Route 236 Planning Study South Berwick, Maine



Prepared for:

Town of South Berwick





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Route 236 Planning Study

South Berwick, Maine

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Glossary of Terms and Definitions

<u>Transportation Demand Management (TDM)</u>: the application of strategies or policies to reduce travel demand. TDM strategies aim to provide greater support for alternative transportation options such as transit, rideshare, walking, cycling, etc.

<u>National Highway System (NHS)</u>: includes the Interstate Highway System and other roads important to the nation's economy and mobility.

Average Annual Daily Traffic (AADT): the average daily traffic volume at a given location over 365 days.

<u>Turning Movement Count (TMC)</u>: The collection of data at a location depicting the volumes and directionality of traffic.

<u>High Crash Location (HCL)</u>: defined by MaineDOT as an intersection of segment of roadway that has a greater than expected number of crashes (Critical Rate Factor > 1.0) over a three-year period.

<u>Critical Rate Factor (CRF)</u>: the ratio of the actual crash rate at an intersection or segment of roadway to the statistically calculated critical rate.

Synchro / SimTraffic: The software utilized to model traffic flow simulations.

<u>Level of service (LOS)</u>: the metric utilized to determine the control delay, measured A through F, with A being optimal and F being unacceptable.

<u>Manual on Uniform Traffic Control Devices (MUTCD)</u>: defines the standards used by road managers nationwide to install and maintain traffic control devices on public streets, highways, bikeways, and private roads.

<u>WB-67</u>: A typical semi-trailer truck as defined by the Federal Highway Administration. The WB-67 is 67 feet between the centerline of the front and rearmost axle, plus overhangs for an effective length of 76 feet.

<u>National Cooperative Highway Research Program (NCHRP)</u>: a national research program carried out through the support of the Federal Highway Administration and other partners. The NCHRP develops cooperative research reports that are utilized nationwide for engineering-based decision making.

<u>Access Management:</u> the management of access points to adjacent land parcels along roadways aimed at reducing conflict points. Access management implementations can increase capacity, manage congestion, and reduce crashes.

<u>Road Diet</u>: a technique in transportation to reduce the number of vehicular travel lanes, or the effective roadway width to reallocate space or achieve alterative goals through a roadway corridor.

<u>Two-Way Left-Turn Lane (TWLTL)</u>: a shared center lane exclusive for the use of left-turning traffic in either direction.

<u>Americans with Disabilities Act (ADA)</u>: prohibits discrimination against people with disabilities in this case, in the transportation and public accommodation sector.

<u>Rectangular Rapid Flashing Beacon (RRFB)</u>: a traffic control device that is pedestrian actuated and is intended to increase driver awareness of pedestrians at mid-block or uncontrolled intersections. RRFBs flash with an alternating frequency when activated.

1.0 Introduction

The Town of South Berwick, Maine is a York County bedroom community located on the New Hampshire border. Comprised of a historic village centered on Main Street (Route 236/Route 4), businesses, residences, and schools are all located within a half mile radius of the downtown.

The downtown corresponds with an approximate 1,000-foot stretch of roadway where Route 4 and Route 236 coincide as a major thoroughfare. Commuters from neighboring communities utilize Main Street as the primary throughway to access local employment opportunities, contributing to an average daily vehicle count through the corridor of just under 19,500 vehicles per day. This level of traffic provides challenges to the approximate 7,500 residents of South Berwick.

These challenges are not unique and have been documented within the community for several years. There is an extensive list of previous studies that have been undertaken to develop a solution to the ongoing traffic congestion and safety concerns, dating back to the 1980's and most recently by Sebago Technics, Inc. (Sebago) in 2010. Recommendations compiled from that study were not implemented. Therefore, the Town of South Berwick (Town) retained Sebago to reevaluate existing and future traffic considerations along Main Street.

The determined study area is shown in Figure 1 in the Technical Appendix and includes the following intersections with Main Street:

- 1. Dow Highway (Route 236)
- 2. Academy Street
- 3. Paul Street
- 4. Portland Street (Route 4)
- 5. Young Street
- 6. Norton Street

Study Area Figure

Additionally, the access drives for the Central Elementary School were included to understand impacts from the traffic volumes and patterns to and from the school.

2.0 Purpose and Need

A kick-off meeting was held with Town Staff on August 8, 2022, to discuss goals for the study and to walk the Main Street corridor. The Town's goals for the traffic study include:

- Review mitigation opportunities for vehicular congestion.
- Provide pedestrian safety and connectivity through the corridor.
- Acknowledge the larger goal of the downtown vitalization, including vehicular and pedestrian access to local businesses.
- Understand the implications of traffic changes on Main Street to nearby local roads and neighborhoods.

It was determined that the study should focus on recommendations for tangible physical improvements, as opposed to Transportation Demand Management (TDM) strategies, as TDM strategies were a significant focus of the 2010 study.

Previous Study Efforts

Through discussions with the Town, it was determined the previous study would remain as background and basis for the current reevaluation efforts, rather than replacing the study given the amount of time that has passed. Sebago was retained for the previous study in 2008 by the Kittery Area Comprehensive Transportation System (KACTS) and the Town to expand on a 2008 study completed by the Maine Department of Transportation (MaineDOT) for the Route 236 corridor. The MaineDOT study highlighted several safety and capacity issues within the Town that warranted further investigation.

Sebago's efforts included a robust public process with five (5) advisory committee meetings and three (3) public meetings. This process directed the purpose and need: to focus on improving vehicular mobility through access management and increase pedestrian and vehicular safety. The study reviewed several options, including providing for a bypass, intersection reconfigurations, and access management strategies. Recommendations included development of a TDM program aimed at reducing the number of commuters via carpool, increasing van share, reviewing park and ride opportunities, and exploring transit feasibility. A phased implementation plan included the following:

<u>Phase 1</u>: Relocate the Central Elementary School Access from Main Street to a backdoor entrance to Young Street.

Rendering from previous report, showing development of a backdoor entrance to Young Street.

<u>Phase 2</u>: Streetscaping implementations including curb bump outs, sidewalk construction, gateway treatments, and added green space with street trees. Underground infrastructure for future signal installations were to be provided at the Main Street intersections of Portland Street and Dow Highway.

<u>Phase 3</u>: Determine if implementations from TDM strategies had measurable impacts on the corridor. If not, install the traffic signal at the intersection of Main Street and Dow Highway and retain police officer traffic control during the AM peak hour at the intersection of Main Street and Portland Street.

<u>Phase 4</u>: Install the traffic signal at Main Street and Portland Street to replace the longstanding use of police officer traffic control during the AM peak hour period. The total estimate cost for the four phases was \$2.2 million in 2009 construction dollars.

