

Executive Summary

Project Background

The North Main Street Corridor of Brewer provides the connection between I-395 and Route 9 (a.k.a. 'The Airline'). As a result, a significant portion of the traffic utilizing this corridor is pass-through traffic, in particular, truck traffic. This traffic contributes to the sometimes excessive queuing that takes place along this corridor, on occasion interfering with operations at closely-spaced signalized intersections.

The design of North Main Street between the Penobscot River Bridge and the Joshua L. Chamberlain Bridge has limited capacity, and as such results in congestion during various times of the day. The traffic situation is also affected by the grade of North Main Street south of State Street, as the road goes over the railroad. Trucks face difficulty climbing this grade. In addition, the signal at Center Street does not provide adequate acceleration distance for these trucks to reach proper travel speeds when climbing this grade.

Parker Street and Betton Street intersect North Main Street approximately 60 feet from each other. This offset configuration creates an unsafe situation by introducing additional maneuvers needed to cross North Main Street. Rather than just proceeding straight through a four-legged intersection, a vehicle must first turn right, and then make a quick left turn, potentially blocking the roadway to a vehicle making the movement from the opposing direction. This additional time in the middle of the road increases the number of potential vehicle conflicts at those intersections.

Traffic entering and exiting this corridor, particularly trucks, face inadequate radii when making turns to and from North Main Street. These movements are further complicated by the current parking layouts along North Main Street, which reduce turning area, and in some cases, reduce sight distances.

With the proposed redevelopment of the Eastern Fine Paper Company on South Main Street as part of the Waterfront Development Project as well as numerous other projects in Brewer, such as the recent construction of Dirigo Drive, retail, and medical office space, the area is poised for significant new traffic, approximately a 30 percent increase over a ten-year time frame. As the downtown corridor for the City, it is critical for North Main Street to remain a viable and usable transportation corridor.

The City of Brewer, along with the Bangor Area Comprehensive Transportation System (BACTS) formed an Advisory Committee to oversee this study of the North Main Street corridor.

The Maine Department of Transportation (MaineDOT) is currently completing an Environmental Impact Study for a connection of I-395 to Route 9, east of Brewer. While the Advisory Committee is in favor of the I-395 extension, the decision was made to proceed with this study as though it will not be constructed within the ten-year horizon of this study.

Gorrill-Palmer Consulting Engineers Inc. has prepared a study of several design alternatives to improve operations and safety of the North Main Street corridor. Following is a summary of the major findings of the study.

The Advisory Committee provided an outline of proposed development and/or redevelopment in Brewer, as well as some development in Bangor, which would increase traffic along the North Main Street corridor. Our office then determined the expected trip generation for each development based on commonly accepted data from the Institute of Transportation Engineers (ITE). These additional trips were then applied to the corridor based on current travel patterns. This additional development is estimated at a 30 percent growth over the next ten years. Typically, background growth is roughly one and one-half percent to two percent per year. This anticipated development results in traffic growth along North Main Street of almost three percent per year. For the purposes of this study, a three percent annual growth rate was used. This data is provided in Tables 2.9, 2.10 and 2.11, within the body of the report.

Alternatives Considered

Our office, with the input of the Advisory Committee, identified twelve improvement alternatives. Of these twelve, it was determined that seven of them warranted further consideration. Each of the seven alternatives identified for further analysis is discussed below. The additional alternatives that were considered are discussed in the study; however, for various reasons these alternatives were eliminated for further evaluation.

Improvement Alternative 1 – Realign Betton Street and Parker Street - Improvement Alternative 1 would realign Betton Street as it approaches North Main Street to create a four-leg intersection. This realignment of the Betton Street/Parker Street intersection would require acquisition of some right-of-way, as well as the taking of the property located on the southwesterly corner of the intersection. A realignment of the two off-set intersections into one four leg intersection will ease the confusion of those intersections by reducing the number of movements and possible conflicts at that location. The current movement of a vehicle first turning right, followed by a quick left turn, while potentially blocking the roadway to a vehicle making the movement from the opposing direction, would be replaced by one straight movement across North Main Street. By reducing the amount of time that a vehicle is in the middle of the road, the number of potential vehicle conflicts will also be reduced.

Improvement Alternative 2 – Relocate Traffic Signal From Center Street to Parker Street/Betton Street - Improvement Alternative 2 involves removing the traffic signal from the Center Street intersection and relocating it to the newly aligned Parker Street/Betton Street intersection. The proximity of Center Street to the signalized intersection at State Street, combined with the grade of the incline between the two intersections, often causes the vehicle queue to extend south of the Center Street intersection. This problem is exacerbated by the volume of heavy trucks on the corridor. Trucks that have to stop for a red signal at Center Street have difficulty accelerating up the hill in order to continue through the State Street intersection. By relocating the signal to the Parker Street/Betton Street intersection, the distance between signals is approximately doubled.

Traffic destined to or from Penobscot Square and/or Bangor via the Penobscot Bridge would now access North Main Street via Betton Street. This improvement alternative would also allow for the full closure of the westerly leg of Center Street to vehicular traffic in favor of a pedestrian mall, if desired. Even if the closure of Center Street is not the City's plan, the removal of the traffic signal at that intersection allows for other possibilities, such as making Center Street a one-way, or closing Center Street at North Main Street, so that all vehicular traffic on the westerly leg of Center Street must use Penobscot Street and either State Street or Betton Street. However, this increase in traffic along Betton Street and Penobscot Street will increase conflicts with parked vehicles along these two segments. This alternative should not be implemented until suitable replacement parking, such as the parking garage, is in place.

While the installation of a traffic signal at Parker Street/Betton Street does have the potential to encourage Parker Street as an alternate route, the implementation of select traffic calming measures along Parker Street could discourage this 'cut through' traffic and minimize any adverse impacts. The overall operational efficiency of North Main Street could be substantially improved by the implementation of this alternative.

Improvement Alternative 3 – Coordinate Traffic Signals - Currently, there is a traffic signal located at the bottom of the hill at the Center Street intersection. This signal and the signal at State Street are coordinated in favor of southbound traffic, coming down the hill from State Street. This improvement alternative would re-time the signals, and coordinated the three signals, Wilson Street, Parker Street/Betton Street (relocated from Center Street), and State Street, in favor of northbound traffic traveling up the grade toward State Street. This relatively simple improvement, combined with the relocated traffic signal as described in Improvement Alternative 2, would greatly reduce the queuing along North Main Street northbound at the State Street intersection. Regardless of any other improvements, the timing and coordination of the traffic signals can improve the operation of this corridor and should be evaluated and updated as necessary.

Improvement Alternative 5 – Eliminate On-Street Parking, With Two Southbound Through Lanes - On-street parking currently lines both sides of North Main Street, from Wilson Street to Parker Street/Betton Street. The potential conflicts, and the delays associated with each of these parking maneuvers contributes to the loss of capacity of the roadway. By the year 2015, traffic volumes on southbound North Main Street will result in excessive queuing at Wilson Street with a single through lane. During peak hours, these queues could extend as far back as through the Betton Street/Parker Street intersection. The addition of a second southbound through lane will reduce the queuing at the Wilson Street intersection. However, in order to provide this additional southbound travel lane, on-street parking will need to be eliminated, from Betton Street/Parker Street to Wilson Street.

The planned construction of a parking garage at Betton Street and Penobscot Street could provide relief for some of the loss of on-street parking. However, the area between Wilson Street and Union Street will be the most challenging due to the lack of available off-street parking and the distance from the garage site. Potential parking locations along Union Street or behind the buildings on the River side of North Main Street are options under this scenario. The property on the southwesterly corner of North Main Street and Union Street has been identified as one potential location. Additionally, the City should consider creating a parking lot at 172 North Main Street, which is the vacant building north of the Girl Scout Headquarters.

Improvement Alternative 7 – Right In/Right Out Only at Center Street - This improvement alternative would make the easterly leg of Center Street a right in/right out access only. The elimination of the traffic signal from the Center Street intersection, while beneficial in many ways, is not without some inherent problems. Vehicles traveling southbound on North Main Street that no longer have to stop for a red signal may not be expecting vehicles to be stopped in traffic waiting to turn left onto Center Street. Given the small number of vehicles expected to make this turn, the movement should be prohibited. The traffic could turn left on State Street and access Center Street via one of the connecting streets.

Additionally, without the signal, southbound traffic may not be expecting left turning traffic from Center Street to southbound North Main Street. If the left turn out is prohibited, these few vehicles could access either Parker Street or State Street and then make the left turn at a signalized intersection.

A one-way option, from North Main Street to East Summer Street was also considered. However, due to the locations of businesses within this block of Center Street, maintaining a two-way traffic flow was considered a priority.

Improvement Alternative 8 – Right In/Right Out Only at Union Street - This improvement alternative would make Union Street a right in/right out access only. Currently, the intersection of Union Street with North Main Street experiences a relatively large number of crashes due to poor visibility/lack of sight distance from the easterly leg of Union Street. By making Union Street a one-way away from North Main Street, this conflict will no longer exist.

Improvement Alternative 9 – Eliminate Left Turns From Side Streets - This improvement alternative would eliminate the potential conflicts and delays caused by left turning traffic from the side streets entering the main stream of traffic. This could be accomplished with the construction of a center median along the corridor, from Wilson Street to State Street. An additional benefit of this alternative could be the complete elimination of the signal at Center Street. Alternatively, the signal could still be relocated to the Betton Street/Parker Street intersection, with a break in the median to allow for left turns and U-turns to change direction.

However, this alternative would result in a lot of recirculation along the corridor, and an increased potential of U-turning traffic. Additionally, the westerly leg of Union Street and the easterly leg of Church Street have no other connections. Careful consideration of these issues, along with a thorough, detailed analysis of the anticipated resulting traffic patterns and potential new connections will need to be evaluated prior to implementing this alternative.

Improvement Alternative 10 – Protected Left Turn From Southbound North Main Street to Eastbound Wilson Street - This improvement would require the re-timing of the traffic signal to allow a protected left turn phase for southbound North Main Street traffic destined for eastbound Wilson Street. It appears that there is adequate right-of-way for the implementation of this alternative. A more detailed analysis would be required for final design.

Evaluation of Alternative Combinations

In order to realize the full benefit of the above described alternatives, the improvements need to include combinations of various alternatives. Our office conducted an analysis of four combinations of improvements. A discussion of each of these combinations follows.

Combination 1 - Improvement Alternatives 1, 2 and 3 This results in the Parker Street/Betton Street intersection being realigned to create a four-leg signalized intersection, with no signal at Center Street, and the coordination of the signals from Wilson Street to State Street, in favor of northbound traffic.

While moving the signal and coordinating signals along the entire corridor does provide some improvement, the majority of the intersections will still fail during the peak hours.

Combination 2 - Improvement Alternatives 1, 2, 3 and 5 This combination results in the Parker Street/Betton Street intersection being realigned to create a four-leg signalized intersection, with no signal at Center Street, the coordination of the signals from Wilson Street to State Street, in favor of northbound traffic, and the elimination of on-street parking to allow for two southbound travel lanes, from Betton Street to Wilson Street.

The addition of a southbound travel lane greatly improves the operational efficiency of the overall corridor. While the Wilson Street intersection does still see an increase in delay, and consequently a decrease in level of service to 'E', the queue lengths are less than with one southbound lane. The addition of the second southbound lane helps alleviate queues extending through the unsignalized intersections, thereby improving those levels of service.

