

The following comments were received at the I-93 Transit Investment Study public meeting held on April 10, 2007 at Methuen City Hall, Methuen, Massachusetts.

- There was a comment thanking the project team for excellent work. The alternatives should be considered in relation to air quality impacts. The M & L line alternative looks promising. There is a great opportunity for Massachusetts towns to benefit from this project.

- There was a general concurrence with the above comments. The scope of the project is excellent. Derry, Salem, and Methuen have multiple town centers, one of which is a result of rail. Provided a reminder of how this project came to fruition. Boston is not just an employment destination, but also a medical, sports, and educational destination. Must remember to consider reverse commute and the positive effect on property values that result from transit. For example, Haverhill is enjoying a renaissance because of transit.

- There was a comment that the I-93 congestion will continue to worsen in the coming years. This type of planning effort takes 10-12 years to occur, and the corridor should be built now. Questioned the length of time to reinstate the M & L line.

- There were questions raised regarding the I-93 widening including what if they only widened the highway to three lanes in each direction and the fourth lane was dedicated to transit? What if the median was used for transit? What if there was a toll for single occupant vehicles? What about considering rail from Boston to Concord, NH? What if transit were faster and more visible to drivers who were stuck in traffic?

- There was a comment about the congestion bottleneck on I-93 around I-495. This makes Methuen a good candidate for a rail improvement to absorb transportation traffic headed south. Any new lanes built between Methuen and Concord will always fill up. The bus parking lots are already full. The Route 28 alignment is a good candidate for rail as there is existing (but not operating) rail beds there and it goes through downtown areas.

- There was a written comment submitted that stated: "The work done so far and the work planned for the immediate future are very commendable and very encouraging. However, the facts of the rapidly worsening conditions in the I-93 corridor suggest that this is a much more urgent matter than has been recognized up to now. Something should be done very soon to prevent further encroachment upon the railroad right-of-way."

- There was a written comment that stated: “I would like to see some form of rail travel from Manchester, NH to Lawrence and/or Woburn, via the M & L branch line. Rail transit is more reliable in bad weather.”

I-93 Transit Investment Study Public Meeting
Summary of Comments

April 11, 2007
Derry Municipal Center, Derry, NH

The following comments were received at the I-93 Transit Investment Study public meeting held on April 11, 2007 at Derry Municipal Center, Derry, New Hampshire.

- There was comment that the railroad bed is used as a park and open space by residents. The Highway alignment is the most direct route. The Western alignment appears to be the easiest to construct/implement as it is already in use. Need to look at the airport's effect on air quality and trains' effects on noise and air quality. Many residents came to New Hampshire for open space and would like to share transportations' pollution with others.

- There was a comment that a railroad alternative should be part of a master transportation system. The study is doing a great job of looking at multimodal solutions. Need to look at alternatives and what is going on in the region. Boston is not just an employment destination, but also a medical, sports, and educational destination. Southern New Hampshire is part of the Boston transportation region. New Hampshire is not going to have another opportunity like this to have a positive effect on transportation and growth. Don't let it pass by.

- There was a comment supporting rail along the I-93 highway. The Eastern alignment will not work because there is no parking in downtown Derry and downtown Derry cannot handle the growth that might come from transit. Rail is also an expensive alternative.

- There was a comment that the study should consider the alternatives effect on climate change. This needs to be taken seriously. Traffic is a major CO_2 generator, while mass transit offers some reductions. However, the mass transit options that may seem the most preferred could have the highest impact on climate change. The study should include a comparative table that illustrates varying impacts on CO2 of different options.

- There was a comment to consider other commuting patterns. For example, many people do not commute to Boston, but instead commute to the I-93, 128, 495 corridors and Merrimack Valley. These commuters may not benefit from train or express bus service to Boston.

- There was a discussion on the current status of the Windham Rail Trail Alliance. This trail is getting a lot of use by families. This study should consider recreation. There was also a suggestion that the study should conduct a cost-benefit ratio of the alternatives. Not impressed with the northside total commuter ridership ability can only take 26,000 cars off the road. Supports using the fourth lane of the I-93 widening for bus lane. Questioned where parking lots will be located for rail service. Does not think there are any good areas for this. Suggests using I-93 as a spine for improvements.