Public Outreach

Following a meeting with the Town Council to introduce the study efforts on August 23, 2022, a Town Council Meeting was held on October 18, 2022, with public comment.

Sebago solicited feedback on existing concerns and requested input for future considerations, utilizing MaineDOT's *Complete Streets Policy* as a basis to understand corridor priorities. Over 25 members of the public spoke, generating the following consistent themes from the meeting:

Slide from the Public Meeting Presentation outlining options to consider for future implementation.

- Speeding is problematic at times and traffic calming is a high priority.
- Significant amounts of traffic make intersection movements challenging.
- The corridor lacks pedestrian visibility and generally pedestrians do not feel safe.

It was evident that the residents are passionate about the South Berwick community but find that the traffic challenges have negative impacts on the character of the community. There is a strong desire to find solutions that are inviting and compliment the historical nature of the downtown.

3.0 Existing Conditions

MaineDOT classifies roadways in the state by priority ranging from 1 (Maine Turnpike, the Interstate System, and key arterials) to 5 (local roadways). Main Street (Route 236/4), Dow Highway (Route 236), and Portland Street (Route 4) are all Priority 2 State Highways, which means they are high priority, but not on the National Highway System (NHS). Because the roadways are classified as State Highways, the intersections are considered "major" intersections. The remaining roadways within the study area are priority 5, local roads and are considered "minor" intersections with Main Street. All the roadways within the study area have a posted speed limit of 25 miles per hour (MPH).

Main Street from Dow Highway to Norton Street has a singular lane in each direction for northbound and southbound through traffic. In the southbound direction, an exclusive left-turn lane is provided at the intersection of Dow Highway. In the northbound direction an exclusive right-turn lane is provided at the intersection of Portland Street.

Between Academy Street and Portland Street are several access points to local businesses and the Central Elementary School. A two-way left-turn lane is provided to accommodate these movements. Onstreet parking is also provided throughout the corridor and is most densely located between Portland Street and Norton Street.

Traffic Volumes

A review of historical count data from MaineDOT was completed utilizing MaineDOT's Traffic Database to understand vehicular volume trends within the last

On-street parking in the vicinity of Portland Street.

ten (10) years. Average annual daily traffic (AADT) volumes were reviewed in the study area and are summarized in Table 1.

MaineDOT		Count Year			
Count Station	Location		2016	2019	2022
01206	Route 4 (Main St), SW/O Central St	10,340	9,890	10,600	9,540
01605	Route 4/236 (Main St), S/O Paul St	-	20,210	19,820	19,040
01601	Route 236 (Main St), N/O Route 4 (Portland St)	10,020	-	9,740	9,260
01204	Route 236 (Dow Highway), S/O Route 4 (Main St)	13,760	13,950	-	13,130
01508	Academy St, NW/O Union St	1,840	1,600	-	-
00106	Route 4 (Portland St), SW/O Colcord St	13,020	13,270	13,500	12,080
01802	Norton St, NE/O Route 236 (Main St)	3,070	3,480	2,580	3,140

Table 1 – Average Annual Daily Traffic Data

As demonstrated above, the AADT on Main Street increased in the long-term period from 2013 to 2019 and then decreased during the short-term period from 2019 to 2022.

To determine peak hour volumes for analysis purposes, 12-hour turning movement counts (TMCs) were collected on September 14, 2022, from 6:00 AM to 6:00 PM at the study area intersections. The counts, which are included in the Appendix, were completed in September to assure both vehicular

and pedestrian traffic data associated to the **Central Elementary** School was captured. The volumes were factored to the 30th highest hour, the volumes utilized for traffic analysis purposes as they represent peak summer conditions. Main Street is classified by the MaineDOT as a Group I – Urban Roadway, resulting in a 3% increase from

observed September volumes to adjusted peak summer conditions. The peak hour volumes are summarized in Figure 2 in the Appendix.

Chart 1 demonstrates that the corridor experiences two distinct peaks between the periods of 7:00 to 9:00 AM and 3:00 to 5:00 PM, as typical of a commuter heavy corridor. The peak hours for the corridor occurred from 7:15 to 8:15 AM and from 4:15 to 5:15 PM. Based on the above graph, overall traffic volumes steadily rise preceding the AM peak hour and decrease following the PM peak hour,

demonstrating that the peaks for the corridor were likely captured within the data collection period.

The 2010 study utilized a 12-hour TMC at the intersection of Main Street and Portland Street from June 1, 2006. To understand

long-term traffic trends for a typical peak summer day, this data was compared to the 2022 volumes in Chart 2. The 12-hour peak summer volume was approximately 14,680 vehicles in 2006 and 17,095 in 2022. In 2006, volumes during the peak hours were approximately 7% and 8% lower than 2022 volumes during the AM and PM peak hour periods, respectively.

Heavy Vehicles

An important metric for existing conditions analysis and future intersection evaluation is the percentage of heavy vehicles in the overall traffic volumes. The percentages for movements at the two major intersections, collected in the TMCs, are shown in Table 2 and graphically in Figure 3 in the Appendix.

Intersection of Main Street and Portland Street			
Movement	AM Peak Hour	PM Peak Hour	
Main Street Southbound Left	5.5%ª	0.0%	
Main Street Northbound Right	6.5%	2.0%	
Portland Street Westbound Left	7.5%	4.0%	
Portland Street Westbound Right	0.0%	1.0% ^b	
Intersection of Ma	in Street and Dow Highw	ay	
Intersection of Ma Movement	in Street and Dow Highw AM Peak Hour	ay PM Peak Hour	
Intersection of Ma Movement Main Street Southbound Left	in Street and Dow Highw AM Peak Hour 5.5%	ay PM Peak Hour 3.0%	
Intersection of Ma Movement Main Street Southbound Left Main Street Northbound Right	in Street and Dow Highw AM Peak Hour 5.5% 2.5%	ay PM Peak Hour 3.0% 1.0%	
Intersection of Ma Movement Main Street Southbound Left Main Street Northbound Right Dow Highway Westbound Left	in Street and Dow Highw AM Peak Hour 5.5% 2.5% 4.5%	ay PM Peak Hour 3.0% 1.0% 0.0%	

Table 2 – Heavy Vehicle Percentage by Movement

^a Two trucks of 36 total movements

^b One truck of 98 total movements

Pedestrian and Bicycle Volumes

Main Street does not have dedicated bicycle facilities but has consistent pedestrian facilities. Sidewalks are located on both sides of Main Street from Academy Street to Norton Street, varying in width from 5 feet to 10 feet in the vicinity of the businesses at Portland Street. Between Academy Street and Dow Highway, sidewalk is provided along the west side of Main Street.

