Central Avenue
Dover, NH

Merry Street to
Old Rollinsford Road

Transportation Improvement Plan

January 2009

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Table of Contents

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FINAL REPORT
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January, 2009

1. Introduction

Central Avenue, also NH Routes 9 and 108, is the major north-south arterial within the City of Dover. It bisects the Central Business District (CBD), while running to the east of and parallel to the Spaulding Turnpike. The particular focus for this Study is an existing three-lane section located north of the CBD, in the area of Wentworth-Douglass Hospital. The stated Study Area limits are from Merry Street to Old Rollinsford Road, a distance of about 1,600 feet. North of Merry Street, Central Avenue is five lanes, with two travel lanes in each direction and a center two-way left turn lane. South of Old Rollinsford Road (in the vicinity of Oak Street), Central Avenue widens to allow on-street parking. Three lanes are maintained until Ham Street, where the center turn lane stops and the roadway becomes two lanes leading into the CBD.

The Study Area is in the midst of a land use transformation away from its historical residential use. Wentworth-Douglass Hospital, the primary feature in the Study Area, is a sizeable employer within the community as well as a major regional service provider. The Hospital recently expanded by adding new medical and parking facilities. Further expansion plans (100 new beds) are expected in the near future. The City also has before it an application for medical office facilities to be constructed across the street from the Hospital complex in the place of several single family homes. Other properties in the Study Area are currently for sale and being marketed as commercial properties.

Given expected changes in land use within this section of Central Avenue over the next 10-20 years, the City has commissioned this evaluation of current and future traffic operations to determine if action needs to be taken to preserve mobility and safety for this important arterial while still allowing growth to occur on abutting properties. The City would like to create a combined land use/transportation plan that preserves the functional integrity of Central Avenue as a major arterial into and out of the City's CBD, while balancing the public and private needs for access to the adjacent land parcels.

2. Existing Conditions

An Existing Conditions Analysis Report was prepared for the Study Area in July 2008. This document summarized the data collection efforts conducted as part of this Study effort and presented some initial findings regarding safety and capacity on this section of Central Avenue. A full copy of this Interim Report is available at City Planning, but the highlights are summarized below.

Existing Land Use and Zoning

Central Avenue between Old Rollinsford Road and Merry Street is characterized by a mix of land uses – some medical, some residential, and some commercial. The existing zoning within the Study Area is predominantly O, Office, along both sides of Central Avenue, with the exception of an area of B-3, Thoroughfare Business, at the northeast end of the Study Area. To the east of the Study Area is the Town boundary with Rollinsford. To the west is R-12, Medium Density Residential. See Figure 1.

Roadway Features

Central Avenue between Merry Street and Old Rollinsford Road is generally 38-39 feet curb-to-curb. The current pavement markings allow for one 11 foot travel lane in each direction, an 11 foot center two-way left turn lane, and two 2.5 to 3 foot shoulders. There are 5 foot minimum concrete sidewalks on both sides of the street the entire length of the Study Area. For most of the length, a grass esplanade ranging in width from 2 feet to 5 feet exists between the curbing and sidewalks.

Aerial utility poles line the street on the west side for most of its length.

The existing pavement is in fair condition, but is beginning to show signs of distress.

The COAST and Wildcat Transit both have established routes along this section of Central Avenue. Bus Stops are located curbside in both directions on Central Avenue in front of the Hospital.

Within the Study Area (1,600 feet in length) there are six intersecting side streets and major entrances – Old Rollinsford Road, Abbott Street, Lowell Street, Merry Street, the emergency entrance to the Hospital, and the entrance to Hannaford's. In addition, there are a total of twenty-three (23) curb cuts associated with existing residences or businesses. See Figure 1.

Daily Traffic Volumes

The Strafford Regional Planning Commission placed Automatic Traffic Recording (ATR) tubes across Central Avenue during the week of June 2-9, 2008 at a location near #802 Central Avenue, the Direct Sign business. The bi-directional Average Daily Traffic (ADT) recorded for

this time period was 22,279 vehicles. It should be noted that school was in session during this data collection period.

Traffic Composition and Speed

Data from the ATR counts indicated that the vehicle composition on Central Avenue is predominantly passenger cars and small trucks, Vehicle Classifications 1-6. The percentage of large trucks, Classes 7-10, is approximately 2 percent of the typical traffic stream.

The posted speed is 30 mph. Spot travel speed information was also recorded at the ATR location. Data showed that the 85 percentile speed at this mid-block location was 37 mph in the northbound direction and 39 mph in the southbound direction.

Peak Hour Volumes

Based on the ATR data, the peak hour period of 4:45 to 5:45 PM on Friday was selected for analysis. This time period is approximately 7% higher than the typical weekday PM peak hour, and therefore, represents a typical worst case scenario for the Corridor. Subsequently, two hour long turning movement counts were collected at the following intersections on Friday, June 13, 2008, between 4:00 PM and 6:00 PM:

- Central at Morin
- Central at Glenwood
- Central at Hannaford's
- Central at Merry
- Central at Hospital
- Central at Lowell
- Central at Abbott
- Central at Old Rollinsford
- Central at Oak

It should be noted that four of the above intersections are outside the Study Area limits – Morin, Glenwood, Hannaford's, and Oak. Data was collected at these intersections to see if signal coordination could be achieved throughout the Corridor as a means of improving traffic flow. The results of these counts are depicted on Figure 2, 2008 Existing PM Peak Hour Volumes.

Traffic Signal Equipment Inventory

All signalized intersections within the Study Area have new Eagle EPAC 300 controllers. These were installed as part of a signal upgrade project in 2004. The controller at Hannaford's is the Master for this group in the City's MarcNX centrally controlled signal management system. The signals at Morin, Glenwood, and Hannaford's have a hardwire interconnect and are coordinated. The signal at Old Rollinsford has a D Connector, but we saw no evidence of a physical interconnect. This controller did seem to be time-based coordinated with the three intersections to the north. The traffic signal at Oak Street was not interconnected or coordinated with the other signals. It is programmed to operate "free".

During our site inspection, we noted that the pedestrian push button next to the Hannaford's controller was broken. We also observed that the pedestrian heads on the Shopping Plaza side of the Morin intersection were not working properly either. We also noted that the SB and NB left turn movements at Morin are currently operating protected/permitted, which means left turns are allowed to make turns across two lanes of opposing traffic. We did not research the accident history at this intersection because it is not officially part of the Study Area. In Maine, this would violate State policy because of the potential safety hazard. Left turn movements opposing two lanes of traffic are required to be protected only. The City should review the crash data at this intersection to see if there is a problem caused by this situation. If so, then the traffic signal should be reprogrammed to make the Central Avenue left turns protected only rather than protected/permitted.

Existing Traffic Operations

A Synchro/SimTraffic model was created to analyze the existing traffic operations along Central Avenue from Morin to Oak Streets. The traffic signal phasings and timings used for this initial model were those recorded during the inventory of the existing signal equipment. Therefore, this particular model represented existing conditions as they are on the street today. In other words, no attempt was made to optimize existing signal performance as part of this initial analysis. The results of this existing conditions analysis are presented in Tables 1-6 and shown on Figure 3.

Table 1
Existing Signalized Intersection Performance
Central at Morin

Approach	LOS[1]	Movement	LOS[1]	95th Percentile Queue (FT)[2]
Central Ave. SB	A	SB LT	B	94
		SB TH	A	142
		SB RT	A	114
Central Ave. NB	A	NB LT	B	46
		NB TH	A	286
		NB RT	A	292
Morin EB	C	EB LT	D	84
		EB TH	-	-
		EB RT	A	84
Shaw's WB	A	WB LT	D	66
		WB TH	C	66
		WB RT	A	46
		Overall	A	

[1] LOS stands for Level of Service. Level of Service is a measure of average delay experienced by a vehicle as is travels through an intersection or section of roadway. It is expressed in terms of A through F, with A being the optimal and F being unsatisfactory or high delay. An LOS of D is usually acceptable in most urbanized areas.

[2] 95th percentile queue is the length of back-up on each intersection approach that is not expected to be exceeded more than 5% of the time.

Table 2
Existing Signalized Intersection Performance
Central at Glenwood

Approach	LOS	Movement	LOS	95th Percentile Queue (FT)
Central Ave. SB	B	SB LT	D	100
		SB TH	B	304
		SB RT	A	102
Central Ave. NB	B	NB LT	**E**	140
		NB TH	B	279
		NB RT	A	39
Glenwood EB	**F**	EB LT	**F**	566
		EB TH	**F**	369
		EB RT	**F**	43
Shaw's WB	C	WB LT	D	97
		WB TH	C	103
		WB RT	A	-
		Overall	**E**	

Table 3
Existing Signalized Intersection Performance
Central at Hannaford's

Approach	LOS	Movement	LOS	95th Percentile Queue (FT)
Central Ave. SB	A	SB LT	D	148
		SB TH	A	233
Central Ave. NB	A	NB TH	B	406*
		NB RT	A	406*
Hannaford's WB	B	WB LT	D	129
		WB RT	A	53
		Overall	B	

* This queue frequently spills past Merry Street

Table 4
Existing Unsignalized Intersection Performance
Central at Hospital

Approach	LOS	Movement	LOS	95th Percentile Queue (FT)
Central Ave. SB	A	SB LT	C	59
		SB TH	A	-
Central Ave. NB	A	NB TH	A	-
		NB RT	A	-
Hospital WB	D	WB LT	D	97
		WB RT	D	107
		Overall	A	

Table 5
Existing Signalized Intersection Performance
Central at Old Rollinsford

Approach	LOS	Movement	LOS	95th Percentile Queue (FT)
Central Ave. SB	B	SB LT	D	53
		SB TH	B	366*
Central Ave. NB	B	NB TH	B	510**
		NB RT	A	-
O. Rollinsford WB	C	WB LT	D	185
		WB RT	C	112
		Overall	B	

* This queue frequently spills past Abbott and Lowell Streets.
** This queue frequently spills past Abbey Sawyer Memorial Highway.