- There was a comment about restricting truck traffic during rush hours.

- There was a comment supporting the Windham Rail Trail. Support rail along the Highway alignment. However, there will be a few problems at the state border that will require special coordination. Suggests immediate bus system improvements, as they are the most economical, and transitioning to rail improvements later.

- There was a question asking for more detail on the demographic data and analysis.

- There was a comment about the Eastern alignment and its negative effect on the Rail Trail. In addition, many commuters travel to places such as Andover, rather than Boston, for work. Can the study encourage economic development in other areas? Suggested developing jobs in NH.

- There was a comment concurring with the need for a cost-benefit analysis. A major benefit of rail is getting people off of I-93. Should take into account transit oriented development scenarios and any induced growth that will result from the highway widening. There was a request that the study use current assumptions, rather than outdated ones, for cost of parking, etc. There was also a comment that the Highway alternative is not a feasible alternative because of the high cost and because it will not allow for transit oriented development.

- There was a question if freight will have access to the rail lines if the Highway alignment rail is constructed. Concerned with chemical spills. Suggested employer based buses as a good alternative.

- There was a comment stressing the growing numbers of reverse commuters. More Massachusetts' license plates are heading north into New Hampshire, including to Manchester Airport.

- There was a comment about the Western alignment and the coal trains. Need to consider the potential freight / passenger train conflict. There was also concern expressed that the growth of congestion at the 495/93 Interchange needs to be considered.

- There was a comment that the Western corridor rail is single tracked and this potential freight / passenger conflict could be avoided with proper scheduling. Questioned the cost of the I-93 widening ($718 M).

- There was a question about NHDOT's ability to pay for the highway widening.

- There was a comment that it was important for the public to know that the widening costs include inflation, 13 to 1 ratio wetlands relocation, and the costs associated with the lawsuit.

- There was a comment supporting the highway alignment as it is the fastest. Supports economic development.

- There was a comment supporting the highway widening as it is critical to support tourism and economic development in New Hampshire as well as Manchester Airport.

- There was a comment that the state will not be able to bring businesses into the area until the highway is widened. The lawsuit is driving up the cost of the highway.

- There was a comment that businesses will not locate here until freight can move here. Supports highway widening, including fourth lane. Does not support the Eastern alignment because does not want a train in downtown Derry. Does not think Highway alignment is feasible.

- There was a comment supporting the lawsuit related to the widening of the highway and its effects (closer look at environmental issues such as wetlands).

I-93 Transit Investment Study
Summary of Comments

November 27, 2007
Andover Public Library, Andover, MA

The following comments were received at the public meeting for the I-93 Transit Investment Study held on Tuesday, November 27, 2007, at the Andover Public Library in Andover, Massachusetts. Responses to questions are in italics.

- When you developed operation and management costs for the bus service alternatives, did you base the costs on a private or public operator? *Response: The project team believes that these costs won't vary much between either a public or private operator.*

- What is the breakdown of costs for the $70 million to start up a bus service utilizing the road shoulders? *Response: It will take about $100,000/mile along the 50-mile corridor to upgrade the shoulders to accommodate buses ($5 million), $20 million for vehicles, $30 million for bridge modification and the remaining amount for stations.*

- Do you know people are already driving in the shoulders on I-93 north of Route 125? *Response: Yes. The use of the breakdown in Massachusetts for peak hour travel is viewed as a temporary measure to relieve congestion in that segment of I-93.*

- Is there a specific idea of what is the baseline cost to carry an alternative forward? *Response: This will be evaluated by the study team.*

- What will prevent cars from driving into the shoulder lane intended for buses? *Response: We expect that enough buses will be using the lane to prevent "empty lane syndrome." We have forecasted 20 buses an hour will be on I-93 from New Hampshire. If we add in current Massachusetts bus services, there will be a bus approximately every two minutes.*