Combination 3 - Improvement Alternatives 1, 2, 3, 5 and 10 This combination results in the Parker Street/Betton Street intersection being realigned to create a four-leg signalized intersection, with no signal at Center Street, and the coordination of the signals from Wilson Street to State Street, in favor of northbound traffic. This analysis also includes the addition of a protected left turn phase from southbound North Main Street to eastbound Wilson Street, and the elimination of on-street parking to allow for two southbound travel lanes, from Betton Street to Wilson Street.

The addition of the second southbound travel lane combined with a protected left turn from southbound North Main Street onto eastbound Wilson Street greatly improves the operational efficiency of the corridor. Keeping in mind that the Wilson Street intersection currently operates at LOS 'D', LOS 'E' after a 30 percent increase in traffic is a reasonable impact. While the queues generated by traffic even after these improvements still exceed the storage capacity of the majority of the approaches to the signalized intersections, they do not cause the same degree of backups as experienced with the other alternatives. However, The Wilson Street, State Street, and Union Street intersections still experience occasional upstream blocking.

Combination 4 - Improvement Alternatives 1, 2, 3, 5, 7, 8 and 10 This combination results in the Parker Street/Betton Street intersection being realigned to create a four-leg signalized intersection, with no signal at Center Street, and the coordination of the signals from Wilson Street to State Street, in favor of northbound traffic. This analysis also includes the addition of a

protected left turn phase from southbound North Main Street to eastbound Wilson Street, and the elimination of on-street parking to allow for two southbound travel lanes, from Betton Street to Wilson Street. Additionally, the easterly legs of both Center Street and Union Street have been defined as right in/right out only.

This combination of alternatives appears to provide the most benefit to the efficiency of the North Main Street corridor. The Wilson Street and State Street intersections, which currently operate at LOS 'D' and 'C' respectively, will continue to operate at those same acceptable levels of service through the ten-year study forecast. Additionally, the levels of service of the unsignalized intersections are not degraded with these improvements. It should be noted that the queues generated under this scenario do still meet or exceed the available storage capacity on most of the approaches to the Wilson Street and State Street intersections. However, this is still an improvement to the queues experienced under today's conditions. Also, the Wilson Street and State Street intersections will still, on occasion, experience upstream blocking.

Recommendations

The committee recommends that the North Main Street corridor include the combination of alternatives as described in Combination 4. In addition, the inclusion of the following signage, crosswalk markings, etc. should also be made.

Additional Improvements

While the following recommendations were not specifically evaluated, they should be included in any upgrade of North Main Street are:

- Provide marked crosswalks at the following intersections
 - State Street and North Main Street - a marked crosswalk should be provided across the southerly leg of North Main Street to connect to the existing crosswalk across State Street. Also, this intersection would be a good location of pedestrian countdown signals.
 - Betton Street/Parker Street and North Main Street – all legs
 - Union Street and North Main Street – the easterly leg of Union Street and the northerly leg of North Main Street;
 - Wilson Street and North Main Street – all legs
- Rehabilitate existing sidewalks and ramps to meet the Americans with Disabilities Act (ADA) standards;
- Install new and/or additional overhead lane signage
 - Northbound approaching the State Street intersection – “Two Through Lanes” and “Slower Traffic Keep Right”
 - Southbound approaching the State Street intersection – Directional signage for I-95 and I-395 to use State Street
 - Northbound along corridor – overhead lane use signage at Parker Street/Betton Street
 - Southbound along corridor – overhead lane use signage at Church Street and Union Street;
- Upgrade all traffic signals to 12-inch lenses with back plates.

Finally, while the extension of I-395 was not incorporated into this study, the indications are that the construction of the I-395 extension is essential to help relieve congestion, preserve neighborhoods, and increase capacity along the North Main Street corridor. However, the extension of the Interstate alone will not be enough to reduce the volume of truck traffic through the North Main Street corridor. The current vehicle weight limits for the Interstate System would need to be increased to provide the hoped for relief from through truck traffic.

Chapter 1

Introduction

Project Background

Brewer, with a population of approximately 9,000 people, is a growing community with ever-increasing transportation demands. Until 1954, the only access across the Penobscot River was via the State Street Bridge. Traffic needs for the City and surrounding area resulted in the construction of the Joshua L. Chamberlain Bridge and later, the I-395 Bridge, providing much needed access to the Interstate Highway System, as well as Bangor.

With the terminus of I-395 at Route 1A to the east of this corridor, traffic destined for Route 9 (a.k.a. "The Airline") and points east often exits I-395 at Exit 4 and utilizes the North Main Street corridor to reach Route 9. As a result, a significant portion of the traffic utilizing this corridor is pass-through traffic, and in particular, truck traffic. This traffic contributes to the sometimes excessive queuing that takes place along this corridor, on occasion interfering with operations at closely-spaced signalized intersections.

With the proposed redevelopment of the Eastern Fine Paper Company on South Main Street as part of the Waterfront Development Project as well as numerous other projects in Brewer, such as the recent construction of Dirigo Drive, retail, and medical office space, the area is poised for significant new traffic. As the downtown corridor for the City, it is critical for North Main Street to remain a viable and usable transportation corridor.

Study Area

The study area focuses on North Main Street, from Wilson Street northeasterly to State Street, including each intersection along the corridor. Any improvements to the North Main Street Corridor are likely to impact Penobscot Street as well. Therefore, the following intersections were examined for this study:

- North Main Street at Wilson Street
- North Main Street at Union Street
- North Main Street at Church Street
- North Main Street at Parker Street/Betton Street
- North Main Street at Center Street
- North Main Street at State Street
- State Street at Penobscot Square

Project Goals

It is important to develop a set of guiding principles to serve as a benchmark by which to evaluate the effectiveness and impact of various alternatives. The main purpose of this study is to develop a set of alternatives that will improve the operations and efficiency of North Main Street, without negatively impacting the various business and residential uses along the corridor.

Although it is of the utmost importance to provide long-term designs for North Main Street as a carrier of vehicular traffic, other concerns must be kept in mind as well. East of this corridor, the land use is primarily residential, and right-of-way limitations effectively prevent widening in this area. Given the sensitivity of this area to short and long-term traffic growth, any improvement plan must keep the needs of residents as well as businesses in mind.

As this corridor was developed well before current travel patterns were established, many issues have come into play during the intervening years. The Plan should address all these issues, as well as issues of overall truck access and progression.

Lastly, this corridor poses difficulty for travelers of other modes. Few amenities exist for pedestrians, and few to none for bicyclists, and the current traffic types and levels on the roadway make for a less than ideal situation for riders. Any plan for this corridor should strive to balance the needs of other users with that of vehicular traffic.

Chapter 2

Existing Conditions

The North Main Street Corridor provides the connection between I-395 and Route 9 (a.k.a. “The Airline”). As a result, a significant portion of the traffic utilizing this corridor is pass-through traffic, in particular, truck traffic. This traffic contributes to the sometimes excessive queuing that takes place along this corridor, on occasion interfering with operations at closely-spaced signalized intersections.

The design of North Main Street between the bridges has limited capacity, and as such results in congestion during various times of the day. The traffic situation is also affected by the grade of North Main Street west of State Street, as the road goes over the railroad. Trucks face difficulty climbing this grade. In addition, the signal at Center Street does not provide adequate acceleration distance for these trucks to reach proper travel speeds when climbing this grade.

Parker Street and Betton Street intersect North Main Street approximately 60 feet from each other. This offset configuration creates an unsafe situation by introducing additional maneuvers needed to cross North Main Street. Rather than just proceeding straight through a four-legged intersection, a vehicle must first turn right, and then make a quick left turn, potentially blocking the roadway to a vehicle making the movement from the opposing direction. This additional time in the middle of the road increases the number of potential vehicle conflicts at those intersections.

Traffic entering and exiting this corridor, particularly trucks, face inadequate radii when making turns to and from North Main Street. These movements are further complicated by the current parking layouts along North Main Street, which reduce turning area, and in some cases, reduce sight distances.

Data Collection

Our office collected the following turning movement counts:

- August 25, 2005, from 3:00 to 6:00 PM:
 - North Main Street at Wilson Street
- September 1, 2005, from 3:00 to 6:00 PM:
 - State Street at Penobscot Street
 - North Main Street at State Street
 - North Main Street at Center Street (3:30 to 5:45 PM)
- September 22, 2005, from 3:00 to 6:00 PM:
 - North Main Street at Betton Street
 - North Main Street at Parker Street
 - North Main Street at Church Street
 - North Main Street at Union Street

In addition to the turning movement counts, our office collected directional ATR data, including traffic volumes and vehicle classifications, on North Main Street, south of Center Street in front

of the Girl Scout Headquarters. This data was collected from Tuesday afternoon, August 2, 2005, through Saturday afternoon, August 6, 2005. This data shows an Annual Average Daily Traffic volume of approximately 11,300 vehicles along this section of North Main Street, with approximately seven percent of that volume being heavy truck traffic.

A review of historical data obtained from the Maine Department of Transportation (MaineDOT) shows that the average volumes along the corridor, while fluctuating slightly within the past ten years, have remained relatively stable. MaineDOT data shows the following statistics for Route 9 (North Main Street) southwest of Center Street:

Year	AADT
1996	12,100
1999	14,680*
2002	13,970
2005	11,300**

*This count was taken northeast of Parker Street.

**The 2005 count was taken by GPCEI August 2-5, in front of the Girl Scout Headquarters.

Additional data obtained from MaineDOT from the East-West Corridor Study shows the following truck volumes along the Route 9 and Route 46 corridors:

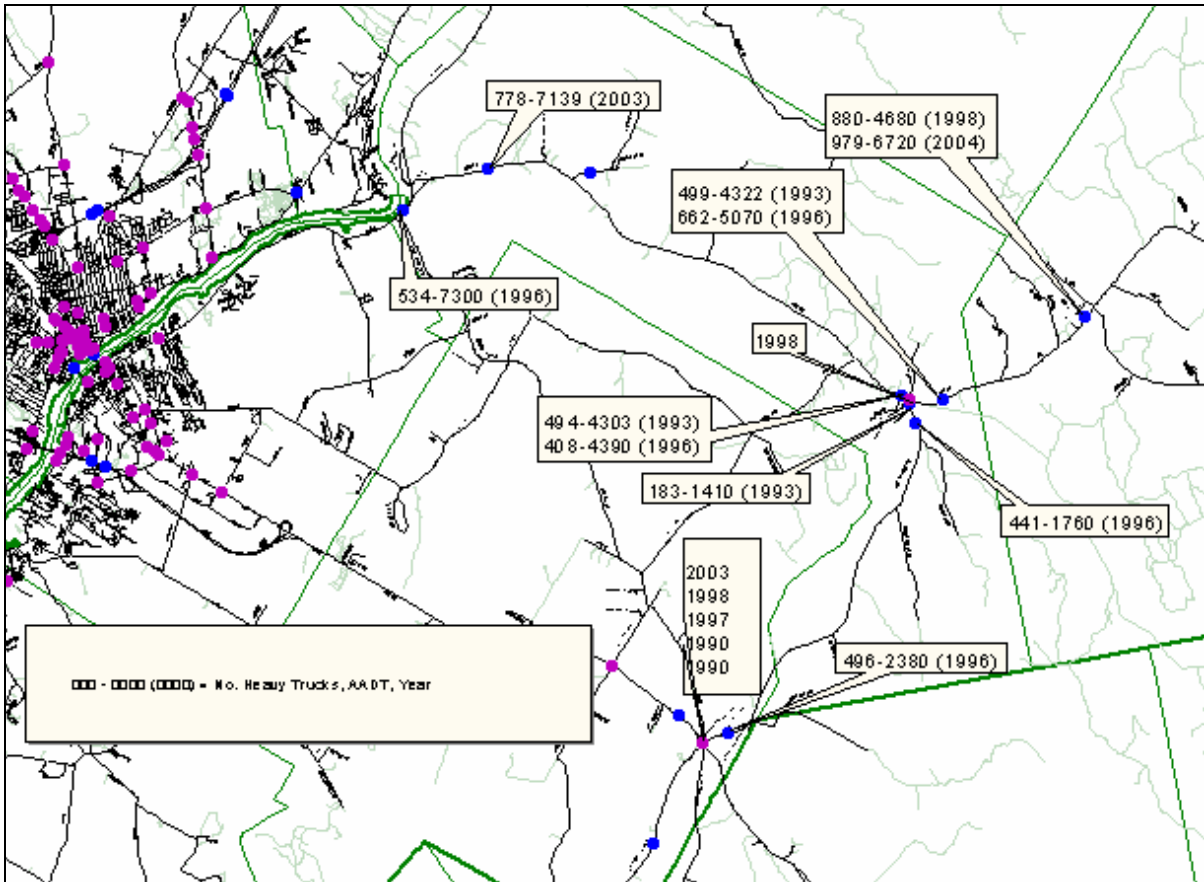


Figure 2.1: Truck Traffic Volumes, Routes 9 and 46, From MaineDOT

Additional data provided by MaineDOT, from the East-West Corridor Study, indicates an increase in truck traffic to approximately sixteen percent of overall traffic volumes by 2015, without the construction of the I-395 extension.