Table 6
Existing Signalized Intersection Performance
Central at Oak

Approach	LOS	Movement	LOS	95th Percentile Queue (FT)
Central Ave. SB	C	SB LT	D	345
		SB TH	A	414
		SB RT	A	414
Central Ave. NB	C	NB LT	C	41
		NB TH	C	371
		NB RT	A	45
Reservoir EB	D	EB LT	D	77
		EB TH	C	77
		EB RT	C	77
Oak WB	C	WB LT	D	124
		WB TH	D	124
		WB RT	B	173
		Overall	C	

The unsignalized intersections of Merry, Lowell, and Abbott Streets with Central Avenue often experience spill back and are blocked by the queues from the traffic signals at Hannaford's and Old Rollinsford Road resulting in poor LOS for these locations.

Central Avenue currently operates at a reasonable LOS for most of its length during the weekday PM peak period. There are several locations where queues get quite long and block some intersections as stated above, but for the most part vehicles move quite well through the Study Area. Field observations (northbound and southbound travel time runs on Central Avenue during the PM peak hour) made on June 27, 2008 seemed to validate these model results. Using the Transportation Research Board's (TRB's) Highway Capacity Manual's methodology for urban streets, the recorded average travel speeds between Oak Street and Morin ranged from

17.7 mph NB to 18.9 mph SB. These travel speeds equate to a roadway LOS of D for this Class III urban street.

The most noticeable deficiency in the corridor appears to be the intersection of Glenwood. This intersection is outside the official Study Area, but motorists experience excessive delays and poor LOS on Glenwood during the peak hour due to the limited available green time allotted to this intersection leg.

Recent Crash History

With the assistance of the Dover Police Department, STI was able to review the specific accident reports on file for the three year period, 2005-2007, for the Study Area. Sgt. Marn Speidel, of the Department, identified 51 incident reports that dealt with accidents on Central Avenue between Old Rollinsford Road and Merry Street. STI evaluated this information at the Police Station on May 6, 2008. The findings of this investigation revealed the following:

- The percentage of crashes involving NB and SB vehicles was about evenly split - 27 (or 53%) involved vehicles traveling SB on Central Avenue, and 24 (or 47%) involved vehicles traveling NB.
- 92% (47) occurred during the daylight hour.
- 76% (39) occurred on dry pavement.
- 24% (12) occurred during snow, ice or rainy conditions.
- 59% (30) of the crashes were rear-ends as a result of congestion (stop and go traffic).
- No major injuries or fatalities occurred, only 1 had a confirmed injury, 11 had possible injuries, and 39 or 75% of the crashes had no injuries – property damage only.
- 5 involved the SB two-to-one lane merge.
- 5 involved exiting left turn vehicles from Abbott Street.
- 3 involved exiting left turn vehicles from Merry Street.
- Only 2 crashes occurred at the signalized intersection of Old Rollinsford Road.
- No crashes occurred at Lowell Street.
- Only 1 crash occurred at the Emergency Access to the Hospital.
- 76% (39) occurred on Central Avenue between intersections.

Figure 4 illustrates the main findings of this investigation.

3. Anticipated Future Traffic Growth

Overall Central Avenue has experienced considerable growth in traffic volumes since 2004. According to Strafford Regional Planning Commission historical records, volumes on Central Avenue between Glenwood and Hannaford's, have risen 47% (17,000 to 25,000), and north of Chestnut the increase has been 26% (17,000 to 21,000). While no specific Automatic Traffic Recorder counts are available for the section of Central Avenue that is the focus of this

Study, turning movement data was available from the City's traffic signal upgrade project completed in 2004, and the Hospital parking garage expansion project in this same timeframe. From this information, it is interesting that traffic on Central Avenue in front of the Hospital has not increased since 2004, but remained fairly stable, which is not consistent with other growth within the Corridor. It may be that motorists with time constraints are avoiding this section of Central Avenue and using the Turnpike instead.

Given the current economic times, it is unlikely that traffic growth within the Study Area will be significant over the next ten years. The current slowdown in the economy and the price of gas are beginning to have an effect on traditional driving habits. Therefore, the future forecast for background growth selected for this Study is 0.75% per year compounded for the ten-year planning horizon. This translates to a total increase of about 8% by the year 2018. Figure 5 presents these trips and how they have been assigned to the Study Area network.

This background growth, however, does not include the direct changes in trip generation that may occur within the Study Area due to redevelopments and expansions. To estimate these trips, we used two sources – one was the Hospital's traffic engineer for their current expansion plans, and the other was a "build out" scenario we developed based on the City's current zoning and the one development proposal that was currently before the City for Site Plan approval.

The Hospital's proposed expansion plan calls for an additional 160,561 s.f. of space to be built on their campus. Using ITE standard trip rates for this type of land use we estimated 189 new trips would be added to Central Avenue during the PM peak hour. This would be broken down into 127 exiting and 63 entering the Hospital. This data was compared with some field count information gathered by the Hospital's traffic engineer and found to correlate fairly well. These peak hour trips were assigned to the Study Area road network and can be seen in Figure 6.

For the other Study Area redevelopment trips, we created the "build out" scenario that is shown in Figure 7. The trip generation resulting from these land use changes can be seen in Table 7.

Table 7
Potential Future Trip Generation Caused by Study Area Redevelopment

Location/ ITE LUC	Size (1,000 S.F.)	Trip Rate	Total	Enter	Exit
Lot A - #710 Medical Office	17	3.72	63	17	46
Lot B – LUC #565 Day Care	8.25	13.18	109	51	58
Lot C – LUC #710 Medical Office	22.4	3.72	83	22	61
Lot D – LUC #230 Residential Condos	8	0.52	4	3	1
Lot D – LUC #710 Medical Office	24	3.72	89	24	65
Totals			348	117	231

Note: LUC is ITE's Land Use Code

Figure 8 illustrates how these trips were distributed onto the Study Area network.

The 2018 volumes for the Study Area were then derived by combining the new trips estimated for background growth from 2008 to 2018 (Figure 5), the current Hospital's expansion (Figure 6), and the potential changes in Study Area land uses (Figure 8) with the 2008 existing volumes (Figure 2). Figure 9 presents these combined volumes.

With the above set of assumptions regarding the next ten years, it appears that traffic on Central Avenue through the Study Area could increase by as much as 14-19 percent over today's volumes.

4. Future Traffic Operations - 2018

A second Synchro/SimTraffic model was created using the traffic volumes in Figure 9 to analyze the Study Area's traffic operations in the future analysis year of 2018. The underlying assumptions of this model were that the Corridor's redevelopment would happen as envisioned in Figure 7, i.e. curb cuts would be reduced on Central Avenue, and several parcels would develop means of rear access. Another assumption was that the City would monitor the Corridor's traffic signal system and alter its programming as needed to optimize arterial flow. For the model, this consisted of reducing the cycle length of the coordination plan for the northerly three intersections from 90 seconds to 70 seconds, adding a phase for the additional leg at Hannaford's, reducing the cycle length at Old Rollinsford Road from 90 seconds to 70 seconds, and increasing the cycle length at Oak Street from 70 seconds to 80 seconds. Finally, the last assumption was that the intersection of Central Avenue and Old Rollinsford would be relocated approximately 100 feet southerly from its present location in keeping with the Hospital's current expansion proposal[3]. The results of this scenario are presented in Tables 8-13 and shown on Figure 10. Using the TRB's Highway Capacity Manual's methodology for urban streets, the average travel speeds under this future scenario would deteriorate slightly (1-2 mph in each direction), but remain in the LOS D range for this Class III urban street.

Table 8
2018 Signalized Intersection Performance
Central at Morin

Approach	LOS	Movement	LOS	95th Percentile Queue (FT)
Central Ave. SB	A	SB LT	C	140
		SB TH	A	166
		SB RT	A	188
Central Ave. NB	A	NB LT	B	34
		NB TH	A	208
		NB RT	A	215
Morin EB	C	EB LT	C	65
		EB TH	-	-
		EB RT	B	65
Shaw's WB	A	WB LT	D	53
		WB TH	B	53
		WB RT	A	65
		Overall	A	

[3] The proposed relocation of Old Rollinsford Road southerly could have two negative effects on traffic operations on Central Avenue. First, the existing NB free right turn lane would be eliminated, or at least reduced in length significantly. This will lengthen the NB queues on Central Avenue. Second, the existing Old Rollinsford Road intersection is a 3-legged intersection. With the relocation, this intersection would add a fourth leg and it is not known what impacts this would have on the overall operation of the new intersection compared with today. Both of these issues should be evaluated by the Hospital as part of their Site Plan Review process and appropriate mitigation plans proposed and implemented by the Hospital – one example being to create an exclusive NB RT lane for the Hospital at the new Old Rollinsford Road intersection.