- Plans for the Lowell junction interchange is moving forward and 8,000 -10,000 new jobs are predicted. Was this factored into you forecasts? *Response: We use state provided data that includes projected regional job growth.*

- How many more trains will be coming through Andover if the Manchester & Lawrence (M&L) and Haverhill lines are put into service? *Response: More than double the number of trains (26 to well over 50) will be coming through Andover. One precondition of any M&L work is to double the track through Andover as it's currently one of the busiest pieces of single track in America. Besides the existing commuter train, 10 Downeaster and up to 12 freight trains use the track daily.*

- If you don’t provide more parking at the Andover station that will be a problem.

- The bus from Andover is cheaper and offers more convenient times than the train. My daily commute by train, when you factor in $2 for parking at the station, $4 subway fare, and $6.50 each way for the train, adds up to a lot of money. But, the ride on the train is smoother and more pleasant.

- The public doesn’t realize the brutal social, environmental and safety costs of driving. Long commutes cause people to miss family. More needs to be stated about the costs of our road system.

- We’re seeing real estate ads saying “we’re near Haverhill station” or other stations. Clearly proximity to train stations has an economic benefit. You should advertise this benefit.

- Are you recommending double tracking? *Response: Yes.*

- Why couldn’t you do both bus and train? *Response: That is a possible outcome.*

- It seems like towns should recognize the opportunity rail provides and get involved financially to make it work.

- So many studies show people would like not to have to drive their car but people get so used to their cars they don’t think about transit.

- What role can we, as citizens, play at this stage to advance a project? How do we keep it moving? Is this study a sign of commitment that the state will help? *Response: It will be up to the legislators to decide if there is enough public support to fund transit. The study team will identify the funding needed and develop a strategic implementation plan for review by the two states.*

- When you use the year 2030 for planning transit, does this mean nothing will happen until then? *Response: No. 2030 is the year we use for forecasting, but service can be up and running before that.*

- How do you decide what to implement? Do you pick low hanging fruit? The things that make sense? *Response: Low hanging fruit may not be edible or laying on the ground so are not desirable. We will recommend the approaches that are effective.*

- It seems like it would be easier to get transit projects in Massachusetts. In New Hampshire we have a 30-year plan focused on widening I-93. Our elected officials have hung their hopes on widening I-93. We haven’t been given a transit alternative.

- This study seems to be a good sign for transit.

- Every time there’s a gas hike or with the threat of global warming you would think people would make the connection. All political and market forces should support public transit but it’s just not happening.

I-93 Transit Investment Study
Summary of Comments

November 28, 2007
Salem High School, Salem, NH

The following comments were received at the public meeting for the I-93 Transit Investment Study held on Wednesday, November 28, 2007, at Salem High School, Salem, New Hampshire. Responses to questions are in italics.

- Have you considered extending the end of the M&L (Manchester & Lawrence rail line) at exit 5 to the airport? People may want to get to the airport by train. *Response: Yes. But access to locations within the airport would be complicated.*

- Have you taken into consideration that some alternatives would work better during snow conditions? For example, train would be better than bus.

- When you figured the cost of a shoulder bus service, what are the costs since the road is already built? *Response: The shoulder will need some modest improvements but most of the costs are for parking, stations and vehicles.*

- Are you considering state or private ownership of the bus service? *Response: There is not a big cost difference. A public subsidy will be needed for both..*

- Is there a simple explanation of why operating and maintenance costs are much higher for buses? *Response: The higher costs are associated with the significantly higher number of busses that will be needed to provide the level of service, as well as maintaining the equipment, etc. The operating cost would be associated with the more extensive bus schedule, i.e. labor and fuel costs for running the separate schedules from Manchester, Derry, etc.*

- Will there be barriers to prevent cars from driving into the shoulder lane reserved for buses? If not, cars could drive into it and slow the buses. *Response: No. It is important that the shoulder be available for breakdowns, enforcement actions and other emergency needs. In the event the shoulder is occupied, the bus driver will have to merge into the general purpose lane.*

