GORRILL PALMER

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# Safety and Travel Time Savings
# Downtown Waterville BUILD Grant Application
## Waterville, Maine

**Date:** July 17, 2018
**Subject:** Safety and Travel Time Savings for BUILD Grant Application
Waterville, Maine
**To:** Paul Ureneck, Colby College
**From:** Randy Dunton / Emily Tynes, Gorrill Palmer

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Gorrill Palmer (GP) has prepared this evaluation of Travel Time and Safety Savings due to the proposed intersection modifications outlined in the *Downtown Waterville Feasibility Study* completed in December 2016 by GP in association with BFJ Planning and Mitchell & Associates. This evaluation has been completed to supplement the BUILD Grant Application being completed by the City of Waterville and Colby College. This study proposed three concepts at key intersections in the study area (attached). GP used the USDOT *Benefit-Cost Analysis Guidance for Discretionary Grant Program* to evaluate the estimated monetary benefits of the proposed concepts. The following summarizes the methodology and results of the evaluation:

*Benefit-Cost Analysis Guidance for Discretionary Grant Program:* 4.1 Value of Travel Time Savings

The Downtown Waterville project involved not only the conversion of two one-way streets to two-way streets, it also included creating intersections that do not currently exist. This creation of connections will improve the flexibility in travel routes for both private and commercial vehicles, thus reducing both vehicle miles travelled and overall travel times. Calculating this improvement is challenging for this project in that the origin and destination of countless potential routes would be impossible to analyze. For the purpose of this evaluation, we reviewed the following three signalized intersections, one of which does not currently exists:

- Water Street / Main Street / Spring Street (Existing intersection)
- Center Street / College Street / Main Street (Existing intersection)
- College Avenue / Front Street / Main Street (Proposed new intersection)

For the two existing signalized intersections we compared the overall intersection delay for the PM peak hour. The design year for the study was 2037. The original study focused on the PM peak hour since that was the most congested time period.

2037 PM Peak Hour with Existing Geometry

- Water / Main / Spring – Overall Delay 27.2 seconds per vehicle = 0.00756 hr per vehicle
- Center / College / Main – Overall Delay 46.9 seconds per vehicle = 0.01303 hr per vehicle

2037 PM Peak Hour with Proposed Geometry

- Water / Main / Spring – Overall Delay 28.6 seconds per vehicle = 0.00794 hr per vehicle

- Center / College / Main – Overall Delay 46.9 seconds per vehicle = 0.01303 hr per vehicle

As the results show, the intersections are primarily the same both before and after. The significant benefit is the improvement of pedestrian accommodations at the intersections, especially the intersection of Water / Main / Spring.

For the proposed signalized intersection of College / Front / Main, we reviewed numerous movements, comparing the predevelopment travel time to the intersection delay for that same movement. The following movements were evaluated.

- Northbound Front Street to Westbound Chaplin Street
- Eastbound Chaplin Street to Northbound College Avenue
- Northbound College Street to Westbound Chaplin Street

2037 PM Peak Hour with Existing Geometry (Movements Require Use of Circuitous Route over a bridge):

Northbound Front Street to Westbound Chaplin Street - Travel Distance (2640 ft) / speed limit (44 ft per second) = travel time (60 seconds per vehicle) = travel time (0.01667 hours per vehicle)

Eastbound Chaplin Street to Northbound College Avenue - Travel Distance (2640 ft) / speed limit (44 ft per second) = travel time (60 seconds per vehicle) = travel time (0.01667 hours per vehicle)

Northbound College Street to Westbound Chaplin Street - Travel Distance (2588 ft) / speed limit (44 ft per second) = travel time (58.8 seconds per vehicle) = travel time (0.01633 hours per vehicle)

2037 PM Peak Hour with Proposed Geometry (Signalized Intersection):

Northbound Front Street to Westbound Chaplin Street - Travel Distance (670 ft) / speed limit (44 ft per second) + Travel Distance (340 ft) / speed limit (36.67 ft per second) + Approach Signal Delay (5.8 seconds per vehicle) = travel time (30.3 seconds per vehicle) = travel time (0.00842 hours per vehicle)

Eastbound Chaplin Street to Northbound College Avenue - Travel Distance (610 ft) / speed limit (36.67 ft per second) + Approach Signal Delay (13.9 seconds per vehicle) = travel time (30.5 seconds per vehicle) = travel time (0.00848 hours per vehicle)

Northbound College Street to Westbound Chaplin Street - Travel Distance (700 ft) / speed limit (36.67 ft per second) + Approach Signal Delay (14.6 seconds per vehicle) = travel time (33.7 seconds per vehicle) = travel time (0.00936 hours per vehicle)

Net Change:

Northbound Front Street to Westbound Chaplin Street: Before Travel Time (0.01667 hours per vehicle) – After Travel Time (0.00842 hours per vehicle) = Net Change in Travel Time (0.00825 hours per vehicle)

Eastbound Chaplin Street to Northbound College Avenue: Before Travel Time (0.01667 hours per vehicle) – After Travel Time (0.00848 hours per vehicle) = Net Change in Travel Time (0.00819 hours per vehicle)

Northbound College Street to Westbound Chaplin Street: Before Travel Time (0.01633 hours per vehicle) – After Travel Time (0.00936 hours per vehicle) = Net Change in Travel Time (0.00697 hours per vehicle)

Estimated Annual Traffic Volumes:

Northbound Front Street to Westbound Chaplin Street: 258,542 vehicles per year

Eastbound Chaplin Street to Northbound College Avenue: 118,625 vehicles per year

Northbound College Street to Westbound Chaplin Street: 57,792 vehicles per year

Value of Travel Time Savings:

Northbound Front Street to Westbound Chaplin Street: Net Change (0.00825 hours per vehicle) * Annual Traffic (258,542 vehicles per year) * Vehicle Occupancy (1.39 people per vehicle) * Hourly Value of Travel Time ($14.80 per person-hour) = Value of Travel Time Savings ($43,879.49 per year)

Eastbound Chaplin Street to Northbound College Avenue: Net Change (0.00819 hours per vehicle) * Annual Traffic (118,625 vehicles per year) * Vehicle Occupancy (1.39 people per vehicle) * Hourly Value of Travel Time ($14.80 per person-hour) = Value of Travel Time Savings ($19,986.50 per year)

Northbound College Street to Westbound Chaplin Street: Net Change (0.00697 hours per vehicle) * Annual Traffic (57,792 vehicles per year) * Vehicle Occupancy (1.39 people per vehicle) * Hourly Value of Travel Time ($14.80 per person-hour) = Value of Travel Time Savings ($8,286.61 per year)

Conclusion:

The two existing signalized intersections are forecast to maintain approximately the same delay while significantly improving pedestrian safety and accommodations at the intersection.

The proposed intersection is forecast to provide an estimated travel time savings of **$72,152.60 per year. Over a typical 20 year design life, this results in $1,443,052 in savings.**

*Benefit-Cost Analysis Guidance for Discretionary Grant Program:* 4.3 Safety Benefits:

The following is from the Final Report "Downtown Waterville Feasibility Study, Waterville, Maine" dated December 2016. Submitted To: City of Waterville and Submitted by: Gorrill Palmer Consulting Engineers.

*"Safety Review*

*One of the goals of this study is to recommend alternatives to increase safety in the downtown area for all modes of travel. As discussed previously, the project study area*

*has nine high crash locations (HCLs) and 33 locations that meet one of the two HCL criteria. A safety analysis was completed to estimate the safety benefits for vehicular traffic from the proposed alternatives. To assist the GP study team, MaineDOT conducted a safety analysis of the proposed change in traffic circulation on downtown streets. The focus of this safety analysis is the facilities most affected by a conversion of Main Street and Front Street to two-way traffic: (1) the two one-way segments of Main Street and Front Street, (2) the intersection of Main Street / Elm Street / College Avenue, and (3) the proposed, signalized four-leg intersection of Front Street / Chaplin Street / College Avenue.*

*Some potential changes in design include the following:*

- *Change two lane one-way traffic flows on Main Street and Front Street to two-way traffic flow with a single lane in each direction.*
- *Change angled on-street parking spaces on Main Street to parallel on-street parking. Some isolated locations may remain angled parking but the majority would be converted to parallel.*
- *Create a buffer between the travel lane and on-street parking along Main Street.*
- *Create a new at-grade intersection of Front Street / Chaplin Street / College Avenue.*

*AASHTO's Highway Safety Manual (HSM), 1st Edition, Volume 2 was used to quantify the potential changes in the expected average crash frequency of these facilities for both the existing and proposed conditions.*