Crosswalks are located just south of Academy Street, north and south of Portland Street, and just south of Norton Street. Additional mid-block crossing locations occur at the Post Office Access and in the vicinity of the Town Hall and Central Elementary School. Both locations have pedestrian actuated Rectangular Rapid Flashing Beacons (RRFBs).

The TMCs captured both pedestrian and bicycle volumes through the corridor. Near the Central School, 15 bicycles southbound and 16 bicycles northbound on Main Street

RRFB at the Central Elementary School and Town Hall crosswalk.

were observed, accounting for 0.5% of the total volume along Main Street. Pedestrian volumes are summarized in Table 3 and graphically in Figure 4 in the Appendix.

Intersection of Main Street and Dow Highway				
Peak Hour Period	AM Peak Hour	PM Peak Hour		
Vehicular Peak Hour	0	0		
Pedestrian Peak Hour	2 (8:15 – 9:15 AM)	1 (3:00 – 4:00 PM)		
Intersectio	on of Main Street and Acade	emy Street		
Peak Hour Period	AM Peak Hour	PM Peak Hour		
Vehicular Peak Hour	1	7		
Pedestrian Peak Hour	5 (10:00 – 11:00 AM)	8 (3:15 – 4:15 PM)		
Main Street at	Central Elementary School	and Town Hall		
Peak Hour Period	AM Peak Hour	PM Peak Hour		
Vehicular Peak Hour	10	7		
Pedestrian Peak Hour	12 (7:45 – 8:45 AM)	23 (3:00 – 4:00 PM)		
Intersection of Main Street and Portland Street				
Peak Hour Period	AM Peak Hour	PM Peak Hour		
Vehicular Peak Hour	1	15		
Pedestrian Peak Hour	13 (9:45 – 10:45 AM)	18 (3:15 – 4:15)		

Table 3 – Pedestrian Volumes Crossing Main Street

Safety Review

MaineDOT compiles crash data for roadways across the state to outline locations that have a higherthan-expected crash rate and potential safety deficiency. The metrics utilized to characterize a high crash location (HCL) include the number of crashes over a three-year period and the critical rate factor (CRF). The critical rate factor is the ratio of the actual crash rate at an intersection or segment of roadway to the statistically calculated critical rate.

An intersection or section of roadway is deemed an HCL if two criteria are met: a CRF greater than 1.0 and a minimum of eight (8) crashes during that three-year period. As such, crash data for the most recent three-year period from 2019 to 2021 was obtained from MaineDOT for the study area. The detailed crash data is included in the Appendix and is summarized in Tables 4 and 5.

Node	Location	# of Crashes (CRF)
63402	Main Street and Dow Highway	10 (1.52)
56697	Main Street and Academy Street	10 (1.63)
57011	Main Street and Paul Street	0 (0.00)
56698	Main Street and Portland Street	13 (2.08)
56012	Main Street and Young Street	0 (0.00)
55799	Main Street and Norton Street	4 (1.11)

Table 4 – Intersection Crash Summary

Table 5	– Segment	Crash Summary	1
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Segment / Link	Location	# of Crashes (CRF)
56694 - 63403	Dow Hwy between Vine St and Cumberland Farms	7 (0.38)
63402 - 56697	Main St between Dow Hwy and Academy St	2 (0.35)
56697 - 57011	Main St between Academy St and Paul St	5 (0.68)
57011 - 56698	Main St between Paul St and Portland St	2 (0.69)
56698 - 56012	Main St between Portland St and Young St	5 (1.35)
66042 - 56699	Portland St between Main St and Colcord St	7 (1.64)
56012 - 55799	Main Street between Young Street and Norton Street	0 (0.00)

As demonstrated in the previous tables, there are three (3) high crash locations within the study area: the Main Street intersections of Dow Highway, Academy Street, and Portland Street. The MaineDOT crash diagrams for these locations are included in the Appendix and summarized below. It should be noted that the Main Street links from Academy Street to Paul Street and Portland Street to Young Street were recently high crash locations. The most recent available crash diagrams were also reviewed below.

Intersection of Main Street and Dow Highway

The intersection of Main Street and Dow Highway had ten (10) crashes and a CRF of 1.52 from 2019 to 2021. Five (5) crashes were angle collisions caused by Dow Highway vehicles failing to yield to a Main Street vehicle. Four (4) crashes were rear-end crashes on the Dow Highway approach. One (1) crash was a single-vehicle roadway departure crash caused by cell phone use. It should be noted that this intersection has been a high crash location every study period from 2012 to 2014 through 2017 to 2019.

Intersection of Main Street and Academy Street

The intersection of Main Street and Academy Street had ten (10) crashes and a CRF of 1.63 from 2019 to 2021. The ten (10) crashes included seven (7) angle collisions and three (3) rear-ends. Six (6) of the angle collisions were caused when a vehicle turning left from Academy Street failed to yield to traffic on Main Street. It should also be noted that two (2) of the crashes were attributed to vehicular action while a pedestrian was in the Main Street crosswalk. This intersection has been classified as a high crash location since the 2017 to 2019 period.

Intersection of Main Street and Portland Street

The intersection of Main Street and Portland Street had 13 crashes and a CRF of 2.08 from 2019 to 2021. The crashes include seven (7) rear-ends, five (5) angle collisions, and one (1) sideswipe when a tractor trailer made a wide turn to avoid a parked vehicle. It should be noted that this intersection has been a high crash location since the 2012 to 2014 period.

Main Street Segment between Academy Street and Paul Street

The segment of Main Street between Academy Street and Paul Street was identified as a previous high crash location from the 2006 to 2008 period to the 2009 to 2011 period and then again from 2014 to 2016 period to the 2017 to 2019 period. Given the extensive crash history, the most recent available crash diagram from 2017 to 2019 was reviewed for crash patterns. The link had nine (9) crashes and a CRF of 1.21. Three (3) crashes were rear-ends, two involving vehicles that stopped for pedestrians in the crosswalks. Three (3) crashes involved parked vehicles, one from a door swing, one due to backing into a parked vehicle, and one attributed to operating under the influence (OUI). The final three (3) crashes were a single vehicle departure from the roadway attributed to an OUI, a single vehicle overturn due to sand on the road, and a failure to yield taking a left from a commercial driveway.

Main Street Segment between Portland Street and Young Street

Similarly, the Main Street segment between Portland Street and Young Street was a previous high crash location from 2013 to 2015 through the period of 2017 to 2019. As such, the most recent available crash diagram from 2017 to 2019 was reviewed. The link had eight (8) crashes and a CRF of 2.14. One (1) crash was a rear-end involving a vehicle stopped for pedestrians in the crosswalk. The seven (7) additional crashes involved parked vehicles failing to navigate either in or out of a parking space.