Table 9
2018 Signalized Intersection Performance
Central at Glenwood

Approach	LOS	Movement	LOS	95th Percentile Queue (FT)
Central Ave. SB	D	SB LT	E	82
		SB TH	D	636
		SB RT	D	121
Central Ave. NB	B	NB LT	**E**	190
		NB TH	B	304
		NB RT	A	43
Glenwood EB	**E**	EB LT	**F**	482
		EB TH	C	170
		EB RT	B	-
Shaw's WB	C	WB LT	D	94
		WB TH	D	90
		WB RT	A	--
		Overall	D	

Table 10
2018 Signalized Intersection Performance
Central at Hannaford's

Approach	LOS	Movement	LOS	95th Percentile Queue (FT)
Central Ave. SB	B	SB LT	C	163
		SB TH	A	236
Central Ave. NB	B	NB TH	B	731 (363*)
		NB RT	B	731 (363*)
Hannaford's WB	**E**	WB LT	**F**	304
		WB RT	A	107
Driveway EB	D	EB LT	D	52
		EB RT	A	52
		Overall	B	

* With restriping of the first 100' of the center two-way left turn lane into a NB thru lane

Table 11
2018 Unsignalized Intersection Performance
Central at Hospital

Approach	LOS	Movement	LOS	95th Percentile Queue (FT)
Central Ave. SB	A	SB LT	C	64
		SB TH	A	161*
Central Ave. NB	A	NB TH	A	-
		NB RT	A	-
Hospital WB	**F**	WB LT	**F**	272
		WB RT	**F**	238
Development EB	**F**	EB LT	**F**	111
		EB RT	**F**	111
		Overall	C	

* This queue is a result of spill back from Old Rollinsford Road

Table 12
2018 Signalized Intersection Performance
Central at Old Rollinsford

Approach	LOS	Movement	LOS	95th Percentile Queue (FT)
Central Ave. SB	B	SB LT	D	50
		SB TH	B	623*
Central Ave. NB	B	NB TH	B	680**
		NB RT	B	69
O. Rollinsford WB	**F**	WB LT	**F**	514
		WB RT	**F**	151
		Overall	C	

* This queue will spill past Abbott and Lowell Streets.
** This queue will spill past Abbey Sawyer Memorial Highway and sometimes reach Oak Street.

Table 13
2018 Signalized Intersection Performance
Central at Oak

Approach	LOS	Movement	LOS	95th Percentile Queue (FT)
Central Ave. SB	E	SB LT	F	378 (400*)
		SB TH	C	1557 (379*)
		SB RT	C	1557 (379*)
Central Ave. NB	C	NB LT	D	45
		NB TH	C	496
		NB RT	A	40
Reservoir EB	D	EB LT	C	89
		EB TH	D	89
		EB RT	D	89
Oak WB	D	WB LT	F	241
		WB TH	F	241
		WB RT	C	198
		Overall	D	

* With restriping of the center two-way left turn lane into a SB left turn lane for a total of 400 feet

It can be seen from Tables 8-13 that operations are beginning to fail in a number of locations as a result of the projected growth in traffic within the Study Area. In particular, Glenwood has begun to fail again and experience long queues similar to today, exiting traffic from Hannaford's will experience long delays and poor LOS, both minor approaches at the Hospital entrance will experience long delays and poor LOS, exiting traffic from Old Rollinsford Road (also the Hospital) will experience long delays and poor LOS, and two legs of the Oak Street intersection will have long delays and poor LOS. Several of these locations can be corrected by altering the existing pavement markings. For instance, if the two NB thru lanes at the Hannaford's intersection were lengthened by 100 feet by shortening the two-way center left turn lane, the queue for this movement would reduce from 731 feet to 363 feet. If the SB left turn lane at Oak Street were lengthened from 200 feet to 400 feet by shortening the two-way center left turn lane, the queue at this location would be reduced from 1,557 feet to 379 feet. Finally if a NB right turn lane were provided at relocated Old Rollinsford Road, the queue in this lane would be reduced. While making these pavement marking changes improves operations on Central Avenue, they will come at the expense of the abutting properties in the immediate vicinity. Access into and out of these abutting properties during the PM peak hour will become very difficult, if not impossible. For this reason, we believe that alternative means of access from these properties should be investigated immediately. Fortunately, there is a plan proposed herein for addressing the abutters near the Hannaford's intersection.

What is not readily apparent is a solution to the access into and out of the Hospital at either of their entrances on Central Avenue. The unsignalized entrance will experience SB spill back from the Old Rollinsford Road traffic signal, even after it is relocated 100 feet southerly. The Old Rollinsford Road traffic signal in its relocated position will provide failing LOS for the Old Rollinsford Road leg in order to keep traffic moving on Central Avenue. The Hospital should explore these issues with the City during their upcoming Site Plan review, and provide some mitigating action strategies that they are willing to implement, such as providing an exclusive

NB RT lane into the relocated Old Rollinsford Road intersection to minimize NB queues at the traffic signal.

The results presented above do not reflect any attempt on the part of the City, the businesses within the Study Area, or the community as a whole to change existing travel habits or commuting choices. This is essentially a picture of the status quo ten years hence with some alterations in signal timing and pavement markings.

It should be noted that other traffic control alternatives were explored as part of this analysis, such as adding a traffic signal at the Hospital entrance and removing the traffic signal at Old Rollinsford Road. In addition, roundabouts were cursorily considered for the hospital entrance and the Old Rollinsford Road intersection. Unfortunately, none of these strategies seemed to result in better overall operations from what exists today for traffic control.

5. Public Process

Two public, or stakeholder, meetings were held as part of the Study Process – the first on July 10 and the second on December 8, 2008. The first meeting attracted 10-15 members of the public, including residents and business owners from the Study Area. The purpose of this meeting was to present the findings of an existing conditions analysis that included information on traffic volumes, corridor levels of service, queue lengths, and crash data. The consultant team sought input and ideas on how to address these findings as presented. Feedback included making Merry Street one-way in, making Lowell Street one-way in, and signalizing Abbot Street as part of the Old Rollinsford Road intersection. In addition, the residents present discouraged the idea that local streets be used to expand Central Avenue's capacity. Cut-through traffic on existing neighborhood streets would not be viewed as a positive outcome of this Study, and any new parallel streets to ease congestion on Central Avenue should be located on the east side of Central Avenue – not the west side. Roundabouts were discussed as a traffic control strategy, but these were not perceived positively among some attendees. The COAST indicated that their business was on the rise and they would be willing to work with the City to improve service to this area, if businesses would be cooperative.

The consultant team used the second public/stakeholder meeting to present its draft recommendations and again seek feedback before finalizing the Study. The attendance at this meeting was similar to the first meeting – 10-15 members of the public, including residents and corridor businesses. A forecast was presented for future traffic volumes within the corridor, and a series of actions were outlined that addressed short-term, intermediate-term and long-term corridor needs. Comments expressed by those present included the ability to make left turns out of Lowell Street once the new development was built on Lots 794 to 800, and relocating the traffic signal heads on Central Avenue at Old Rollinsford Road such that Abbot Street would be apart of this intersection. Page Street residents were concerned that the idea of providing an access drive for Lots 806 to 818 might eventually lead to a connection with Page Street and make it a through street with increased traffic. They suggested this recommendation be shifted to the long-term category and done in conjunction with this area's redevelopment. Someone questioned whether Lowell Street should be realigned with the Hospital emergency entrance. Positive comments were received about adding a formal bus pull out and shelter at the Hospital to increase transit usage. Responses to these comments from the consultant team were as follows:

- Realigning Lowell Street with the Hospital entrance – This was considered by the consultants, but the vertical profile of Lowell Street is rather steep as it approaches Central Avenue. This was felt to be problematic for exiting vehicles, especially in the winter. Another complicating factor was the pending redevelopment of Lots 794-802. This site plan would have to be substantially reworked, and land acquired from this developer to realign Lowell Street. Given that there were no documented accidents at this location and the Study recommendations included the provision of a new a median island in Central Avenue northerly of Lowell Street to improve safety at this location, it was felt that the cost of realignment was far greater than the expected benefits.

- Incorporating Abbott Street into the Old Rollinsford Road signalized intersection - (Post Meeting Response) This idea was analyzed by the consultants and found to yield a lower performance level for traffic passing through this intersection than the existing condition. Because Abbott Street and Old Rollinsford Road are offset and not directly across from each other, each street would need to be operated on its own phase, which would reduce green time on Central Avenue. As a result, queues on Central Avenue would increase substantially in both directions. In addition, if Old Rollinsford Road is relocated southerly, the offset between Old Rollinsford and Abbott would be about 200 feet, which would make operations potentially unsafe in off-peak times for NB vehicles that might not entirely clear the intersection before the Abbot Street phase was called.

- Timing of rear access drive using Page Street ROW – (Post Meeting Response) This particular area has safety issues today with the SB merge. The consultants considered delaying this recommendation as suggested by Page Street residents, but decided it would be best to investigate it sooner rather than later, so it remains as a short-term action item.

City staff provided the consultant with comments, as well. These can be addressed as follows:

- Why not realign Lowell Street with the Hospital entrance? See response to similar public comment above.

- Why not close off Abbott Street? This is certainly a possibility, but we heard from area residents that they did not want more traffic on their neighborhood streets. A full or partial closure of Abbott Street would seem to do just that. Instead, we proposed a solution to make exiting Abbott Street safer.

- Did we consider creating a connection from the Hospital to Ridge Street? We did and realized that this would involve the acquisition of one or more residential properties. This, in combination with the fact that the benefits from a traffic diversion perspective were not that apparent, led the consultants to conclude that this ideas was not worth pursuing.

6. Improvement Actions – Short Term (2008)

Study Objectives

It is important to keep the three main objectives of this Study in mind while reviewing the following recommended improvement actions.

- Preserve and improve mobility and efficiency for Central Avenue without any roadway widening.

- Maintain access to abutting properties within the corridor to allow for orderly redevelopment through access management and other proven techniques.

- Improve safety for all users of this main artery.

Traffic Signal Retiming

The City can improve the overall traffic operations on Central Avenue from Morin to Oak Street simply by adjusting the current traffic signal timings and phasings. The arterial traffic flow for Central Avenue can be improved and a minimum LOS of D achieved for most all of the side street movements by adjusting the current traffic signal system programming. Morin, Glenwood, and Hannaford's should remain coordinated, but there does not appear to be a noticeable advantage to interconnect and coordinate Old Rollinsford and Oak Street. The system seems to work fine when these locations remain operating in a "free" mode.

