RSG INC.
TRANSPORTATION

Biddeford Mill District Master Plan:

Multi-modal Transportation Assessment

Biddeford, Maine

October 2009

DATA ■ ANALYSIS ■ SOLUTIONS

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1.0 INTRODUCTION

Resource Systems Group (RSG) was retained to assess existing (2005) and future (2025) traffic conditions in downtown Biddeford, Maine. Included in this analysis are the following elements:

- Level of Service and Queuing Analysis
- Safety Assessment
- Recommended Mitigation
- Cost Estimates
- Transportation Demand Management information

The traffic analysis relies upon design standards and analysis procedures documented in the 2000 Highway Capacity Manual,[1] Trip Generation,[2] A Policy on Geometric Design of Highways and Streets,[3] and the Manual on Uniform Traffic Control Devices (MUTCD). This study also relies upon the traffic volume and safety data from the Downtown Biddeford Parking and Traffic Study (DBPTS).[4]

2.0 2005 EXISTING CONDITIONS

2.1 Study Area

For the purposes of this transportation analysis, the study area consists of the entire Biddeford Mill District and the adjacent roadways. All roadways are two lanes, and most have on-street parking in both directions. Shoulders, if any, are narrow, and the roadway is frequently bounded by historic buildings within the Mill District.

Within the study area, there are six study intersections:

- Elm St/Main St
- Main St/Lincoln St
- Main St/York St
- Main St/Laconia St/Alfred St
- Main St/Hill St/Water St
- Main St/South Entrance

The Main Street/Elm Street intersection is the only fully operational signalized intersection; Main Street/Hill Street/Water Street has a signal installed but is presently "in flash," and all others are two-way stop controlled.

These intersections and their existing lane configurations are shown in Figure 1.

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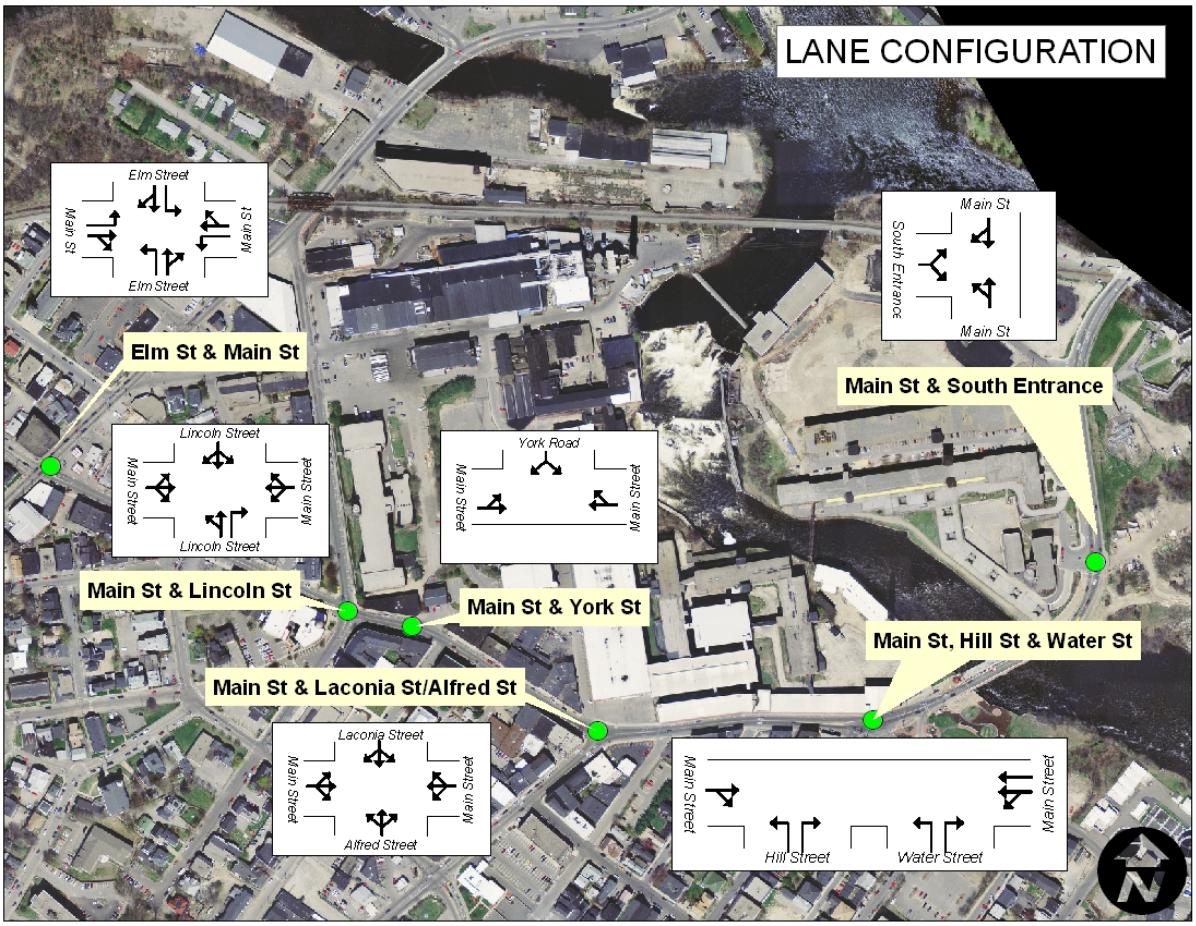
[1] Transportation Research Board, National Research Council, *Highway Capacity Manual* (Washington, DC: National Academy of Sciences, 2000).

[2] Institute of Transportation Engineers, *Trip Generation* 8th Edition (Washington, D.C.: Institute of Transportation Engineers, 2008).

[3] American Association of State Highway and Transportation Officials (AASHTO), *A Policy on Geometric Design of Highways and Streets*, 4th Edition (Washington DC: AASHTO, 2004).

[4] Gorril-Palmer Consulting Engineers, Inc., *Downtown Parking and Traffic Study*, 2006.

Figure 1: Study Area Intersections and Lane Configurations



2.2 Traffic Volumes

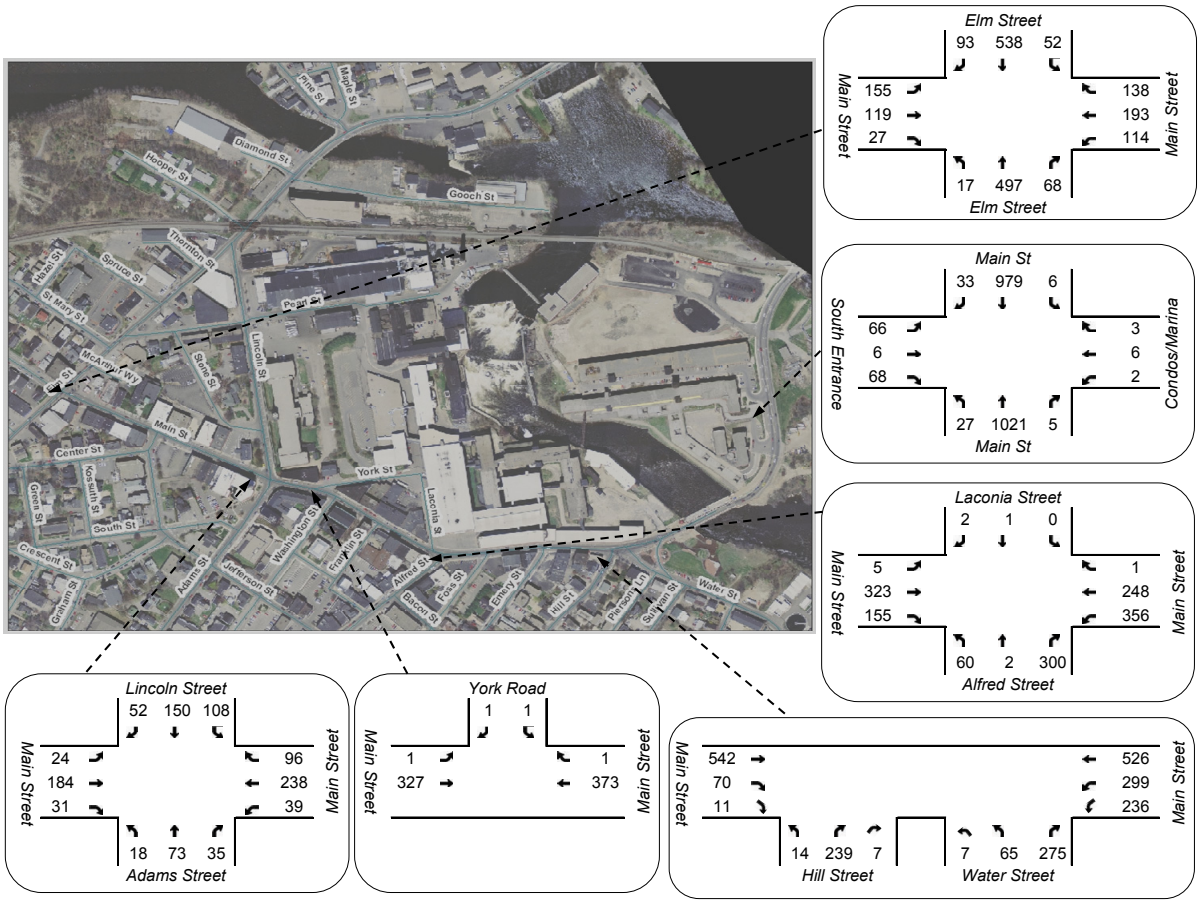
This study used the traffic volumes and recommendations from the Downtown Biddeford Parking and Traffic Study (DBPTS) as a starting point for analysis[1]. The present study differs from the DBPTS in that it assumes a greater amount of growth within the Mill District which, in turn, translates into more traffic in the future. Traffic volumes for relevant study intersections are shown in Figure 2.[2]

[1] The DBPTS evaluated conditions in 2005 and 2025 so these years are used in this study as well.