*Figure 1 shows the results of the HSM analysis of the existing conditions of Main Street, Front Street, and the intersection of Main Street / Elm Street / College Avenue. The analysis accounted for the combination of both angle and parallel parking along Main Street, reflecting the existing proportions of roadway associated with each type of parking. The analysis shows that approximately 26 crashes could be expected per year on Front Street and Main Street, combined, and approximately four crashes per year could be expected at the intersection of Main Street / Elm Street / College Avenue. In total, approximately 30 crashes could be expected at these facilities, with 11 of these crashes being injury crashes and 19 being property-damage-only.*

*Figure 1. Expected Crashes Per Year - Existing Conditions*

| Expected Crashes Per Year – Existing Conditions | | | | |
|---|---|---|---|---|
| Facility | Type | Expected Crashes Per Year | | |
| | | Total | Injury | Property Damage Only |
| Main Street / Front Street | Pair of one-way Streets | 25.82 | 9.12 | 16.70 |
| Main / Elm / College | 4-leg signalized intersection | 4.14 | 1.71 | 2.42 |
| Combined Total | | 29.96 | 10.83 | 19.12 |

*The proposed conditions were also analyzed via the HSM. The changes analyzed include: (1) changing Main Street and Front Street from one-way traffic flow to two-way traffic flow, (2) changing angled on-street parking on Main Street to parallel on-street parking with the exception of some isolate locations, (3) minor changes to the intersection of Main Street / Elm Street / College Avenue, including converting Main Street from one-way traffic flow to two-way traffic flow and adding a protected left-turn pocket for those traveling north on Main Street wishing to access the Rite Aid parking lot, and (4) creating a new, at-grade intersection of Front Street / Chaplin Street / College Avenue. The results of the analysis are shown in Figure 2. Both Main Street and Front Street would be expected to have approximately 3 crashes per year. The intersection of Main Street / Elm Street / College Avenue would be expected to have a decrease in crashes from 4.14 crashes per year with existing conditions to 3.72 crashes per year with the proposed conditions. The new signalized intersection of Front Street / Chaplin Street / College Avenue would be expected to have approximately 4 crashes per year. In total, nearly 14 crashes per year would be expected with the proposed changes, with 5 being injury crashes and 9 being property-damage-only crashes.*

*Figure 2. Expected Crashes Per Year - Proposed Conditions*

| Expected Crashes Per Year – Proposed Conditions | | | | |
|---|---|---|---|---|
| Facility | Type | Expected Crashes Per Year | | |
| | | Total | Injury | Property Damage Only |
| Main Street | 2-lane, 2-way Street | 3.16 | 1.13 | 2.03 |
| Front Street | 2-lane, 2-way Street | 3.01 | 1.01 | 2.01 |
| Main / Elm / College | 4-leg signalized intersection | 3.72 | 1.58 | 2.14 |
| Front / Chaplin / College | New 4-leg signalized intersection | 3.80 | 1.26 | 2.53 |
| Combined Total | | 13.69 | 4.98 | 8.71 |

*Overall, the analysis shows that, with the proposed changes, the frequency of crashes on these facilities could be reduced from 30 crashes per year to 14 crashes per year. Both injury and property-damage-only crashes could decrease by more than half, even with the creation of a new intersection at Front Street / Chaplin Street / College Avenue. The proposed changes are expected to provide significant safety improvements at these facilities."*

Conclusion:

The following is the calculated safety benefit based on this information.

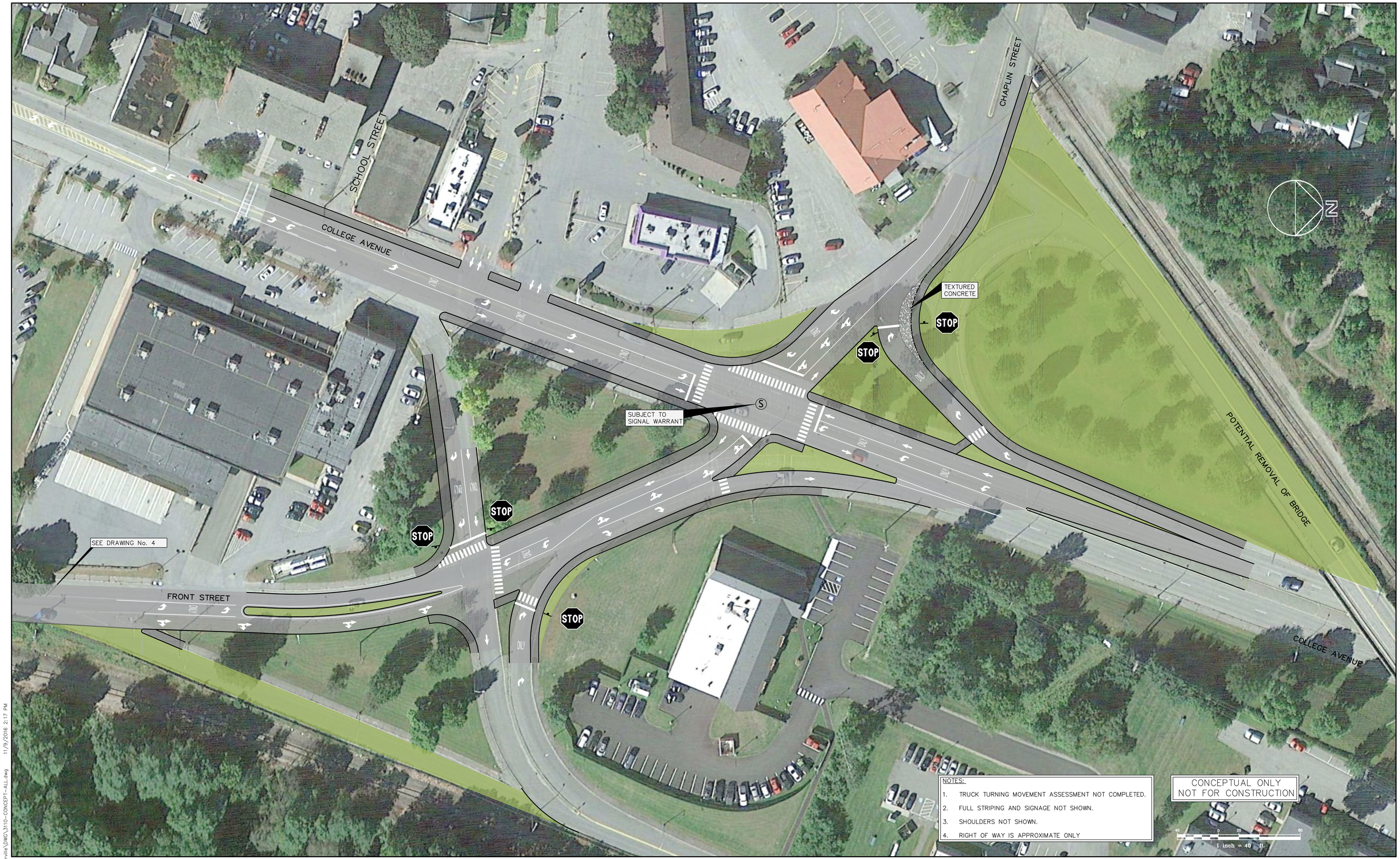
| | Total | Injury | Property Damage Only |
|---|---|---|---|
| Existing | 29.96 | 10.83 | 19.12 |
| Proposed | 13.69 | 4.98 | 8.71 |
| Decrease | 16.27 | 5.85 | 10.41 |

Value of Reduced Fatalities and Injuries from USDOT "Benefit-Cost Analysis Guidance for Discretionary Grant Program" Appendix A, Table A-1

Based on KABCO Levels:

Benefits: 5.85 crashes / year * $174,000 + 10.41 crashes / year * $3,200 = **$1,051,212 per year. Over a typical 20 year design life, this results in $21,024,240 in savings.**

In addition to vehicular safety, it should be noted that this project is expected to have a significant positive impact on the safety of pedestrians, not only at the intersections but along Front Street and Main Street. One of the primary goals of the project in creating two two-way roads versus a one-way pair was to remove cut-through traffic from the Main Street where the primary pedestrian activity occurs and put it on Front Street, which will operate as a de-facto by-pass around the pedestrian oriented downtown Main Street.

