

Memorandum

11337-02

To: Tex Haeuser, Director of Planning, City of South Portland

From: Curtis Thompson, EI, Transportation Engineer, Sebago Technics
Steve Sawyer, P.E., Senior Vice President of Transportation Services, Sebago Technics

Date: November 20th, 2018

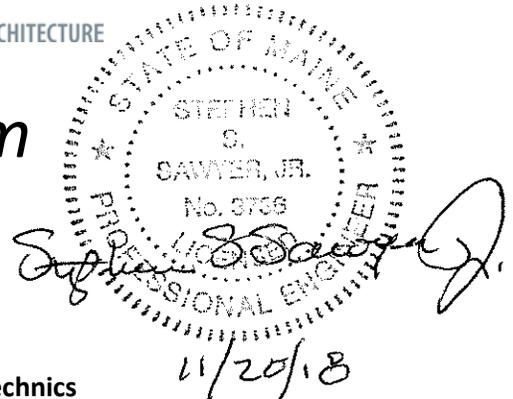
Subject: Broadway at South Kelsey St. and Broadway at Hill St. Safety Study

The following memo details our evaluation of the intersections of Broadway at Hill Street and Hoyt Street and Broadway at South Kelsey Street in South Portland. It is our understanding that a number of residents of the area have expressed concerns relating to pedestrian and vehicular safety at these intersections. The following sections detail the existing conditions based on traffic volumes collected at the intersections, an overview of the three year crash history, and a summary of various traffic calming and pedestrian safety improvements for your consideration.

Existing Conditions

In general Broadway is relatively straight and flat in the proximity of the intersection leading to sight distances beyond the minimum requirements. Broadway is considered to be a minor arterial by the Maine DOT and is considered the primary way of travel east and west through South Portland. There are 12 foot travel lanes in each direction and the eastbound shoulder is approximately 8 feet wide to allow for parking where the westbound shoulder is only 7 feet and parking is not permitted. The posted speed is 30 miles per hour.

Broadway at this location has an Average Annual Daily Traffic of roughly 13,500 vehicles which is significant for a two lane roadway. Traffic movement counts were collected on October 30th 2018 at the intersections during the AM and PM peak hours and when Kaler School releases and the count summary is attached.



The three year (2015-2017) crash history was requested from the Maine Department of Transportation; the summary is attached and is outlined in Table 1 below. Overall, none of the intersections or segments were considered to be High Crash Locations by the Maine Department of Transportation. In general most of the crashes appeared to be caused by eastbound congestion along Broadway likely due to the various construction projects over the last few years. From the crash data it is evident that drivers are not expecting to stop. The existing signal at Elm Street with side mounted post-top signals is not very visible from either direction and may also be adding to the issue. A new signal is being installed as part of the ongoing sewer project and this new signal will have mast arms that will allow the signal heads to be positioned over the lanes for increased visibility.

Table 1: Three Year Crash History

Intersections

Node	Description	# of Crashes	CRF	HCL
P14665	Broadway & Hill St	4	0.64	No
A14666	Broadway & Hoyt St	0	0	No
14443	Broadway & S. Kelsey St	6	0.97	No

Roadway Segments

Link	Description	# of Crashes	CRF	HCL
14664-14665	Broadway – Cole St to Hill St	2	0.54	No
14665-14666	Broadway – Hill St to Hoyt St	1	0.42	No
14666-14443	Broadway – Hoyt St to S Kelsey St	4	1.05	No
14443-66204	Broadway – S Kelsey St to Valley St	4	0.78	No

Traffic Calming and Pedestrian Visibility

The following are possible traffic calming and pedestrian visibility improvements were suggested by the Bike-Ped Committee;

- Dynamic Speed Feedback Signs
- Adding Additional Rectangular Rapid Flashing Beacon Signs
- Adding Safety Signage Along Broadway
- Adding Roadway Paint to Better Warn Drivers
- Installing Speed Tables at Crosswalks.

Each improvement is described in greater detail in the following Sections and those that we believe are viable are included on the attached concepts plan.