The raw turning movement volumes and the ATR data are shown on Figure 2 of Appendix A.

On-Street Parking

On-street parking is currently allowed along the following road segments within the study area:

- East side of North Main Street, from Wilson Street to Center Street
- West side of North Main Street, from Union Street to Betton Street
- Center Street, both sides, from North Main Street to Penobscot Street
- East side of Penobscot Street, from Center Street to State Street

The availability of on-street parking is an asset to the local businesses along the corridor, as well as to the pedestrians. On-street parking can often times provide a buffer between the travel lanes and the sidewalk, thereby helping pedestrians feel more separated from the traffic. However, it can also be a detriment to the capacity and safety of the corridor. The number of parking maneuvers along a roadway can reduce the through capacity of that road, while increasing the number of potential conflicts with other vehicles, as well as bicyclists and pedestrians. At the same time, the presence of on-street parking can reduce the sight distance at intersections, potentially leading to collisions.

Bicycle and Pedestrian Amenities

Our office conducted a visual survey of the corridor to collect information on bicycle and pedestrian amenities. There are no bicycle lanes along the corridor, and the current traffic types and levels on the roadway make for a less than ideal situation for bicycle riders. The planned Brewer Historic Waterfront Trail, which will be a multi-use recreational trail along the Penobscot River, runs parallel to the corridor and is a viable alternative to North Main Street for bicyclists and pedestrians. Construction of the trail is expected to begin in 2006. There are sidewalks along both sides of North Main Street, from Wilson Street to Center Street. The sidewalk on the easterly side of North Main Street continues to the State Street intersection. Crosswalks exist at most intersections, typically on two of the four legs of the intersection. There do not appear to be any marked crosswalks at the Wilson Street intersection, and only one marked crosswalk at the State Street intersection. As part of the collection of turning movement data, our office also collected data on the number of pedestrian movements at each intersection along the corridor during the peak hour. This pedestrian data is summarized below:

Table 2.1: Peak Hour Pedestrian Volumes - 2005

Intersection	Number of Pedestrians
North Main Street @ Wilson Street	8
North Main Street @ Union Street	12
North Main Street @ Church Street	1
North Main Street @ Parker Street/Betton Street	0
North Main Street @ Center Street	4
North Main Street @ State Street	0

Capacity and Level of Service

Our office performed an analysis of the capacity and level of service of the existing conditions in terms of delays and queues. All analyses were done using the Synchro/SimTraffic software. Level of service rankings are similar to the academic ranking system where an 'A' is very good with little control delay and an 'F' represents very poor conditions with long delays. A Level of Service (LOS) 'D' or higher is desirable for a signalized intersection. At an unsignalized intersection, if the level of service falls below a 'D', an evaluation should be made to determine if a traffic signal is warranted.

The following tables summarize the relationship between control delay and level of service:

Table 2.2: Level of Service Criteria for Unsignalized Intersections

Level of Service (LOS)	Control Delay per Vehicle (sec)
A	Up to 10.0
B	10.1 to 15.0
C	15.1 to 25.0
D	25.1 to 35.0
E	35.1 to 50.0
F	Greater than 50.0

Table 2.3: Level of Service Criteria for Signalized Intersections

Level of Service (LOS)	Control Delay per Vehicle (sec)
A	Up to 10.0
B	10.1 to 20.0
C	20.1 to 35.0
D	35.1 to 55.0
E	55.1 to 80.0
F	Greater than 80.0

The software model was used to evaluate the 2005 conditions to get a baseline of information for comparison with future growth and needs. The results for the capacity and queue analyses are shown in the following tables:

Table 2.4: Level of Service for North Main Street Signalized Intersections - 2005

Intersection/ Approach	2005 Volumes		Intersection/ Approach	2005 Volumes	
	Delay (sec)	LOS		Delay (sec)	LOS
Wilson Street			Center Street		
Wilson St – EBL	84	F	Center St – EBLT	39	D
Wilson St – EBT	41	D	Center St – EBR	6	A
Wilson St – EBR	21	C	North Main St – NBL	6	A
South Main St – NBL	39	D	North Main St – NBTR	3	A
South Main St – NBTR	25	C	Center St – WBLTR	39	D
Wilson St – WBL	60	E	North Main St – SBLTR	3	A
Wilson St – WBTR	27	C	Overall Intersection	6	A
North Main St – SBL	51	D	State Street		
North Main St – SBT	43	D	State St – EBL	56	E
North Main St – SBR	11	B	State St – EBTR	19	B
Overall Intersection	37	D	North Main St – NBT	37	D
			North Main St – NBTR	36	D
			State St – WBT	32	C
			State St – WBTR	30	C
			North Main St – SBL	46	D
			North Main St – SBT	23	C
			North Main St – SBR	6	A
			Overall Intersection	30	C

Table 2.5: Level of Service for North Main Street Unsignalized Intersections – 2005

Intersection/ Approach	2005 Volumes		Intersection/ Approach	2005 Volumes	
	Delay (sec)	LOS		Delay (sec)	LOS
Union Street			Church Street		
Union St – EBLTR	37	E	Church St – EBLTR	17	B
North Main St – NBLTR	2	A	North Main St – NBLTR	1	A
Union St – WBLTR	46	E	Church St – WBLTR	16	B
North Main St – SBLTR	9	A	North Main St – SBLTR	3	A
Overall Intersection	7	A	Overall Intersection	3	A
Parker Street			Betton Street		
North Main St – NBTR	2	A	Betton St – EBLR	11	B
Parker St – WBLR	11	B	North Main St – NBLT	1	A
North Main St – SBLT	1	A	North Main St – SBTR	2	A
Overall Intersection	2	A	Overall Intersection	1	A

The tables above indicate that, overall, the corridor is currently operating at acceptable levels of service. However, a number of individual lane groups are operating at LOS ‘D’ or worse. The Union Street approaches are experiencing long delays, even though the intersection is at LOS ‘A’. This is due to its proximity to the signalized intersection at Wilson Street. Queues from Wilson Street at times are extending through the Union Street intersection. Also, the Wilson Street intersection currently operates at LOS ‘D’ during the peak hour, with two lane groups experiencing a delay of 60 seconds or more.

Table 2.6: Queue Analyses for North Main Street Signalized Intersections – 2005

Intersection/ Approach	2005 Volumes		Intersection/ Approach	2005 Volumes	
	Available	95 th Percentile		Available	95 th Percentile
Wilson Street			Center Street		
Wilson St – EBL	275 ft	300 ft	Center St – EBLT	N/A	75 ft
Wilson St – EBT	N/A	625 ft	Center St – EBR	N/A	80 ft
Wilson St – EBR	275 ft	165 ft	North Main St – NBL	275 ft	105 ft
South Main St – NBL	275 ft	190 ft	North Main St – NBTR	N/A	140 ft
South Main St – NBTR	N/A	300 ft	Center St – WBLTR	N/A	75 ft
Wilson St – WBL	150 ft	110 ft	North Main St – SBLTR	N/A	110 ft
Wilson St – WBTR	N/A	235 ft	State Street		
North Main St – SBL	100 ft	110 ft	State St – EBL	260 ft	250 ft
North Main St – SBT	N/A	280 ft	State St – EBTR	N/A	305 ft
North Main St – SBR	150 ft	205 ft	North Main St – NBT	N/A	180 ft
			North Main St – NBTR	N/A	185 ft
			State St – WBT	N/A	200 ft
			State St – WBTR	N/A	200 ft
			North Main St – SBL	80 ft	90 ft
			North Main St – SBT	N/A	275 ft
			North Main St – SBR	80 ft	135 ft

Notes: N/A – Not applicable in travel lane

Table 2.7: Queue Analyses for North Main Street Unsignalized Intersections – 2005

Intersection/ Approach	2005 Volumes		Intersection/ Approach	2005 Volumes	
	Available	95 th Percentile		Available	95 th Percentile
Union Street			Church Street		
Union St – EBLTR	N/A	50 ft	Church St – EBLTR	N/A	50 ft
North Main St – NBLTR	N/A	75 ft	North Main St – NBLTR	N/A	50 ft
Union St – WBLTR	N/A	75 ft	Church St – WBLTR	N/A	50 ft
North Main St – SBLTR	N/A	205 ft	North Main St – SBLTR	N/A	120 ft
Parker Street			Betton Street		
North Main St – NBTR	N/A	75 ft	Betton St – EBLR	N/A	50 ft
Parker St – WBLR	N/A	55 ft	North Main St – NBLT	N/A	50 ft
North Main St – SBLT	N/A	50 ft	North Main St – SBTR	N/A	100 ft

Notes: N/A – Not applicable in travel lane

As the above tables indicate, the queues are either approaching or exceeding the available storage lengths on virtually all of the approaches at both the Wilson Street and the State Street intersections. Given the location of both of these intersections, at an end of two of the bridges that connect Bangor to Brewer, the operational efficiency of each is crucial to the overall operations of the corridor.

Collision History

Our office obtained the collision history for the North Main Street Corridor and surrounding areas from the Maine Department of Transportation (MaineDOT). A location is classified 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. A CRF compares the actual crash rate of each intersection or road segment to the Statewide crash rate of similar locations. A CRF less than 1.00 indicates a lower than average crash rate.

The following tables summarize the collision history for the study area for the three-year period 2002-2004.