[2] The Main Street/York Road intersection was not a part of the DBPTS; volumes for this intersection are estimated.

Figure 2: 2005 No Build Volumes

2005 PM Peak Hour



2.3 Level of Service Definition

Level-of-service (LOS) is a qualitative measure describing the operating conditions as perceived by motorists driving in a traffic stream. LOS is estimated using the procedures outlined in the 2000 Highway Capacity Manual. In addition to traffic volumes, key inputs include the number of lanes at each intersection and the traffic signal timing plans. The LOS results are based on the existing lane configurations and control types (signalized or unsignalized) at each study intersection.

The 2000 Highway Capacity Manual defines six qualitative grades to describe the level of service at an intersection. Level-of-Service is based on the average control delay per vehicle. Figure 3 shows the various LOS grades and descriptions for signalized and unsignalized intersections.

Figure 3. Level-of-Service Criteria for Signalized and Unsignalized Intersections

LOS	Characteristics	Unsignalized Total Delay (sec)	Signalized Total Delay (sec)
A	Little or no delay	≤ 10.0	≤ 10.0
B	Short delays	10.1-15.0	10.1-20.0
C	Average delays	15.1-25.0	20.1-35.0
D	Long delays	25.1-35.0	35.1-55.0
E	Very long delays	35.1-50.0	55.1-80.0
F	Extreme delays	> 50.0	> 80.0

The delay thresholds for LOS at signalized and unsignalized intersections differ because of the driver's expectations of the operating efficiency for the respective traffic control conditions. According to HCM procedures, an overall LOS cannot be calculated for two-way stop-controlled intersections because not all movements experience delay. In signalized and all-way stop-controlled intersections, all movements experience delay and an overall LOS can be calculated.

2.4 Level of Service Results and Queuing

The Highway Capacity Manual procedures implemented within Synchro (v7), a traffic analysis software package from Trafficware, were used to assess congestion at the study intersections. SimTraffic was used to assess average queues. Figure 4 presents the LOS and queuing results during the 2005 weekday PM peak hour for all study intersections. This analysis assumes that the Main Street/Hill Street/Water Street intersection operates with a fully-functioning signal. An unsignalized analysis for this intersection is presented in section 2.4.1.

Detailed Synchro LOS worksheets are available in Appendix A. Detailed SimTraffic queuing worksheets are available in Appendix B.

Figure 4: 2005 LOS, Delay and Queues (feet)

	2005 PM Peak Hour		
	No Build		
	LOS	Delay	Avg Queue
Elm St/Main St			
Overall	B	20	
EB Left - Main St	C	28	69
EB Thru/Right - Main St	B	16	121
WB Left - Main St	B	18	52
WB Thru/Right - Main St	C	21	131
NB Left - Elm St	B	10	11
NB Thru/Right - Elm St	B	18	190
SB Left - Elm St	B	12	31
SB Thru/Right - Elm St	C	21	229
Main St/Hill St/Water St			
Overall	F	85	
EB Thru/Right/Right - Main St	F	>100	613
WB Left, Left, Thru - Main St	E	67	659
NB Left/Thru/Right - Hill St	C	32	396
NB Left/Thru/Right - Water St	F	>100	100
Main St/South Entrance (Saco)			
Overall	B	12	
EB Left/Thru/Right - South Entrance	D	52	112
NB Left/Thru - Main St	B	10	222
SB Thru/Right - Main St	A	9	>1000
Main St/Adams St/Lincoln St			
EB - Main St	A	1	10
WB - Main St	A	1	16
NB - Adams St	C	21	35
SB - Lincoln St	F	>100	115
Main St/York St			
EB - Main St	A	<1	1
WB - Main St	A	<1	0
SB - York St	B	13	2
Main St/Alfred St/Laconia St			
EB - Main St	A	<1	49
WB - Main St	A	8	238
NB - Alfred St	F	>100	525
SB - Laconia St	D	30	1

The intersection of Main Street/Hill Street/Water Street currently operates at LOS F, with extensive queues in all directions. Although the other two signalized intersections operate at LOS B, there is excessive southbound queuing at the Main Street/South Entrance intersection.

At the unsignalized intersections, two approaches are currently failing with excessive queues:

- Southbound at Lincoln Street
- Northbound at Alfred Street

2.4.1 Main Street/Hill Street/Water Street

The Main Street/Hill Street/Water Street traffic signal currently operates "in flash," which means that the traffic signal equipment is fully installed, but flashes in yellow for the Main Street approaches and flashes in red for the side street approaches. Therefore the intersection currently operates more like a stop-controlled intersection.

Due to the unconventional alignment of this intersection, the Highway Capacity Manual methodology for determining delay is not applicable. However, an estimate of delay and queues can both be obtained through microsimulation. Figure 5 presents these results using SimTraffic to calculate delay and queues.

Figure 5: 2005 LOS, Delays, and Queues at Main St/Hill St/Water Street – Unsignalized Analysis

	2005 PM Peak Hour		
	No Build		
	LOS	Delay	Avg Queue
Main St/Hill St/Water St			
Overall	F	>100	
EB Thru/Right/Right - Main St	A	3	16
WB Left, Left, Thru - Main St	F	>100	619
NB Left/Thru/Right - Hill St	F	>100	>1000
NB Left/Thru/Right - Water St	F	>100	>1000

Although microsimulation and HCM take different approaches to calculate delay and therefore cannot be directly compared, it is evident that the Main Street/Water Street/Hill Street intersection operates with extensive delays and queues, particularly on the Northbound approaches (Hill St and Water St) in the existing condition.

2.5 Safety

The Maine Department of Transportation (MaineDOT) classifies a road section or intersection as a High Crash Location (HCL) if it meets both of the following criteria:

1. Eight or more crashes over a three-year period, and;
2. A Critical Rate Factor (CRF) of 1.00 or greater for the same three-year period.[1]

Based on 2002-2004 crash data, there are four High Crash Location (HCL) intersections within the study area:

- Main St/Lincoln St
- Main St/Laconia St/Alfred St
- Main St/Hill St
- Main St/Water St