Tables 14-19 illustrate the improvement in traffic operations that can be achieved today by reducing the cycle length from 100 seconds to 70 seconds and adjusting the green times at Oak Street, reducing the cycle length from 90 seconds to 70 seconds and adjusting the green times at Old Rollinsford Road, and adjusting the phasing, green times and offset at Glenwood.

Table 14
2008 Signalized Intersection Performance
Central at Morin

Approach	LOS (*)	Movement	LOS		95th Percentile Queue (FT)	
			Existing	Optimized	Existing	Optimized
Central Ave. SB	A (A)	SB LT	B	B	94	86
		SB TH	A	A	142	127
		SB RT	A	A	114	103
Central Ave. NB	A (A)	NB LT	B	B	46	24
		NB TH	A	A	286	318
		NB RT	A	A	292	312
Morin EB	C (D)	EB LT	D	D	84	93
		EB TH	-	-	-	-
		EB RT	A	B	84	93
Shaw's WB	A (A)	WB LT	D	D	66	58
		WB TH	C	D	66	58
		WB RT	A	A	46	97
		Overall	A	A		

* LOS under the optimized condition

Table 15
2008 Signalized Intersection Performance
Central at Glenwood

Approach	LOS (*)	Movement	LOS		95th Percentile Queue (FT)	
			Existing	Optimized	Existing	Optimized
Central Ave. SB	B (C)	SB LT	D	D	100	148
		SB TH	B	C	304	366
		SB RT	A	B	102	124
Central Ave. NB	B (C)	NB LT	**E**	D	140	143
		NB TH	B	C	279	469**
		NB RT	A	A	39	66
Glenwood EB	**F** (C)	EB LT	**F**	D	566	208
		EB TH	**F**	C	369	78
		EB RT	**F**	A	43	53
Shaw's WB	C (C)	WB LT	D	D	97	99
		WB TH	C	D	103	88
		WB RT	A	A	-	-
		Overall	**E**	C		

* LOS under the optimized condition
****** This queue increased as a result of reallocating green time to Glenwood.

Table 16
2008 Signalized Intersection Performance
Central at Hannaford's

Approach	LOS (*)	Movement	LOS		95th Percentile Queue (FT)	
			Existing	Optimized	Existing	Optimized
Central Ave. SB	A (B)	SB LT	D	D	148	145
		SB TH	A	A	233	351
Central Ave. NB	A (B)	NB TH	B	B	406**	908***(350)
		NB RT	A	B	406**	908***(350)
Hannaford's WB	B (B)	WB LT	D	D	129	143
		WB RT	A	A	53	63
		Overall	B	B		

* LOS under the optimized condition

** This queue frequently spills past Merry Street

*** This queue lengthened as a result of reallocating green time to Glenwood. It is unlikely though that this queue would reach this length because motorists would use the two-way center turn lane for NB storage.

(350) With restriping of the first 100 feet of the center 2-way left turn lane into a NB thru lane this queue can be reduced to 350 feet.

Table 17
2008 Unsignalized Intersection Performance
Central at Hospital

Approach	LOS (*)	Movement	LOS		95th Percentile Queue (FT)	
			Existing	Optimized	Existing	Optimized
Central Ave. SB	A (A)	SB LT	C	B	59	54
		SB TH	A	A	-	-
Central Ave. NB	A (A)	NB TH	A	A	-	-
		NB RT	A	A	-	-
Hospital WB	D (D)	WB LT	D	D	97	81
		WB RT	D	C	107	117
		Overall	A	A		

* LOS under the optimized condition

Table 18
2008 Signalized Intersection Performance
Central at Old Rollinsford

Approach	LOS (*)	Movement	LOS		95th Percentile Queue (FT)	
			Existing	Optimized	Existing	Optimized
Central Ave. SB	B (A)	SB LT	D	C	53	48
		SB TH	B	A	366**	367**
Central Ave. NB	B (B)	NB TH	B	B	510***	450***
		NB RT	A	A	-	102
O. Rollinsford WB	C (D)	WB LT	D	**E**	185	238
		WB RT	C	D	112	135
		Overall	B	B		

* LOS under the optimized condition
** This queue frequently spills past Abbott Street.
*** This queue frequently spills past Abbey Sawyer Memorial Highway.

Table 19
2008 Signalized Intersection Performance
Central at Oak

Approach	LOS (*)	Movement	LOS		95th Percentile Queue (FT)	
			Existing	Optimized	Existing	Optimized
Central Ave. SB	C (B)	SB LT	D	D	345	309
		SB TH	A	A	414	176
		SB RT	A	A	414	176
Central Ave. NB	C (B)	NB LT	C	C	41	17
		NB TH	C	B	371	347
		NB RT	A	A	45	45
Reservoir EB	D (C)	EB LT	D	C	77	69
		EB TH	C	C	77	69
		EB RT	C	B	77	69
Oak WB	C (C)	WB LT	D	D	124	165
		WB TH	D	D	124	165
		WB RT	B	B	173	159
		Overall	C	C		

* LOS under the optimized condition

It is evident from Tables 14-19 that optimization of the traffic signals will improve a number of movements within the corridor. In particular, the failing Glenwood approach is corrected to a LOS C. The queues on Central Avenue will get longer at some locations with the optimization because of the reallocation of green time among some of the side streets. This can be addressed in part by altering the existing pavement markings as suggested in the Section 4 under the discussion of 2018 queue lengths.

Overall network delay on Central Avenue from Morin to Oak will be reduced by 27 percent, from 85 seconds to 62 seconds. Network delay is the average delay per vehicle experienced by all vehicles entering and exiting Central Avenue from Morin to Oak during the analysis period. Over the course of a year, this will add up. Using the above figures, approximately 58 hours of travel time and 32 gallons of gasoline can be saved by motorists regularly traveling through this section of Central Avenue during one PM peak hour. Over a year this would amount to over 5,200 hours of travel time and 3,880 gallons of gasoline saved. In addition, approximately 36 less pounds of HC, and 30 less pounds of CO would be released into the atmosphere. This is just in the first year and only during the afternoon rush hour.

Other Short Term Improvement Actions

Other immediate or short-term improvement actions that can be taken by the City include the following. These suggestions are in no particular order of preference.

- Fully implement the City's centrally managed traffic signal system software (MarcNX) for the Central Avenue traffic signals. When the City replaced the traffic signals on Central Avenue in 2004 they also purchased software for centrally managing these signals. The software was set up at the time, but has not been kept current. The City should reacquaint itself with this software, update it with the optimized 2008 timings and establish a regular daily monitoring program for managing this signal system so that travel can continue to be optimized within this corridor into the future.

- Repair the pedestrian push button at Hannaford's and the pedestrian signal heads at Morin. Also investigate the crash data for the Morin street intersection to see if there is a problem with Central Avenue left turns crossing two lanes of traffic on the existing permitted phase. If so, change the phasing for these movements to protected only.

- None of the intersections evaluated as part of this Study are fully ADA compliant. Truncated domes need to be installed at all crosswalks, and audible pedestrian push buttons should also be provided. In addition, we suggest that the pedestrian heads be changed to the LED countdown type.

- Review the pedestrian phase programming for all intersections within the corridor. If it is exclusive, we strongly suggest changing it to concurrent, unless it is part of a school walking route, to improve traffic flow on Central Avenue. It is recognized that this will be a change of current City policy.

- Convert the Merry Street connection to Central Avenue to "in only" – no exiting permitted. The existing Merry Street connection to Central Avenue is somewhat redundant. The signalized intersection for Hannaford's is within 200 feet. Our traffic analysis and field observations confirmed that NB traffic often queues past Merry Street, blocking the ability to exit this street during the PM peak hour. The crash data compiled for the corridor (2005-2007) indicated that three angle crashes occurred at this location involving motorists exiting Merry Street through the NB queue waiting at the Hannaford traffic signal. Conversion of this intersection to "in only" will not

severely impact abutting properties, since access to Ridge Street will remain. This action, though, will eliminate a current safety problem for the Study Area. See Figure 11. *It should be noted that it is our understanding that the City currently does not have rights to access the Hannaford's traffic signal from Ridge Street. This situation should be rectified by the City through negotiations with Hannaford.*

- Upgrade traffic signal at Old Rollinsford Road[4]. Vanesse Hangen Brustlin, Inc. (VHB) conducted a review of the traffic signal at Old Rollinsford Road in 2006 and sent a letter to the City on August 21, 2006 with some suggested equipment changes. These included:

    - Change the pedestal mounted right-turn red arrow indicator for the right-turn movement from Old Rollinsford Road with a red ball indication.

    - Rewire the westbound right-turn wire loop detector on Old Rollinsford Road to Phase 1.

    - Replace the existing pedestrian push button on the northeast corner of the intersection and add a second pedestrian push button so that concurrent pedestrian movements can be achieved across Old Rollinsford Road. Currently, the pedestrian actuations initiate an "exclusive" pedestrian phase where all traffic stops, rather than only the traffic on the street being crossed by the pedestrian. This action would allow the pedestrian crossing time for Central Avenue to be reduced and therefore improve traffic flow within the corridor.

    - A W2-5 "Y"-type sign with street name designations or similar type sign that delineates Old Rollinsford Road/ Wentworth Douglas Hospital from the Central Avenue through movement should be installed on the pedestal pole currently being used for the emergency vehicle preemption receiver located at the nose of the NB delta island.

[4] This action will not be necessary if the Hospital moves forward with a relocation of the Old Rollinsford intersection as the preliminary plans indicate.