Table 2.8: Maine DOT Crash Data for 2002-2004: Intersections

Node	Intersection	# of Collisions	CRF	HCL?
7094	Route 9 (North Main St) at Union St	7	1.00	No
7095	Route 9 (North Main St) at Church St	1	0.16	No
4472	Route 9 (North Main St) at Parker St	0	0	No
7096	Route 9 (North Main St) at Betton St	5	0.44	No
7097	Route 9 (North Main St) at Center St	6	0.27	No
7098	Route 9 (North Main St) at State St	31	0.90	No
7099	State St at RR X-ing	0	0	No
7100	State St @ Penobscot St	17	0.68	No
7093	Route 9 (North Main St) at Wilson St/South Main St	25	0.78	No

Table 2.9: Maine DOT Crash Data for 2002-2004: Road Segments

Nodes	Street	From	To	# of Collisions	CRF	HCL?
7092-7093	South Main St	Brimmer St	Wilson St	6	0.85	No
7093-7094	North Main St	Wilson St	Union St	8	1.52	Yes
7094-7095	North Main St	Union St	Church St	1	0.19	No
4472-7095	North Main St	Church St	Parker St	2	0.39	No
4472-7096	North Main St	Parker St	Betton St	3	0.78	No
7096-7097	North Main St	Betton St	Center St	2	0.44	No
7097-7098	North Main St	Center St	State St	0	0	No
6044-7098	North Main St	State St	Holyoke St	5	0.83	No
7098-7206	State St	North Main St	Jordan St	7	0.65	No
7098-7099	State St	North Main St	RR X-ing	5	0.81	No
7099-7100	State St	RR X-ing	Penobscot St	1	0.41	No
7100-8680	Penobscot River Bridge	Penobscot St	Town Line	4	0.24	No
7093-7194	Wilson St	North Main St	Summer St	2	0.26	No
7093-7195	Wilson St	North Main St	Chamberlain Bridge (Town Line)	5	0.44	No

As shown in the tables above, while there is only one High Crash Location within the study area, the segment of North Main Street from Wilson Street to Union Street, the corridor as a whole does experience a high number of crashes. Our office examined the collision reports for the 89 collisions on North Main Street, from Wilson Street to State Street, and prepared a collision diagram, which is shown in Appendix C.

Of the 25 collisions at the North Main Street/Wilson Street intersection, the following four patterns are the most prevalent:

- Rear-end collisions coming off the Joshua Chamberlain Bridge;
- Rear-end collision on southbound North Main Street;
- Left turns from Chamberlain Bridge to northbound North Main Street failing to yield to through traffic; and
- Improper lane changes along southbound North Main Street.

Poor visibility of overhead signage is a likely contributing factor in the southbound North Main Street collisions.

Of the seven collisions at the North Main Street/Union Street intersection, six occurred as a result of traffic exiting westbound Union Street failing to yield to North Main Street traffic. Obstructed sight distance due to the on street parking was cited as a factor in most of the collisions.

All of the collisions that occurred at the North Main Street/Parker Street/Betton Street intersections followed the same pattern; the lead vehicle slowed/stopped in traffic on North Main Street to turn left, and the trailing vehicle was unable to stop in time. There are no left turn lanes for this intersection in either direction.

The pattern of collisions at the North Main Street/Center Street intersection was evenly divided between improper lane change/improper turn and disregard of traffic control, especially when in red flash mode.

Of the 31 collisions at the North Main Street/State Street intersection, thirteen were the result of disregarding the traffic control device, worsened when in red flash (at night). Of these thirteen collisions, eight were disregarding the northbound North Main Street signal, and the remaining five were disregarding the westbound State Street signal. There were also four rear-end collisions on the southbound North Main Street slip lane to State Street. The remaining collisions were due to either driver inattention or following too close. There was also one collision involving a vehicle making an illegal left turn from northbound North Main Street onto westbound State Street.

There was also one collision each involving a pedestrian and a bicyclist. Both of those collisions were due to driver inattention/failure to yield.

Overall, along the entire corridor, the general safety issues can be broken down into the following categories:

- Disregard of traffic signals, especially when in red flash mode (at night);
- Lack of left turn lanes on North Main Street;
- Sight distance obstructions due to on-street parking; or
- Improper lane changes and improper turns.

Design Year

The design year for alternatives for the North Main Street corridor is the year 2015. The raw turning movement volumes were adjusted to 2015 volumes based on anticipated future development on and adjacent to the corridor. The information relative to future development was provided by the Advisory Committee. Our office then determined the expected trip generation for each development based on commonly accepted data from the Institute of Transportation Engineers (ITE). These additional trips were then applied to the corridor based on current travel patterns. This additional development is estimated at a 30 percent growth over the next ten years. Typically, background growth is roughly one and one-half percent to two percent per year. This anticipated development results in traffic growth along North Main Street of almost three percent per year. For the purposes of this study, a three percent annual growth rate was used. The 2015 adjusted volumes are shown on Figure 3 of Appendix A. The following tables outline the development included in this growth and its anticipated additional traffic volumes on the North Main Street corridor.

Table 2.10: Anticipated Development Along North Main Street by 2015

Development	Size	Trips Generated (PM Peak)	Assumptions	Trips Through Study Area	Enter/Exit Development
City Hall Redevelopment	14,000 s.f. Office	58	7,400 s.f. Town Hall and 6,600 s.f. Library	58	9/49
Waterfront Condominiums	20 units	16	2.2 acres at 5,000 s.f. per unit	16	10/6
Getchell Brothers Redevelopment	28,800 s.f.	91	2.4 acres at 12,000 s.f. leasable per acre	91	46/45

Table 2.11: Brewer Development Impacting Corridor (by 2015)

Development	Size	Trips Generated (PM Peak)	Assumptions	Trips Through Study Area	Enter/Exit Development
Eastern Fine Paper Redevelopment	60 Apartments	40	30% primary (total 160) 50% primary (total 415)	13	116/135
	55,000 s.f. Office	112		36	
	25,000 s.f. Retail	48		15	
	45,000 s.f. Restaurants	208		66	
	40,000 s.f. Cultural Arts	84		27	
	75,000 s.f. Entertain/Sports Arena	189		60	
	1,500 seat Ice Arena	102		33	
	Total with 20% shared use	626		251	
Eastern Maine Healthcare	60,000 s.f. Cancer Center	223		Used assignment from Wilson Street Study	
Wilson Street Development	120,000 s.f. Home Improvement	92	30% primary (total 305)	6	3/3
	240,000 s.f. Retail	270	30% primary (total 900)	19	10/9
	24,000 s.f. Restaurants	131	50% primary (total 262)	9	5/4
Brewer Professional Center	380,000 s.f. Office	525		158	24/134
Eastern Maine Healthcare/Wilson Street Development 2001 (JN233)	675,000 s.f. Medical Office	902	credit of 455 trips for 148,507 s.f. existing; credit of 223 trips for cancer center	Used assignment from Wilson Street Development Study	
Dirigo Drive full-build out	204,000 s.f. Business Park	291	25.5 ac @ 8,000 s.f. leasable per acre	131	33/98
Drive-In property	100,000 s.f. Business Park	151	12.5 ac @ 8,000 s.f. leasable per acre	68	17/51
New K-8 school	900 students	23	10% of PM peak hour of generator	9	4/5
Pepsi bldg & bowling alley & parcel behind Applebee's	195,900 s.f. Retail (combined)	242	Specialty Retail Center & Discount Store (30% primary - total 808)	17	9/8
Riverview Heights (Rte 9)	29 single-family units	35		35	23/12
Parking Garage Betton@ Penobscot	200 spaces	183	50% office use/50% retail use	183	60/123

Table 2.12: Bangor Development Impacting Corridor (by 2015)

Development	Size	Trips Generated (PM Peak)	Assumptions	Trips Through Study Area	Enter/Exit Development
Bangor Racino - Penn National	1,500 Slot Machines	424		4	3/1
Bangor Mall Area Development	650,000 s.f. Retail	662	30% primary (total 2208)	13	7/6
Bangor Downtown Court System	130,000 s.f. Office	222		33	5/28
Bangor waterfront hotel	150 Rooms + 10,000s.f. Conf Ctr	89		1	1/1

Summary of Existing Deficiencies

As the preceding data indicates, the North Main Street corridor is currently functioning near capacity during the peak hours. There are excessive queues at the signalized intersections, a large number of collisions along the corridor, and heavy volumes of truck traffic.

With the terminus of I-395 at Route 1A to the east of this corridor, traffic destined for Route 9 (a.k.a. “The Airline”) and points east often exits I-395 at Exit 4 and utilizes the North Main Street corridor to reach Route 9. As a result, a significant portion of the traffic utilizing this corridor is pass-through traffic, and in particular, truck traffic. While the construction of the I-395 connector will take some of the through traffic off Route 9, it alone will not help alleviate the problems associated with the volume of heavy truck traffic. The weight limit for the Interstate System must also be increased in order to decrease the volume of truck traffic on North Main Street. Data provided by MaineDOT predicts that percentage of truck traffic along this corridor could nearly double by 2015, to approximately thirteen percent. This traffic contributes to the sometimes excessive queuing that takes place along this corridor, on occasion interfering with operations at closely-spaced signalized intersections, and will only continue to degrade the corridor if improvements are not made.

The presence of cars parked along the corridor often limits the sight distances for those trying to access the corridor from the side streets. Additionally, this on-street parking reduces the capacity of the roadway. Adequate and appropriate sites for off-street parking need to be determined.

With the proposed redevelopment of the Eastern Fine Paper Company on South Main Street as part of the Waterfront Development Project as well as numerous other projects in Brewer, such as the recent construction of Dirigo Drive, retail, and medical office space, the area is poised for significant new traffic. As the downtown corridor for the City, it is critical for North Main Street to remain a viable and usable transportation corridor.

Chapter 3

Identification of Improvement Alternatives

A variety of improvement alternatives are available for consideration along this corridor. Given the myriad of deficiencies and prospective growth of the corridor, a combination of alternatives could be implemented to ensure that North Main Street remains a viable and usable transportation corridor through the Downtown of the City. Following are descriptions of 12 different improvements that can be considered. Many of these improvement alternatives are the direct result of comments and ideas from the Advisory Committee. Figure 3.1, at the end of this chapter, depicts a combination of Improvement Alternatives 1, 2 and 5.

Improvement Alternative 1 – Realign Betton Street and Parker Street

As previously discussed, Betton Street and Parker Street currently intersect North Main Street approximately 60 feet offset from each other. Improvement Alternative 1 would realign Betton Street as it approaches North Main Street to create a four-leg intersection. This realignment of the Betton Street/Parker Street intersection would require acquisition of some right-of-way, as well as the taking of the property located on the southwesterly corner of the intersection.

Although this improvement alternative does include potentially substantial right-of-way impacts, it should be considered a viable alternative for the overall safety and operation of this corridor.

A realignment of the two off-set intersections into one four-leg intersection will ease the confusion of those intersections by reducing the number of movements and possible conflicts at that location. The current movement of a vehicle first turning right, followed by a quick left turn, while potentially blocking the roadway to a vehicle making the movement from the opposing direction, would be replaced by one straight movement across North Main Street. By reducing the amount of time that a vehicle is in the middle of the road, the number of potential vehicle conflicts will also be reduced.

Improvement Alternative 2 – Relocate Traffic Signal From Center Street to Parker Street/Betton Street

Improvement Alternative 2 involves removing the traffic signal from the Center Street intersection and relocating it to the newly aligned Parker Street/Betton Street intersection. The proximity of Center Street to the signalized intersection at State Street, combined with the grade of the incline between the two intersections, often causes the vehicle queue to extend south of the Center Street intersection. This problem is exacerbated by the volume of heavy trucks on the corridor. Trucks that have to stop for a red signal at Center Street have difficulty accelerating up the hill in order to continue through the State Street intersection. By relocating the signal to the Parker Street/Betton Street intersection, the distance between signals is approximately doubled.

Traffic destined to or from Penobscot Square and/or Bangor via the Penobscot Bridge would now access North Main Street via Betton Street. This improvement alternative would also allow

for the full closure of the westerly leg of Center Street to vehicular traffic in favor of a pedestrian mall, if desired. Even if the closure of Center Street is not the City's plan, the removal of the traffic signal at that intersection allows for other possibilities, such as making Center Street a one-way, or closing Center Street at North Main Street, so that all vehicular traffic on the westerly leg of Center Street must use Penobscot Street and either State Street or Betton Street. However, this increase in traffic along Betton Street and Penobscot Street will increase conflicts with parked vehicles along these two segments. This alternative should not be implemented until suitable replacement parking, such as the parking garage, is in place.