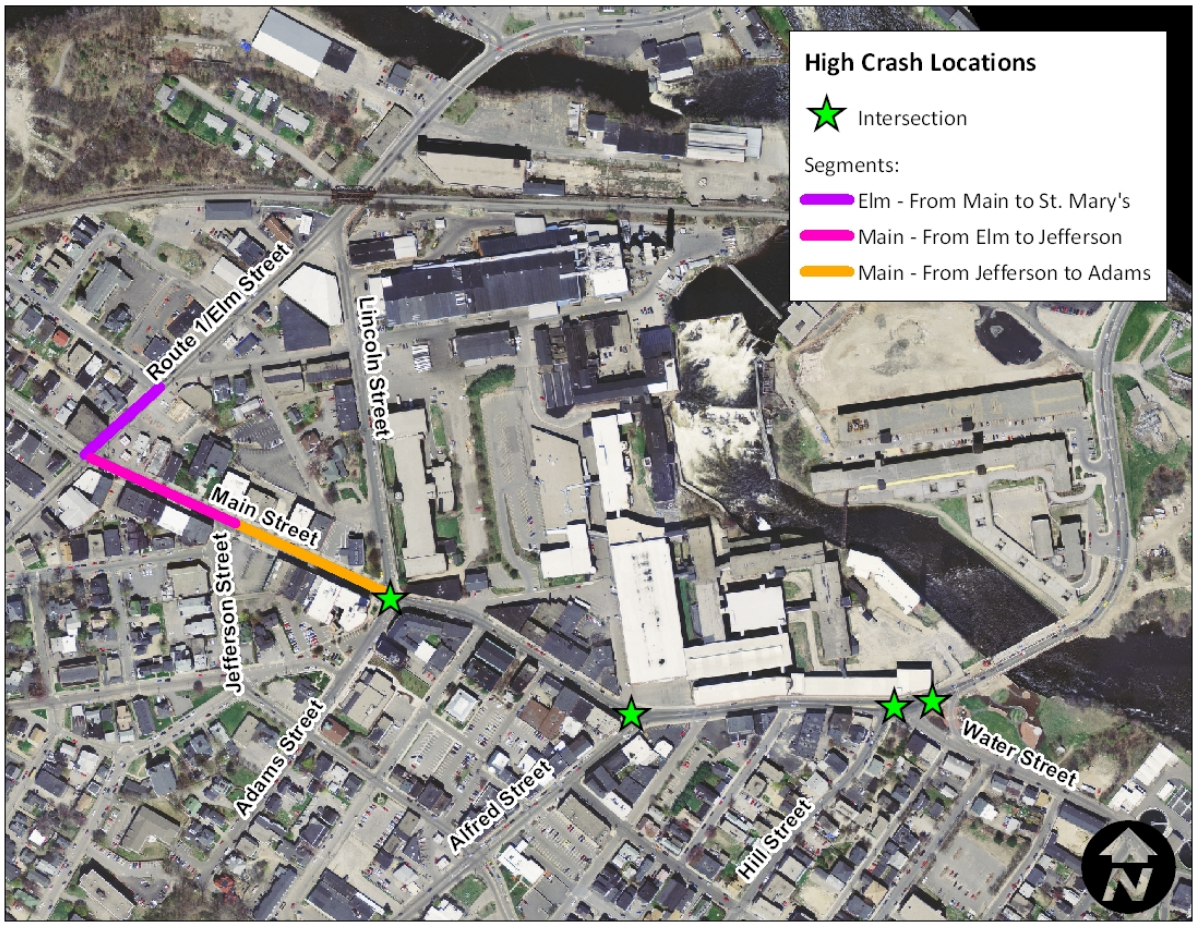
Additionally, there are three HCL segments:

- Elm from Main to St. Mary's
- Main from Elm to Jefferson
- Main from Jefferson to Adams

These High Crash Locations are shown in Figure 6.

[1] The CRF is a ratio of the actual crash rate of each intersection or road segment to the Statewide crash rate of similar locations. A CRF of 1.00 indicates average crash conditions.

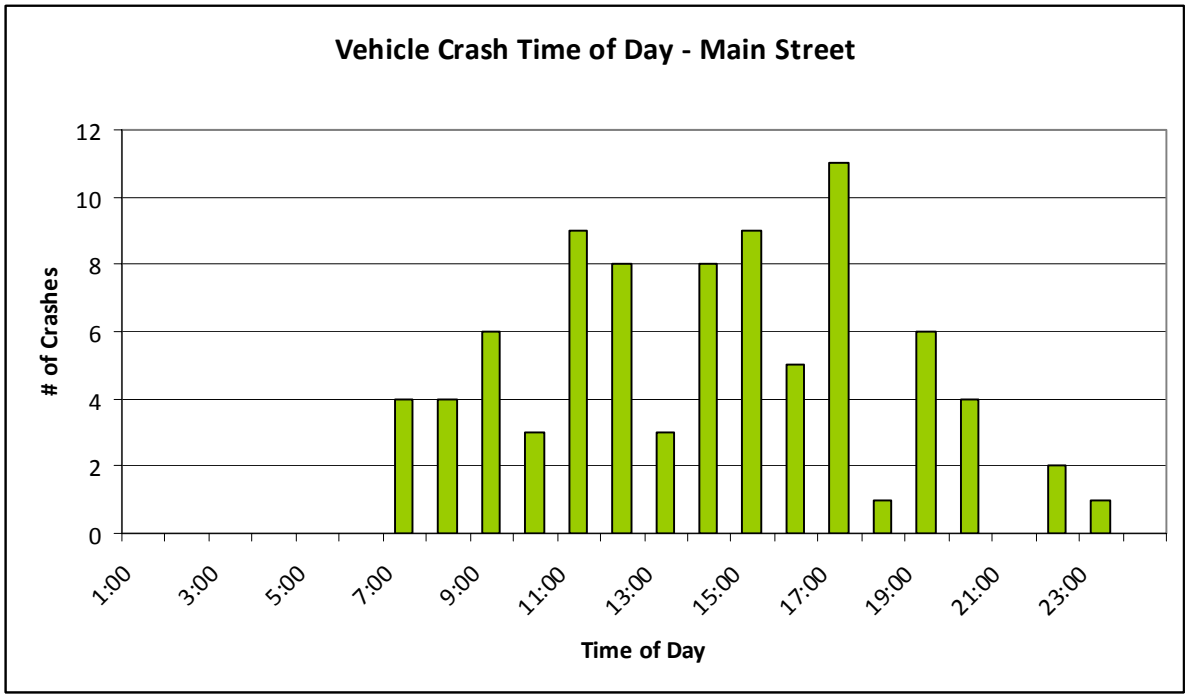
Figure 6: High Crash Locations



Based on the individual crash data, the number one cause of collision was "Driver inattention – Distraction." Other leading causes include "failure to yield right-of-way," "improper turns," and "following too close."

The time of day appears to have a relationship with the number of crashes that occur (Figure 7). Note that the highest occurrence of crashes typically occurs during the mid-day and PM peak hours.

Figure 7: Crash Time of Day - 2002-2004



2.6 Transit

There are several existing transit services operating in the greater Biddeford area. The downtown area is serviced by the Shuttle Bus Tri-Town Service ("The Local"), which provides service between Biddeford, Saco, and Old Orchard Beach. This bus alternates between the Alfred Street and Elm Street loops, and travels 15 weekday round-trips; 10 Saturday round-trips; and five weekend round-trips.

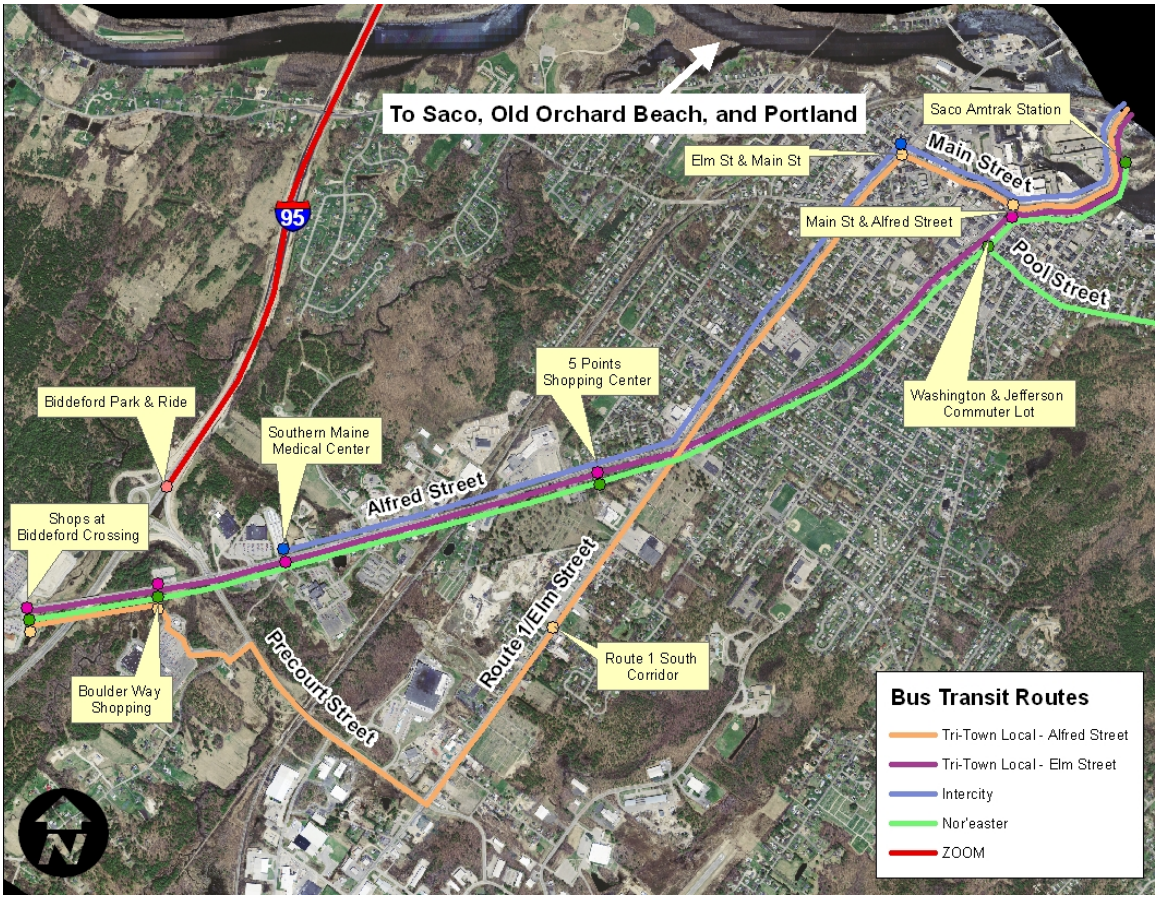
The Shuttle Bus also provides Intercity Service, which connects Biddeford to Portland via Old Orchard Beach, Scarborough, and the South Portland Maine Mall. This route provides six weekday round-trips; five on Saturday and three on Sunday.