- Improve signage and pavement markings for the SB lane reduction at Merry Street. Central Avenue SB has a lane drop just south of Merry Street – the two thru lanes become one. The area is currently signed with two ground mounted lane ends signs (W4-2 and W9-2 left), but these signs are old and not very noticeable. The pavement markings are laid out without any clarity as to which lane ends – the right or the left. This may be causing some confusion. Crash data reveals that 5 sideswipe accidents occurred at this location. While sideswipe-type accidents are common and to be expected at lane drops, improvements in signage (an overhead mounted lane ends sign, W4-2 left or W9-2 left) and modifications to the lane striping that clarify the left lane is to merge right would improve this situation.

- Implement safety measures for left-turners exiting Abbott Street. The crash data for the Study Area indicates that there is a problem with cars exiting Abbott Street attempting to make a left-turn onto Central Avenue NB. It appears that the SB queues from the Old Rollinsford Road traffic signal tend to block Abbott Street. Vehicles trying to exit Abbott Street during this situation are sometimes let out by vehicles waiting in the thru lane queue, but are struck by vehicles in the middle turn lane traveling SB to turn left into the Hospital at Old Rollinsford Road. A total of 5 crashes occurred between 2005-2007 with this as the scenario. A solution to this situation would be to install raised median islands in Central Avenue between the two Hospital entrances to restrict access to the left-turn lane at Old Rollinsford Road. If access to the left-turn storage bay were controlled, the conflicts now occurring would be prevented and this safety issue eliminated. See Figure 11.

- Pursue the development of a rear access driveway within the existing Page Street ROW for access to Parcels # 806, 812, 814, 816, and 818. This driveway would connect with the signalized intersection at Hannaford's and would thus facilitate exiting safely from these parcels onto Central Avenue. This driveway would not connect with the end of existing Page Street, so that it could not be used as a "cut-through" the Page Street neighborhood. See Figure 11.

- Review current zoning with an eye toward targeting low traffic generating uses. The build out scenario created to estimate future traffic generated within the Study Area associated with the redevelopment of the existing residential properties was created on the basis of current zoning parameters. The land uses selected for this analysis (See Table 7) are all allowable under the current zoning. A mix of office and supporting services (a Day Care) were assumed. The net result was a total of 348 new trips generated during the PM peak hour. While it is impossible to predict with certainty how this section of Central Avenue will ultimately redevelop, the scenario presented does conform with current zoning requirements. It is recommended, therefore, that the City reexamine its current zoning for this section of Central Avenue to see if it could institute some more restrictive provisions that would

target lower traffic generators. For instance, the Day Care is currently a permitted use, but it is evident from Table 7 that it carries with it a much higher trip producing rate than the medical offices. Another example would be that General Office space has a trip rate less than half of the Medical and Dental Office rate (1.49 per 1,000 s.f. during the PM peak hour vs. 3.72 per 1,000 s.f.). Being proactive to focus on lower traffic producing developments in the corridor will result in less pressure on Central Avenue as eventual redevelopment occurs.

- Explore traffic reducing strategies for the Corridor. Since increasing capacity is not an option for this corridor, the City and its abutters should collectively explore various ways to better manage travel demand. Typical strategies include altering work schedules by implementing flextime and/or compressed work weeks, encouraging telework by certain employees, and promoting alternatives to driving to work alone. According to the 2000 Census:

  - 81.8% of New Hampshire residents drove to work alone.
  - 9.8% car pooled.
  - 0.7% used public transportation.
  - 2.9% walked.
  - 0.8% biked.
  - 4.0% worked at home.
  -The average commuting time to work was 25.3 minutes.

  Fortunately, much of the required infrastructure is already in place for the Dover community to achieve success in this area.

  Currently there are two bus lines that service Central Avenue – the COAST and Wildcat Transit. We met with representatives of the COAST and they admit that their service on Central Avenue is not currently that robust. Two issues were cited for this lack of ridership – one was their current headways, which are about 1 hour and 20 minutes, and the other was the fact that the corridor is not very transit friendly, i.e. no bus stop pull outs, no shelters for waiting passengers, and no provisions on adjacent sites to accommodate employees or patrons arriving on foot. The COAST indicated a willingness to work with the City and area businesses to increase their service during peak commuting times if corridor businesses were willing to encourage its usage by their employees.

  Employers can provide transit passes to employees tax free in addition to their existing salary. Employers deduct the cost of the benefit from their corporate income taxes. The benefit is free from all federal income and payroll taxes to the employee because the passes are treated as tax-free fringe benefits rather than taxable salary. An example of this is Boulder, Colorado's Eco Pass.

  The City and the COAST are about to launch *FastTrans*, a new "flexible route" Dover-centric transit system with the first available run to link the downtown transportation center with the City's north end. The Sixth Street Route of this service will feature several scheduled stops along the northern corridor, including the Strafford County Complex, the Exit 9 Park and Ride, Liberty Mutual and Measured

Progress. COAST has long run a scheduled bus service in Dover, but it is the tailored flexibility of the FastTrans that makes this a one-of-a-kind in the area. Rather than limiting riders to a rigid pickup and drop-off schedule, FastTrans will feature "call stops" that allow passengers to call the COAST dispatch to schedule a pickup at one of several stops in adjacent neighborhoods to the pulse route. For a fee of $1.50, residents can then hitch a ride to anywhere along the typical route, and eventually, to the transportation center where they could connect with other FastTrans routes to other parts of the City. In the end this service is not a straight line service, it's a pulse that has specific ends and beginnings and a couple of mainline stops. Major employers, such as the Hospital, are encouraged to become partners with the City in this venture because it is quite possible that this service could offer some regular users of the Central Avenue Corridor an alternative to using their own vehicle.

Another opportunity that exists for the City and the Central Avenue Corridor businesses is to join a program called *Seacoast Commuter Options*. This is a NHDOT sponsored nonprofit organization of employers working together to address employee transportation issues in the Greater Portsmouth and Seacoast New Hampshire Area. The program was started in 2002 with a mission to maintain the economic viability of the Seacoast Region by reducing traffic congestion and improving air quality through the creation of services and materials that promote commuting alternatives to driving alone to work. One of the main offerings is a regional web-based rideshare matching program, the success of which depends on area business participation. The more companies that participate, the larger the database becomes. According to the 2000 Census, over 15,000 jobs exist in Dover with only 32 percent being filled by Dover residents. This means that the City experiences over 10,000 commuters from outside the City daily.

Seacoast Commuter Option's headquarters are located at the Pease Trade Port in Portsmouth. The administration of the program is currently being provided by the firm TransAction Associates of Waltham, MA. According to their President, Cindy Frene, Wentworth Douglass Hospital is already a member, and does have a Guaranteed Ride Home Program in place. She was not aware of the success of this effort, though. Seacoast is currently working with Portsmouth Regional Hospital on the development of a vanpool program for their employees. She indicated that Liberty Mutual is a member in Massachusetts, but she did not believe that they had joined the Seacoast Program to date.

This program seems like a great resource for Dover area businesses, but currently lacks the promotion and marketing in order for it to be really successful. Possibly this could be a joint effort by the Chamber of Commerce, Dover Main Street Program and the City. The City could also consider including a provision in their Site Plan Review procedures that would require new commercial/office developments above a certain size to join this program and initiate their own trip reduction program. The benefits seem to outweigh the costs, particularly when you consider the cost of parking. In addition, employers can enhance employee recruitment and retention, improve their public image, and contribute to an improved environment by reducing auto emissions, roadway congestion, and conserving energy. To be effective, though, studies have shown that financial incentives are necessary. Company programs that offer

enhanced alternatives, such as vanpools, with financial incentives could realize an average trip reduction of up to 20 percent.

Being the major employer within the Study Area, the Hospital, needs to take the lead in this effort by setting an example for others to follow. Data from the Hospital indicates that there are approximately 1,500 employees working at this facility, which has over 1,000 parking spaces today – 70 percent of which are allocated to employees. The Hospital's current expansion plans call for an additional 2 levels on the existing parking garage to accommodate the needs of the expanded patient service area. It is our understanding that the additional 284 spaces are actually more than they need, but it is impractical to construct less than a full level on the present garage. If the Hospital could achieve a 15 percent shift in current employee travel habits, they would need approximately 105 less employee parking spaces (15% of 700 spaces today). This would eliminate the need for the planned parking garage expansion. A shift of only 7-8% might eliminate the need for the second level on the garage. In either case, it would seem like the return on investment for the Hospital would be positive – given the cost of parking garage construction. In addition, the traffic on Central Avenue would be reduced by a comparable amount – thereby helping to maintain traffic operations within this important corridor. It would seem to be a win-win for all concerned. Commitments like this will be necessary, if the community is to be successful in preserving reasonable mobility along Central Avenue.

7. Improvement Actions – Intermediate Term (2009-2013)

As the City looks to the future and redevelopment occurs along Central Avenue, there are a number of things that the City could focus on that would help achieve the main goals of this Study. These fall mainly into the following categories:

- Access Management.
- Developing the use of rear access points for corridor businesses.
- Requiring new developments and expansion of existing businesses to incorporate trip reducing strategies in their development plans.

More specifically, suggested improvement actions include the following:

- Focus on making the Study Area more transit friendly. Have bus stop pull outs constructed and covered shelters provided for waiting patrons. If the NB bus stop remains in front of the Hospital, require the Hospital to provide a formal bus stop pull out with shelter and create an inviting entrance for transit users to enter their facility. Currently there is no obvious means of entry into the Hospital from the sidewalk where the bus currently discharges it's patrons. See example plans contained in the Appendix.

- Strategically locate access points for new developments. To the extent possible locate access points away from signalized intersections and their approach queues. Also, strongly promote "in only" access off Central Avenue with exiting maneuvers via rear connections to either Ridge Street or a new driveway connecting with the

Hannaford's traffic signal. An example of how this could be accomplished is illustrated on Figure 11.