- When you propose operating buses on I-93 shoulders, have you accounted for the fact that from the Massachusetts state line to Rte 125 the shoulders are already in use during commuting hours? *Answer: Yes. A policy decision would have to be made by the state transportation agency about using the shoulder exclusively for buses.*

- It is not a wise move to stop trains at the Anderson Transit Center in Woburn. People want a one-seat ride to work. There are two examples where train transfers were required on lines that had been direct – in Montreal and Chicago. Ridership dropped by 50% and within two years both routes were abandoned. *Response: We agree with this assessment and have dropped the Anderson alternative for further consideration.*

- In New Hampshire we already have two good examples of Transit Oriented Development (TOD) – Salem Depot and Downtown Derry. *Response: Downtown Derry has a TOD feel. In Derry we'd be looking at infill (building on smaller vacant lots between buildings). In Salem there is a large vacant parcel near I-93.*

- Is there an assumption that TOD will increase ridership? *Response: When we do the numbers for the federal government we are not allowed to factor this in to our ridership projections. However, those who are in the transportation planning environment know that in the real world ridership will increase where there is housing near transit. We will do a sensitivity analysis for this study that includes this factor so the states will have the kind of information it needs to make decisions.*

- Does the $170 million for the Manchester & Lawrence (M&L) line address capacity needs in Massachusetts? *Response: Yes. We've factored into the cost double tracking (the now single track segments) in MA.*

- In our current environment where homeland security is a big issue, it seems like there would be a big advantage to having redundancy in our transportation system. Is any value placed on the M&L as being in a separate corridor to I-93 so if there is a problem on one corridor, the other can still operate. We shouldn't put all our eggs in one basket so there is still an option if there is a major shutdown. *Response: To date we haven't considered the redundancy option.*

- Ridership has been several times more than projected for virtually every rail, light rail, expanded rail system.

- Rail corridors offer more development opportunity than bus. *Response: When considering economic development, the M&L line is head and shoulders above the rest, including rail in the median.*

- Downtown Haverhill is a good example of TOD.

- TOD offers opportunity for reverse commutes. Metro North sees a great number of reverse commuters because businesses have moved out of downtown Boston. If we only expand I-93 do we put ourselves at a disadvantage?

- We need to look into the future. People will go to Boston for more than work – for sports, entertainment. There is a tourism market. And, the person I want to sell my house to may want to commute to Boston by train.

- The Downeaster service was fought. People thought it would put the buses out of business but bus service is increasing as well. Would you do both rail and bus? *Response: Both could be developed. Buses in shoulders could be put in service while rail service was developed over the longer term.*

- Have you considered stopping at Rte 128 to service businesses there? *Response: We will stop at Anderson but Rte 128 and Rte 495 is a big, diverse market and hard to serve with transit.*

- Is 2030 your time horizon? *Response: Yes*

- Will buses travel as slow as cars? *Response: Yes, if the shoulders are not made available as an exclusive busway.*

- How often will trains or buses run? *Response: Every half hour at peak times, hourly during the day.*

- Did you figure your estimates of travel time for transit to only include travel between stations and for cars to only include the commuting time spent on I-93 [not including time accessing I-93 or transit]? *Response: Yes, the travel times at this stage were estimated using common points (station locations) to compare modes and alternatives, travel times to those common points are estimated to be similar between alternatives.*

- Will you have more developed costs at the next meeting? *Response: Yes.*

- Has congestion at the interchanges that will slow buses been figured into the commute time estimate? *Response: Yes.*

- Has an HOV lane been considered? *Response: The NH Dept. of Transportation has looked into having an HOV lane and it was not shown to be effective.*

Question: I don’t understand why the incremental approach isn’t practical for the rail alternative.
Response: The study’s context is I-93; there is not enough benefit from the rail alternative to pursue it at this time. One needs to look beyond this particular study.

Question: Has there been any consideration to feasibility of rail in light of chloride pollution?
Response: No. This will be looked at in the Environmental Assessment.