The ZOOM Turnpike Express is a commuter service from Biddeford and Saco Park and Ride lots into downtown Portland. This bus completes six weekday round-trips and no weekend service.

Lastly, there is the Nor'easter Express, which provides service from September to May. This route connects the University of New England with Saco and Downtown Biddeford with the following service trips: 10 round-trips Monday through Thursday, 19 round-trips on Friday, 13 on Saturday and seven on Sunday.

These four routes are mapped in Figure 8.

Figure 8: Bus Transit Routes



On the Tri-Town line, Downtown Biddeford is the second-most popular stop – second only to the Old Orchard Beach stop, which is the final stop on the route.[1] Further, ridership has shown steady growth in both the short and long term history:

- 21% increase in annual ridership from FY 2007 to FY 2008
- 55% increase in annual ridership over the last 10 years

[1] Based on daily boardings and alightings.

Figure 9: Tri-Town Average Daily Boardings

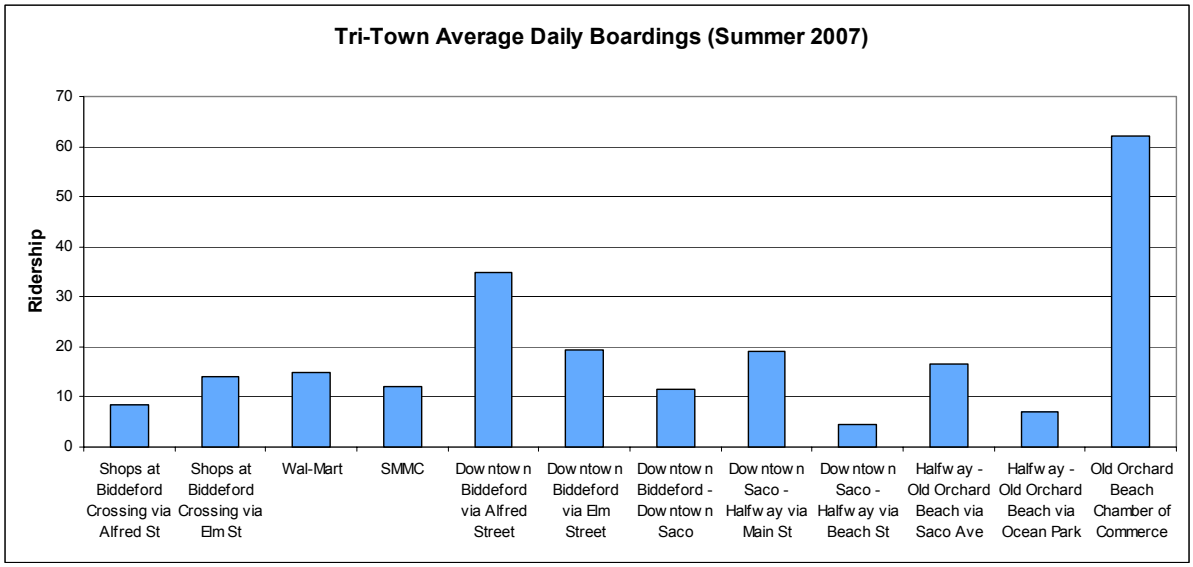
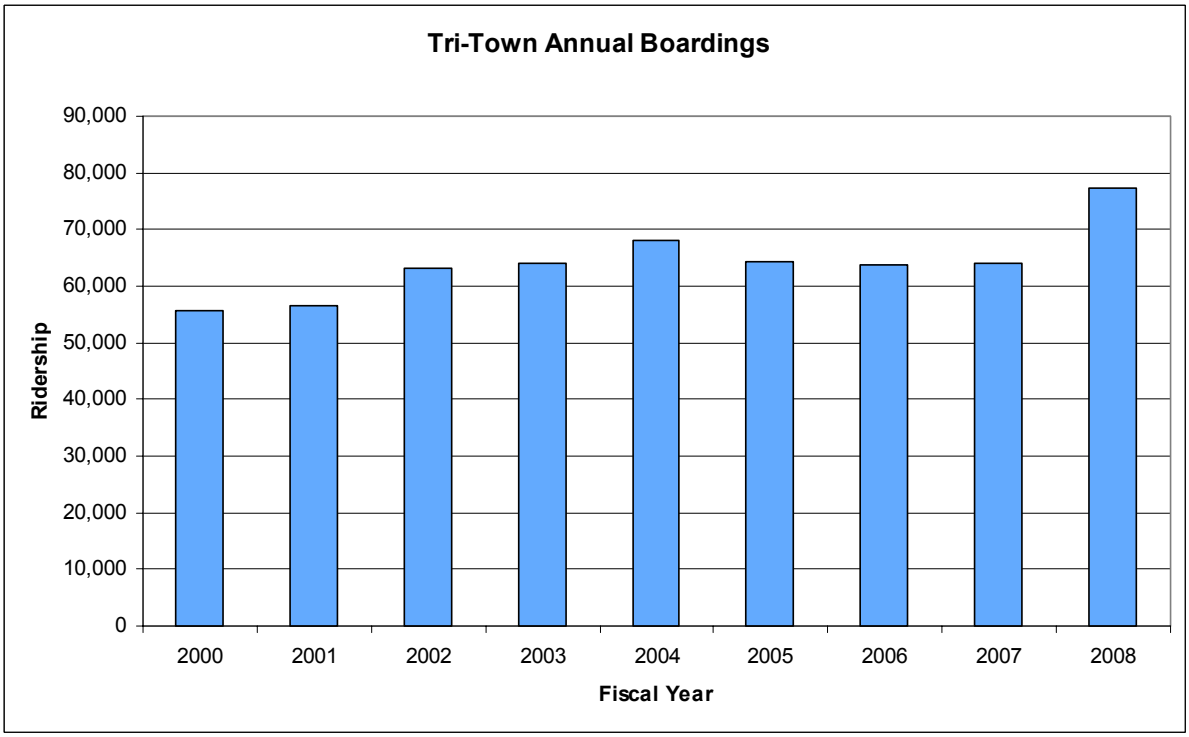
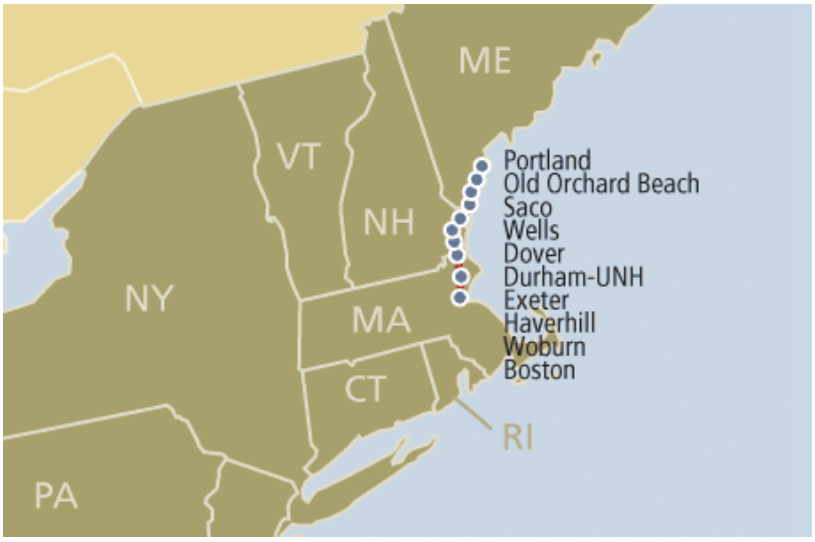


Figure 10: Tri-Town Annual Boardings



Just over the bridge from Downtown Biddeford is the Amtrak Train Station on Saco Island. This station is serviced by the Downeaster, which travels from Portland to Boston with five daily round trips into and out of Saco (Figure 11).

Figure 11: Amtrak Downeaster Service



Other transit options in the area include taxi cabs and the York County Community Action Corporation (YCCAC) – a scheduled bus service for York County residents. This service, which is provided for shopping and medical reasons, is available to residents who call 24 hours in advance to schedule service.

2.7 Pedestrian Facilities

The City of Biddeford has a well connected sidewalk network which extends and connects to all downtown areas. Marked crosswalks exist on at least one leg of almost all downtown intersections.

The DBPTS recommended the rehabilitation of existing sidewalks and ramps to meet the Americans with Disabilities Act (ADA) standards. This study has inventoried and assessed sidewalk conditions within the study area, and found four segments to be in below average condition (Figure 12).