Dynamic Speed Feedback Signs

Dynamic speed feedback signs alert traffic when their speeds exceed the posted limit and are typically installed in locations where the speed limits change significantly or in neighborhood streets that are used for a cut through and have been proven to noticeably reduce the amount of vehicles traveling above the speed limit. Due to the straight and flat geometry on Broadway and the wide shoulders, it is likely that the natural free flow speed on Broadway is greater than the posted speed. Dynamic Speed Feedback Signs could be installed in place of the existing speed limit sign located on Broadway northbound opposite Cole Street and near the existing School Zone warning flasher southbound north of South Kelsey Street.



Rectangular Rapid Flashing Beacon Signs

Rectangular Rapid Flashing Beacon signs, commonly known as RRFBs, are proven to improve pedestrian visibility and greatly increase motorist yield rates at a crosswalk. They are commonly only installed for the crosswalks crossing the major roadway in order to limit sign pollution and to keep the signs impactful to motorists. Currently the crosswalk at South Kelsey Street is supplemented by RRFBs and is the only official crossing under existing conditions where RRFBs would be typically recommended.



Additional Signage and Roadway Markings

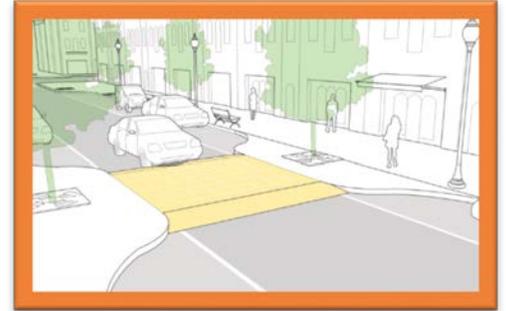
The existing signage in the study area is mostly centered on supporting the crosswalk at South Kelsey Street, including the RRFB pedestrian crossing signs and "stop for pedestrians in crosswalk" signs mounted on bus stop signs near the intersection. Additional pedestrian crossing warning signs with the "ahead" plaque could be added 200' north and south of the crosswalk on Broadway to give drivers an advanced warning of the upcoming crosswalk. Further yield triangles could be painted 20' north and south of the crosswalk with "yield here for pedestrian" signs replacing the existing "stop for pedestrians in crosswalk" signs.



The parking on the west side of Broadway could be painted which would give the effect of visually obstructing the shoulder making the road feel narrower, in turn reducing travel speeds.

Speed Tables

Speed tables reduce speeds by forcing traffic to significantly slow their speed in order to safely navigate the speed table. In general speed tables are found on low volume residential roads or within school campuses or parking lots to manage speeds. The Maine Department of Transportation has Guidelines for the use of traffic calming devices. In summary, the guidelines for minor arterials states that the prime function of the arterial is to provide mobility for transportation system users and that traffic calming on minor arterials should not be considered unless it can be shown that the 85th percentile speed is greater than 10 miles per hour over the posted and that other remediation hasn't shown improvement in speed compliance. In our opinion, speed tables should not be installed at this locations because of the congestion related crash history in this segment of Broadway and the high importance of mobility.



Other Possible Improvements

The inclusion of curb extensions at the South Kelsey Street intersection would reduce the shoulder down to 4 feet in each direction, which will still comfortably allow bicycle traffic to pass the extension. This will reduce the total pedestrian crossing distance by roughly 7 feet and allow the existing RRFBs to be relocated closer to the travel lane increasing their overall effectiveness. The reduction in shoulder width at the South Kelsey Street intersection will also reduce the free flow speed on Broadway. Additionally, the extensions will allow for even greater sight distance on the north side of Broadway, where on-street parking is allowed. Curb extensions at each intersection are shown on the attached concept plans and were designed based on the turning templates for a large school bus when appropriate.

The sidewalk on the southern side of Broadway is not continuous between Hoyt Street and the parking lot of T.A. Napolitano. There appears to be adequate right of way on this side of the road and there are signs of pedestrian traffic along the curb which is supported by the pedestrian volumes observed during the traffic counts.