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Drawing Name: CONCEPTUAL LAYOUT

Project: Waterville Feasibility Study
Waterville, Maine

Client: City of Waterville
One Common St, Waterville, Me 04901

Drawing No. 1

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Drawing No. 2


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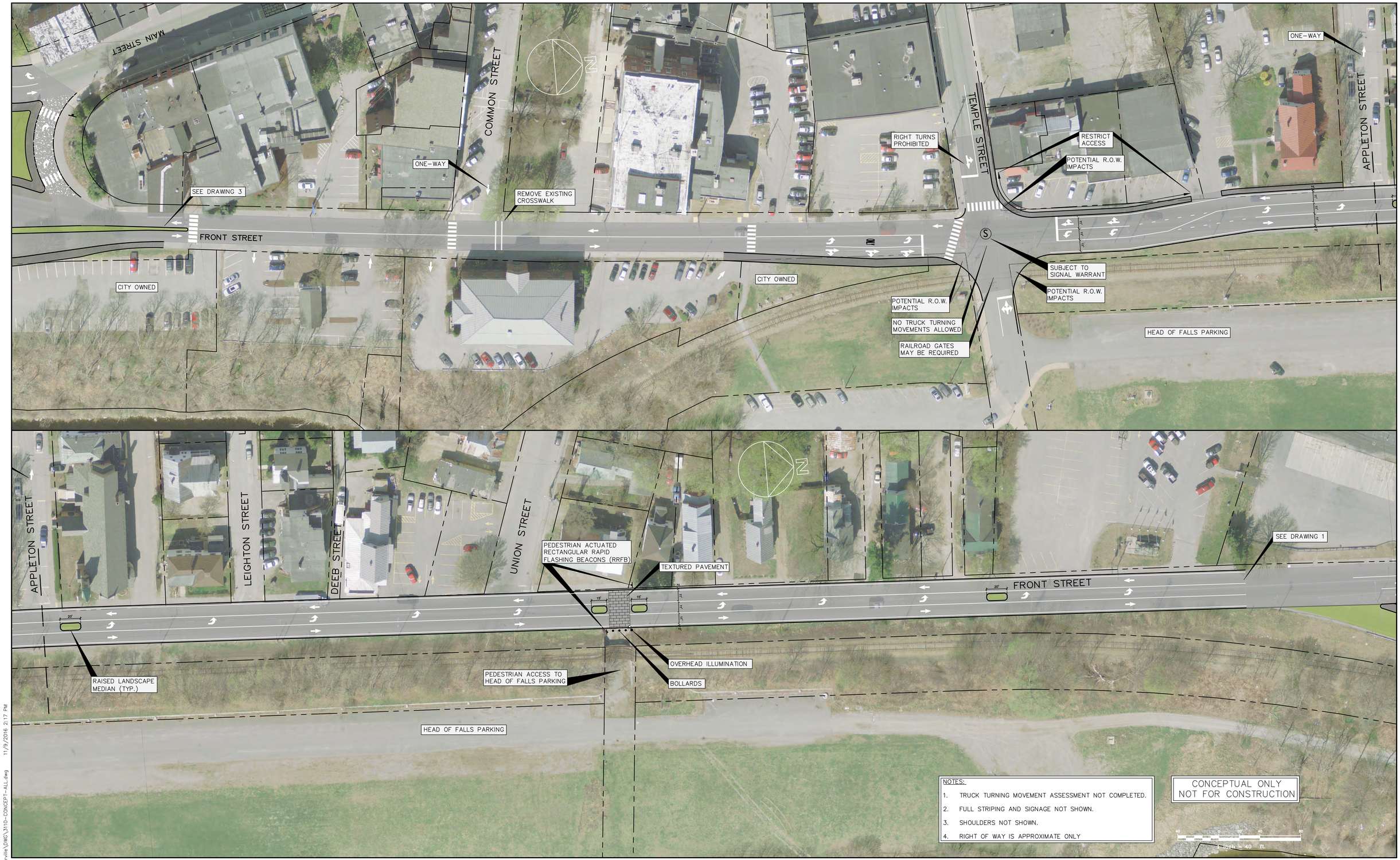
Drawing No. 3




NOTES:

1. TRUCK TURNING MOVEMENT ASSESSMENT NOT COMPLETED.
2. FULL STRIPING AND SIGNAGE NOT SHOWN.
3. SHOULDERS NOT SHOWN.
4. RIGHT OF WAY IS APPROXIMATE ONLY

CONCEPTUAL ONLY
NOT FOR CONSTRUCTION

1 inch = 40 ft.

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Waterville, Maine

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One Common St, Waterville, Me 04901

Drawing No. 4

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POTENTIAL OUTDOOR GATHERING AREA

EXISTING PARKING SPACES TO REMAIN

SEE DRAWING No. 3

RAISED CROSSWALK

DELIVERY

MAIN STREET

DELIVERY

DIAGONAL PARKING(45°) VAN ADA SPACE TO BE IDENTIFIED

DIAGONAL PARKING(45°) VAN ADA SPACE TO BE IDENTIFIED

POTENTIAL RAISED INTERSECTION

TRANSIT

PARALLEL PARKING

ONE WAY

PARALLEL PARKING

TYPICAL SPACE 8' x 24'

PARALLEL PARKING

COMMON STREET

TEMPLE STREET

SEE DRAWING No. 3

FRONT STREET

ELM STREET

CENTER STREET

DIAGONAL PARKING(45°) VAN ADA SPACE TO BE IDENTIFIED

POTENTIAL RAISED INTERSECTION

DIAGONAL PARKING(45°) VAN ADA SPACE TO BE IDENTIFIED

POTENTIAL REMOVAL OF PARKING SPACES

PEDESTRIAN BUMPOUT (TYP.)

POST OFFICE

SEE DRAWING No. 2

DELIVERY

MAIN STREET

TRANSIT

TYPICAL SPACE 8' x 24'

PARALLEL PARKING

POTENTIAL RAISED CROSSWALK (TYP. OF MAIN STREET)

POTENTIAL REMOVAL OF PARKING SPACES

PARALLEL PARKING

TEMPLE STREET

APPLETON STREET

NOTES:

1. TRUCK TURNING MOVEMENT ASSESSMENT NOT COMPLETED.
2. FULL STRIPING AND SIGNAGE NOT SHOWN.
3. SHOULDERS NOT SHOWN.
4. RIGHT OF WAY IS APPROXIMATE ONLY
5. ADDITIONAL ADA SPACES TO BE IDENTIFIED IN FINAL DESIGN.

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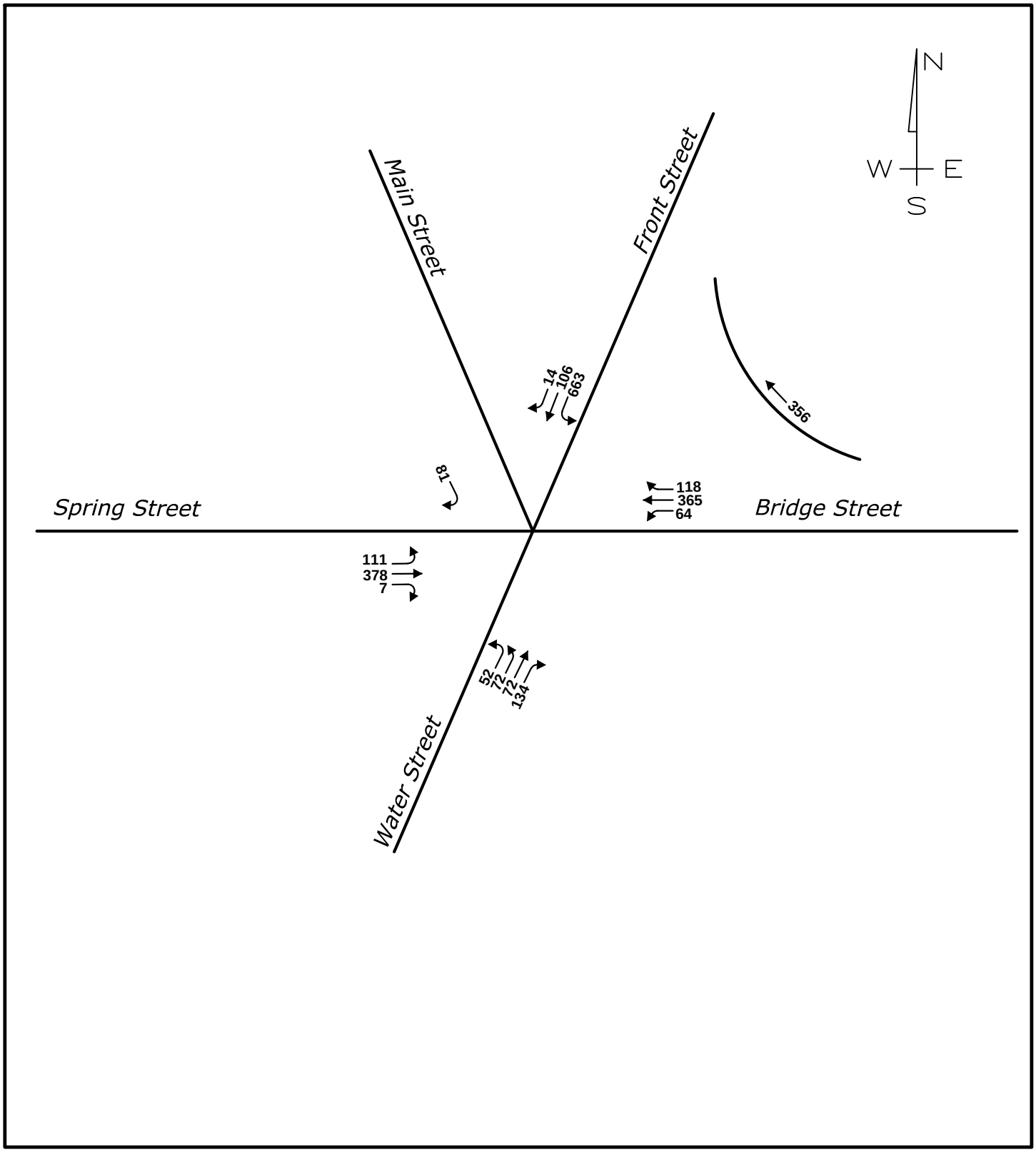
Drawing No. 5