- Consolidate new curb cuts by sharing entrances among developments. Limiting the overall number of curb cuts within the Study Area will reduce side friction for arterial users and thus improve overall traffic flow along Central Avenue. See Figure 11 for an example of how this might look.

- Reevaluate traffic signal timings as new development occurs. It will be important to keep the traffic signals in this corridor fine tuned for traffic volumes as they may change in the future. As was seen earlier in the optimization of existing conditions (2008), traffic signal programming can make a significant difference in traffic operations. As new projects within the Study Area are being evaluated in the future by the City's Planning Board, they should be looked at in the context of the overall corridor's traffic operations. Traffic impact studies should be performed by the applicants using current traffic signal programming, and the area of impact evaluated should include all of the intersections from Morin Street to Oak Street. The City will have an optimized 2008 Synchro model as a byproduct of this Study. This model can be used by applicants for the next 2-3 years as a basis for their analysis. Once traffic volumes change significantly, though, this model should be updated and the traffic signal timings adjusted appropriately The cost of this analysis and any signal timing adjustments should be borne by the applicants.

8. Improvement Actions – Long Term (2008-2018)

An overall goal of the City for this section of Central Avenue should be to actively manage the performance of this corridor because of its critical position in the City's roadway network. This can be done by:

- closely monitoring the performance of the existing traffic signal system, which is set up to be centrally managed using MarcNX software,

- controlling growth and the increased traffic that is typically attendant to it, and

- actively campaigning for a greater use of alternative modes by existing corridor users to relieve pressures on the corridor and maintain operational performance and safety.

There is one other specific action that should also be pursued by the City long term. This is:

- Work with the Town of Rollinsford to change the classification of Shady Lane in Rollinsford from a Class VI unmaintained roadway to a Class V maintained road, so that Rollinsford would have a direct connection to the Hospital and Central Avenue from Rollins Road. Such a link would reduce traffic on Central Avenue and Oak Street, and provide the Town of Rollinsford with improved access to the Hospital for emergencies.

9. Summary and Conclusions

This Study provides the City with a comprehensive evaluation of Central Avenue from Merry Street to Old Rollinsford Road, a 1,600-foot section in the vicinity of Wentworth Douglass Hospital. It also provides some data and recommendations for the intersections of Morin, Glenwood, Hannaford's, and Oak Streets. Data collected as part of the Study has allowed for a thorough evaluation of existing conditions both in terms of capacity and safety. Development plans have also been examined in an attempt to forecast future conditions in the year 2018. The findings of this Study can be summarized as follows:

- Average Daily Traffic (ADT) volumes on Central Avenue are in excess of 22,000 vehicles per day.
- Crash data (2005-2007) indicates that over 50 accidents occurred within the Study Area during this three year period, most of which were due to driver inattention during congested time periods.
- Traffic flow today on Central Avenue through the Study Area during the PM peak hour is LOS D. There are long queues at the traffic signals and it is difficult to exit side streets. The eastbound leg of the Glennwood intersection is the major capacity problem. It only operates at LOS F, with long delays.
- Traffic operations can be improved noticeably with refinements to the existing traffic signal timings. This is a relatively easy fix that will yield immediate positive results.
- Recommendations are provided for three accident-prone locations in the Study Area to address existing safety concerns. These locations are Merry Street, the SB two-lane to one-lane merge opposite Merry Street, and Abbott Street.
- It is apparent that by 2018 traffic volumes will reach levels where the system will begin to break down. It will be very difficult to exit side streets, including both Hospital entrances.
- The ever-increasing queues experienced within the Study Area as traffic increases can be addressed by adding capacity to the existing roadway system or by reducing the number of vehicles traveling in the corridor.
- Without the ability to add additional thru lanes to Central Avenue, improvements in capacity are limited to Transportation Systems Management (TSM) options. These include reducing the number of curb cuts through aggressive access management, getting the left turns out of the through traffic stream (this has already been done with the center left turn lane), and continuously optimizing performance of the traffic signals along the corridor. All of these strategies are recommended for the Study Area.
- A number of trip reduction strategies are also recommended. These include making the corridor more transit friendly (i.e. take actions to increase ridership on the COAST, Wildcat Transit, and the new Fast Trans), encouraging corridor businesses to consider altering their work schedules and promoting alternatives to driving alone among their employees, reviewing existing zoning to limit redevelopment within the Study Area to low traffic generating uses, and incorporating requirements in the Site Plan ordinance for large developments to join the area's Transportation Management

Association, Seacoast Commuter Options, and establish programs aimed at providing commuter choice alternatives for their employees.

- There is one "new" roadway proposed as part of the plan. It is within existing Rights of Way and should be explored over the next few years. This would be a joint initiative with the Town of Rollinsford and involves opening up the extension of Old Rollinsford Road through to Rollins Road in Rollinsford. This requires changing the classification of this roadway from Class VI to Class V. We met with both the Rollinsford Selectmen and Planning Board on this matter and received enough encouragement that it is recommended as part of the long range plan.

Unfortunately, there is no one silver bullet that will solve the issues facing the City and the Central Avenue abutters in the Study Area. Central Avenue is a vital link in the City's and Region's roadway network and is expected to remain as such into the future as there are limited alternatives for north-south travel in the City. This three-lane section of roadway has a practical limit in its ability to funnel traffic to and from Dover's downtown. Without additional lane capacity, the community must attack the problem from many different angles. The actions presented herein each by themselves may not be that noticeable, but together they will enable the community to meet its overall objectives for this artery, which are to preserve the character of the corridor while maintaining reasonable traffic operations and safety for its users. It will not be easy to orchestrate and implement the recommendations contained herein, mainly because it will involve changing people's attitudes about their travel habits. Change does not come easy, but the slowing economy and gas prices may be good incentives.

The City will need to take the lead in seeing that these recommendations are implemented. This is not to say that the City will need to be the sole participant or funder of the suggested capital improvements. To the contrary, as developers come forward with plans for this Study Area, there also will need to be a willingness to participate in the solution to the corridor's long term needs. It is in everyone's best interest to maintain Central Avenue's mobility as well as safe access to abutting properties. We see the City evaluating each project on its own merits, and determining a reasonable scope for off-site improvements in addition to on-site accommodations. Developers should be allowed the opportunity to present trip reduction strategies as part of their development plans in lieu of off-site improvements, if the plans are reasonable. In instances where this is not the case, developers can be responsible for the actual design and construction of the required off-site improvements under the supervision of the City.

10. Next Steps

During the course of this Study, contact was made with NHDOT about their safety program. It appears that the DOT has funding available for safety improving projects and routinely take municipal applications for these funds. We suggest that the City pursue this possibility with the state. In our view the facts regarding the crash history in this corridor support many of the capital improvements listed herein as immediate actions. (See the STI letter dated October 10, 2008 in the Appendix.) It is suggested that this proposal be vetted among City staff, presented to the City Council for approval to apply for state grant funding, and the recommended improvements added to the City's CIP as soon as is practical.

Appendix

TRANSIT COOPERATIVE RESEARCH PROGRAM

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TCRP Report 19

Guidelines for the Location and Design of Bus Stops

Transportation Research Board
National Research Council

Chapter 2

THE BIG PICTURE

COORDINATION AND COOPERATION—Hypothetical Medical Center

Both transit and city officials agree that advantages exist when coordination occurs among governmental entities and with neighborhood organizations, developers and others. Most major successes (i.e., design and access, proper placement) involved a good, close working relationship between the transit agency and the city.

Hypothetical Medical Center Example

Locating bus stops at land uses surrounded by large parking lots is a common occurrence. This situation is especially evident along suburban arterials developed with current zoning regulations that encourage the building of extensive parking lots in front of the land use. The large parking lots serve as barriers between the bus stop and the land use. Bus patrons must walk through an uninviting environment (i.e., long stretches of asphalt, between parked cars) to reach the building or bus stop. The size of the parking lot also discourages the transit vehicle from boarding and alighting passengers directly adjacent to the building due to the potential for increased points of conflict with general vehicular traffic and pedestrians in the parking lot. The bus travel time and distance would also increase considerably if route deviations into parking lots occurred at every stop.

An example of the need to coordinate the location of the bus stop with the land use is illustrated by the hypothetical medical development on the following pages. Because elderly or medically disabled individuals may use this bus stop more than other bus stops along the route, it is critical that bus patrons are provided with a safe and direct route from the bus stop to the hospital.

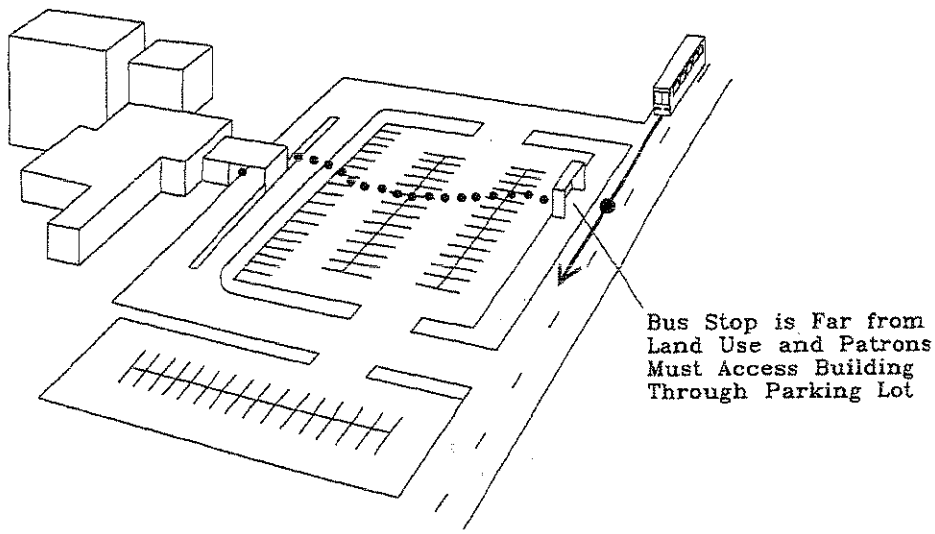
The examples show the potential problems and solutions associated with coordinating a bus stop with this type of development. Both existing and new development scenarios are presented and advantages and disadvantages of each potential solution are listed below. The large number of solutions for the same problem highlights the fact that each site can have multiple solutions. Coordination among the different players involved (i.e., transit agency, city, medical center, developer) can enhance the comfort and safety of bus patrons getting to this stop and can improve transit service to this site.