Question: When is the earliest BOS may be seen?
Response: 5 years. BOS would be built in consecutive segments – beginning with the section closest to Boston where the congestion is most severe and there would be the biggest travel time savings. Next segment would be to the 93/95 interchange in Woburn and progressively move north into New Hampshire.

I-93 Transit Investment Study
Public Meeting – October 1, 2008, 6 p.m.
Manchester City Hall
Manchester, NH

Kit Morgan of the New Hampshire Department of Transportation welcomed members of the public and introduced Ken Kinney, of HNTB, the consultant hired to conduct the study. Ken Kinney said the study team looked at 15 alternatives; tonight's meeting will focus on the final two. The screening of alternatives was focused on purpose and need, which included the objectives of removing cars from I-93 and fostering more compact development around transit.

Two final proposals were the Manchester and Lawrence (M&L) commuter line and express bus service with the bus traveling on the shoulder of I-93 – bus on shoulder (BOS). The northern terminus of M&L would be Exit 5 on I-93 south of Manchester. The line would not go to downtown Manchester. This possibility was studied but because some of the right-of-way was lost when Manchester Airport was developed, the cost of tunneling under the airport property would be as much as the cost of establishing service from Exit 5 to Boston.

The purpose of BOS is to get faster trips. It has been done successfully in other cities. Buses would run all day with frequencies of 15 or 30 minutes during peak periods.

When comparing capital costs of the M&L rail and the BOS service, rail would cost $197 million versus $88 million. Operating costs of BOS would be 50% less than rail and revenue is expected to be about the same. Each would generate about the same number (approximately 10,000) of riders per average weekday. Environmental impacts are about the same. But the rail would have significantly better community impact because it spurs more compact development in the vicinity of train stations.

In general, the M&L has higher benefits (especially regarding land use) but also higher costs. However, this corridor also has the greater challenges to implementation. The consultant does not believe that, under current evaluation criteria, this corridor would be likely to receive federal funds. In addition, there are significant challenges to community acceptance because some of the corridor is used as bike path. There are many grade crossings and there could be opposition to increased noise.

However, because the state of New Hampshire owns the right-of-way, the study team anticipates that at some future time (possibly after the study's 2030 horizon year) land use and other conditions may change and the M&L line may become more viable. The study recommends the state should maintain control of the line for future use.

The study recommends the New Hampshire Main Line (Boston-Nashua-Manchester) should be developed as a priority rail line.

The study team recommends that the two states take steps now to begin the implementation of a Manchester-Boston BOS. This would include agreements between the two states, establish an implementation task force, develop a facility and operation plan and perform an environmental assessment.

Question: What land use assumptions were used when looking at potential stations?
Response: 2006 Metropolitan Planning Organization projections. In addition we did some sensitivity analysis for Transit Oriented Development (TOD) with high residential that increased ridership by 15%.

A second sensitivity analysis performed used different employment and different population figures that increased ridership 10% but there were big swings in ridership. Some locations had less, while others more than doubled. The biggest shift showed a drop in employment in New Hampshire so there were fewer work trips but Boston became a more important employment center, with more people taking transit.

Finally, we performed a third sensitivity analysis on the impact of increased gas prices. We calculated the impact of gasoline at $5.60/gallon and did not increase train fare. New Hampshire ridership increased by 20%, with the percentage of increase falling off as stations got closer to Boston.

Question: How will BOS impact I-93 that already is planned to go to 4-lanes in each direction? How much wider will it need to be to drive on shoulders?
Response: I-93 will be built with a 10-foot shoulder but with a sub-base, grading and embankment of the shoulder to accommodate an additional 2 feet. In MA the shoulders are generally 10 feet and there is enough room under bridges for BOS. However, a lot of drainage work is needed to support BOS.

Question: Where do I go if I have a breakdown? Will there be space beyond the shoulder?
Response: Massachusetts currently uses shoulders in some areas of I-93 during peak hours for general purpose traffic. It has pull-out lanes every half mile and we assume this would be built in for BOS. Shoulders also are used as travel lanes only during peak hours and therefore would be available for emergency use most of the time.