# SIGNALIZED INTERSECTION 2037 PM POSTDEVELOPMENT
# FRONT ST + MAIN ST TWO-WAY ASSUMED VOLUMES - FRONT MAJOR

Figure No. 13




## DOWNTOWN TRANSPORTATION STUDY
## WATERVILLE, MAINE

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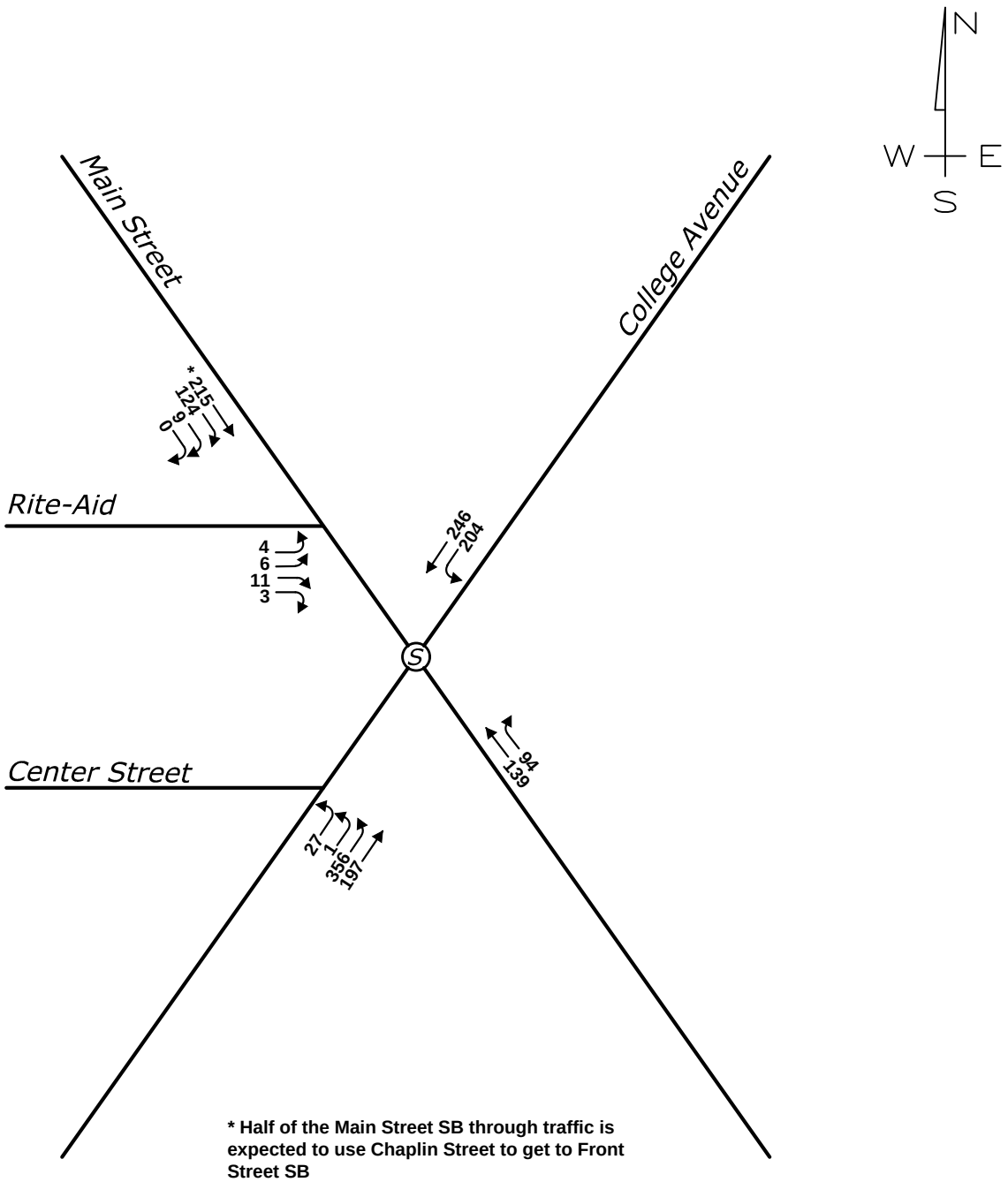
# SIGNALIZED INTERSECTION 2037 PM POSTDEVELOPMENT
# FRONT ST & MAIN ST 2-WAY ASSUMED VOLUMES - FRONT MAJOR

Figure No. 7




*** Half of the Main Street SB through traffic is expected to use Chaplin Street to get to Front Street SB**

# DOWNTOWN TRANSPORTATION STUDY
# WATERVILLE, MAINE

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## 1: Water St/Main St & Spring St/Bridge St & Front Street Performance by approach

| Approach | EB | WB | NB | SB | All |
|---|---|---|---|---|---|
| Denied Del/Veh (s) | 0.0 | 1.9 | 2.4 | 0.0 | 1.0 |
| Total Del/Veh (s) | 32.2 | 20.6 | 25.7 | 31.8 | 27.2 |
| Denied Entry Before | 0 | 0 | 0 | 0 | 0 |
| Denied Entry After | 0 | 1 | 0 | 0 | 1 |

## 4: Main St & Concourse/Temple Performance by approach

| Approach | EB | WB | SB | All |
|---|---|---|---|---|
| Denied Del/Veh (s) | 0.0 | 0.0 | 0.0 | 0.0 |
| Total Del/Veh (s) | 9.8 | 17.8 | 6.0 | 8.8 |
| Denied Entry Before | 0 | 0 | 0 | 0 |
| Denied Entry After | 0 | 0 | 0 | 0 |

## 6: Front Street & Temple Performance by approach

| Approach | EB | WB | NB | All |
|---|---|---|---|---|
| Denied Del/Veh (s) | 0.2 | 0.1 | 0.0 | 0.1 |
| Total Del/Veh (s) | 12.7 | 7.5 | 10.9 | 11.1 |
| Denied Entry Before | 0 | 0 | 0 | 0 |
| Denied Entry After | 0 | 0 | 0 | 0 |

## 11: Silver St/Concourse & Spring St Performance by approach

| Approach | EB | WB | NB | SB | All |
|---|---|---|---|---|---|
| Denied Del/Veh (s) | 0.0 | 0.0 | 2.6 | 0.5 | 1.0 |
| Total Del/Veh (s) | 21.3 | 13.5 | 8.6 | 15.3 | 13.1 |
| Denied Entry Before | 0 | 0 | 0 | 0 | 0 |
| Denied Entry After | 0 | 0 | 0 | 0 | 0 |

## 12: Center St/College Ave & Elm St & Main St Performance by approach

| Approach | EB | NB | SB | SW | All |
|---|---|---|---|---|---|
| Denied Del/Veh (s) | 0.1 | 0.0 | 0.0 | 0.2 | 0.1 |
| Total Del/Veh (s) | 56.6 | 56.3 | 40.8 | 44.9 | 46.9 |
| Denied Entry Before | 0 | 0 | 0 | 0 | 0 |
| Denied Entry After | 0 | 0 | 0 | 0 | 0 |

## 14: Elm St & Spring St Performance by approach

| Approach | EB | WB | NB | SB | All |
|---|---|---|---|---|---|
| Denied Del/Veh (s) | 0.1 | 0.0 | 0.9 | 0.6 | 0.5 |
| Total Del/Veh (s) | 15.4 | 14.2 | 13.6 | 10.0 | 12.5 |
| Denied Entry Before | 0 | 0 | 0 | 0 | 0 |
| Denied Entry After | 0 | 0 | 0 | 0 | 0 |