Intersection Analysis

Capacity and Queue Analysis

An existing conditions model of the corridor was built to analyze conditions during the peak hour periods. Capacity analysis was performed utilizing Synchro/SimTraffic v.11 to determine the level of service (LOS) at each study area intersection. LOS is the metric utilized to determine the control delay, measured A through F, with A being optimal and F being unacceptable. The LOS and control delay for unsignalized and signalized intersections are depicted in the Highway Capacity Manual (HCM) 6 and shown in Table 6.

Level of Service (LOS)	Unsignalized Control Delay (Sec./Vehicle)	Signalized Control Delay (Sec./Vehicle)
А	≤10	≤10
В	>10-≤15	>10-≤20
С	>15-≤25	>20-≤35
D	>25-≤35	>35-≤55
E	>35-≤50	>55-≤80
F	>50	>80

Table 6 – Level of Service from Control Delay

Capacity analysis was completed utilizing the above methodologies during the AM and PM analysis periods for 2022 existing conditions. The results are summarized with the delay in seconds followed by the level of service in Table 7 for the major Main Street intersections of Dow Highway and Portland Street, as well as the minor intersection of Academy Street. The reports for the entire corridor are provided in the Appendix.

	Delay in Seconds/Vehicle (LOS)		
wovement	AM Peak Hour	PM Peak Hour	
Main Street and Dow Highway	Unsigr	nalized	
Main Street SB Left	23.9 (C)	41.9 (E)	
Dow Highway NW Left	(F)	(F)	
Dow Highway NW Right	(F)	(F)	
Overall Intersection	(F)	(F)	
Main Street and Portland Street	Unsignalized		
Main Street SB Left	9.8 (A)	(F)	
Portland Street SW Left	(F)	(F)	
Portland Street SW Right	(F)	(F)	
Overall Intersection	(F)	(F)	
Main Street and Academy Street	Unsigr	nalized	
Academy Street WB Left	(F)	(F)	
Academy Street WB Right	27.4 (D)	(F)	
Main Street NB Left	10.7 (B)	5.3 (A)	
Main Street SB Left	6.6 (A)	14.9 (B)	

Table 7 – Level of Service from Control Delay2022 Existing Conditions

As outlined above, it is evident that there are significant capacity constraints through Main Street during both peak hour periods, with the levels of traffic on Main Street significantly impacting movements to and from the major side streets. Both the intersections of Dow Highway and Portland Street are operating overall at LOS "F" during both peak hour periods. Additionally, the following movements through the study area are operating at LOS "E" or worse during either peak hour period:

- Aroma Joe's lefts (AM)
- Central School Driveway lefts and rights (AM)
- Town Hall Driveway lefts (AM and PM)
- Paul Street lefts (AM)
- Young Street lefts and rights (PM)
- Norton Street lefts and rights (PM)

A queue analysis was also completed utilizing Synchro/SimTraffic. The 95th percentile queues during the peak hours are summarized in Table 8 with queues that exceed 1,000 feet or exceed the available storage highlighted.

Movement	Length (Feet)		
wovement	Available Storage	AM Peak Hour	PM Peak Hour
Main Street and Dow Highway		Unsignalized	-
Main Street SB Left	310	339	304
Dow Highway NW Left	-	1,172	1,169
Dow Highway NW Right	360	551	678
Main Street and Portland Street	Unsignalized		-
Main Street NB Right	290	27	51
Main Street SB Left	-	198	437
Portland Street SW Left	-	1,284	1,036
Portland Street SW Right	250	424	310
Main Street and Academy Street	Unsignalized		
Academy Street WB Left	-	217	470
Academy Street WB Right	65	80	115
Main Street SB Left	45	55	43

Table 8 – 95th Percentile Queue Analysis2022 Existing Conditions

Signal Warrant Evaluation

Often mitigation efforts for failing levels of service and angle collisions at an unsignalized intersection include review for traffic signalization. The Manual on Uniform Traffic Control Devices (MUTCD) has nine (9) warrants for review to determine the need for a traffic signal. As such, these warrants were reviewed for average day volumes. Because the Town of South Berwick is an isolated community with a population of less than 10,000 people, it is appropriate to apply the 70% reduction factor to the signal warrant analysis for each location.

Warrant 1 – Eight-Hour Vehicular Volume requires that eight (8) of the 12 counted hours exceed the volume thresholds for critical movements. This warrant allows for traffic signalization if one of two conditions are met:

- Condition A Minimum Vehicular Volume: "intended for application at locations where a large volume of intersecting traffic is the principal reason to consider installing a traffic control signal."
- Condition B Interruption of Continuous Traffic: "intended for application at locations where Condition A is not satisfied and where the traffic volume on a major street is so heavy that traffic on a minor intersecting street suffers excessive delay or conflict in entering or crossing the major street."

Sebago reviewed Warrant 1 for the Main Street intersections of Dow Highway, Portland Street, and Academy Street given the failing levels of service and demonstrated crash history. Additionally, Norton Street was reviewed given the volumes, the delay for exiting Norton Street movements, and feedback from the Town and the Public. The warrant charts are provided in the Appendix and summarized in Table 9.

Table 9 – Traffic Signal Warrant 1 Results2022 Existing Volumes

Location	Major Approach	Minor Approach	Warrant Results
Main Street and Portland Street	Main Street (NB + SB)	Portland Street Lefts	Yes, Condition A
Main Street and Dow Highway	Man Street (NB)	Main Street Lefts (SB)	Yes, Condition A
Main Street and Academy Street	Main Street (NB + SB)	Academy Street Lefts + Rights ¹	No
Main Street and Norton Street	Main Street (NB + SB)	Norton Street Lefts	Yes, Condition A + B ²

¹ Rights turns are generally subtracted from this volume if there is the ability to by-pass left-turns. Academy Street is wide enough to provide by-pass for approximately 65 feet. However, given the high volume of right-turns they are likely contributing to long queues and delays on this approach and were therefore included.

² Meets 7/8 hours for Condition A, volumes are 3% short of meeting all 8 hours.

As outlined in Table 9, both Main Street intersections of Portland Street and Dow Highway meet signal warrants under existing conditions.

Norton Street meets warrants under Condition A + B which is defined in the MUTCD as "the combination of Conditions A and B is intended for application at locations where Condition A is not satisfied, and Condition B is not satisfied and should be applied only after an adequate trial of other alternatives that could cause less delay and inconvenience to traffic has failed to solve the traffic problems."