This improvement alternative could result in Parker Street being used as an alternate route to/from Wilson Street, especially if plans for a parking garage at the intersection of Betton Street and Penobscot Street do proceed. Care will need to be taken, and possible traffic calming measures may need to be implemented along Parker Street, to minimize adverse impacts.

While the installation of a traffic signal at Parker Street/Betton Street does have the potential to encourage Parker Street as an alternate route, the implementation of select traffic calming measures along Parker Street could discourage this 'cut through' traffic and minimize any adverse impacts. The overall operational efficiency of North Main Street could be substantially improved by the implementation of this alternative.

Improvement Alternative 3 – Coordinate Traffic Signals

Currently, the traffic signals at Center Street and State Street are coordinated in favor of southbound traffic, coming down the hill from State Street. This improvement alternative would re-time the signals, and coordinated the three signals, Wilson Street, Parker Street/Betton Street, and State Street, in favor of northbound traffic traveling up the grade toward State Street.

This relatively simple improvement, combined with the relocated traffic signal as described in Improvement Alternative 2, would greatly reduce the queuing along North Main Street northbound at the State Street intersection. Regardless of any other improvements, the timing and coordination of the traffic signals can improve the operation of this corridor and should be evaluated and updated as necessary.

Improvement Alternative 4 – Eliminate Certain On-Street Parking

Currently, the intersection of Union Street with North Main Street experiences a relatively large number of crashes due to poor visibility/lack of sight distance from the easterly leg of Union Street. A major contributing factor to this lack of sight distance is the presence of on-street parking, northbound, between Wilson Street and Union Street. The elimination of these parking spaces would improve visibility and safety at that intersection.

While the elimination of on-street parking is always a sensitive issue, safety needs to be given high consideration. Potential suitable areas of off-street parking in close proximity to the Wilson Street/Union Street block include on the southerly side of Union Street, from North Main Street towards Summer Street, or potentially behind the buildings on the River side of North Main Street.

Improvement Alternative 5 – Eliminate On-Street Parking, With Two Southbound Through Lanes

On-street parking currently lines both sides of North Main Street, from Wilson Street to Parker Street/Betton Street. The potential conflicts, and the delays associated with each of these parking maneuvers contributes to the loss of capacity of the roadway. By the year 2015, traffic volumes on southbound North Main Street will result in excessive queuing at Wilson Street with a single through lane. During peak hours, these queues could extend as far back as through the Betton Street/Parker Street intersection. The addition of a second southbound through lane will reduce the queuing at the Wilson Street intersection. However, in order to provide this additional southbound travel lane, on-street parking will need to be eliminated, from Betton Street/Parker Street to Wilson Street.

The planned construction of a parking garage at Betton Street and Penobscot Street could provide relief for some of the loss of on-street parking. However, the area between Wilson Street and Union Street will be the most challenging. The previously described potential parking locations along Union Street or behind the buildings on the River side of North Main Street are also options under this scenario. Additionally, the City may be able to acquire property along the corridor to provide some parking relief. The property on the southwesterly corner of North Main Street and Union Street has been identified as one potential location. Also, the City currently owns the property located at 172 North Main Street. This parcel could be cleared and a parking lot constructed.

The addition of a southbound travel lane will greatly improve the efficiency of North Main Street and help to alleviate the queues from the Wilson Street signal in particular. However, this alternative should not be implemented until suitable off-street parking areas have been established as replacements for the on-street parking that is to be eliminated. The construction of the parking garage at Betton Street and Penobscot Street could provide the majority of the off-street parking that will be needed.

Improvement Alternative 6 – On-Street Parking Restrictions By Time of Day

As a modification to Improvement Alternative 5, on-street parking could be restricted by time of day. This would still provide the businesses with parking during the majority of the day, while still providing for traffic flow during peak hours. This could be a compromise on the impact of complete elimination of on-street parking. This alternative is not without drawbacks however, in terms of enforcement.

Due to the potential for problems and need for enforcement with this alternative, the Committee felt it was not a viable solution for the North Main Street corridor.

Improvement Alternative 7 – Right In/Right Out Only at Center Street

This improvement alternative would make the easterly leg of Center Street a right in/right out access only. The elimination of the traffic signal from the Center Street intersection, while beneficial in many ways, is not without some inherent problems. Vehicles traveling southbound

on North Main Street that no longer have to stop for a red signal may not be expecting vehicles to be stopped in traffic waiting to turn left onto Center Street. Given the small number of vehicles expected to make this turn, the movement should be prohibited. The traffic could turn left on State Street and access Center Street via one of the connecting streets.

Additionally, without the signal, southbound traffic may not be expecting left turning traffic from Center Street to southbound North Main Street. If the left turn out is prohibited, these few vehicles could access either Parker Street or State Street and then make the left turn at a signalized intersection.

This improvement could be implemented with little difficulty. However, this change can only be implemented after the signal has been removed from the North Main Street/Center Street intersection. Also, the westerly leg of Center Street should be closed or converted to one-way traffic.

Improvement Alternative 8 – Right In/Right Out Only at Union Street

This improvement alternative would make the easterly leg of Union Street a right in/right out access only. Currently, the intersection of Union Street with North Main Street experiences a relatively large number of crashes due to poor visibility/lack of sight distance from the easterly leg of Union Street. By making Union Street right in/right out, the potential for this type of conflict will be reduced.

A modification of this alternative would be to make Union Street a one-way, from North Main Street to East Summer Street. This, however, could create additional issues at the credit union on the southeasterly corner of the intersection, resulting in increased “cut through” traffic utilizing the credit union parking lot for access to/from North Main Street. Therefore, this modification was not evaluated any further.

If on-street parking is eliminated between Wilson Street and Union Street the safety conflict is removed and this alternative does not provide as much benefit to the corridor.

Improvement Alternative 9 – Eliminate Left Turns From Side Streets

This improvement alternative would eliminate the potential conflicts and delays caused by left turning traffic from the side streets entering the main stream of traffic. This could be accomplished with the construction of a center median along the corridor, from Wilson Street to State Street. An additional benefit of this alternative could be the complete elimination of the signal at Center Street. Alternatively, the signal could still be relocated to the Betton Street/Parker Street intersection, with a break in the median to allow for left turns and U-turns to change direction.

This alternative, which would increase the capacity and efficiency of the corridor, is a drastic measure that would result in a lot of recirculation along the corridor, and an increased potential of U-turning traffic. Additionally, the westerly leg of Union Street and the easterly leg of Church Street have no other connections. Careful consideration of these issues, along with a thorough,

detailed analysis of the anticipated resulting traffic patterns and potential new connections will need to be evaluated prior to implementing this alternative.

Improvement Alternative 10 – Protected Left Turn From Southbound North Main Street to Eastbound Wilson Street

This improvement would require the re-timing of the traffic signal to allow for a protected left-turn phase for southbound North Main Street traffic destined for eastbound Wilson Street. It appears that there is adequate right-of-way for the implementation of this alternative. A more detailed analysis would be required for final design.

Improvement Alternative 11 – Eliminate Parking at Northeast Corner of North Main Street/Wilson Street

This alternative would eliminate the parking in front of the business located on the northeast corner of the North Main Street/Wilson Street intersection. The purpose of this is to try to gain an additional travel lane along this stretch of North Main Street.

This alternative may be necessary to provide the protected left turn as described in improvement alternative 10; however, there does not appear to be adequate right-of-way to maintain an additional northbound travel lane. Therefore, this alternative was not evaluated any further.

Improvement Alternative 12 – Construct a Ramp From State Street Toward Parker Street

This improvement alternative would involve the construction of a ramp from Parker Street to State Street, and could be used to reduce the grade over the rail line. This alternative would result in significant visual impact to the corridor and the adjacent neighborhoods.

Chapter 4

Operational Evaluation of Alternatives

Our office performed an analysis of the capacity and level of service of various combinations of the improvement alternatives discussed above, in terms of delays and queues. All analyses were done using the Synchro/SimTraffic software. The software model was used for the 2005 conditions to get a baseline of information, then again for each of six various combinations of the most viable improvement alternatives. The tables are all based on the SimTraffic software reports. Level of service rankings are similar to the academic ranking system where an 'A' is very good with little control delay and an 'F' represents very poor conditions with long delays. A Level of Service (LOS) 'D' or higher is desirable for a signalized intersection. At an unsignalized intersection, if the level of service falls below a 'D', an evaluation should be made to determine if a traffic signal is warranted.

The following tables summarize the relationship between control delay and level of service:

Table 4.1: Level of Service Criteria for Unsignalized Intersections

Level of Service	Control Delay per Vehicle (sec)
A	Up to 10.0
B	10.1 to 15.0
C	15.1 to 25.0
D	25.1 to 35.0
E	35.1 to 50.0
F	Greater than 50.0

Table 4.2: Level of Service Criteria for Signalized Intersections

Level of Service	Control Delay per Vehicle (sec)
A	Up to 10.0
B	10.1 to 20.0
C	20.1 to 35.0
D	35.1 to 55.0
E	55.1 to 80.0
F	Greater than 80.0

2015 Analysis With Only Northbound Signal Coordination

This analysis looks at the impact of the increased traffic on the existing roadway network with only the coordination of the signals from Wilson Street to State Street, in favor of northbound traffic. The results for the capacity and queue analyses are shown in the following tables:

Table 4.3: Level of Service for North Main Street Signalized Intersections – 2015

Intersection/ Approach	2005 Volumes		2015 Volumes	
	Delay (sec)	LOS	Delay (sec)	LOS
Wilson Street				
Wilson St – EBL	84	F	59	E
Wilson St – EBT	41	D	51	D
Wilson St – EBR	21	C	30	C
South Main St – NBL	39	D	>100	F
South Main St – NBTR	25	C	>100	F
Wilson St – WBL	60	E	85	F
Wilson St – WBTR	27	C	57	E
North Main St – SBL	51	D	>100	F
North Main St – SBT	43	D	96	F
North Main St – SBR	11	B	24	C
Overall Intersection	37	D	>100	F
Center Street				
Center St – EBLT	39	D	36	D
Center St – EBR	6	A	95	F
North Main St – NBL	6	A	15	B
North Main St – NBTR	3	A	13	B
Center St – WBLTR	39	D	>100	F
North Main St – SBLTR	3	A	58	E
Overall Intersection	6	A	55	D
State Street				
State St – EBL	56	E	34	C
State St – EBTR	19	B	27	C
North Main St – NBT	37	D	40	D
North Main St – NBTR	36	D	36	D
State St – WBT	32	C	34	C
State St – WBTR	30	C	29	C
North Main St – SBL	46	D	>100	F
North Main St – SBT	23	C	95	F
North Main St – SBR	6	A	46	D
Overall Intersection	30	C	40	D

Table 4.4: Level of Service for North Main Street Unsignalized Intersections – 2015

Intersection/ Approach	2005 Volumes		2015 Volumes	
	Delay (sec)	LOS	Delay	LOS
Union Street				
Union St – EBLTR	37	E	>100	F
North Main St – NBLTR	2	A	6	A
Union St – WBLTR	46	E	>100	F
North Main St – SBLTR	9	A	65	F
Overall Intersection	7	A	>100	F
Church Street				
Church St – EBLTR	17	B	>100	F
North Main St – NBLTR	1	A	3	A
Church St – WBLTR	16	B	>100	F
North Main St – SBLTR	3	A	74	F
Overall Intersection	3	A	91	F
Parker Street				
North Main St – NBTR	2	A	5	A
Parker St – WBLR	11	B	>100	F
North Main St – SBLT	1	A	6	A
Overall Intersection	2	A	63	F
Betton Street				
North Main St – NBTR	11	B	1	A
Betton St – EBLR	1	A	>100	F
North Main St – SBLT	2	A	53	F
Overall Intersection	1	A	61	F

As the above tables indicate, while the coordination can improve a few individual approaches along the corridor, the existing configuration of the North Main Street corridor cannot handle the additional traffic volumes without any improvements. With the projected development, both the Center Street and State Street intersections will be operating virtually at capacity, and the Wilson Street intersection will fail in the peak hour. All of the unsignalized intersections will also fail, due to the volumes and queues on North Main Street.