## 18: Main St & Eustis Pkwy/Oak St Performance by approach

| Approach | EB | WB | NB | SB | All |
|---|---|---|---|---|---|
| Denied Del/Veh (s) | 0.2 | 1.4 | 0.7 | 1.3 | 1.0 |
| Total Del/Veh (s) | 23.1 | 14.8 | 26.2 | 14.8 | 19.8 |
| Denied Entry Before | 0 | 0 | 0 | 0 | 0 |
| Denied Entry After | 0 | 0 | 0 | 0 | 0 |

## 21: Elm St & Park St/Appleton St Performance by approach

| Approach | EB | WB | NB | SB | All |
|---|---|---|---|---|---|
| Denied Del/Veh (s) | 0.2 | 2.5 | 0.0 | 0.3 | 0.6 |
| Total Del/Veh (s) | 12.3 | 9.7 | 11.4 | 8.7 | 10.4 |
| Denied Entry Before | 0 | 0 | 0 | 0 | 0 |
| Denied Entry After | 0 | 0 | 0 | 0 | 0 |

## Total Network Performance

| | |
|---|---|
| Denied Del/Veh (s) | 1.4 |
| Total Del/Veh (s) | 53.0 |
| Denied Entry Before | 0 |
| Denied Entry After | 1 |

## 3: Front Street & Spring Street/Bridge Street Performance by approach

| Approach | EB | WB | NB | SB | All |
|---|---|---|---|---|---|
| Denied Del/Veh (s) | 0.8 | 1.5 | 3.0 | 0.6 | 1.3 |
| Total Del/Veh (s) | 33.0 | 25.1 | 28.5 | 29.7 | 28.6 |
| Denied Entry Before | 0 | 0 | 0 | 0 | 0 |
| Denied Entry After | 0 | 0 | 0 | 0 | 0 |

## Total Network Performance

| | |
|---|---|
| Denied Del/Veh (s) | 1.3 |
| Total Del/Veh (s) | 30.7 |
| Denied Entry Before | 0 |
| Denied Entry After | 0 |

## 3: Center Street/College Avenue & Elm Street/Main Street & Rite-Aid Performance by approach

| Approach | EB | NB | SB | NW | SW | All |
|---|---|---|---|---|---|---|
| Denied Del/Veh (s) | 0.1 | 0.2 | 1.4 | 0.2 | 0.2 | 0.4 |
| Total Del/Veh (s) | 44.2 | 47.6 | 42.0 | 46.0 | 50.3 | 46.9 |
| Denied Entry Before | 0 | 0 | 0 | 0 | 0 | 0 |
| Denied Entry After | 0 | 0 | 0 | 0 | 0 | 0 |

## Total Network Performance

| | |
|---|---|
| Denied Del/Veh (s) | 0.4 |
| Total Del/Veh (s) | 49.5 |
| Denied Entry Before | 0 |
| Denied Entry After | 0 |

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JOB 3456 - Waterville Build Grant
SHEET NO. 1 OF 2
CALCULATED BY ET DATE 7/16/18
CHECKED BY _____ DATE _____
SCALE _____

## Estimated Value of Travel Time Savings: College/Front/Main

Speed Limits:

Front St (posted) & Colby Circle (Assumed): $\frac{30\text{mph}}{3600\text{s/hr}} * 5280\text{ft/mi} = 44\text{ft/sec}$

College Ave (posted) & Chaplin St (Assumed): $\frac{25\text{mph}}{3600\text{s/hr}} * 5280\text{ft/mi} = 36.67\text{ft/sec}$

Existing Travel Times: (Distances from MaineDOT MapViewer)

NB Front → WB Chaplin

$$\frac{(0.11\text{mi} + 0.01\text{mi} + 0.33\text{mi} + 0.05\text{mi}) * 5{,}280\text{ft/mi}}{44\text{ft/sec}} = 60\text{s/v} = 0.01667\text{hr/veh}$$

EB Chaplin → NB College

$$\frac{(0.03\text{mi} + 0.33\text{mi} + 0.07\text{mi} + 0.07\text{mi}) * 5{,}280\text{ft/mi}}{44\text{ft/sec}} = 60\text{s/v} = 0.01667\text{hr/veh}$$

NB College → WB Chaplin

$$\frac{(0.05\text{mi} + 0.05\text{mi} + 0.01\text{mi} + 0.33\text{mi} + 0.05\text{mi}) * 5{,}280\text{ft/mi}}{44\text{ft/sec}} = 58.8\text{s/v} = 0.01633\text{hr/veh}$$

Proposed Travel Times: (Distances measured on Concept Plan, signal delay from SimTraffic)

NB Front → WB Chaplin

$$\frac{(290\text{ft} + 380\text{ft})}{44\text{ft/s}} + \frac{340\text{ft}}{36.67\text{ft/s}} + 5.8\text{ sec/veh} = 30.3\text{sec/veh} = 0.00842\text{hr/veh}$$

EB Chaplin → NB College

$$\frac{(340\text{ft} + 270\text{ft})}{36.67\text{ft}} + 13.9\text{ sec/veh} = 30.5\text{sec/veh} = 0.00848\text{hr/veh}$$

NB College → WB Chaplin

$$\frac{(340\text{ft} + 340\text{ft})}{36.67\text{ft}} + 14.6\text{ sec/veh} = 33.7\text{sec/veh} = 0.00936\text{hr/veh}$$

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SCALE

## Estimated Value of Travel Time Savings: College/Front/Main (cont.)

Net Change in Travel Time

NB Front → WB Chaplin

0.01667 hr/veh − 0.00842 hr/veh = 0.00825 hr/veh

EB Chaplin → NB College

0.01667 hr/veh − 0.00848 hr/veh = 0.00819 hr/veh

NB College → WB Chaplin

0.01633 hr/veh − 0.00936 hr/veh = 0.00697 hr/veh

Estimated Annual Traffic Volumes (Based on Fig. 12, assumes vols are 12% of AADT)

NB Front → WB Chaplin

$\frac{85 \text{ veh}}{0.12 \text{ AADT}} * 365 \text{ days/yr} = 258{,}542 \text{ veh/yr}$

EB Chaplin → NB College

$\frac{39 \text{ veh}}{0.12 \text{ AADT}} * 365 \text{ days/yr} = 118{,}625 \text{ veh/yr}$

NB College → WB Chaplin

$\frac{19 \text{ veh}}{0.12 \text{ AADT}} * 365 \text{ days/yr} = 57{,}792 \text{ veh/yr}$

Value of Travel Time Savings: from USDOT "Benefit-Cost Analysis Guidance for Discretionary Grant Programs" Appendix A, Table A-3, "All Purposes" and Table A-4 "Average Vehicle Occupancy"

NB Front → WB Chaplin

0.00825 hr/veh * 258,542 veh/yr * 1.39 person/veh * $14.80/person-hr = $43,879.49/yr

EB Chaplin → NB College

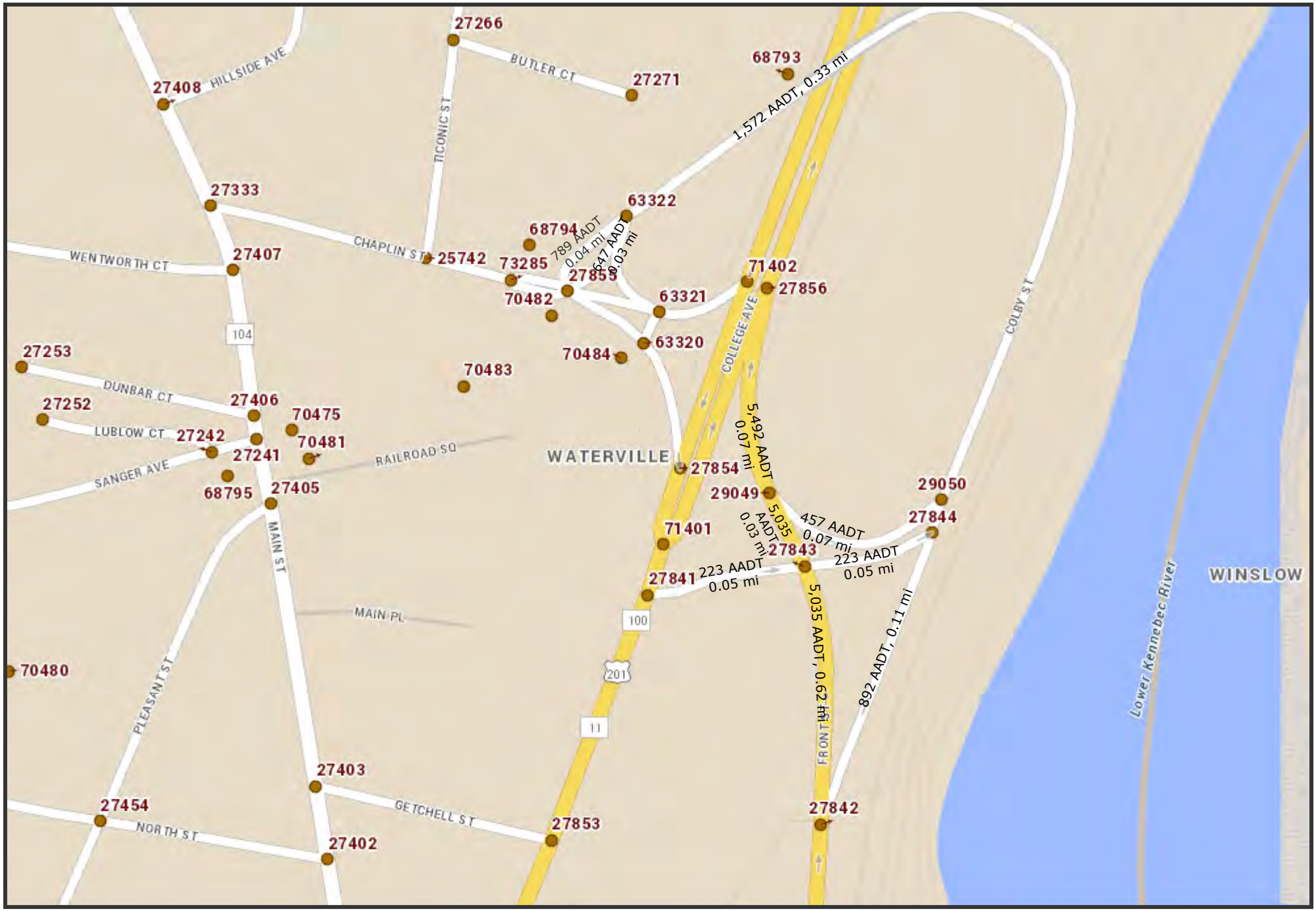
0.00819 hr/veh * 118,625 veh/yr * 1.39 person/veh * $14.80/person-hr = $19,986.50