THE BIG PICTURE

Chapter **2**

COORDINATION & COOPERATION—Hypothetical Medical Center

Hypothetical Medical Center: Providing access without coordination and cooperation.



Positives:

- (+) Bus remains on a main thoroughfare, minimizing total travel time along the bus route.
- (+) Bus stop is more visible to passing vehicles and helps advertise the availability and location of public transit.

Negatives:

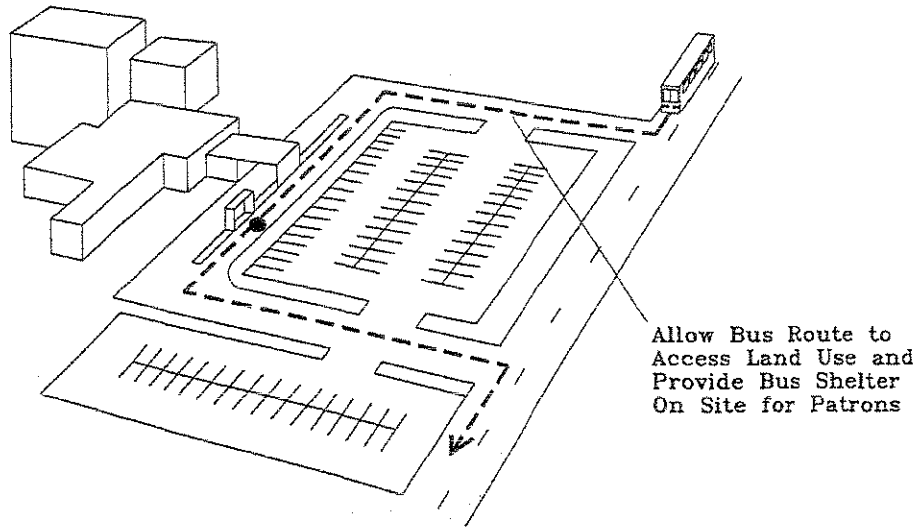
- (-) Patrons must walk through a vast parking lot to reach the medical center.
- (-) Potential exists for vehicular and pedestrian conflicts as patrons walk through parking lot.
- (-) Parking lot is uninviting and offers little in the way of environmental comfort.
- (-) Security of patrons may be compromised as they walk through parking lot.

Chapter 2

THE BIG PICTURE

COORDINATION & COOPERATION—Hypothetical Medical Center

Hypothetical Medical Center: Deviating the route.



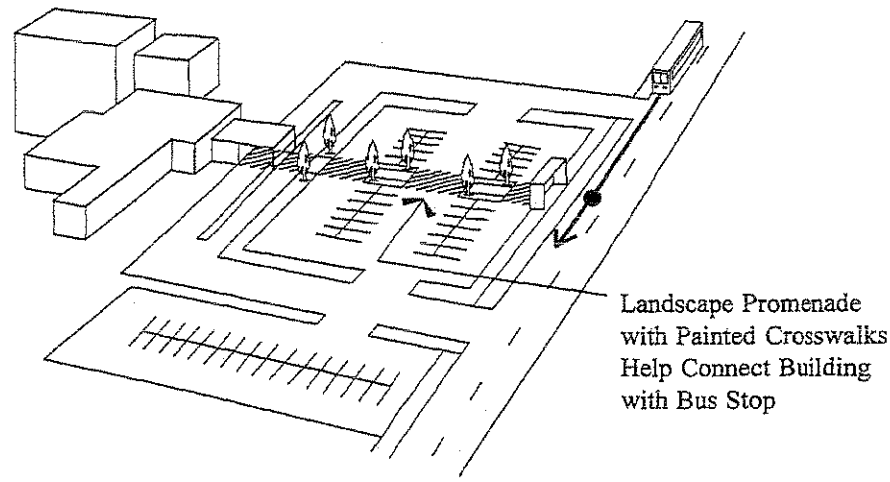
Positives:

- (+) Permits bus route to access land uses more directly.
- (+) Potential for shared use of overhang for bus patrons during inclement weather.
- (+) Reduces walking time and distance from the land use to the bus stop.
- (+) Reduces the potential for vehicular/pedestrian conflicts in the parking lot.
- (+) Patron security may be enhanced through proximity to land use. Indirect surveillance from the land use may be increased and the number of potential hiding places is removed by placing the stop adjacent to the building.

Negatives:

- (-) Bus/general vehicle conflicts may increase by having the route deviate into the parking areas.
- (-) Route travel time and distance are increased.

Hypothetical Medical Center: Installing a pedestrian promenade through the parking lot.



Positives:

- (+) Bus vehicle remains on a main thoroughfare, minimizing trip time and distance.
- (+) Reduces opportunity for pedestrian/vehicular conflicts in parking lot by constructing a well-defined pedestrian corridor.
- (+) Patron comfort is enhanced by providing shade trees along a promenade.
- (+) Security of patrons may be enhanced if the promenade is well-lit.

Negatives:

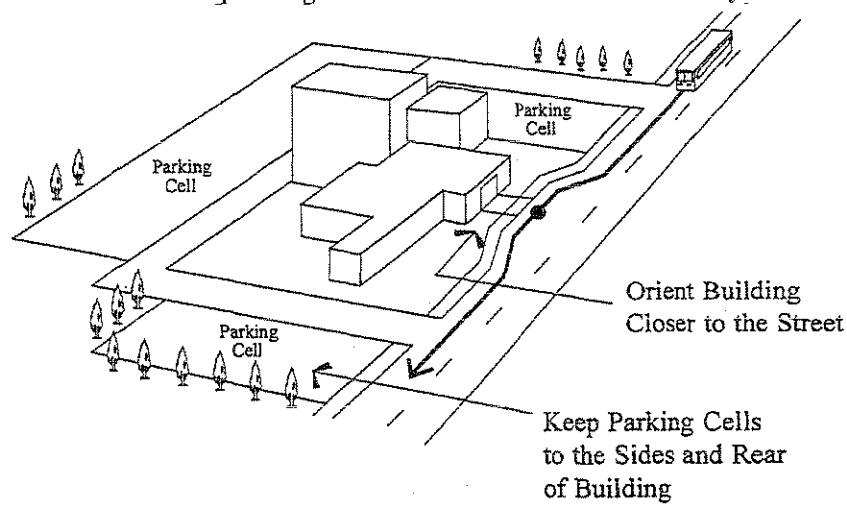
- (-) Does not reduce walking distance or time between the land use and the bus stop.
- (-) Patron security may still be compromised if the promenade is not well used, well-lit, or sight-lines are restricted by vegetation.

Chapter **2**

THE BIG PICTURE

COORDINATION & COOPERATION—Hypothetical Medical Center

Hypothetical Medical Center: Orienting building closer to the street and having parking to the rear and sides of the facility.



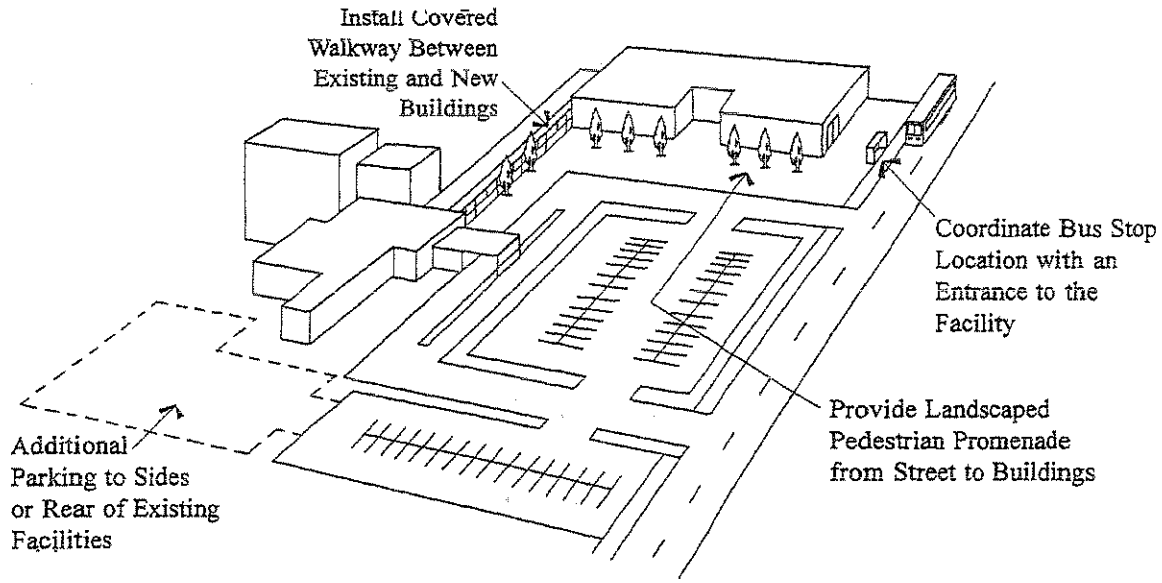
Positives:

- (+) Transit passenger walking time and distance is reduced since the building is near the road.
- (+) Patron security is enhanced by having indirect surveillance from the building and passing vehicular traffic.
- (+) Potential for pedestrian/vehicular conflicts are reduced between the land use and the bus stop.
- (+) Potential for shared use of the building facilities, such as overhangs and atriums, by bus patrons during inclement weather.
- (+) Bus remains on main route by eliminating the need to deviate into a parking lot.