Given the results of Warrant 1 for both Norton Street and Academy Street, Warrant 2 – Four-Hour Vehicular Volume was reviewed. Both intersections meet the minimum volumes for the four-hour warrant. It should be noted that Academy Street would not meet these signal warrants if the right-turns were discounted completely from the analysis.

4.0 Summary of Alternatives

Based on the results of the existing conditions analysis and feedback from the Town and the Public, Sebago explored several iterations of proposed solutions. The corridor was modeled in Synchro/SimTraffic with over ten iterations of options to determine feasible scenarios to bring to conceptual design level. These options are provided in more detail in the Appendix.

Intersection Alternatives

The intersection alternatives focus on the major Main Street intersections of Dow Highway and Portland Street. Academy Street and Norton Street were considered for intersection implementations but ultimately not pursued conceptually.

Norton Street primarily provides access to residential and small-scale traffic generators, and the traffic patterns observed from the turning movement counts appear to be greater than generated by the uses alone. With residential uses, more traffic generally exits during the AM period and enters during the PM. Norton Street has more exiting traffic consistently throughout the 12-hour count period, with a heavy percentage turning left. It is likely that the imbalance is due to drivers attempting to bypass the long queues for left-turns on Portland Street by navigating to Norton Street. For this reason, Sebago recommends focusing on improvements at Main Street and Portland Street. If the delay for traffic on Portland Street can be minimized, it is likely there would be a reduction in vehicles using Norton Street to avoid the congested intersection.

At Academy Street, alternatives were explored for improvements as this location is a high crash location. Both signalization and roundabout treatment were reviewed as a part of the SimTraffic model. However, adding delay for Main Street movements with either of these options created queue spillback to Dow Highway and ultimately negative impacts to the network. Like Norton Street, the intersection also has a higher volume of right-turns during the PM peak hour that may be bypass longer queues at Dow Highway. The volumes do not signify as obvious of a bypass correlation as Norton Street, but it is possible some percentage of vehicles may relocate after improvements at Dow Highway. For these reasons, Sebago recommends focusing on improvements at Dow Highway and Main Street to understand if overarching corridor improvements have positive results on the intersection.

Traffic Signals – Alternative 1

Two alternatives for signalization were reviewed for 2022 existing volumes. These volumes include an assumption of approximately 75% of Norton Street cut through traffic relocating, as shown in Figure 5 in the Appendix. It should be noted that no Academy Street traffic was relocated given the less obvious bypass correlation.

The first alternative focused on analysis to signalize both Main Street intersections of Portland Street and Dow Highway, retaining the existing lane uses. The traffic signals were modeled as a coordinated signal system, which is defined as signal timing that synchronizes traffic movements and manages the progression speed where uninterrupted flow is desired along a corridor (in this case Main Street). The capacity results are summarized in Table 10.

Mourant	Delay (LOS)		
wovement	AM Peak Hour	PM Peak Hour	
Main Street and Dow Highway	Signo	alized	
Main Street NB Thru	32.3 (C)	37.2 (D)	
Main Street NB Right	26.0 (C)	36.6 (D)	
Main Street SB Left	17.4 (B)	20.1 (C)	
Main Street SB Thru	2.6 (A)	5.6 (A)	
Dow Highway NW Left	42.0 (D)	53.4 (D)	
Dow Highway NW Right	12.6 (B)	37.8 (D)	
Overall Intersection	17.8 (B)	32.2 (C)	
Main Street and Portland Street	Signalized		
Main Street NB Thru	7.0 (A)	7.2 (A)	
Main Street NB Right	1.1 (A)	1.5 (A)	
Main Street SB Left	44.2 (D)	297.7 (F)	
Main Street SB Thru	29.1 (C)	249.5 (F)	
Portland Street SW Left	67.1 (E)	37.2 (D)	
Portland Street SW Right	24.9 (D)	11.8 (B)	
Overall Intersection	29.0 (D)	38.7 (D)	

Table 10 – Level of Service from Control DelaySignalization with Existing Geometry – 2022 Existing Volumes

The signalization of the two intersections, retaining the existing lane uses demonstrated overall intersection improvements during the AM and PM peak hour periods. At Portland Street, Main Street is failing during the PM peak hour as left-turn traffic is continually blocking through traffic. During the AM period, Portland Street lefts are operating at LOS "E." At Dow Highway, many movements are operating at LOS "D". These results signify that this alternative would provide improvements in the short-term to the majority of the movements, but likely would not provide long-term improvements if traffic volumes continue to increase.

Traffic Signals – Alternative 2

The second alternative reviewed opportunities to implement additional capacity at the intersection by adding auxiliary turn lanes. The National Cooperative Highway Research Program (NCHRP) *Report 457 – Evaluating Intersection Improvements* was reviewed for lane addition recommendations based on volume thresholds. The following guidance is provided:

- Add an exclusive left-turn lane when lefts exceed 100 vehicles per hour and the opposing and adjacent through movements exceed 450 vehicles per hour.
- Dual left-turn lanes if the volume exceeds 300 vehicles per hour.
- Exclusive right-turn lane when rights exceed 300 vehicles per hour and adjacent through movement exceeds 300 vehicles per hour.

Based on the above guidance, a left-turn lane for southbound Main Street at Portland Street would be recommended as well as dual left-turn lanes southbound at Dow Highway. To accomplish a dual left-turn, an additional receiving lane on Dow Highway would be required to allow for two lanes of left-turning traffic. Additionally, a right-turn lane was added northbound at Dow Highway. Although the right-turn volume does not surpass the thresholds, the addition of a right-turn lane provides improvements for the overall intersection and approach levels of service. The capacity results for this alternative are summarized in Table 11.

	Delay (LOS)	
Movement	AM Peak Hour	PM Peak Hour
Main Street and Dow Highway	Signalized	
Main Street NB Thru	30.9 (C)	27.1 (C)
Main Street NB Right	9.6 (A)	9.8 (A)
Main Street SB Left	19.8 (B)	24.7 (C)
Main Street SB Thru	24.0 (C)	31.1 (C)
Dow Highway NW Left	32.0 (C)	35.0 (C)
Dow Highway NW Right	12.0 (B)	22.8 (C)
Overall Intersection	20.3 (C)	25.0 (C)
Main Street and Portland Street	Signalized	
Main Street NB Thru	15.7 (B)	13.1 (B)
Main Street NB Right	1.9 (A)	3.5 (A)
Main Street SB Left	26.9 (C)	31.3 (C)
Main Street SB Thru	20.8 (C)	8.4 (A)
Portland Street SW Left	28.3 (C)	29.1 (C)
Portland Street SW Right	6.4 (A)	8.8 (A)
Overall Intersection	17.0 (B)	12.6 (B)

Table 11 – Level of Service from Control DelaySignalization with Proposed Geometry – 2022 Existing Volumes

This alternative provides significant improvement with all movements operating at LOS "C" or better. At the intersection of Main Street and Portland Street, a 150-foot left-turn lane for southbound Main Street improves the operational performance of the intersection from LOS "D" to LOS "B" during both peak periods.