NB College → WB Chaplin

0.00697 hr/veh * 57,792 veh/yr * 1.39 person/veh * $14.80/person-hr = $8,286.61

Total Value of Travel Time Savings: **$72,152.60**

# AADT MAP



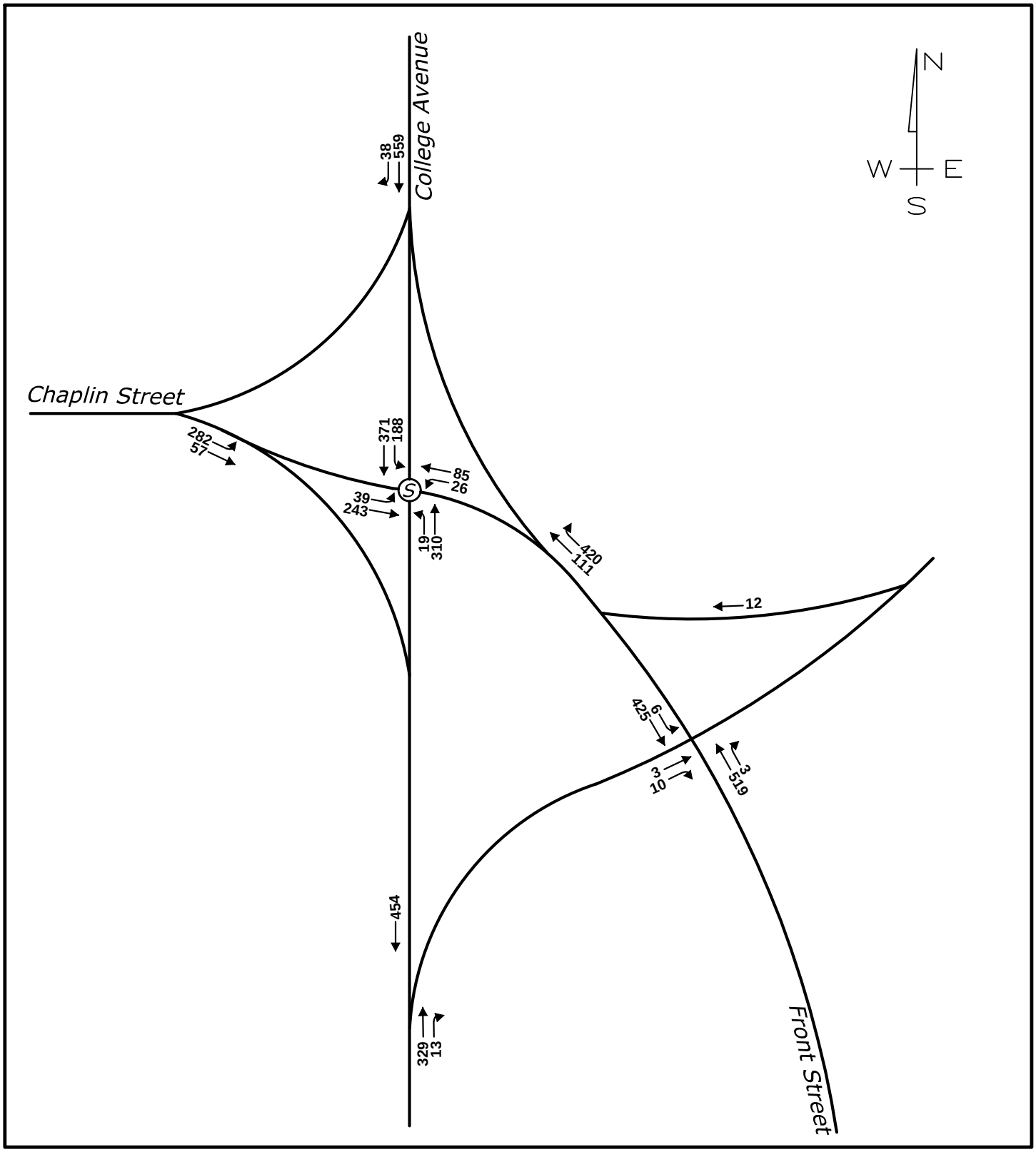

The Maine Department of Transportation provides this publication for information only. Reliance upon this information is at user risk. It is subject to revision and may be incomplete depending upon changing conditions. The Department assumes no liability if injuries or damages result from this information. This map is not intended to support emergency dispatch.

0.085 Miles

1 inch = 0.06 miles

Date: 7/16/2018
Time: 5:50:16 PM

**INTERSECTION 2037 PM POSTDEVELOPMENT**
**FRONT ST + MAIN ST TWO-WAY ASSUMED VOLUMES - FRONT ST MAJOR** Figure No. 12




# DOWNTOWN TRANSPORTATION STUDY
# WATERVILLE, MAINE

Design: ET Scale: NONE
Draft: LAN Date: JUNE 2016
Checked: RED File Name: 3110-TRAFF2.dwg

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## 3: College Ave & Chaplin Street/Front Street Performance by approach

| Approach | EB | WB | NB | SB | All |
|---|---|---|---|---|---|
| Denied Del/Veh (s) | 1.0 | 0.0 | 0.0 | 1.4 | 0.7 |
| Total Del/Veh (s) | 13.9 | 5.8 | 14.6 | 9.0 | 10.0 |
| Denied Entry Before | 0 | 0 | 0 | 1 | 1 |
| Denied Entry After | 0 | 0 | 0 | 0 | 0 |

## 5: College Ave & Colby Street Performance by approach

| Approach | NB | SB | All |
|---|---|---|---|
| Denied Del/Veh (s) | 0.3 | 0.0 | 0.1 |
| Total Del/Veh (s) | 0.5 | 1.5 | 1.1 |
| Denied Entry Before | 0 | 0 | 0 |
| Denied Entry After | 0 | 0 | 0 |