Figure 12: Sidewalk Condition

Street	Condition	Description
Lincoln Street		
Lincoln Mill to Main Street	Below Average	Concrete Sidewalk. Approx. 10' wide. Below average condition with differential settling. Small curb (approx 3-4") reveal indicates that numerous pavement applications have been placed with minimal grinding or cold planing. Asphalt was laid over concrete for leveling.
In front of Bugbee Brown	Below Average	Asphalt Sidewalk. Approx 6-8' wide. Below average condition. Low curb reveal with significant curb settling and poor drainage control.
MERC to Elm Street	Average	Asphalt Sidewalk. Approx 5' wide. Average Condition.
Elm Street		
Lincoln Street to Gooch Street	Good	Brick pavers and concrete sidewalk. Adequate width. Good condition.
Main Street		
Lincoln Street to York Street	Average	Concrete Sidewalk. Approx. 6' wide with 1' brick pavers along curb. Average Condition with slight settling. Average curb reveal of (4-5").
Laconia Street to West Point Mill-South	Below Average	Concrete Sidewalk. Approx. 5' wide. Very poor condition. Very low curb reveal (.5"). The sidewalk is almost at grade to allow for truck use at WestPoint Loading docks.
In front of West Point Mill-South	Good	Concrete Sidewalk. Approx. 5' wide with 1' brick pavers along curb. Good Condition. Granite curb with average curb reveal of 4-6".
West Point Mill-South to North Dam Mill Entrance	Good	Concrete Sidewalk. Approx. 8'-10' wide. Good Condition. Granite curb with average curb reveal of 3-5".
York Street		
Main Street to Laconia Street	Below Average	Asphalt sidewalk. Approx. 5' wide. Below average Condition. Granite curb with Below average curb reveal of 2-4".

2.8 Parking

An inventory was collected for on-street parking on the following streets: Lincoln, York, Laconia, Pearl, and Main. The total inventory on these streets is 194 spaces (Figure 13).

Figure 13: On-Street Parking Capacity

On-Street Parking Capacity

	Type	No.
Lincoln Street		
Main Street to Elm Street	unlimited	28
	2 hr	18
	taxi	3
York Street		
Main Street to Laconia Street	north side, marked	4
Laconia Street		
Main Street to York Street	southeast side, marked	28
Main Street to York Street	northwest side, unmarked	6
Pearl Street		
Stone Street to Lincoln Street	unlimited	17
Main Street		
Adams/Lincoln Street - Alfred Street	2 hr	47
	1 hr	2
	Loading	2
Alfred Street - Hill Street	Unlimited	2
	2 hr	35
	15 minute	2

Off-street parking was also inventoried for the following lots: Westpoint, Northdam Mill, Precision Screw, and Cronkite. These volumes and/or areas are presented in Figure 14.

Figure 14: Off-Street Parking Capacity

Off-Street Parking Capacity

	Type	No.
West Point		
South Lot	Angled	30
West Lot	Angled	162
Northdam Mill		
Main Lot	Open Space	31,000 Sq Ft
Precision Screw		
South Lot	Open Space	20,000 Sq Ft
North Lot	Open Space	7,000 Sq Ft
Cronkite		
Main Lot	Open Space	34,000 Sq Ft

A one-day snapshot of parking occupancy was recorded on 16 June 2008 for the sections of Main, Pearl, and Lincoln in the study area. The number of available spaces on these streets totals 156. At peak occupancy, (12 PM – 1 PM) on-street parking was 47% full.

Table 1: Occupied Spaces: On-Street Parking

Total Spaces	Occupied Spaces							
	9:00 AM	10:00 AM	11:00 AM	12:00 PM	1:00 PM	2:00 PM	3:00 PM	4:00 PM
156	46	52	56	74	74	55	57	68
	29%	**33%**	**36%**	**47%**	**47%**	**35%**	**37%**	**44%**

3.0 2025 Future Conditions

3.1 2025 Traffic Volumes

The Downtown Biddeford Parking and Traffic Study applied a zero percent annual adjustment to traffic volumes. This assumption was based on historic study area volumes, which have ranged from relatively unchanged to declining over the past ten years. This study adopts those same assumptions; thus the 2025 background traffic volumes are unchanged from the 2005 volumes. Overall traffic volumes for this study are different, however, due to the build-out assumptions for the Mill District.

3.2 Trip Generation and Distribution

ITE's Trip Generation was used to determine the number of vehicle trips currently entering and exiting the project area. The following land use codes were used in determining existing trip generation:

- 110: General Light Industrial
- 710: General Office Building
- 820: Shopping Center

Studies of mixed-use developments have shown that the combination of land uses typically produces fewer vehicle trips than independent land uses on independent parcels. For instance, when residential and office land uses are combined within one development, it is anticipated that a resident might walk from their residence to their office, thus eliminating one vehicle trip. ITE's data indicates that this assumption applies to residential, office, and retail land uses. For this study, we also assumed that this would apply to the light industrial land use.

Mixed-use reduction rates are based on ITE's Trip Generation Handbook for the PM peak hour. For this project area, a 23% mixed-use reduction was applied to the total trip generation.

Based on existing occupancy data, the previously mentioned trip generation rates, and the mixed-use reduction factor, the Biddeford Mill District currently generates roughly 745 vehicle trips in the PM peak hour.

The same land use codes were used to project future trip generation, with the addition of land use code 230: Residential Condominium/Townhouse. Using projected land use types and information detailed in Chapter 7, the future scenario is anticipated to generate 1762 vehicle trips in the PM peak hour. This results in a net difference of 1017 additional vehicle trips in the PM peak hour throughout the study area.

To distribute these trips throughout the network, various assumptions were made based on parking availability and land use by area. These assumptions are shown in Figure 15.

Figure 15: Existing and Projected Vehicle Trip Generation and Distribution

Elm & Gooch

	% of Trips*	Existing	Projected	Net Change
Area 1	20%	100	236	136
Area 2	0%	0	0	0
Area 3	0%	0	0	0
Area 4	100%	57	134	77
				214

Lincoln & Pearl

	% of Trips*	Existing	Projected	Net Change
Area 1	40%	200	473	273
Area 2	20%	28	67	39
Area 3	60%	28	67	39
Area 4	0%	0	0	0
				350

Main & York

	% of Trips*	Existing	Projected	Net Change
Area 1	15%	75	177	102
Area 2	25%	35	84	48
Area 3	15%	7	17	10
Area 4	0%	0	0	0
				160

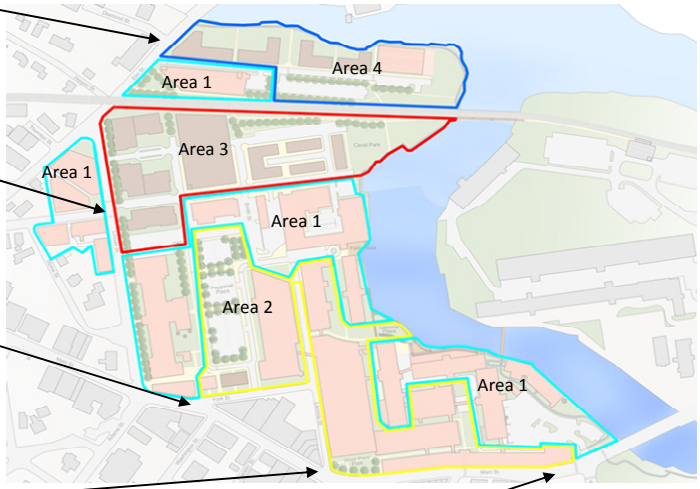
Main, Alfred & Laconia

	% of Trips*	Existing	Projected	Net Change
Area 1	20%	100	236	136
Area 2	35%	50	117	68
Area 3	25%	12	28	16
Area 4	0%	0	0	0
				220

Main, Hill & Water

	% of Trips*	Existing	Projected	Net Change
Area 1	5%	25	59	34
Area 2	20%	28	67	39
Area 3	0%	0	0	0
Area 4	0%	0	0	0
				73