At Main Street and Dow Highway, the overall intersection operations are similar between alternatives. However, this option provides greater capacity improving all movements to LOS "C" or better during both peak hour periods. The addition of the dual left-turn lanes also minimizes the potential for queue spillback to extend to Academy Street. With overall better operations at the intersection, movements are serviced more often, reducing the necessary storage length for the Dow Highway approach from 360 feet to 200 feet.

While these implementations offer solutions to the two major intersections, it should be noted that the other intersections and driveways through the corridor still experience capacity constraints.

Roundabouts

In addition to signalization, roundabouts were also evaluated as potential intersection solutions. Planning level design criteria for roundabouts was reviewed from the NCHRP 672 Report – *Roundabouts*. To determine the required roundabout size at each intersection the following criteria was noted:

- The threshold for one lane entry is 1,000 vehicles per hour on an approach with 1,000 to 1,300 vehicles potentially warranting two-lane entry.
- The typical inscribed diameter for a single-lane roundabout is 90 to 180 feet. To accommodate large tractor trailer trucks (classified as WB-67 by the Federal Highway Administration) diameters are recommended in the range of 130 to 180 feet.

Given the possible right-of-way constraints with building faces and historical properties, it was assumed a single lane roundabout was likely the most feasible. Based on a review of the volumes, this is marginally feasible, with northbound Main Street at Portland Street requiring a two-lane approach. The analysis of the lane requirements and thresholds is provided in the Appendix and the capacity results are summarized in Table 12.

Mourant	Delay (LOS)	
Movement	AM Peak Hour	PM Peak Hour
Main Street and Dow Highway	Roundabout	
Main St NB Thru	12.8 (B)	57.3 (F)
Main St NB Right	12.3 (B)	60.3 (F)
Main St SB Left	7.3 (A)	3.1 (A)
Main St SB Thru	7.2 (A)	3.2 (A)
Dow Highway NW Left	4.9 (A)	43.4 (E)
Dow Highway NW Right	4.8 (A)	41.1 (E)
Overall Intersection	8.0 (A)	35.2 (E)
Main Street and Portland Street	Roundabout	
Main St NB Thru	1.2 (A)	2.2 (A)
Main St NB Right	1.2 (A)	1.3 (A)
Main St SB Left	13.4 (B)	3.5 (A)
Main St SB Thru	12.3 (B)	3.6 (A)
Portland St SW Left	9.7 (A)	6.5 (A)
Portland St SW Right	9.5 (A)	6.5 (A)
Overall Intersection	7.2 (A)	3.1 (A)

Table 12 – Level of Service from Control DelayRoundabout Analysis – 2022 Existing Volumes

At the intersection of Main Street and Portland Street, the analysis showed significantly improved operations with all movements at LOS "B" or better. Given the results. a Concept Plan, which is attached to this report and included in the Technical Appendix, was developed to determine the feasibility. A single-lane roundabout with a northbound dual entry approach was determined to be feasible with an inscribed diameter of 124 feet. The provided inscribed diameter is less than the 130-

Roundabout concept at the intersection of Main Street and Portland Street.

foot minimum listed previously for planning purposes, as the existing geometry of the intersection approaches allow a lesser diameter while still accommodating WB-67 movements. It should be noted that the northbound approach angle is considered substandard, and the crosswalks would need to be moved further away from the intersection in some instances to accommodate truck movements.

At the intersection of Main Street and Dow Highway, some movements were operating at LOS "E" with the intersection at LOS "F" overall, as also confirmed by the 6th edition of HCM's roundabout capacity methodology. Similarly, a Concept Plan for a single-lane roundabout was

Roundabout concept at the intersection of Main Street and Dow Highway.

developed to determine if a multi-lane roundabout was feasible to pursue. The inscribed diameter required for a single lane roundabout would likely require right-of-way impacts. As such, a two-lane roundabout was determined to be infeasible and not pursued further from a capacity of conceptual level.

Corridor Considerations

Additional review of the entire corridor was completed to compile recommendations for access management, pedestrian improvements, parking, and traffic calming. The Concept Plans, which are attached to this report and provided in the Technical Appendix, outline those considerations.

Access Management

Access management is the strategy of reducing conflict points by means of reducing driveway widths, the number of driveways, and the spacing of driveways. Considerations provided align with the MaineDOT's *Chapter 299 Highway Driveway and Entrance Rules* as follows:

- Reducing parcel driveways to one full movement, or two with one-way flow. Driveways should be between 22 feet and 30 feet for two-way flow.
- Corner clearance should be 100 feet from an unsignalized intersection and 125 feet from a signalized intersection.
- Sharing access points when practical.
- Removing the Main Street access on corner parcels that have access to a side street.

A recommendation of the previous report was to provide access management for the Central Elementary School, which currently has access along Main Street in the area with the highest traffic volumes. A backdoor access to Young Street was proposed via vacant land adjacent to the library. This was not completed, and new development has since occurred on the previously identified land. To revisit this possibility, right-ofway impacts would be required on an undeveloped portion of the parcel referred to as Map 028/Lot 027.

Sebago also reviewed opportunities for connection to Central Street to the south. Upon further investigation, Central Street is a privately owned way. This connection would require right-of-way impacts on an undeveloped portion of the parcel referred to as Map 028/Lot 081.

South Berwick parcel maps showing parcels adjacent to the Central Elementary School that would be impacted to create a backdoor access for the school to either Young Street or Central Street.

Traffic Calming

A theme that was consistently heard from the public was the need for traffic calming through the corridor. Alternatives were reviewed with a focus on the area between Academy Street and Portland Street. The first alternative aimed to reduce the amount of pavement by means of a "road diet." It was determined that the two-way left turn-lane (TWLTL) should be retained for safety and mobility to provide left-turning traffic a location to wait while completing a left-turn into the numerous properties and side streets. The TWLTL also provides the opportunity for a two-stage exit for vehicles taking a left from the driveways in this area. To provide pavement reduction strategies without removing the TWLTL, a provided alternative removes the on-street parking. The space is reallocated as esplanade that could be utilized for street trees or pedestrian scale lighting.

Alternative to remove on-street parking and reallocate the space to esplanade. The Town could consider landscaping or lighting opportunities within the esplanade.