## 6: Front Street & Colby Street Performance by approach

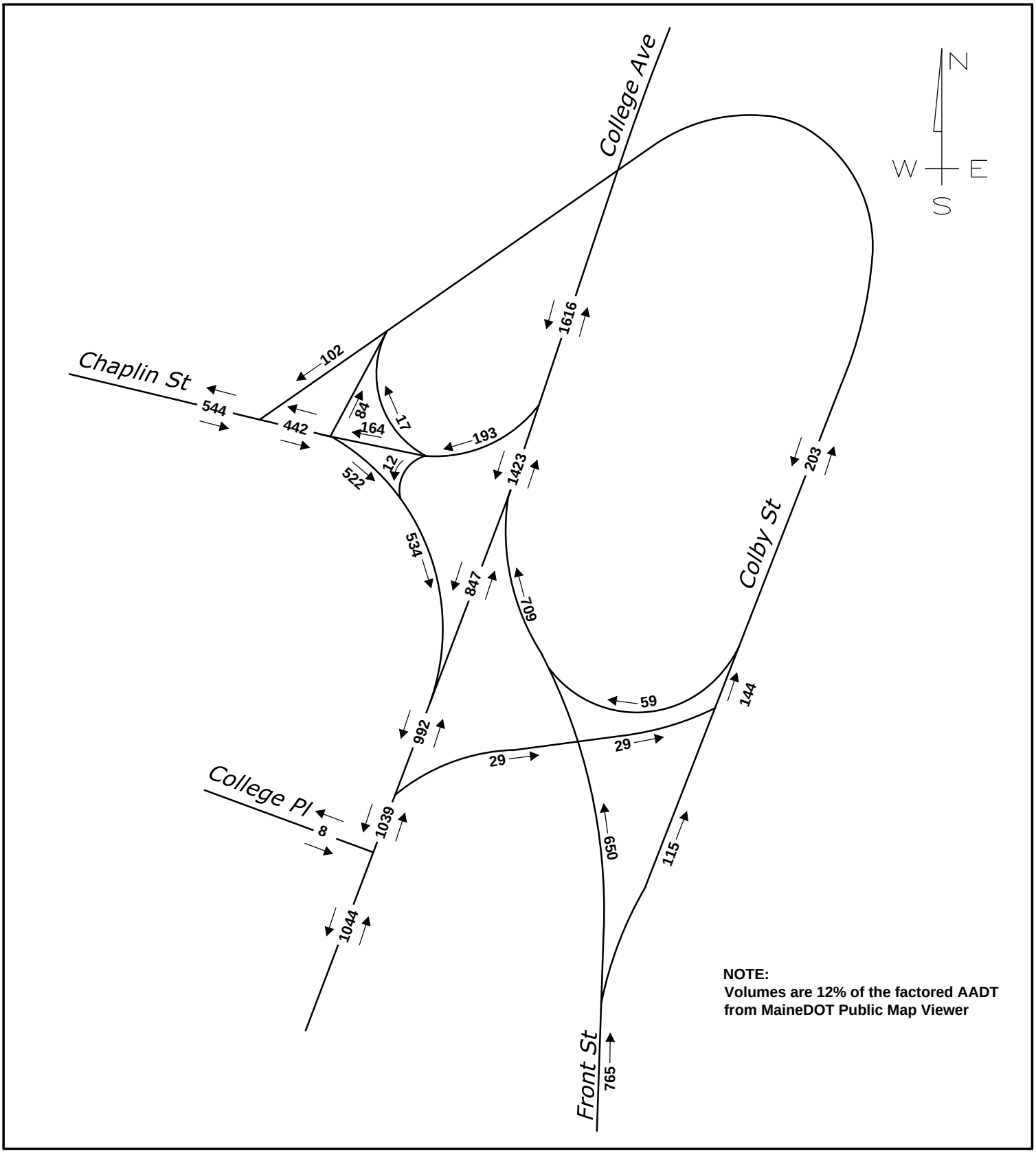
| Approach | EB | WB | NB | SB | All |
|---|---|---|---|---|---|
| Denied Del/Veh (s) | 0.0 | 0.1 | 0.4 | 0.0 | 0.2 |
| Total Del/Veh (s) | 5.3 | 1.6 | 0.6 | 1.5 | 1.1 |
| Denied Entry Before | 0 | 0 | 0 | 0 | 0 |
| Denied Entry After | 0 | 0 | 0 | 0 | 0 |

## Total Network Performance

| | |
|---|---|
| Denied Del/Veh (s) | 0.8 |
| Total Del/Veh (s) | 12.3 |
| Denied Entry Before | 1 |
| Denied Entry After | 0 |

# Estimated Peak Hour Traffic Volumes

Figure No. 2




## DOWNTOWN TRANSPORTATION STUDY
## WATERVILLE, MAINE

| | | | |
|---|---|---|---|
| Design: | ET | Scale: | NONE |
| Draft: | LAN | Date: | JUNE 2016 |
| Checked: | RED | File Name: | 3110-TRAFF3.dwg |

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*Table A-3: Value of Travel Time Savings*

| Recommended Monetized Value(s) | References and Notes |
|---|---|

**Recommended Hourly Values of Travel Time Savings (2017 U.S. $ per person-hour)**

| Category | Hourly Value |
|---|---|
| **In-Vehicle Travel**[1] | |
| Personal[2] | $14.20 |
| Business[3] | $26.50 |
| All Purposes[4] | $14.80 |
| **Commercial Vehicle Operators**[5] | |
| Truck Drivers | $28.60 |
| Bus Drivers | $30.00 |
| Transit Rail Operators | $48.90 |
| Locomotive Engineers | $44.90 |

1\ Values apply to all combinations of in-vehicle and other transit time on surface transportation modes. Walk access, waiting, and transfer time should be valued at $28.40 per hour for personal travel when actions affect only those elements of travel time.

2\ Values for personal travel based on local travel values as described in USDOT's Value of Travel Time guidance. Where applicants also have specific information on the mix of local versus long-distance intercity travel (i.e., trips over 50 miles in length) on a facility, then the local travel values of time may be blended with the long-distance intercity personal travel value of $19.90 per hour.

3\ Note that business travel does not include commuting travel, which should be valued at the personal travel rate. Travel on high-speed rail service that would be competitive with air travel should be valued at $37.80 per hour for personal travel and $66.00 for business travel.

4\ Weighted average based on a typical distribution of local travel by surface modes (95.4% personal, 4.6% business). Applicants should apply their own distribution of business versus personal travel where such information is available.

5\ Includes only the value of time for the operator, not passengers or freight.

*Revised Departmental Guidance on Valuation of Travel Time in Economic Analysis*

https://www.transportation.gov/office-policy/transportation-policy/revised-departmental-guidance-valuation-travel-time-economic

### *Table A-4: Average Vehicle Occupancy*

| Recommended Monetized Value(s) | References and Notes |
|---|---|
| **Vehicle Type** / **Occupancy**<br>Passenger vehicles — 1.39<br>Trucks — 1.00 | *Federal Highway Administration Highway Statistics 2016, Table VM1* |

### *Table A-5: Vehicle Operating Costs*

| Recommended Monetized Value(s) | References and Notes |
|---|---|
| **Vehicle Type** / **Recommended Value per Mile ($2017)**<br>Light Duty Vehicles[1] — $0.39<br>Commercial Trucks[2] — $0.90 | |
| 1\ Based on an average light duty vehicle and includes operating costs such as gasoline, maintenance, tires, and depreciation (assuming an average of 15,000 miles driven per year). The value omits other ownership costs that are mostly fixed or transfers (insurance, license, registration, taxes, and financing charges). | *American Automobile Association, Your Driving Costs – 2017 Edition (2017)* https://exchange.aaa.com/automotive/driving-costs/#.Wt9eRojwa72 |
| 2\ Value includes fuel costs, truck/trailer lease or purchase payments, repair and maintenance, truck insurance premiums, permits and licenses, and tires. The value omits tolls (transfers) and driver wages and benefits (already included in value of travel time savings) and is inflated to 2017 dollars using the GDP deflator. | *American Transportation Research Institute, An Analysis of the Operational Costs of Trucking: 2017 Update (2017)* http://atri-online.org/wp-content/uploads/2017/10/ATRI-Operational-Costs-of-Trucking-2017-10-2017.pdf |

# Waterville Downtown Traffic Circulation Safety Analysis Tech Memo December 2016

## Introduction

One of the goals of this study is to recommend alternatives to increase safety in the downtown area for all modes of travel. As discussed previously, the project study area has nine high crash locations (HCLs) and 33 locations that meet one of the two HCL criteria. A safety analysis was completed to estimate the safety benefits for vehicular traffic from the proposed alternatives. To assist the GP study team, MaineDOT conducted a safety analysis of the proposed change in traffic circulation on downtown streets. The focus of this safety analysis is the facilities most affected by a conversion of Main Street and Front Street to two-way traffic: (1) the two one-way segments of Main Street and Front Street, (2) the intersection of Main Street / Elm Street / College Avenue, and (3) the proposed, signalized four-leg intersection of Front Street / Chaplin Street / College Avenue.

Some potential changes in the facilities include the following:

- Change two lane one-way traffic flows on Main Street and Front Street to two-way traffic flow with a single lane in each direction.
- Change angled on-street parking spaces on Main Street to parallel on-street parking. Some isolated locations may remain angled parking but the majority would be converted to parallel.
- Create a buffer between the travel lane and on-street parking along Main Street.
- Create a new at-grade intersection of Front Street / Chaplin Street / College Avenue.

AASHTO's *Highway Safety Manual (HSM), 1st Edition, Volume 2* was used to quantify the potential changes in the expected average crash frequency of these facilities for both the existing and proposed conditions.