Additionally, a crosswalk location should be considered at the Cole Street intersection as a pedestrian was hit at this location and this location is a natural crossing for the neighborhood supported by Cole Street for pedestrians heading to and from either Campbell's Market or the Kaler School. The proposed crosswalk would connect into the sidewalk mentioned previously connecting Hoyt Street to the T.A. Napolitano parking lot and could be supplemented by curb extensions and RRFBs.

Traffic Signal Warrant Analysis

The existing traffic volumes at the intersection of Broadway at Hill Street and Hoyt Street and the intersection of Broadway and South Kelsey Street were compared to the requirements for the Traffic Signal Warrants defined in the 2009 Manual on Uniform Traffic Control Devices (MUTCD). Overall there are 9 warrants in total and they are listed below:

1. Eight-Hour Vehicular Volume
2. Four-Hour Vehicular Volume
3. Peak Hour Vehicular Volume
4. Pedestrian Volume
5. School Crossing
6. Coordinated Signal System
7. Crash Experience
8. Roadway Network
9. Intersection near a Grade Crossing

A detailed summary of the requirements and calculations required for each signal warrant at both intersections is attached at the end of this memo.

The hourly volumes at each intersection were inputted into the eight-hour, four-hour, and peak hour vehicle volume warrants (Warrants 1, 2, and 3, respectively) to determine if the volumes were greater than the required minimums. It was determined using MaineDOT Weekly Group Mean Factors that the traffic volumes counted on Broadway are roughly 9% greater than the traffic expected on the average day, as such the counted volumes were reduced appropriately.

Warrant 1 has three conditions and only one needs to be met to satisfy the warrant. Condition A checks to see if the greater minor approach volume is large enough to meet the warrant without significant major approach volumes. To meet Condition A the higher volume minor approach is required to have greater than 150 vehicles in an hour. Condition B considers the volumes on the major street approaches to determine if there is opportunity for minor street traffic to enter the major street. This condition requires the major approaches to have a combined volume of 750 vehicles and at least 75 vehicles on the higher volume minor approach. Condition AB is a combination of the previous two with reduced requirements, 600 vehicles per hour on the major street and 120 vehicles per hour on the higher volume minor approach. None of the hours counted at the Hill Street and Hoyt Street intersection met the minimum requirements under any of the conditions, thus Warrant 1 was not met. At the South Kelsey intersection the two AM hours both met condition B, however the other four hours counted did not meet any of the requirements and thus Warrant 1 was not met. It is worth noting that at both intersections Broadway has more than enough existing traffic to meet the requirements for any of the conditions of Warrant 1, as such any increase in Broadway traffic will not change the outcome of the analysis.

Warrant 2 checks to see if the traffic during 4 hours of the day are high enough to consider a signal. This warrant's requirements are based on a roughly linear relationship between the major and minor approaches. The warrant requires four of the hourly volume points to be above the plotted line (this chart can be seen in the attached warrant summary). None of the counted hours were above the requirements at either intersection, and thus Warrant 2 was not met.

Warrant 3 evaluates the peak hour and is typically applied to intersections near large office complexes, manufacturing plants, industrial complexes, or other high-occupancy vehicle facilities that attract or

discharge large numbers over a short time. Warrant 3 utilizes a near linear relationship between the major and minor approaches like Warrant 2. Neither intersection's peak hour met the minimum volume requirements for Warrant 3.

Warrant 5 evaluates the need of a traffic signal based on the presence of school children. The warrant requires there to be a minimum of 20 schoolchildren crossing the major roadway during the highest crossing hour and that there is not an adequate gap in traffic per minute that the school children are using the crossing. Only 15 pedestrians were counted between 7:30 AM and 8:30 AM, thus the requirement of 20 schoolchildren was not met. It is worth noting that it is generally not recommended to install a traffic signal if an intersection meets Warrant 5 alone before considering other remedial measures, which there is already a crossing guard present at the intersection during the school peak hours and RRFBs.