An option that was discussed with the Town was providing a raised median island along Main Street, replacing the two-way left-turn lane between Academy Street and Portland Street. In reviewing left-turn movements through this section, many of them operate at LOS "E" or LOS "F" due to the high volumes of traffic on Main Street during the peak hours. A raised island would restrict movements to rights in and out only and would also serve as traffic calming. Given the existing Central Elementary School access, it was determined this option should not be pursued.

Pedestrian Accommodations

The Concept Plans outline sidewalk reconstruction efforts throughout the corridor to accommodate shifting curb lines and upgrades to the Americans with Disabilities Act (ADA) standards. The corridor has existing infrastructure on both sides of Main Street, aside from a short segment on the east side between Dow Highway and Academy Street. It is recommended this section be added to provide additional connectivity from Academy Street to Dow Highway, providing the opportunity for pedestrians to continue south without the need to cross Main Street.

Depending on the alternative outlined in the Concept Plans, crosswalk locations are outlined as follows:

- An existing crosswalk south of Dow Highway is proposed to be retained. This would be a signalized crossing if a signal is installed at this intersection.
- An existing crosswalk south of Academy Street was removed in the Dow Highway signalized condition. Based on the counts, this does not appear to be a highly utilized crosswalk and contributed to a crash history at the intersection. Pedestrians southbound could continue along a newly installed sidewalk and cross via a controlled crosswalk at Dow Highway. Alternatively, pedestrians can continue north and cross via the retained mid-block crosswalk with RRFBs.
- The existing mid-block crosswalk at the Central Elementary School was retained. The RRFBs should be upgraded to current standards. If on-street parking is retained in this area, the Concept Plans show curb extensions to provide greater pedestrian visibility and a shorter crossing distance. It should be noted that curb extensions are also recommended as a traffic calming implementation.
- All crosswalks at Portland Street are retained. These would all be signalized crossings if a signal is installed at this intersection.
- The existing mid-block crossing at the post office was removed. If the proposed access management at the post office is completed and the crosswalk removed, additional accommodations for on-street parking can be completed.
- The existing Norton Street crosswalk was retained to the north of the intersection with proposed curb extensions to provide visibility around the on-street parking and act as traffic calming as vehicles enter the downtown. It is recommended this crosswalk be outfitted with RRFBs.

Conceptual crosswalk option at Norton Street with curb extensions that would provide traffic calming to vehicular traffic entering the downtown.

On-Street Parking

MaineDOT provides design guidance for on-street parking. This guidance outlines parking restrictions within 20 feet of a crosswalk (unless curb extensions are provided), within 25 feet of an intersection, or within 10 feet of a driveway. As such, the Concept Plans demonstrate locations where parking may remain based on this guidance. Additionally, an alternative from Academy Street to Portland Street shows an option to retain the on-street parking through this section as opposed to the previously discussed road diet option.

Conceptual option to retain on-street parking were available from Academy Street to Portland Street.

One opportunity for additional on-street parking is the conversion of Paul Street to one-way only in the easterly direction. Paul Street is located just 80 feet south of where the stop bar would be located if the intersection of Main Street and Portland Street is signalized. Vehicles exiting Paul Street may often be blocked by the queue from the signalized condition and often may choose an alternative route. Additionally, the intersection will be located within MaineDOT's corner clearance recommendation of 125 feet from a signalized intersection. Given the proximity to the downtown businesses, Paul Street may be an opportunity to provide additional downtown parking.

5.0 Recommended Alternative

Based on the previous discussions, it is Sebago's professional opinion that the Town should pursue signalization with the implementation of new auxiliary turn lanes at the Main Street intersections of Dow Highway and Portland Street.

Although the roundabout at Main Street and Portland Street works from an operational perspective under 2022 conditions, the single lane roundabout does not provide significant reserve capacity to accommodate future growth in traffic volumes. A two-lane roundabout at either intersection is not feasible due to geometric and space constraints.

Analysis of signalization at both Portland Street and Dow Highway demonstrate available capacity under 2022 conditions. Additionally, signalization provides the greatest flexibility, by means of both retiming the signals as traffic patterns grow and change, and by also coordinating the two signals to optimize platooning traffic through the corridor. It is also important to note that traffic signalization allows the implementation of emergency vehicle pre-emption technology.

Concept Plan to signalize the intersection of Main Street and Portland Street.

With emergency services located in close proximity to Norton Street, this will allow prioritization of emergency vehicles through the corridor.

The signalization of both Portland Street and Dow Highway will also provide pedestrian phases with vehicular traffic stopped, providing more protection than under the free-flowing or roundabout conditions.

Concept Plan to signalize the intersection of Main Street and Dow Highway.

Future Volume Analysis

The recommended alternative for the intersections was reviewed for future conditions to determine long-term capacity and determine queue lengths for storage lanes. As discussed in Section 3, the corridor saw long-term growth of approximately 0.5% annually. This rate was utilized to project the 2022 volumes to 2042 future conditions. The 2042 volumes are shown in Figure 6 in the Appendix. Based on these volumes, the corridor timings were reevaluated, resulting in the capacity analysis results shown in Table 13 and 95th percentile queue results in Table 14.

Table 13 – Level of Service from Control DelaySignalization with Proposed Geometry – 2042 Future Volumes

Movement	Delay (LOS)		
wovement	AM Peak Hour	PM Peak Hour	
Main Street and Dow Highway	Signalized		
Main Street NB Thru	30.2 (C)	46.0 (D)	
Main Street NB Right	9.3 (A)	26.4 (C)	
Main Street SB Left	29.7 (C)	31.0 (C)	
Main Street SB Thru	34.9 (C)	42.7 (D)	
Dow Highway NW Left	30.0 (C)	37.9 (D)	
Dow Highway NW Right	15.3 (B)	30.1 (C)	
Overall Intersection	25.8 (C) 36.4 (D)		
Main Street and Portland Street	Signalized		
Main Street NB Thru	15.6 (B)	13.3 (B)	
Main St NB Right	2.2 (A)	4.0 (A)	
Main Street SB Left	34.5 (C)	35.9 (D)	
Main Street SB Thru	33.1 (C)	11.1 (B)	
Portland Street SW Left	40.1 (D)	31.3 (C)	
Portland Street SW Right	15.3 (B)	10.5 (B)	
Overall Intersection	24.3 (C)	13.9 (B)	

Table 14 – 95th Percentile Queue AnalysisSignalization with Proposed Geometry – 2042 Future Volumes