Table 4.5: Queue Analyses for North Main Street Signalized Intersections – 2015

Intersection/ Approach	2005 Volumes		2015 Volumes	
	Available	95 th Percentile	Available	95 th Percentile
Wilson Street				
Wilson St – EBL	275 ft	300 ft	275 ft	245 ft
Wilson St – EBT	N/A	625 ft	N/A	920 ft
Wilson St – EBR	275 ft	165 ft	275 ft	235 ft
South Main St – NBL	275 ft	190 ft	275 ft	365 ft
South Main St – NBTR	N/A	300 ft	N/A	1600 ft
Wilson St – WBL	150 ft	110 ft	150 ft	160 ft
Wilson St – WBTR	N/A	235 ft	N/A	530 ft
North Main St – SBL	100 ft	110 ft	100 ft	105 ft
North Main St – SBT	N/A	280 ft	N/A	275 ft
North Main St – SBR	150 ft	205 ft	150 ft	220 ft
Center Street				
Center St – EBLT	N/A	75 ft	N/A	50 ft
Center St – EBR	N/A	80 ft	N/A	315 ft
North Main St – NBL	275 ft	105 ft	275 ft	135 ft
North Main St – NBTR	N/A	140 ft	N/A	220 ft
Center St – WBLTR	N/A	75 ft	N/A	370 ft
North Main St – SBLTR	N/A	110 ft	N/A	280 ft
State Street				
State St – EBL	260 ft	250 ft	260 ft	375 ft
State St – EBTR	N/A	305 ft	N/A	395 ft
North Main St – NBT	N/A	180 ft	N/A	170 ft
North Main St – NBTR	N/A	185 ft	N/A	175 ft
State St – WBT	N/A	200 ft	N/A	225 ft
State St – WBTR	N/A	200 ft	N/A	215 ft
North Main St – SBL	80 ft	90 ft	80 ft	130 ft
North Main St – SBT	N/A	275 ft	N/A	310 ft
North Main St – SBR	80 ft	135 ft	80 ft	145 ft

Notes: N/A – Not applicable in travel lane

Table 4.6: Queue Analyses for North Main Street Unsignalized Intersections – 2015

Intersection/ Approach	2005 Volumes		2015 Volumes	
	Available	95 th Percentile	Available	95 th Percentile
Union Street				
Union St – EBLTR	N/A	50 ft	N/A	270 ft
North Main St – NBLTR	N/A	75 ft	N/A	180 ft
Union St – WBLTR	N/A	75 ft	N/A	660 ft
North Main St – SBLTR	N/A	205 ft	N/A	240 ft
Church Street				
Church St – EBLTR	N/A	50 ft	N/A	335 ft
North Main St – NBLTR	N/A	50 ft	N/A	90 ft
Church St – WBLTR	N/A	50 ft	N/A	220 ft
North Main St – SBLTR	N/A	120 ft	N/A	355 ft
Parker Street				
North Main St – NBTR	N/A	75 ft	N/A	140 ft
Parker St – WBLR	N/A	55 ft	N/A	845 ft
North Main St – SBLT	N/A	50 ft	N/A	50 ft
Betton Street				
North Main St – NBTR	N/A	50 ft	N/A	40 ft
Betton St – EBLR	N/A	50 ft	N/A	420 ft
North Main St – SBLT	N/A	100 ft	N/A	320 ft

Notes: N/A – Not applicable in travel lane

As the above tables indicate, the queues are either approaching or exceeding the available storage lengths on virtually all of the approaches at both the Wilson Street and the State Street intersections. This also corresponds to the levels of service at these two intersections, which are 'F' and 'D', respectively. The North Main Street queues from the Wilson Street southbound extend to the Union Street intersection. However, from the Union Street intersection, the southbound queues extend back through the Church Street intersection. This pattern continues right back through the corridor to State Street. The northbound queues do not exhibit this pattern to the degree of the southbound traffic. Northbound, the queue from Center Street extends back almost to Betton Street. This correlates with the LOS 'F' for each of the unsignalized intersections.

Combination 1 - Improvement Alternatives 1, 2 and 3

This analysis looks at the combination of implementing Improvement Alternatives 1, 2 and 3. This results in the Parker Street/Betton Street intersection being realigned to create a four-leg signalized intersection, with no signal at Center Street, and the coordination of the signals from Wilson Street to State Street, in favor of northbound traffic. The results for the capacity and queue analyses are shown in the following tables:

Table 4.7: Level of Service for North Main Street Signalized Intersections – Combination 1

Intersection/ Approach	2015 Volumes		Intersection/ Approach	2015 Volumes	
	Delay (sec)	LOS		Delay (sec)	LOS
Wilson Street			Betton/Parker Streets		
Wilson St – EBL	87	F	Betton St – EBLT	26	C
Wilson St – EBT	57	E	Betton St – EBR	>100	F
Wilson St – EBR	33	C	North Main St – NBL	12	A
South Main St – NBL	>100	F	North Main St – NBTR	9	A
South Main St – NBTR	>100	F	Parker St – WBLTR	>100	F
Wilson St – WBL	>100	F	North Main St – SBLTR	22	C
Wilson St – WBTR	>100	F	Overall Intersection	>100	F
North Main St – SBL	79	E	State Street		
North Main St – SBT	64	E	State St – EBL	33	C
North Main St – SBR	25	C	State St – EBTR	13	B
Overall Intersection	>100	F	North Main St – NBT	21	B
			North Main St – NBTR	20	B
			State St – WBT	34	C
			State St – WBTR	32	C
			North Main St – SBL	53	D
			North Main St – SBT	31	C
			North Main St – SBR	12	B
			Overall Intersection	25	C

**Table 4.8: Level of Service for North Main Street
Unsignalized Intersections – Combination 1**

Intersection/ Approach	2015 Volumes	
	Delay (sec)	LOS
Union Street		
Union St – EBLTR	>100	F
North Main St – NBLTR	4	A
Union St – WBLTR	>100	F
North Main St – SBLTR	42	E
Overall Intersection	>100	F
Church Street		
Church St – EBLTR	>100	F
North Main St – NBLTR	2	A
Church St – WBLTR	>100	F
North Main St – SBLTR	50	E
Overall Intersection	75	F
Center Street		
North Main St – NBTR	1	A
Center St – WBLR	12	B
North Main St – SBLT	2	A
Overall Intersection	2	A

As the above tables indicate, this is really not an acceptable solution. While it is an improvement over only changing the coordination and timing of the signals, the majority of the intersections are still failing during the peak hour under this alternative.

Table 4.9: Queue Analyses for North Main Street Signalized Intersections – Combination 1

Intersection/ Approach	2015 Volumes		Intersection/ Approach	2015 Volumes	
	Available	95 th Percentile		Available	95 th Percentile
Wilson Street			Parker/Betton Streets		
Wilson St – EBL	275 ft	310 ft	Betton St – EBLT	N/A	40 ft
Wilson St – EBT	N/A	1010 ft	Betton St – EBR	N/A	455 ft
Wilson St – EBR	275 ft	300 ft	North Main St – NBL	150 ft	155 ft
South Main St – NBL	275 ft	355 ft	North Main St – NBTR	N/A	240 ft
South Main St – NBTR	N/A	1565 ft	Parker St – WBLTR	N/A	960 ft
Wilson St – WBL	150 ft	215 ft	North Main St – SBLTR	N/A	255 ft
Wilson St – WBTR	N/A	720 ft	State Street		
North Main St – SBL	100 ft	90 ft	State St – EBL	260 ft	200 ft
North Main St – SBT	N/A	265 ft	State St – EBTR	N/A	400 ft
North Main St – SBR	150 ft	200 ft	North Main St – NBT	N/A	135 ft
			North Main St – NBTR	N/A	130 ft
			State St – WBT	N/A	220 ft
			State St – WBTR	N/A	215 ft
			North Main St – SBL	80 ft	125 ft
			North Main St – SBT	N/A	335 ft
			North Main St – SBR	80 ft	140 ft

Notes: N/A – Not applicable in travel lane

**Table 4.10: Queue Analyses for North Main Street
Unsignalized Intersections – Combination 1**

Intersection/ Approach	2015 Volumes	
	Available	95 th Percentile
Union Street		
Union St – EBLTR	N/A	280 ft
North Main St – NBLTR	N/A	140 ft
Union St – WBLTR	N/A	535 ft
North Main St – SBLTR	N/A	210 ft
Church Street		
Church St – EBLTR	N/A	340 ft
North Main St – NBLTR	N/A	85 ft
Church St – WBLTR	N/A	285 ft
North Main St – SBLTR	N/A	370 ft
Center Street		
North Main St – NBTR	N/A	15 ft
Center St – WBLR	N/A	55 ft
North Main St – SBLT	N/A	65 ft

Notes: N/A – Not applicable in travel lane

As the above tables indicate, the queues are either approaching or exceeding the available storage lengths on virtually all of the approaches at both the Wilson Street and the State Street intersections. This also corresponds to the levels of service at these two intersections, which are ‘F’ and ‘C’, respectively. The North Main Street queues from the Wilson Street southbound extend almost to the Union Street intersection. From the Union Street intersection, the southbound queues extend back to Church Street. The southbound queues from Church Street extend back through the Betton Street/Parker Street intersection, thereby causing the failure of the signalized intersection as well. This correlates with the LOS ‘F’ for each of the unsignalized intersections except Center Street.

Combination 2 - Improvement Alternatives 1, 2, 3 and 5

This analysis looks at the combination of implementing Improvement Alternatives 1, 2, 3 and 5. This results in the Parker Street/Betton Street intersection being realigned to create a four-leg signalized intersection, with no signal at Center Street, the coordination of the signals from Wilson Street to State Street, in favor of northbound traffic, and the elimination of on-street parking to allow for two southbound travel lanes, from Betton Street to Wilson Street. The results for the capacity and queue analyses are shown in the following tables:

Table 4.11: Level of Service for North Main Street Signalized Intersections – Combination 2

Intersection/ Approach	2015 Volumes		Intersection/ Approach	2015 Volumes	
	Delay (sec)	LOS		Delay (sec)	LOS
Wilson Street			Betton/Parker Streets		
Wilson St – EBL	>100	F	Betton St – EBLT	32	C
Wilson St – EBT	66	E	Betton St – EBR	4	A
Wilson St – EBR	43	D	North Main St – NBL	24	C
South Main St – NBL	>100	F	North Main St – NBTR	29	C
South Main St – NBTR	85	F	Parker St – WBLTR	19	B
Wilson St – WBL	>100	F	North Main St – SBL	30	C
Wilson St – WBTR	70	E	North Main St – SBTR	14	B
North Main St – SBLT	45	D	Overall Intersection	19	B
North Main St – SBT	43	D	State Street		
North Main St – SBR	9	A	State St – EBL	39	D
Overall Intersection	79	E	State St – EBTR	15	B
			North Main St – NBT	32	C
			North Main St – NBTR	31	C
			State St – WBT	30	C
			State St – WBTR	28	C
			North Main St – SBL	57	E
			North Main St – SBT	26	C
			North Main St – SBR	8	A
			Overall Intersection	26	C

Table 4.12: Level of Service for North Main Street Unsignalized Intersections – Combination 2

Intersection/ Approach	2015 Volumes	
	Delay (sec)	LOS
Union Street		
Union St – EBLTR	19	C
North Main St – NBLTR	3	A
Union St – WBLTR	21	C
North Main St – SBLT	3	A
North Main St – SBTR	3	A
Overall Intersection	4	A
Church Street		
Church St – EBLTR	11	B
North Main St – NBLTR	2	A
Church St – WBLTR	8	A
North Main St – SBLT	1	A
North Main St – SBTR	1	A
Overall Intersection	2	A
Center Street		
North Main St – NBT	2	A
North Main St – NBR	1	A
Center St – WBLR	10	B
North Main St – SBLT	1	A
Overall Intersection	2	A

As the above tables indicate, the addition of a second southbound travel lane greatly improves the operational efficiency of this corridor. The Wilson Street intersection still does experience a decline in the level of service, going from LOS ‘D’ to LOS ‘E’, going from an overall 37 second delay today to a 79 second overall delay. The efficiency of the State Street intersection would

remain virtually unchanged, still functioning at LOS ‘C’. The addition of the southbound travel lanes also noticeably improves the LOS for the unsignalized intersections along the corridor.