All the remaining Warrants were not applicable to either intersection and a brief summary of the results are shown in the Table 1 below:

Table 1: Warrant Summary

Warrant 4: Pedestrian Volume	< 100 Pedestrians/Hour
Warrant 6: Coordinated Signal	Not Within Coordinated System
Warrant 7: Crash Experience	< 5 Correctable Crashes in 12 Month Period
Warrant 8: Roadway Network	Not at Crossing of Two Major Routes
Warrant 9: Railroad Crossing	Not Adjacent to Rail Crossing

As can be seen neither intersection was close to meeting the minimum requirements for the traffic signal warrants defined in the MUTCD. As such, a traffic signal is not recommended at either location.

Broadway at Hill Street Concept Alternatives

The existing intersection between Broadway and Hill Street is at a flat angle that is less than 15 degrees and Hill Street is yield controlled. Due to the angle some of the traffic movements both into and out of Hill Street can be made at higher speeds leading to safety concerns. We have evaluated a few different alternative designs for the intersection including relocating a portion of Hill Street so that the intersection is in line with Cole Street and moving the intersection roughly midway between its existing location and Cole Street to create an off-set “T” intersection.

The first alternative we explored was moving the Hill Street intersection to the Cole Street intersection and the concept layout is shown on the attached Alternative 1 Sheet. In summary, we extended Cole Street to Hill Street and then ended Hill Street just north of the last driveway. Although this alternative seemed to be the intuitive location for the Hill Street intersection, it was found that there were a number of design issues and concerns with the new layout. The issues and concerns are briefly described below.

- The utility pole that is located opposite Cole Street is both in line with the transmission lines on the east side of Broadway and also serves as the guy pole for the transmission lines on Cole Street and as such cannot easily be moved, which limits the location of the Cole Street extension. Additionally there appears that there is not enough width to construct the extension between the utility pole and a nearby tree
- A large amount of right of way will need to be acquired due to the extension’s location based on property lines retrieved from the City’s GIS system.
- It is unlikely that there will be significant traffic volume crossing Broadway from Cole Street to the extension, reducing the benefits of this location.
- Due to the utility pole mentioned above, the curb radius is limited on the north side of the Cole Street extension which will make it difficult for larger vehicles such as school busses to make the right turn from the extension without encroaching the Broadway southbound lane. Hill Street is signed at both ends with “no thru truck” signs, however based on our traffic counts it does appear that the school busses utilize Hill Street.

To mitigate the issues mentioned above we explored off-setting the Hill Street “T” intersection from Cole Street and converting the intersection to stop controlled. The concept layout for this alternative is shown on the attached Alternative 2 Sheet. This design increases the angle between Broadway and Hill Street to roughly 75 degrees greatly increasing sight distance to the south and limiting speeds for turning traffic. There is also a significant reduction in the required right of way and the only major impact is a flag pole.

Both of the above alternatives would allow for the pavement in front of Campbell’s Market to be rebuilt to both better define the Hoyt Street intersection and to create a safe location for pedestrians to travel along Broadway. The attached concept plan shows a possible layout for a raised sidewalk and the accommodations for a formal parking spot on Broadway.

Conclusions

The attached Concept Plan summarizes the proposed improvements to the Broadway intersections at Hill Street, Hoyt Street, and South Kelsey Street. Overall the largest change is the relocation of the Hill Street intersection which creates separation between Hill Street and Hoyt Street, steepens the angle between Broadway and Hill Street to 75 degrees greatly increasing sight distance, and lowers speeds for turning vehicles. The recommended pedestrian improvements include connecting the sidewalk at Hoyt Street to the sidewalk to the south, a crosswalk between the sidewalk at Cole Street and the proposed sidewalk, curb extensions at crosswalks to improve visibility and reduce crossing distance, and additional signage and paint to increase the visibility of the crosswalks and improve driver recognition.

Attachments

Count Summary
Crash Summary

Concept Plan

Signal Warrant Analysis: Broadway at South Kelsey Street
Signal Warrant Analysis: Broadway at Hill Street and Hoyt Street

Hill Street Alternative 1
Hill Street Alternative 2