Question: If I lived in Manchester and wanted to travel to Salem, would BOS be available?
Response: No. Buses will travel non-stop to Boston. We studied ridership and learned there are only three locations riders typically disembark – Lawrence, Anderson and Boston.

Question: Is any BOS proposed from Concord?
Response: No. Ridership volumes are too low.

Question: How much of the M&L is active in New Hampshire?

Response: None. There is no track on the line right now. That's actually beneficial because it will be less expensive to reconstruct new track. The right-of-way for the New Hampshire segment is controlled by the state. There are some allowed and not allowed incursions on the right-of-way. In Massachusetts the line was controlled by a freight operation but is currently owned by MBTA.

Question: Do any other regions allow car or vanpools to use BOS?
Response: BOS is a relatively new program. Allowing this type of use would be a policy decision. This study did not model use by vehicles other buses. There will be 90-100 buses during peak.

Question: Wasn't an objective of the study to reduce cars on I-93? What would be the impact of improved transit?
Response: Less than 5%.

Comment: We need transportation alternatives other than the highway. The expanded I-93 will fail in the future.

Comment: We don't have a transportation system in NH. We have a system of roads and no choice. The Downeaster is an example of the benefits of transit. It's brought renewal to communities like Haverhill, Old Orchard Beach.

Comment: I have trouble with the study recommendations saying the land use changes to allow greater residential density is needed for the M&L to be feasible. Without a commitment to develop the M&L, land use change won't happen.

Question: Why don't we develop a small segment of the M&L – Lawrence to Salem?
Response: From a strategic point of view, building support for one segment at a time is what other communities have done. It's what got the Nashua-Manchester line moving forward.

Comment: But the responsibility for advocating for rail should be done by the state government, not left to communities.

Question: Are stations being located in places with potential to develop community centers? Derry seems to be the only place that has an existing center.
Response: We had that in mind but during analysis proposed stations would be subject to change.

Comment: This study has done a great job in making the connection between land use and transportation. However, I see a disconnect between the findings and recommendations. I am troubled by the federal landscape as it may be changing. Why put off rail for 20 years? Rail will never move forward.
Response: Projects are now judged on three main criteria – land use, cost/benefit and financing. These criteria could change, making it more likely that service could be implemented in less than 20 years.

I-93 Transit Investment Study
Public Meeting – October 2, 2008, 6 p.m.
Methuen City Hall
Methuen, MA

Paul Nelson of the Massachusetts Executive Office of Transportation (EOT) welcomed members of the public and introduced Ken Kinney, of HNTB, the project manager for the consultant team conducting the I-93 Transit Investment Study. Ken said the team looked at 15 alternatives; tonight's meeting will focus on the final two. The screening of alternatives focused on purpose and need of the study, which include objectives of removing cars from I-93 and fostering more compact development around transit.

The two final alternatives were the Manchester and Lawrence (M&L) commuter rail line and express bus service with the bus traveling on the shoulder of I-93 – bus on shoulder (BOS). The northern terminus of M&L would be Exit 5 on I-93 south of Manchester. The commuter rail line would not go to downtown Manchester. This possibility was studied but because some of the rail right-of-way was lost when Manchester Airport was expanded, the cost of tunneling trains through the airport property would be as much as the cost of establishing service from Londonderry Exit 5 to Boston

The purpose of BOS is to get faster trips. It has been done successfully in other cities. Buses would run all day with frequencies of 15 or 30 minutes during peak periods.

When comparing capital costs of the M&L rail and the BOS service, rail would cost $197 million versus $88 million for BOS. Operating costs of BOS would be 50% less than rail and revenue is expected to be about the same. Each would generate about the same number of weekday riders, approximately 10,000 one-way trips. Environmental impacts are about the same. But the rail would have greater positive land-use impact because more compact development would be likely to occur near rail stations.

A new Lawrence rail station would be needed because the M&L alignment would not work with the existing train station in Lawrence.

According to Ken Kinney, one of the most interesting developments of this project was how it evolved from what was perceived primarily a New Hampshire project to a bi-state project with significant benefits for residents of both states.