Table 4.13: Queue Analyses for North Main Street Signalized Intersections – Combination 2

Intersection/ Approach	2015 Volumes		Intersection/ Approach	2015 Volumes	
	Available	95 th Percentile		Available	95 th Percentile
Wilson Street			Parker/Betton Streets		
Wilson St – EBL	275 ft	330 ft	Betton St – EBLT	N/A	55 ft
Wilson St – EBT	N/A	1060 ft	Betton St – EBR	150 FT	65 ft
Wilson St – EBR	275 ft	275 ft	North Main St – NBL	325 FT	165 ft
South Main St – NBL	275 ft	320 ft	North Main St – NBTR	N/A	235 ft
South Main St – NBTR	N/A	380 ft	Parker St – WBLTR	N/A	75 ft
Wilson St – WBL	150 ft	215 ft	North Main St – SBL	100 FT	55 ft
Wilson St – WBTR	N/A	635 ft	North Main St – SBTR	N/A	175 ft
North Main St – SBLT	100 ft	245 ft	State Street		
North Main St – SBT	N/A	235 ft	State St – EBL	260 ft	175 ft
North Main St – SBR	150 ft	165 ft	State St – EBT	N/A	360 ft
			State St – EBTR	N/A	390 ft
			North Main St – NBT	N/A	150 ft
			North Main St – NBTR	N/A	145 ft
			State St – WBT	N/A	215 ft
			State St – WBTR	N/A	205 ft
			North Main St – SBL	80 ft	120 ft
			North Main St – SBT	N/A	320 ft
			North Main St – SBR	80 ft	125 ft

Notes: N/A – Not applicable in travel lane

Table 4.14: Queue Analyses for North Main Street Unsignalized Intersections – Combination 2

Intersection/ Approach	2015 Volumes	
	Available	95 th Percentile
Union Street		
Union St – EBLTR	N/A	75 ft
North Main St – NBLTR	N/A	130 ft
Union St – WBLTR	N/A	55 ft
North Main St – SBLT	N/A	100 ft
North Main St – SBTR	N/A	100 ft
Church Street		
Church St – EBLTR	N/A	80 ft
North Main St – NBLTR	N/A	70 ft
Church St – WBLTR	N/A	40 ft
North Main St – SBLT	N/A	15 ft
North Main St – SBTR	N/A	10 ft
Center Street		
North Main St – NBTR	N/A	N/A
Center St – WBLR	N/A	55 ft
North Main St – SBLT	N/A	25 ft

Notes: N/A – Not applicable in travel lane

As the above tables indicate, the queues are either approaching or exceeding the available storage lengths on all of the approaches of the Wilson Street intersection, as well as the couthbound approaches to the State Street intersection. This also corresponds to the levels of service at these two intersections, which are ‘D’ and ‘C’, respectively. Additionally, the addition of the

second southbound travel lane decrease the length of the queues so they no longer extend back through the unsignalized intersections, which allows movement from the side streets.

Combination 3 - Improvement Alternatives 1, 2, 3, 5 and 10

This analysis looks at the combination of implementing Improvement Alternatives 1, 2 and 3. This results in the Parker Street/Betton Street intersection being realigned to create a four-leg signalized intersection, with no signal at Center Street, and the coordination of the signals from Wilson Street to State Street, in favor of northbound traffic. This analysis also includes the addition of a protected left turn phase from southbound North Main Street to eastbound Wilson Street, and the elimination of on-street parking to allow for two southbound travel lanes, from Betton Street to Wilson Street. The results for the capacity and queue analyses are shown in the following tables:

Table 4.15: Level of Service for North Main Street Signalized Intersections – Combination 3

Intersection/ Approach	2015 Volumes		Intersection/ Approach	2015 Volumes	
	Delay (sec)	LOS		Delay (sec)	LOS
Wilson Street			Betton/Parker Streets		
Wilson St – EBL	63	E	Betton St – EBLT	35	C
Wilson St – EBT	29	C	Betton St – EBR	5	A
Wilson St – EBR	18	B	North Main St – NBL	10	B
South Main St – NBL	98	F	North Main St – NBTR	4	A
South Main St – NBTR	81	F	Parker St – WBLTR	18	B
Wilson St – WBL	>100	F	North Main St – SBLTR	5	A
Wilson St – WBTR	58	E	Overall Intersection	7	A
North Main St – SBL	97	F	State Street		
North Main St – SBT	69	E	State St – EBL	42	D
North Main St – SBR	18	B	State St – EBTR	16	B
Overall Intersection	59	E	North Main St – NBT	27	C
			North Main St – NBTR	26	C
			State St – WBT	27	C
			State St – WBTR	25	C
			North Main St – SBL	41	D
			North Main St – SBT	23	C
			North Main St – SBR	8	A
			Overall Intersection	25	C

**Table 4.16: Level of Service for North Main Street
Unsignalized Intersections – Combination 3**

Intersection/ Approach	2015 Volumes	
	Delay (sec)	LOS
Union Street		
Union St – EBLTR	>100	F
North Main St – NBLTR	4	A
Union St – WBLTR	40	E
North Main St – SBLT	12	B
North Main St – SBTR	12	B
Overall Intersection	14	B
Church Street		
Church St – EBLTR	20	C
North Main St – NBLTR	2	A
Church St – WBLTR	11	B
North Main St – SBLT	2	A
North Main St – SBTR	2	A
Overall Intersection	4	A
Center Street		
North Main St – NBTR	1	A
Center St – WBLR	11	B
North Main St – SBLT	1	A
Overall Intersection	2	A

As the above tables indicate, the addition of the second southbound travel lane really improves the operational efficiency of this corridor, especially when combined with a protected left turn from southbound North Main Street onto eastbound Wilson Street. Keeping in mind that the Wilson Street intersection is currently already operating at LOS ‘D’ today, LOS ‘E’ after a 30 percent increase in traffic is reasonable.

Table 4.17: Queue Analyses for North Main Street Signalized Intersections – Combination 3

Intersection/ Approach	2015 Volumes		Intersection/ Approach	2015 Volumes	
	Available	95 th Percentile		Available	95 th Percentile
Wilson Street			Parker/Betton Streets		
Wilson St – EBL	275 ft	275 ft	Betton St – EBLT	N/A	55 ft
Wilson St – EBT	N/A	420 ft	Betton St – EBR	150 ft	65 ft
Wilson St – EBR	275 ft	175 ft	North Main St – NBL	100 ft	115 ft
South Main St – NBL	275 ft	350 ft	North Main St – NBTR	N/A	160 ft
South Main St – NBTR	N/A	390 ft	Parker St – WBLTR	N/A	70 ft
Wilson St – WBL	150 ft	190 ft	North Main St – SBLTR	N/A	165 ft
Wilson St – WBTR	N/A	535 ft	State Street		
North Main St – SBL	100 ft	95 ft	State St – EBL	260 ft	395 ft
North Main St – SBT	N/A	280 ft	State St – EBTR	N/A	390 ft
North Main St – SBR	150 ft	220 ft	North Main St – NBT	N/A	175 ft
			North Main St – NBTR	N/A	170 ft
			State St – WBT	N/A	210 ft
			State St – WBTR	N/A	210 ft
			North Main St – SBL	80 ft	115 ft
			North Main St – SBT	N/A	310 ft
			North Main St – SBR	80 ft	140 ft

Notes: N/A – Not applicable in travel lane

**Table 4.18: Queue Analyses for North Main Street
Unsignalized Intersections – Combination 3**

Intersection/ Approach	2015 Volumes	
	Available	95 th Percentile
Union Street		
Union St – EBLTR	N/A	180 ft
North Main St – NBLTR	N/A	150 ft
Union St – WBLTR	N/A	55 ft
North Main St – SBLT	N/A	180 ft
North Main St – SBTR	N/A	195 ft
Church Street		
Church St – EBLTR	N/A	120 ft
North Main St – NBLTR	N/A	70 ft
Church St – WBLTR	N/A	40 ft
North Main St – SBLT	N/A	55 ft
North Main St – SBTR	N/A	65 ft
Center Street		
North Main St – NBTR	N/A	10 ft
Center St – WBLR	N/A	55 ft
North Main St – SBLT	N/A	15 ft

Notes: N/A – Not applicable in travel lane

As shown in the above tables, the queues generated by traffic through these improvements, while still exceeding the storage capacity of the majority of the approaches to the signalized intersections, do not cause the same degree of backups as experienced with the other alternatives. However, The Wilson Street, State Street, and Union Street intersections still experience occasional upstream blocking.

Combination 4 - Improvement Alternatives 1, 2, 3, 5, 7, 8 and 10

This analysis looks at the combination of implementing Improvement Alternatives 1, 2 and 3. This results in the Parker Street/Betton Street intersection being realigned to create a four-leg signalized intersection, with no signal at Center Street, and the coordination of the signals from Wilson Street to State Street, in favor of northbound traffic. This analysis also includes the addition of a protected left turn phase from southbound North Main Street to eastbound Wilson Street, and the elimination of on-street parking to allow for two southbound travel lanes, from Betton Street to Wilson Street. Additionally, the easterly legs of both Center Street and Union Street have been defined as right in/right out only. The results for the capacity and queue analyses are shown in the following tables:

Table 4.19: Level of Service for North Main Street Signalized Intersections – Combination 4

Intersection/ Approach	2015 Volumes		Intersection/ Approach	2015 Volumes	
	Delay (sec)	LOS		Delay (sec)	LOS
Wilson Street			Betton/Parker Streets		
Wilson St – EBL	75	E	Betton St – EBLT	28	C
Wilson St – EBT	27	C	Betton St – EBR	4	A
Wilson St – EBR	17	B	North Main St – NBL	11	B
South Main St – NBL	77	F	North Main St – NBTR	8	A
South Main St – NBTR	85	F	Parker St – WBLTR	22	C
Wilson St – WBL	91	F	North Main St – SBLTR	6	A
Wilson St – WBTR	39	D	Overall Intersection	8	A
North Main St – SBL	76	F	State Street		
North Main St – SBT	58	E	State St – EBL	46	D
North Main St – SBR	15	B	State St – EBTR	19	B
Overall Intersection	51	D	North Main St – NBT	27	C
			North Main St – NBTR	27	C
			State St – WBT	33	C
			State St – WBTR	33	C
			North Main St – SBL	41	D
			North Main St – SBT	27	C
			North Main St – SBR	10	A
			Overall Intersection	28	C

Table 4.20: Level of Service for North Main Street Unsignalized Intersections – Combination 4

Intersection/ Approach	2015 Volumes	
	Delay (sec)	LOS
Union Street		
North Main St – NBLTR	4	A
Union St – EBLTR	11	B
North Main St – SBT	6	A
North Main St – SBTR	5	A
Union St – WBR	0	A
Overall Intersection	6	A
Church Street		
Church St – EBLTR	17	B
North Main St – NBLTR	1	A
Church St – WBLTR	8	A
North Main St – SBLT	1	A
North Main St – SBTR	1	A
Overall Intersection	2	A
Center Street		
North Main St – NBTR	1	A
Center St – WBR	2	A
North Main St – SBT	1	A
Overall Intersection	1	A

As the above tables indicate, this combination of alternatives appears to provide the most benefit to the efficiency of the North Main Street corridor. The Wilson Street and State Street intersections, which currently operate at LOS ‘D’ and ‘C’ respectively, will continue to operate at those same acceptable levels of service through the ten-year study forecast. Additionally, the levels of service of the unsignalized intersections are not degraded with these improvements.