## Analysis

### *Main Street and Front Street*

From 2013 to 2015 there were 92 total crashes on Main Street and Front Street, combined. Of these crashes, 37 were driveway related and 55 were non-driveway related. A Highway Safety Manual (HSM) analysis was completed on both the existing conditions and the proposed changes to quantify the potential safety impacts associated with these changes.

The HSM does not currently provide a method specifically for analyzing one-way streets. Therefore, to analyze the existing conditions of Main Street and Front Street, the two one-way roads were analyzed jointly as a two-way four-lane divided urban street. The analysis accounted for the combination of both angle and parallel parking along Main Street, reflecting the existing proportions of roadway associated with each type of parking. All intermediate access points along these two one-way streets were treated as either major or minor driveways.

For the proposed changes, both Main Street and Front Street were analyzed as separate two-lane two-way streets. These changes also include changing angled on-street parking spaces on Main Street to parallel on-street parking, with the exception of some isolated locations. This analysis also took into account that a portion of Front Street would have a center turning lane. Traffic volume shifts from Main Street to Front Street were also considered. With the proposed changes, Front Street would become the major route, so it is expected that thru traffic volumes on Main Street would decrease and thru traffic volumes on Front Street would increase.

The results of both the existing and proposed analyses are shown in Figure 1. The analysis of the existing conditions shows approximately 26 expected crashes per year on Front and Main Street, combined. With the proposed changes, the total expected crashes would be reduced from about 26 crashes per year on Front and Main Street, combined, to approximately 3 crashes per year on each road, or 6 crashes per year, combined.

**Figure 1. HSM Segment Analysis for Front and Main Street.**

| Segment Alternative | Segment Type | Total Crashes per Year | | | Crash Estimate to Compare | Crashes per Year for Comparison | | |
|---|---|---|---|---|---|---|---|---|
| | | Observed | Calculated | | | Total | FI | PDO |
| | | | Predicted | Expected | | | (fatal and injury) | (property damage only) |
| Existing (Front & Main, Combined) | 4D | 31.00 | 9.85 | 25.82 | Expected | 25.82 | 9.12 | 16.70 |
| Main Street (Proposed) | 2U | - | 3.16 | n/a | Predicted | 3.16 | 1.13 | 2.03 |
| Front Street (Proposed) | 3T | - | 3.01 | n/a | Predicted | 3.01 | 1.01 | 2.01 |
| Front & Main Street, Proposed, Combined | - | - | 6.17 | n/a | - | 6.17 | 2.14 | 4.04 |

Along with the reduction in angle parking, the large reduction of crashes from existing to proposed is likely attributed to the change in Main Street from a mixed facility in which thru traffic interacts directly and experiences conflicts with local access traffic (i.e. those looking for a parking space) to one where the thru traffic does not have to interact with local access traffic. Thru traffic is removed from Main Street and redirected to Front Street, which has no on-street parking, removing the conflict between thru and local access traffic, thus reducing the number of crashes.

### *Intersection of Main Street / Elm Street / College Avenue*

There were 14 crashes at the intersection of Main Street / Elm Street / College Avenue from 2013 to 2015. The HSM was used to analyze both the existing intersection and the proposed changes to the intersection. The changes to the intersection include the conversion of Main Street from one-way traffic flow to two-way traffic flow and the addition of a protected left-turn pocket for those traveling north on Main Street wishing to access the Rite Aid parking lot. Right turns remain prohibited from Elm Street onto Main Street and from College Avenue onto Main Street due to the skew of the intersection. No other approach changes are proposed. Traffic volumes on Main Street are also a key component to the analysis. With the proposed one-way to two-way traffic flow changes, Front Street becomes the major route, thus a majority of Main Street thru-traffic would be redirected onto Front Street, thereby reducing the total volume of traffic entering this intersection. The results of the analysis, seen in Figure 2, show a slight decrease in expected crashes from 4.14 to 3.72 crashes per year. In the analysis, this reduction is credited mainly to the reduction in Main Street AADT.

**Figure 2. HSM Safety Analysis for Main Street / Elm Street / College Avenue intersection.**

| Intersection Alternative | Intersection Type | Total Crashes per Year | | | Crash Estimate to Compare | Crashes per Year for Comparison | | |
|---|---|---|---|---|---|---|---|---|
| | | Observed | Calculated | | | Total | FI | PDO |
| | | | Predicted | Expected | | | (fatal and injury) | (property damage only) |
| Main/Elm/College Baseline/No-Build | 4SG | 4.67 | 2.43 | 4.14 | Expected | 4.14 | 1.71 | 2.42 |
| Main/Elm/College Proposed | 4SG | - | 1.96 | 3.72 | Expected | 3.72 | 1.58 | 2.14 |

### *Proposed Intersection of Front Street / Chaplin Street / College Avenue*

The conversion of Front Street and Main Street to two-way traffic flow would result in the creation of a new, signalized intersection at Front Street / Chaplin Street / College Avenue. The proposed intersection was analyzed via the HSM. The results of this analysis, shown in Figure 3, predict that there would be approximately 4 crashes per year at this intersection.

**Figure 3. HSM Safety Analysis for Front Street / Chaplin Street / College Avenue intersection.**

| Intersection Alternative | Intersection Type | Total Crashes per Year | | | Crash Estimate to Compare | Crashes per Year for Comparison | | |
|---|---|---|---|---|---|---|---|---|
| | | Observed | Calculated | | | Total | FI | PDO |
| | | | Predicted | Expected | | | (fatal and injury) | (property damage only) |
| College/Front/Chaplin Proposed | 4SG | - | 3.80 | - | Predicted | 3.80 | 1.26 | 2.53 |

## Safety Results

The results of the HSM analyses for these facilities were combined to compare the overall crashes per year for the existing conditions and the proposed changes. Figure 4 shows the per-year total, fatal-and-injury, and property-damage-only expected crash results from the analyses. The analyses predict a reduction in total crashes per year from 30 to 14, resulting in a decrease in annual fatal-and-injury crashes from 11 to 5 and a decrease in annual property-damage-only crashes from 19 to 9.

**Figure 4. HSM Safety Analysis total combined crashes for existing and proposed alternatives.**

| | Total | FI | PDO |
|---|---|---|---|
| Existing | 29.96 | 10.83 | 19.12 |
| Proposed | 13.69 | 4.98 | 8.71 |

## Summary

This assessment of the proposed change from one-way traffic to two-way traffic, with reduced angle parking, shows that a reduction of crashes is likely along existing facilities, including the intersection of Main Street / Elm Street / College Avenue. Overall, the proposed changes could be expected to reduce total crashes at these facilities by more than half, even with the creation of a new intersection at Front Street / Chaplin Street / College Avenue.

### *Table A-1: Value of Reduced Fatalities and Injuries*

| Recommended Monetized Value(s) | | | | References and Notes |
|---|---|---|---|---|
| **MAIS Level** | **Severity** | **Fraction of VSL** | **Unit value ($2017)** | *Guidance on Treatment of the Economic Value of a Statistical Life in U.S. Department of Transportation Analyses (2016)* https://www.transportation.gov/office-policy/transportation-policy/revised-departmental-guidance-on-valuation-of-a-statistical-life-in-economic-analysis |
| MAIS 1 | Minor | 0.003 | $28,800 | |
| MAIS 2 | Moderate | 0.047 | $451,200 | |
| MAIS 3 | Serious | 0.105 | $1,008,000 | |
| MAIS 4 | Severe | 0.266 | $2,553,600 | |
| MAIS 5 | Critical | 0.593 | $5,692,800 | |
| Fatal | Not Survivable | 1.000 | $9,600,000 | |

| KABCO Level | Monetized Value |
|---|---|
| O – No Injury | $3,200 |
| C – Possible Injury | $63,900 |
| B – Non-incapacitating | $125,000 |
| A – Incapacitating | $459,100 |
| K – Killed | $9,600,000 |
| U – Injured (Severity Unknown) | $174,000 |
| # Accidents Reported (Unknown if Injured) | $132,200 |

**Note:**
The KABCO level values shown result from multiplying the KABCO-level accident's associated MAIS-level probabilities by the recommended unit Value of Injuries given in the MAIS level table, and then summing the products. Accident data may not be presented on an annual basis when it is provided to applicants (i.e. an available report requested in Fall 2011 may record total accidents from 2005-2010). For the purposes of the BCA, is important to annualize data when possible.

### *Table A-2: Property Damage Only (PDO) Crashes*

| Recommended Monetized Value(s) | Reference and Notes |
|---|---|
| $4,327 per vehicle ($2017) | *The Economic and Societal Impact of Motor Vehicle Crashes, 2010 (revised May 2015), Page 12, Table 1-2, Summary of Unit Costs, 2000".*<br><br>Inflated to 2017 dollars using the GDP Deflator. |