In general, the M&L alignment has higher benefits, especially regarding land use, but also higher costs. However, this corridor also has the greater challenges to implementation. The consultant team does not believe that, under current evaluation criteria, this corridor would be likely to receive federal funds. In addition, there are significant challenges to community acceptance because some of the corridor is used as bike path. There are many grade crossings and there could be opposition to increased noise.

However, because the state of New Hampshire owns the right-of-way, the study team anticipates that at some future time (possibly after the study's 2030 horizon year), commuter rail could befeasible. Land use and other conditions may change and the M&L line may become more viable. The study recommends the State of New Hampshire maintain control of the line for future use.

The study recommends the New Hampshire Main Line (Boston-Nashua-Manchester) should be developed as a priority rail line.

The study also recommends that the two states take steps now to begin the implementation of a Manchester-Boston BOS. This would include agreements between the two states, establish an implementation task force, develop a facility and operation plan and perform an environmental assessment.

Question: With a bus on shoulders lane in use, where do people who have a breakdown actually go to break down?
Response: The consultant is working with Mass Highway to figure this out. Breakdown lanes 400-500 feet long will be built every half mile. They exist now in Massachusetts in the section where cars are currently allowed to drive on I-93 shoulders.

Comment: Sometimes you don't get a choice about when you break down.
Response: Buses will be operating on shoulders only when there is congestion. So the shoulders would be occupied very limited periods of time. [Usually he also says buses would pull into general traffic for emergencies or enforcement actions]

Comment: Minnesota and Ottawa are not good examples for BOS.
Response: Other states include Maryland & Virginia.
There has been only one accident in Minnesota, a location that has been using BOS for some time. We know Mass Highway wants to more closely examine the allowable speed and what the driver training may need to be.

Comment: We have passenger cars driving on shoulder lanes now. I'd feel more comfortable with buses.

Question: When you look at ridership, from the point of view to make BOS more compelling so this would be supported, can we get the potential benefits out there? We think more people will ride existing buses if they can get better travel time.
Response: Good point. During the Democratic National Convention buses were permitted on shoulders of I-93, which improved travel times.

Comment: I have serious issues with the idea of driving on shoulders.
Response: You're right. Right now we have drainage structures in the shoulders; ramps at exits aren't aligned properly. We would recommend implementing the BOS in segments. It would start in Boston where the congestion (and benefit) is the greatest and go to Medford. [I don't think it starts in Boston, does it? That's where the viaduct is and

the HOV southbound lane] This would take $25 million. There are other planned projects throughout the corridor that could be built to accommodate BOS but the service in these locations would not operate on a patchwork approach.

Comment: Extend out the left lane as was done during the Democratic National Convention. It worked and it could be implemented before 2013.

Question: Have we had any results in the study of how well received the Route125 shoulder lane to the NH border is being used? What has been the accident rate?
Response: We tried to look at police reports but they were not written accurately enough to know about history of the accidents in this lane.

Question: Did the statistics you used take into account the large multi-use units that are being built?
Response: We used data from various regional planning commissions. Not every specific development is included but generally this data is very accurate.

Question: Why has the Exit 2 Park and Ride not opened? How will you advertise?
Response: The Exit 2 lot and facility has been built; the contractor for bus service has been selected. It will open the end of November. There is an active marketing plan. They'll be a splash when it's ready to go.

Question: New Hampshire has started adding bus service. Your numbers seem a little low. Do you have current numbers? It seems like there is a big increase in numbers of people now riding buses.
Response: We ran a number of sensitivity analyses. One was looking at what the increase in gas prices, equivalent of $5.60/gallon. In New Hampshire it increased ridership by 20 % and went down to a low of 6% increase at Anderson.

Question: You talk about a new station in Lawrence. People have to cross track now. How is it viable to team up with the MBTA as it is now $8 billion in debt?
Response: The M&L would increase use of MBTA as it would improve track.

Comment: Without building anything, increasing 1-2 trains now would make a big difference.