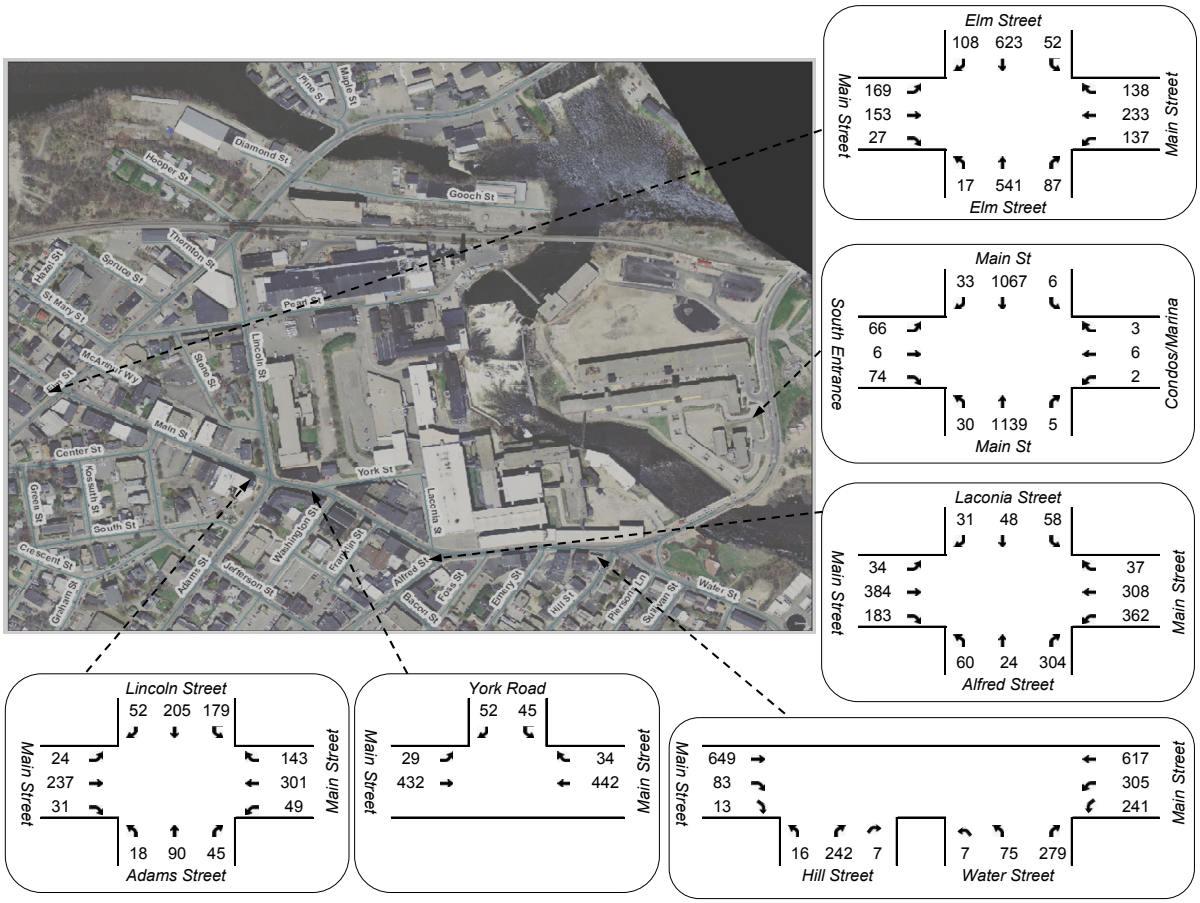
*Refers to the % of trips entering/exiting at that intersection at each area



Build traffic volumes are the sum of the No Build volumes and the additional site-generated traffic. 2025 Build volumes are shown in Figure 16.

Figure 16: 2025 Build Volumes

2025 PM Peak Hour



4.0 INTERSECTION ANALYSIS & MITIGATION

4.1 Intersection Recommendations

The Downtown Biddeford Parking and Traffic Study recommended the following traffic mitigation measures in 2025:

- Relocate access to/from North Dam Mill to better align with Water Street, so that it becomes part of the intersection;
- Retime all the traffic signals throughout the Downtown, maintaining the coordination of the Elm Street signals at Spruce Street and Main Street;
- Construct a roundabout at the intersection of Main Street, Hill Street, Water Street, and the North Dam Mill;
- Implement all-way stop at the intersection of Main Street, Alfred Street and Laconia Street (This is critical if the roundabout is constructed as described above);
- Construct left-turn lanes at the intersection of Main Street and Alfred Street if the intersection does not become an all-way stop;

- Consider the implementation of an all-way stop at Jefferson Street and Adams Street;
- Extension of the left-turn lanes at the intersection of Main Street and Elm Street;

This 2009 study based its initial analysis on these recommendations. However, it is important to note that this 2009 study anticipates a substantially larger amount of development than the DBPTS, thus the projected traffic volumes are also greater. Generally, upon implementation of these recommendations, significant delay and substantial queues remained throughout the Downtown area. As a result, additional measures were determined as needed by intersection. This analysis, including 2025 LOS and Queuing results, is given by intersection in the following sections.

4.1.1 Main Street/Elm Street Intersection

The Main Street/Elm Street intersection is currently signalized with left turn lanes ranging from 50 – 75 feet in length. The DBPTS recommended turn lane extensions and signal re-timing (maintaining coordination) at this intersection. Based on the LOS and queuing analysis from this study, these measures will be sufficient to adequately manage the additional projected traffic (Table 2).

Table 2: Main Street/Elm Street – 2025 LOS and Queues

	2005 PM Peak Hour No Build			2025 PM Peak Hour Build		
	LOS	Delay	Avg Queue	LOS	Delay	Avg Queue
Elm St/Main St						
Overall	B	20		C	25	
EB Left - Main St	C	28	68	D	41	74
EB Thru/Right - Main St	B	16	128	B	17	219
WB Left - Main St	B	18	53	B	19	59
WB Thru/Right - Main St	C	21	139	C	23	177
NB Left - Elm St	B	10	14	B	13	13
NB Thru/Right - Elm St	B	18	180	C	21	220
SB Left - Elm St	B	12	37	B	15	26
SB Thru/Right - Elm St	C	21	233	C	30	203

4.1.2 Main Street/Adams Street/Lincoln Street Intersection

The Main St/Adams St/Lincoln St intersection is currently two-way stop controlled on the Adams and Lincoln Street legs, and operates freely on Main Street. The DBPTS recommends consideration of conversion to an all-way stop to relieve congestion. The LOS and queuing analysis from this study shows that this will be an acceptable intermediate solution; however this will not be sufficient under full build-out of this study's land use assumptions. To fully mitigate the traffic volumes at this intersection, signalization is recommended.

The LOS and queuing impacts of an all-way stop given in Table 3; signalization is shown in Table 4.

Table 3: Main Street/Adams Street/Lincoln Street – 2025 LOS and Queues – Stop Controlled

	2005 PM Peak Hour No Build			2025 PM Peak Hour Build			2025 PM Peak Hour All-Way Stop		
	LOS	Delay	Avg Queue	LOS	Delay	Avg Queue	LOS	Delay	Avg Queue
Main St/Adams St/Lincoln St									
EB - Main St	A	1	14	A	<1	12	D	27	199
WB - Main St	A	1	14	A	1	22	F	94	134
NB - Adams St	C	21	37	D	35	57	B	14	40
SB - Lincoln St	F	>100	107	F	>100	432	F	67	230

Table 4: Main Street/Adams Street/Lincoln Street – 2025 LOS and Queues – Signalized

	2025 PM Peak Hour Mitigated		
	LOS	Delay	Avg Queue
Main St/Adams St/Lincoln St			
Overall	C	24	
EB - Main St	B	18	286
WB - Main St	B	15	148
NB - Adams St	B	19	46
SB - Lincoln St	D	40	326

4.1.3 Main Street/York Street Intersection

The Main Street/York Street intersection is currently two-way stop controlled on the side legs and operates freely on Main Street. This intersection operates acceptably under all scenarios (Table 5).

Table 5: Main Street/York Street – 2025 LOS and Queues

	2005 PM Peak Hour No Build			2025 PM Peak Hour Build		
	LOS	Delay	Avg Queue	LOS	Delay	Avg Queue
Main St/York St						
EB - Main St	A	<1	1	A	<1	21
WB - Main St	A	<1	0	A	<1	1
SB - York St	B	13	2	C	19	42

4.1.4 Main Street/Alfred Street/Laconia Street Intersection

The Main St/Alfred St/Laconia St intersection is currently two-way stop controlled on the Alfred and Laconia Street legs, and operates freely on Main Street. The DBPTS recommends installing left turn lanes at a minimum, and preferably converting this intersection to an all-way stop. Based on the LOS and queuing analysis presented in Table 6, it is evident that conversion to an all-way stop will be an acceptable intermediate solution; however this will not be sufficient under full build-out of this study's land use assumptions.

Table 6: Main Street/Alfred Street/Laconia Street – 2025 LOS and Queues

	2005 PM Peak Hour No Build			2025 PM Peak Hour Build			2025 PM Peak Hour All-Way Stop		
	LOS	Delay	Avg Queue	LOS	Delay	Avg Queue	LOS	Delay	Avg Queue
Main St/Alfred St/Laconia St									
EB - Main St	A	<1	63	A	<1	32	F	220	382
WB - Main St	A	8	264	A	9	245	E	49	146
NB - Alfred St	F	>100	545	F	>100	592	E	44	186
SB - Laconia St	D	30	2	F	>100	138	C	18	252

To fully mitigate the traffic volumes at this intersection, signalization and the construction of left turn lanes is recommended.