Table 4.21: Queue Analyses for North Main Street Signalized Intersections – Combination 4

Intersection/ Approach	2015 Volumes		Intersection/ Approach	2015 Volumes	
	Available	95 th Percentile		Available	95 th Percentile
Wilson Street			Parker/Betton Streets		
Wilson St – EBL	275 ft	320 ft	Betton St – EBLT	N/A	45 ft
Wilson St – EBT	N/A	350 ft	Betton St – EBR	150 ft	65 ft
Wilson St – EBR	275 ft	165 ft	North Main St – NBL	100 ft	115 ft
South Main St – NBL	275 ft	335 ft	North Main St – NBTR	N/A	145 ft
South Main St – NBTR	N/A	385 ft	Parker St – WBLTR	N/A	145 ft
Wilson St – WBL	150 ft	195 ft	North Main St – SBLTR	N/A	190 ft
Wilson St – WBTR	N/A	590 ft	State Street		
North Main St – SBL	100 ft	85 ft	State St – EBL	260 ft	435 ft
North Main St – SBT	N/A	265 ft	State St – EBTR	N/A	400 ft
North Main St – SBR	150 ft	170 ft	North Main St – NBT	N/A	140 ft
			North Main St – NBTR	N/A	150 ft
			State St – WBT	N/A	215 ft
			State St – WBTR	N/A	205 ft
			North Main St – SBL	80 ft	115 ft
			North Main St – SBT	N/A	330 ft
			North Main St – SBR	80 ft	145 ft

Notes: N/A – Not applicable in travel lane

Table 4.22: Queue Analyses for North Main Street Unsignalized Intersections – Combination 4

Intersection/ Approach	2015 Volumes	
	Available	95 th Percentile
Union Street		
North Main St – NBLTR	N/A	165 ft
Union St – EBLTR	N/A	55 ft
Union St – WBR	N/A	25 ft
North Main St – SBLT	N/A	90 ft
North Main St – SBTR	N/A	100 ft
Church Street		
Church St – EBLTR	N/A	120 ft
North Main St – NBLTR	N/A	15 ft
Church St – WBLTR	N/A	40 ft
North Main St – SBLT	N/A	10 ft
North Main St – SBTR	N/A	10 ft
Center Street		
North Main St – NBTR	N/A	N/A
Center St – WBR	N/A	35 ft
North Main St – SBT	N/A	N/A

Notes: N/A – Not applicable in travel lane

As shown in the above tables, the queues generated under this scenario do still meet or exceed the available storage capacity on most of the approaches to the Wilson Street and State Street intersections. However, this is still an improvement to the queues experienced under today’s conditions. Also, the Wilson Street and State Street intersections will still, on occasion, experience upstream blocking.

Chapter 5

Recommendations

As the preceding data indicates, a combination of alternatives will be required to truly provide improved operational efficiency along North Main Street. Any improvements to the corridor are limited by the constraints along the corridor. The adjacent residential uses and limited right-of-way effectively prevent widening of the roadway. Additionally, given the nature of many of the uses on North Main Street, the availability and accessibility of parking must be maintained, as well as the accessibility of the corridor by pedestrians and bicyclists.

Alternative Combinations

The following combination of Improvement Alternatives maintains operational efficiency of the corridor at approximately the same levels of service as 2005:

- Realignment of Betton Street and Parker Street to create a four-leg intersection (Improvement Alternative 1);
- Relocation of the traffic signal from Center Street to the newly aligned Betton Street/Parker Street intersection, and closing Center Street, between North Main Street and Penobscot Street, to vehicular traffic (Improvement Alternative 2);
- Coordination of the traffic signals in favor of northbound traffic (Improvement Alternative 3);
- Elimination of on-street parking to provide two southbound travel lanes, and turn lanes were necessary (Improvement Alternative 5);
- Signal modification to include a protected left-turn phase from southbound North Main Street on to eastbound Wilson Street (Improvement Alternative 10);
- Conversion of the easterly leg of Union Street to right-in/right-out only (Improvement Alternative 8);
- Conversion of the easterly leg of Center Street to right-in/right-out only (Improvement Alternative 7);
- Provide marked crosswalks at the following intersections
 - State Street and North Main Street - a marked crosswalk should be provided across the southerly leg of North Main Street to connect to the existing crosswalk across State Street. Also, this intersection would be a good location of pedestrian countdown signals.
 - Betton Street/Parker Street and North Main Street – all legs, after the intersection is realigned and signalized.
 - Union Street and North Main Street – the easterly leg of Union Street and the northerly leg of North Main Street;
 - Wilson Street and North Main Street – all legs
- Rehabilitate existing sidewalks and ramps to meet the Americans with Disabilities Act (ADA) standards;

- Install new and/or additional overhead lane signage and directional signage
 - Northbound approaching the State Street intersection – “Two Through Lanes” and “Slower Traffic Keep Right”
 - Southbound approaching the State Street intersection – Directional signage for I-95 and I-395 to use State Street
 - Northbound along corridor – overhead lane use signage at Parker Street/Betton Street (after realignment of intersection)
 - Southbound along corridor – overhead lane use signage at Church Street and Union Street (after addition of second travel lane);
- Upgrade all traffic signals to 12-inch lenses with back plates.

While some improvements need to be undertaken together to gain the full benefit, some can be implemented in phases or individually. For example, the installation of directional and lane use signage, the striping of the crosswalks, and the upgrade of sidewalks to be ADA compliant should all be done. The protected left turn phase from southbound North Main Street to eastbound Wilson Street can be installed virtually regardless of any other alternatives. The realignment of Betton Street to meet North Main Street at Parker Street should be done, even without the relocation of the signal from Center Street.

The signal can be removed from Center Street and relocated to the realigned Betton Street even without a complete closure of Center Street. With a newly signalized intersection at Betton Street, traffic destined to or from Penobscot Square and/or Bangor via the Penobscot Bridge would now access North Main Street via Betton Street. This improvement alternative would ultimately allow for the full closure of the westerly leg of Center Street to vehicular traffic in favor of a pedestrian mall, if desired. Even if the closure of Center Street is not the City’s plan, the removal of the traffic signal at that intersection allows for other possibilities, such as making Center Street a one-way, or closing Center Street at North Main Street, so that all vehicular traffic on the westerly leg of Center Street must use Penobscot Street and either State Street or Betton Street.

Conversely, some of the improvement alternatives should only be undertaken upon completion of other steps. For example, before eliminating on-street parking in favor of travel lanes, suitable parking should be made available, either in the form of a new parking lot or structure, or comparable on-street parking in another location.

A phased approach for the major improvements would be as follows:

1. Improvement Alternative 1, the realignment of Betton Street and Parker Street;
2. Improvement Alternatives 2, 3 and 5, the relocation of the traffic signal from Center Street to Betton/Parker Street; the coordination of the signals, and the addition of a second southbound travel lane.
3. At a later date, if deemed appropriate by the City, Improvement Alternatives 7 and 8, the right-in/right-out only of both Center Street and Union Street, could be implemented.

A key point to the implementation plan will be the locating/construction of suitable replacement parking for the on-street spaces that will be eliminated. Construction of the planned parking garage at Betton Street at Penobscot Street should be completed prior to the overall implementation of this plan.

Suggested Implementation Phasing

Steps that could be taken in the immediate future include the following:

- Provide marked crosswalks at the following intersections
 - State Street and North Main Street - a marked crosswalk should be provided across the southerly leg of North Main Street to connect to the existing crosswalk across State Street. Also, this intersection would be a good location of pedestrian countdown signals.
 - Betton Street/Parker Street and North Main Street – all legs, after the intersection is realigned and signalized.
 - Union Street and North Main Street – the easterly leg of Union Street and the northerly leg of North Main Street;
 - Wilson Street and North Main Street – all legs
- Install overhead lane signage and directional signage
 - Northbound approaching the State Street intersection – “Two Through Lanes” and “Slower Traffic Keep Right”
 - Southbound approaching the State Street intersection – Directional signage for I-95 and I-395 to use State Street
- Signal modification to include a protected left-turn phase from southbound North Main Street on to eastbound Wilson Street (Improvement Alternative 10)

Steps that could be planned for the 2008-2009 Biennial Capital Work Plan include:

- Conversion of the easterly leg of Union Street to right-in/right-out only (Improvement Alternative 8)
- Elimination of on-street parking to provide two southbound travel lanes, and turn lanes were necessary (Improvement Alternative 5)
- Rehabilitate existing sidewalks and ramps to meet the Americans with Disabilities Act (ADA) standards (This could be done as a stand alone project to include all intersections; or as an addition to other projects at each intersection, as they move forward).

Steps that would be appropriate to plan for 2010 and beyond include:

- Realignment of Betton Street and Parker Street to create a four-leg intersection (Improvement Alternative 1)
- Relocation of the traffic signal from Center Street to the newly aligned Betton Street/Parker Street intersection, and closing Center Street, between North Main Street and Penobscot Street, to vehicular traffic (Improvement Alternative 2)
- Coordination of the traffic signals in favor of northbound traffic (Improvement Alternative 3)
- Conversion of the easterly leg of Center Street to be right-in/right-out only (Improvement Alternative 7)

- Install new overhead lane signage
 - Northbound along corridor – overhead lane use signage at Parker Street/Betton Street (after realignment of intersection)
- Southbound along corridor – overhead lane use signage at Church Street and Union Street (after addition of second travel lane)

A final note is that this study evaluated the North Main Street corridor as is today; that is, without an extension of I-395. An extension of I-395 would make the Route 9 (North Main Street) corridor a less attractive alternative, thereby reducing the volumes of pass-through traffic. The construction of the I-395 extension is essential to help relieve congestion, preserve neighborhoods, and increase capacity along the North Main Street corridor. However, the extension of the Interstate alone will not be enough to reduce the volume of truck traffic through the North Main Street corridor. The current vehicle weight limits for the Interstate System would need to be increased to provide the hoped for relief from through truck traffic.

Preliminary Opinion of Probable Construction Costs

Our office performed a preliminary opinion of the probable construction costs associated with construction of the improvements included in Combination 4 above. This cost estimate does not include legal or engineering costs, the remediation or removal of any special or hazardous materials such as asbestos, PCB's, etc., costs associated with wetlands, and utility relocations which were assumed to be born by the utility company. The cost estimate does not include right-of-way acquisition, which will be needed for the realignment of the Betton Street/Parker Street intersection. The cost estimate is based on MaineDOT 2005 unit prices and assumes that all projects are completed concurrently. The detailed calculations of the costs are included in Appendix E. The preliminary opinion of the probable construction cost associated with Combination 4 is approximately \$450,000.00.