Question: When park & ride first opened in Massachusetts, Trombly ran the service and it was awesome. When it first started there was no publicity. When Trombly left, it was no longer express and it took too long. Could express bus be put back in? Post publicity in little shed just so people can know bus is there. Let people know, run it often enough and they will come.
Response: *(by Joe Constanzo, Merrimack Valley Regional Transit Authority)* We only have five buses, three in service. We just don't have the equipment. If we had a diamond lane, we could run an express.

Comment: I'd like to commend these gentlemen for doing a study that is not just a transportation study but also looks at land use. BOS sounds nice but you will be affected by what ever is happening (accidents) on the highway. We need only to look locally at how rail service spurs development in communities – Saco and Old Orchard Beach, Maine, downtown Haverhill. The University of New Hampshire used the Downeaster as a marketing tool.

Comment: Successful downtowns are built around train stations.

Comment: People in New Hampshire have done a great job with rails to trails – there can be a cooperative relationship between rail and trails.

Question: Did you ask people why people don't use public transportation? I just don't understand why more people don't use it.
Response: Rail transit only works when you work close to the train stations. You see a lot of cars on the road but they are going to suburban office locations.

Question: What would drive more successful transit?
Response: Concentration of employment in cities or near transit and expensive parking.

Comment: Your comments about New Hampshire and economic development are right on. The traffic congestion on the highway today is real. A multi-strategy approach needs to happen. Massachusetts just floated a $900 million bond for commuter rail. This BOS doesn't seem that much in light of that.
Response: The real cost of development should be evaluated by looking at financing mechanisms. BOS costs $88 million. One half could be funded by the federal government, bring the cost down to $44 million. This number would be shared by two states, bring the cost per state to $22 million. If financed over 20 years the cost of BOS is not as daunting a figure.

Paul Nelson of Massachusetts EOT said participation at public meetings has shown how much more a benefit/need there is for transit in this corridor. Bill Cass of NHDOT said the study has fostered bi-state collaboration. Taking this forward, in NH I-93 is a high priority. As priorities align, there will be more opportunities for transit.

Question: How long does it take for a project to be built?
Response: A standard project, from concept to construction, takes approximately five to ten years. Broad community support is helpful in moving a project forward.

Question: Why not have the buses use the HOV lane?
Response: Trying to get buses in or out of HOV lanes is difficult.

Question: Could another lane be added to I-93 in Massachusetts?
Response: I-93 goes through Middlesex Fells so would be very difficult to widen as it would impact parklands and federal dollars aren't likely.

Question: Could you do a reversible lane?
Response: We looked at it and there are some impediments.

Question: Does the budget include the cost of purchasing trains or buses?
Response: No. The project budget includes all construction costs, reconditioning lanes and passing sidings.

Comment: Federal rules are getting tighter, so I don't think in 2030 the M&L would ever get federal funds.
Response: Today it probably wouldn't satisfy the New Starts funding criteria. To get federal dollars it would be important to be able to demonstrate good land use policy and a realistic financial plan.

Comment: We need to talk to our delegation now to get money for buses. If we don't do it now for 2009, we won't be able to go back for another 6 years.

Question: Is there anything you could use for support on the user end that would indicate to others? Is there anything we can do to help?
Response: It's fundamental. Let your elected leaders know this project is important.

Question: Will this project be competing with I-93/I-95 project?
Response: For state funds yes, but not on the federal level because it's funding source would be transit, not highway funds.

Question: Where does this project stack up as a Massachusetts priority?
Response: Once the recommendations of this study are complete, the projects will be prioritized as part of the existing planning processes in Massachusetts such as each metropolitan planning organization's Regional Transportation Plans and the MBTA's Program for Mass Transportation. Massachusetts will also continue to work closely win New Hampshire to coordinate these efforts.

Question: I'm a lifelong resident of Massachusetts. I've seen development, huge increase in traffic, and the demise of M&L. When did use of the M&L line stop?
Response: Passenger service ended in 1953; freight in the 1980s

Question: Commuter rail is an excellent solution. Is there any stipulation that says freight has to be allowed on line if there is federal money?
Response: No.