The results of this mitigation are shown in Table 7.

Table 7: Main Street/Alfred Street/Laconia Street - Signalized

	2025 PM Peak Hour Mitigated		
	LOS	Delay	Avg Queue
Main St/Alfred St/Laconia St			
Overall	C	30	
EB - Main St	C	30	386
WB - Main St	C	23	267
NB - Alfred St	D	41	114
SB - Laconia St	D	40	106

4.1.5 Main Street/Hill Street/Water Street Intersection

The Main St/Hill St/Water St intersection experiences the most substantial delay and queuing in the study area, and the effects of these delays reverberate throughout the downtown area (Table 8).

Table 8: Main Street/Hill Street/Water Street – 2025 LOS and Queues

	2005 PM Peak Hour No Build			2025 PM Peak Hour Build		
	LOS	Delay	Avg Queue	LOS	Delay	Avg Queue
Main St/Hill St/Water St						
Overall	F	85		F	>100	
EB Thru/Right/Right - Main St	F	>100	614	F	>100	517
WB Left, Left, Thru - Main St	E	67	625	F	>100	677
NB Left/Thru/Right - Hill St	C	32	413	E	78	427
NB Left/Thru/Right - Water St	F	>100	137	F	>100	432

The DBPTS recommends a one-lane roundabout with five approaches, including the re-alignment of the Northdam Mill driveway directly into the roundabout. One of the most significant consequences of this recommendation was that the historic Northdam Mill building would have to be removed.

Based on the traffic volumes developed for this study, it was evident that the one-lane roundabout would be insufficient. A two-lane or hybrid roundabout would process the traffic volume efficiently, however it also came with several significant implications – including the potential demolition of the historic Westpoint Mill Building 20, restricted access at adjacent driveways, and the potential widening of the bridge to Saco. After presenting these findings to the project Steering Committee and the City of Biddeford, it was clear that neither roundabout was an acceptable solution.

At present, a traffic signal exists at this intersection; however it is programmed to be in flash and therefore is not fully utilized. Full signalization was considered, however implementation did not show significant relief to delay and queues due to the intersection configuration and directional vehicular demand.

The scenario that provided the greatest relief with minimized adjacent impact was the creation of two separate intersections, thereby re-aligning the approaches as follows:

- Main Street/Hill Street
- Main Street/Water Street/Northdam Parking Lot

This re-alignment is shown in Figure 17.

Figure 17: Main Street/Hill Street/Water Street Re-Alignment

The re-alignment of the existing Main Street/Hill Street/Water Street intersection into two fully signalized intersections provides for greatly reduced delay and queuing at this intersection and, therefore, throughout the study area (Table 9). The realignment shown above is conceptual, and may shift slightly to minimize impacts to utilities and Mechanics Park.

Table 9: Main Street/Hill Street/Water Street – Re-Aligned

	2025 PM Peak Hour Mitigated		
	LOS	Delay	Avg Queue
Main St/Hill St			
Overall	C	26	
EB Thru/Right - Main St	B	12	533
WB Left/Thru - Main St	C	33	203
NB Left/Right - Hill St	D	37	93
Main St/Water St/Northdam			
Overall	C	21	
EB Left/Thru/Right - Main St	C	25	186
WB Left/Thru/Right - Main St	B	11	349
NB Left/Thru/Right - Water St	D	39	129
SB Left/Thru/Right - Northdam	D	39	32

4.1.6 Main Street/South Entrance Intersection

The Main Street/South Entrance intersection operates under acceptable LOS in the present, future, and mitigated scenarios (Table 10).

Table 10: Main Street/South Entrance – 2025 LOS and Queues

	2005 PM Peak Hour No Build			2025 PM Peak Hour Build			2025 PM Peak Hour Mitigated		
	LOS	Delay	Avg Queue	LOS	Delay	Avg Queue	LOS	Delay	Avg Queue
Main St/South Entrance (Saco)									
Overall	B	12		B	15		B	12	
EB Left/Thru/Right - Entrance	D	52	101	D	53	111	D	55	189
NB Left/Thru - Main St	B	10	214	B	14	240	A	8	89
SB Thru/Right - Main St	A	9	752	B	11	>1000	B	10	646

Note that although no additional mitigation was implemented at this intersection, southbound queues, which become a substantial problem in the 2025 Build scenario, are greatly reduced due to the reconfiguration of the Main Street/Hill Street/Water Street intersection.

4.2 Other Recommendations

With the recommended addition of four signalized intersections, it is critical that these signals form a coordinated network. The network should consist of the following signalized intersections:

- Main Street/Elm Street
- Main Street/Adams Street/Lincoln Street
- Main Street/Alfred Street/Laconia Street
- Main Street/Hill Street
- Main Street/Water Street/Northdam Mill
- Main Street/South Entrance

Although not included in the DBPTS project study area, several other observations were made with regard to intersections within the Mill District. These include:

- Lincoln Street/Pearl Street – two-way stop control appears to sufficiently process 2025 Build traffic volumes
- Elm Street/Gooch Street –two-way stop control does not appear to sufficiently process 2025 Build traffic; further analysis should be taken to determine the level of mitigation needed at this intersection.

The City of Biddeford should coordinate with Saco on mutually beneficial transportation improvements such as continuing to explore opportunities for a one-way loop through Downtown Biddeford and Saco.

4.3 Mitigation Prioritization

Recommendations can be implemented over short-term (1-5 years) and long-term (8-20 year) time horizons. These ranges are estimates given current traffic conditions; traffic congestion should be monitored annually as the Mill District redevelops[1].

Under current conditions, traffic operations at the Main St/Hill St/Water St intersection often fail during peak periods. To some extent, people have become accustomed to this level of congestion. It is not anticipated that congestion will ease in the future; it is more probable that conditions will worsen over

[1] Monitoring studies typically include peak period turning movement counts at 2-3 key intersections, trip generation counts/estimates, LOS or delay study analysis, and general traffic observations. These data and the associated analysis and observations can be recorded in a technical memo to establish a historic record of change.

time. Anticipating a gradual worsening of conditions and increasing frustration among local travelers, it would be prudent to initiate a design study for this intersection such that the City would be able to proceed with financing, permitting and construction at the point where conditions were determined to be intolerable.

Project prioritization should be pursued as follows:

- Short Term:
    1. Commission design of improvements of Main St/Hill St/Water St
    2. Convert Main Street/Alfred Street to all-way stop
    3. Convert Main Street/Adams Street to all-way stop
- Long Term:
    1. Re-Align and signalize Main Street/Hill Street/Water Street/Northdam Mill
    2. Convert Main Street/Alfred Street to signal; add turn lanes
    3. Convert Main Street/Adams Street to signal
    4. Coordinate all signals from Elm Street to South Entrance

The reconstruction of the Main/Hill/Water Street intersections is shown as a long-term project, following the design effort (listed as a short-term recommendation). However, if there was a local consensus to advance the reconstruction of this key intersection, it could proceed quickly after design, permitting, and financing is secured. In other words, reconstruction could occur in the short-term time frame if a public consensus to pursue this was established.

Other recommendations from the DBPTS should be implemented as needed (i.e. extended turn lanes, larger signal heads, etc.). Signal re-timing and coordination along Main Street should occur with each new signal installation.

4.4 Cost Estimates

Cost estimates for all recommended mitigation measures – including the conversion of Alfred and Adams first to all-way stops and later to traffic signals – are shown in Table 11. If all measures are implemented, the estimated cost will be $2.73 million.

Table 11: Cost Estimates

Mitigation Measure		Estimated 2010 Cost
Main & Elm		
	Extend Turn Lanes	$100,000
Main & Adams		
	Convert to All-Way Stop	$50,000
	Install Signal	$300,000
Main & Alfred		
	Convert to All-Way Stop	$100,000
	Install Signal	$300,000
	Install Turn Lanes	$150,000
Main, Hill & Water		
	Re-Align Intersection	$500,000
	Install Signals (2)	$600,000
	Subtotal	$2,100,000
Contingency, Engineering & Design @30%		$630,000
	TOTAL	**$2,730,000**