Movement	Length (Feet)		
wovement	Available Storage	AM Peak Hour	PM Peak Hour
Main Street and Dow Highway	Signalized		
Main Street NB Thru	-	330	784
Main Street NB Right	200	195	297
Main Street SB Left	320	347	254
Main Street SB Left/Thru	-	356	309
Dow Highway NW Left	150	132	212
Dow Highway NW Right	-	319	492
Main Street and Portland Street	Signalized		
Main Street NB Thru	-	120	110
Main Street NB Right	290	106	124
Main Street SB Left	150	162	149
Main Street SB Thru	-	410	192
Portland Street SW Left	-	647	322
Portland Street SW Right	175	132	144

Environmental Impacts

As requested at the Public Meeting, before and after emissions were reviewed for the existing conditions and the recommended proposed condition. SimTraffic reports were utilized to obtain the data for fuel consumption and carbon monoxide (CO) emissions and the results are shown for the peak hours in Table 15. SimTraffic utilizes a fuel consumption-based emissions model where the rates for grams of emissions per gallon of fuel consumed are based on research completed by Oak Ridge Nation Labs for the FHWA in 1999. The estimation model for fuel consumption utilizes the total travel distance, total delay, and number of stops for each vehicle within each simulation and is based on research completed by the McTrans Center at the University of Florida in 2010.

Measurement	Existing Peak Hour	Proposed Peak Hour
AM Fuel Use (gal)	78.6	55.4 (-30.8%)
PM Fuel Use (gal)	128.1	59.2 (-68.9%)
AM CO Emissions (g)	19,757	16,809 (-14.9%)
PM CO Emissions (g)	15,534	13,019 (-16.2%)

While the proposed signalization demonstrates an improvement through the corridor, it should be noted that the results in the table above represent only the peak hour of traffic and not an entire day. Typically, a signalized intersection is less environmentally friendly than an unsignalized intersection when the unsignalized intersection is operating at reasonable levels of service. Given the existing conditions model was oversaturated during the peak hours, there is likely an overestimation in the level of improvement between the existing and proposed values.

Opinion of Cost

Planning level construction costs for the recommended intersection improvements have been estimated in 2023 dollars. Both alternatives provided between Academy Street and Portland Street have also been estimated for the Town's consideration. The estimate spreadsheets are included in the Appendix and summarized in Table 16. It should be noted that the estimates provided are construction costs and do not include any preliminary engineering, construction engineering, or right-of-way related costs.

	Alternative	Cost Estimate (2023 Dollars)
Α	Intersection of Main Street and Dow Highway	\$1,200,000.00
В	Intersection of Main Street and Portland Street	\$1,300,000.00
С	Between Academy Street and Portland Street – Option 1	\$625,000.00
D	Between Academy Street and Portland Street – Option 2	\$750,000.00
	Approximate Preliminary Cost (A + B + C)	\$3,125,000.00
	Approximate Preliminary Cost (A + B + D)	\$3,250,000.00

6.0 Summary and Conclusions

Sebago Technics has completed an analysis of the Main Street (Route 236) corridor from Dow Highway to Norton Street. Several alternatives for the corridor were reviewed, with primary focus on the Main Street intersections of Portland Street and Dow Highway. Both intersections have long-standing capacity constraints and safety deficiencies and have been previously acknowledged for the need for traffic signalization. Other intersections and access points within the study area are also challenged with capacity constraints due to the volume of traffic that travels daily through the corridor.

Traffic analysis and Concept Plans were completed to determine the most feasible improvements that provide long-term benefit to the corridor. Both traffic signalization and roundabout treatments were evaluated at the two major intersections. Although the roundabout at Main Street and Portland Street works from an operational perspective, a single lane roundabout does not provide significant reserve capacity to accommodate future growth in traffic volumes. A two-lane roundabout at either intersection is not feasible due to geometric and space constraints.

Traffic signalization at these intersections also provides the greatest flexibility, by means of both the ability to retime the signals as traffic patterns grow and change, and by also coordinating the two signals to provide optimization of the platooning traffic through the corridor. It should also be noted that at the intersection of Main Street and Portland Street, signalization allows for the retainage of greater amounts of parking for southbound Main Street in the vicinity of the businesses.

At the intersection of Main Street and Dow Highway, it is recommended to modify the intersection to include a shared left-turn and through lane on the southbound approach, allowing for dual left-turns onto Dow Highway. On the northbound approach, construct a through lane and dedicated right-turn lane with 150 feet of storage. At the intersection of Main Street and Portland Street, it is recommended to retain the northbound through lane and dedicated right-turn lane and construct a through lane and dedicated left-turn lane with approximately 150 feet of storage.

The improvements at these two intersections are likely to provide long-term improvements and have greater impacts to this area of South Berwick, as mitigating the existing long delays for Portland Street and Dow Highway should reduce diverted traffic through the local neighborhoods attempting to bypass long queues. Because of that, it is recommended to allow for traffic volumes to re-balance at the intersections of Norton Street and Academy Street. These intersections were also reviewed for potential improvements as a part of this study, however it is Sebago's opinion that mitigating the existing deficiencies at the two major intersections will have positive impacts on diverted traffic to these intersections.

Throughout the remainder of the corridor, Concept Plans were developed with a focus towards access management and pedestrian connectivity. Between Dow Highway and Portland Street, two alternatives were provided: one that reduces pavement widths by removing parking and reallocating space for an esplanade with lighting and street trees, or a second that retains the on-street parking where available.

From a pedestrian connectivity standpoint, the corridor is well equipped with existing infrastructure on both sides of Main Street, aside from a short segment on the east side between Dow Highway and Academy Street. It is recommended to install a new sidewalk through this area to facilitate additional pedestrian connectivity. The plans are inclusive of this new section and provide planning level costs to reconstruct the existing facilities to upgrade to Americans with Disabilities Act (ADA) standards.

It is recommended to relocate curb lines and reconstruct sidewalk as feasible throughout the study area to seek opportunities for shortened crosswalks, additional pedestrian visibility, and for traffic calming purposes. Additionally, it is recommended to pursue access management opportunities between Academy Street and Portland Street and between Portland Street and Norton Street. Reducing the number and width of the existing access points will aid in reducing conflict points not only between vehicles but also between vehicles and pedestrians.

Finally, the Concept Plans outline the recommended crosswalk locations. It was determined that signalization of the Main Street intersections of Portland Street and Dow Highway was also more advantageous than the roundabout options. With the implementation of the roundabout, the crosswalks had to be pushed further away from the intersection and many of the refuge areas were required to be mountable to accommodate large truck movements. Signalization allows a pedestrian phase to operate with vehicles stopped, as opposed to yielding within the roundabout alterative. At the crosswalks located at unsignalized locations, Rectangular Rapid Flashing Beacons are recommended, assuring that all crosswalks within the study area have additional treatments to provide added visibility for pedestrians.

Attachments

Concept Plans