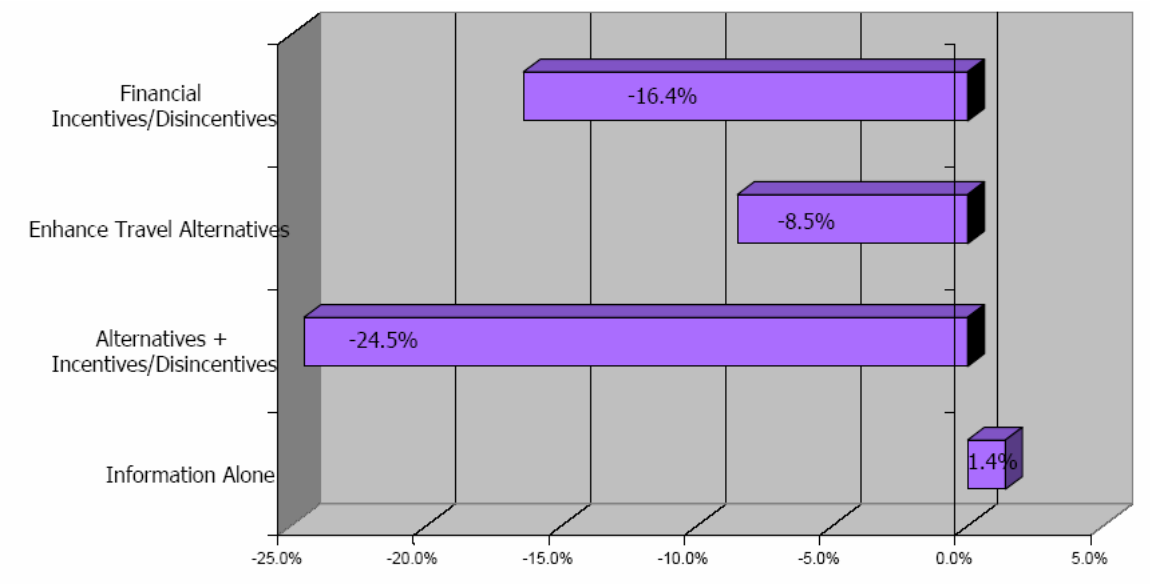
4.5 Transportation Demand Management

Transportation Demand Management (TDM) is a term used to encompass a variety of methods, programs, technologies, and incentives used to manage travel demand. Some TDM principles have become commonplace (transit, carpooling, etc.), while others are less widely utilized (ridematching, incentive systems, etc.). Approaches to TDM vary widely among private employers, institutions, and public entities, but they are unified by one goal: to improve the efficiency of their transportation system.

In Downtown Biddeford, the implementation of a TDM program has the potential to provide tremendous benefit. "Benefit" can be classified in a variety of ways – including reduced congestion on the roadway, increased business activity, improved safety and health benefits. Particularly, the Mill District has the unique opportunity of being at a critical juncture in its history; it is largely under-developed and has the potential for substantial growth. Therefore, this is an important time to implement TDM strategies.

Implemented TDM measures have been shown to significantly impact the number of vehicle trips on the roadway. While providing financial incentives/disincentives or enhancing travel alternatives alone has a sizeable impact on reducing traffic, the combination of the two has been shown to reduce vehicle trips by nearly 25% (Figure 18).

Figure 18: Vehicle Trip Reduction due to TDM Measures[1]



4.5.1 Types of Transportation Demand Management

There are generally three basic types of TDM:

1. Public Sector - this variety is typically run by government departments, such as Transit Agencies, Planning or Economic Development Departments and Environmental Units. Some are run by public employees, while others outsource to consultants through the bid process.
2. Public Sector with Transportation Management Initiative (TMI) – this type of TDM is publicly funded, and usually a joint effort between local business and community representatives.
3. Transportation Management Association (TMA) – a TMA is typically a group of private sector and public sector leaders, and therefore is funded from a variety of sources. Public grants for specific projects can also be contributed.

The type of program needed varies between municipalities, and typically is a result of the source of interest in creating a TDM program (public or private) and funding.

4.5.2 How to Establish Transportation Demand Management Programs

There are four key steps in establishing a TDM program. They are:

1. Determine TDM Type (Public, Private, Combination)
2. Determine Key Players
3. Determine Goals and Schedule
    - Create action teams (to support various initiatives)
    - Meet on a regular basis (weekly or monthly, for instance)
    - Set a theme or goal for each meeting

[1] CCMPO http://www.ccmpo.info/library/TDM/TDM_impacts.pdf

- Have regular visioning sessions (to keep vision and goals fresh, as previous goals are accomplished)

4. Identify Funding Sources
    - Congestion Management and Air Quality (CMAQ) funds can be available for program start-up
    - Revenue from developer agreements
    - Special taxes to fund TDM activities

4.5.3 Roles & Methods

Once the basic structure of the TDM program has been established, there are limitless roles that the group can take on. Depending on interest and the size of the body, the program can tackle one or many initiatives. Local employers and developers are typically the most frequently involved groups, but other parties such as national organizations (ZipCar, Amtrak, etc.) and neighboring communities may also have a vested interest. A partial list of potential roles is provided below.[1]

1. Support to employers:
    - Worksite assessment of existing and potential TDM services
    - Assess travel patterns, trip lengths, and employee origin mapping
    - Recommend appropriate shared-ride modes and worksite initiatives
    - Provide information and awareness events to promote travel alternatives
    - Promotional materials for worksite distribution, including posters, table tents, flyers, e-mail
    - Ridematching for carpooling and vanpooling
    - Technical assistance in TDM program implementation and ongoing operation
2. Support to and requirements of developers:
    - Apply TDM requirements for large single use or any multi-use developments
    - Require traffic impact analysis to include the number of Single Occupant Vehicle (SOV) trips and estimated reduction with TDM measures
    - Provide a list of acceptable TDM approaches that could be used to meet TDM requirements
    - Require the preparation of a TDM plan, which will be a commitment to TDM measures
    - Create a process for requesting a waiver from the regulations
    - Create a means of regulation enforcement, including implementation monitoring

4.5.4 Permit Conditions

Perhaps the most effective way to implement TDM strategies is to make them a requirement of permitting. Conditions should be applied based on the type and location of development, although other factors can also play a role. A partial list of potential permit conditions is provided below.

- Carpooling/Vanpooling/Rideshare requirements:

[1] VTrans, *Traffic Impact Study Guidelines*, page 34, rev. October 2008.

  - A commuter matching service and/or an area wide rideshare program
  - Provide vans for vanpooling
  - Subsidized carpooling or vanpooling
    - Payment for fuel, insurance or parking
    - Use of company vehicles
- Transit requirements:
  - Cooperation with transit to provide additional service (direct or shuttled) to the work site
  - Subsidized bus fares
  - Emergency taxi services
- Facility construction requirements:
  - Separate non-SOV loading/unloading facilities
  - Bicycle racks, lockers and showers
  - An information center that provides information on alternate modes and other travel reduction measures
  - Day care facilities (to reduce commute trips)
- Adjusted work schedules, including:
  - Compressed work weeks and employee-selected starting and stopping hours
  - Establishment of a work-at-home program, for full- or part-time employees (Telecommuting)
- Establish incentive programs:
  - Charge a fee for parking and/or a "rebate" for employees who do not use the parking facility
  - Incentives to encourage employees to live closer to work
  - Preferential parking (close or covered)
  - “Guaranteed Ride Home” program
- Infrastructure Investment, including:
  - Contributions to park and ride lots, bus shelters, sidewalks, bicycle lanes and parking, shared use paths
  - Dedicated capital development funds for capacity

4.5.5 Role of Transit

The Shuttle Bus currently has four transit routes that connect the Downtown Biddeford area to other destinations. Within the realm of TDM, the most effective role that transit can play in reducing vehicles in the downtown area is to provide a free bus service. This can be made possible through the support of the established TDM program.

The Downtown area is well established to create an effective bus loop that links the Mill District in Downtown Biddeford with Water Street in Saco and the Amtrak train station. Additionally, with the mitigation proposed in the previous sections, the Main Street corridor will be well positioned to implement signal priority – a means for extending the green signal phase during transit arrival – at all

new traffic signals. Additionally, some Mill District streets could be identified for transit only to increase the efficiency of the route. This option could be preliminarily explored simply by installing jersey barriers at roadway entrance points, which could be either removed if deemed ineffective or upgraded at a later point.

For optimal use and efficiency, the bus should operate four times per hour (every 15 minutes), and should offer transfer opportunities to other bus routes. A proposed transit route and potential transfer locations have also been identified in Figure 19. It is understood that Water Street in Saco currently runs in the opposite direction; an easterly direction would be preferable for transit purposes to allow passengers to exit the bus on the Mill District side of the street, but that direction could be reversed.

Figure 19: Proposed Bus Route

This bus route could be funded in one of three ways: through an endowment, impact fees (or a combination of the two), or by annual fees assessed to major employers, the TMA, or other beneficiary groups. A shuttle system operating Monday through Saturday from 7 AM to 7 PM is estimated to cost $300,000 to operate annually.[12]

[1] $75/hour * 6 days per week * 52 weeks per year * 12 hours per day = $280.800 per year

[2] Based on this annual cost, roughly $10,000,000 would be needed in an endowment to support this route, assuming a 3% annual growth in principal.

4.5.6 Carsharing

The University of New England participates in ZipCar, an organization that matches members with shared vehicles at a cost-effective rate. There are currently two ZipCars available on the UNE campus. As the redevelopment in the Mill District and surrounding area occurs, inviting ZipCar to place vehicles at key Downtown Biddeford and Mill District locations could be another strategy to further relieve development-related congestion in the study area.