Negatives:

- (-) Challenges traditional land use practices, which may make communities more reluctant to implement such a strategy.
- (-) Confusion may develop concerning responsibilities for the maintenance and up-keep of a bus stop that is near a major generator of activity.

Hypothetical Medical Center: Expanding facility.



Positives:

- (+) Bus vehicle remains on a main thoroughfare.
- (+) Pedestrian access to bus stop is enhanced by juxtaposing building with bus stop and having pedestrian promenades.
- (+) Bus patron comfort is enhanced by the addition of shade trees along the promenade and the installation of a covered walkway between buildings.
- (+) Reduces bus patron exposure to poor weather.

Negatives:

- (-) Pedestrian improvements are costly to construct.
- (-) Requires coordination among many different "players."
- (-) Orientation of new building and parking may challenge traditional land use practices.

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October 10, 2008
08543

Mr. Bruce Woodruff, City Planner
City of Dover, New Hampshire
Municipal Building
288 Central Avenue
Dover, NH 03820

NHDOT Funding for Short Term Actions on Central Avenue

Dear Bruce:

As we discussed this week, I have pursued NHDOT concerning the possibility of their funding some of the short term actions recommended in our Central Avenue Study. I spoke with Stuart Thompson (603-271-1407) at DOT and he indicated that we should make contact with Craig Green, the Administrator of Highway Design, about securing some Highway Safety Improvement Program (HSIP) funding for Central Avenue. HSIP funds are part of FHWA's SAFETEA-LU legislation. They are to be directed at projects that correct or improve a hazardous road location or feature, or address a highway safety problem. I have reviewed our short term recommendations and offer the following supporting arguments for your use.

1. Traffic signal retiming. Refining traffic signal timings along this corridor will improve traffic flow and reduce delay for motorists. Optimizing signal coordination can reduce frustration for network users and thus improve safety by reducing the need for drivers to take unsafe risks.

   Estimated Cost of Implementation for five locations - *$5,500*

2. Repair pedestrian push button at Hannaford's. Non-working pedestrian activation equipment means pedestrians are crossing Central Avenue at this intersection without the benefit of a safe clearance interval.

   Estimated Cost of Construction - *$1,000*

3. Upgrade existing crosswalks at the five intersections to be fully ADA compliant. This will involve the installation truncated domes, and audible pedestrian push buttons with locator tones. In addition, we suggest that the existing pedestrian heads be changed to the LED countdown type, and the pedestrian phases be changed from exclusive to concurrent. Accessibility as defined by the ADA is a safety issue.

Estimated Cost of Construction -

Morin –	*10 new ramps @ $2,500* *8 push buttons @ $2,000* *8 ped heads @ 1,000*
Glenwood -	*14 new ramps @ $2,500* *6 push buttons @ $2,000* *6 ped heads @ $1,000*
Hannaford's -	*6 new ramps @ $2,500* *4 push buttons @ $2,000* *4 ped heads @ $1,000*
Old Rollinsford -	*4 new ramps @ $2,500* *4 push buttons @ $2,000* *4 ped heads @ $1,000*
Oak -	*10 new ramps @ $2,500* *6 push buttons @ $2,000* *6 ped heads @ $1,000*

$194,000

4. Close Merry Street. Eliminate the existing Merry Street connection to Central Avenue, which will eliminate a current point of access with 3 angle crashes over the past three years.

   Estimated Cost of Construction - $15,000

5. Improve signage and pavement markings for SB lane drop at Merry Street. Add a mast arm with overhead signage and upgrade pavement markings to better alert drivers to the need for a merge at this location where 5 sideswipe accidents have occurred in the past three years. According to the Desktop Reference for Crash Reduction Factors, this action should provide a 20% reduction in these types of accidents.

   Estimated Cost of Construction - $13,000

6. Install raised medians in the Center Lane near Lowell and Abbott Streets. Raised center medians will control access to the SB left turn lane and eliminate the possibility of drivers colliding with left turn vehicles exiting Lowell and Abbott Streets. There have been 5 angle crashes at Abbott Street in the past three years.

   Estimated Cost of Construction - $30,000

7. Construct rear access drive within Page Street ROW. Providing a new rear access drive for the 5 properties on the west side of Central Avenue just south of the Hannaford's traffic signal would eliminate the existing unsafe access these properties now have on Central Avenue. This stretch of Central Avenue experiences long queues in the NB direction due to the Hannaford's signal and also has a lane drop in the SB direction. Providing these businesses with direct access to the traffic signal at Hannaford's via a rear driveway would be a much safer means of access for the owners and their patrons. A public ROW exists so the expense would be limited to construction of a 450-foot two-lane driveway and modifications to the traffic signal at Hannaford's.

Estimated Cost of Construction -

Common Excavation – 450'x40'x2'x1/27x$20	*=$ 27,000*
Base Gravel – 450'x35'x2'x1/27x$30	*=$ 35,000*
Pavement – 450'x28'x1/9x440/2000x$150	*=$ 46,500*
Drainage	*=$ 25,000*
Misc.(Loam, Seeding, etc.)	*=$ 20,000*
Traffic Signal Modifications	*=$ 50,000*
Mobilization	*=$ 20,000*
Total	*=$223,500*

8. Summary. The total estimated cost of construction for items 1-7 above equals $482,000. If you add another $65,000 for PE (survey, design and permitting) and $35,000 for construction engineering, the total request to NHDOT might total $582,000. It is my understanding the HSIP funding is on a 90-10 basis, so the City's share would be roughly $60,000.

Give me a call once you have had a chance to review this information and talk among yourselves. I think you may have a chance at some funding, and you should have all the information you need in order to apply.

Sincerely,

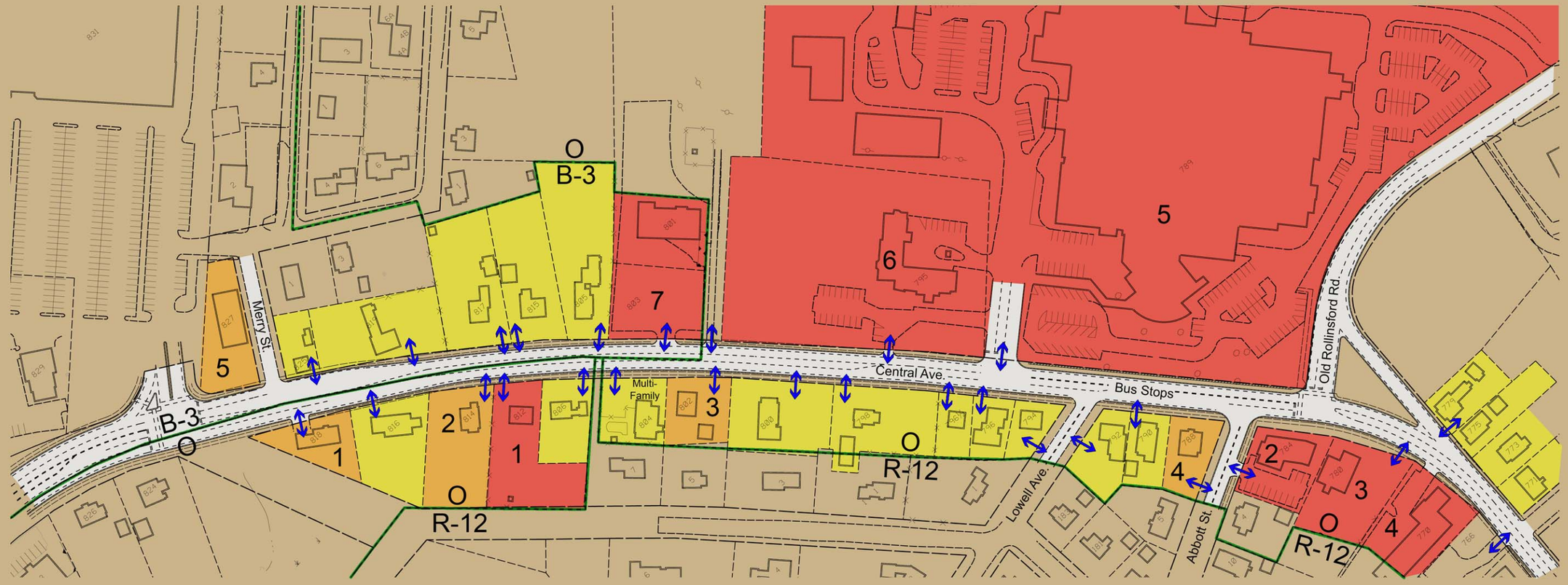
SEBAGO TECHNICS, INC.

Steve

Stephen S. Sawyer, Jr., P.E.
Vice President, Transportation Services

SSS:sss/cb

Figures



Existing Curb Cuts ↔

East Side: 9 Driveways
4 Streets
West Side: 14 Driveways
2 Streets

Existing Zoning

O - Office
R-12 - Medium Density Residential
B-3 -Thoroughfare Business

Land Use

- Residential
- Medical
  1. Blackman Chiropractic Center Medical Office
  2. Dermatology Medical Offices
  3. O.A.R.S. Medical Office
  4. Garrison Medical Offices
  5. Wentworth Douglass Hospital
  6. Wentworth Home
  7. Wentworth Professional Building
- Other
  1. Flynn Insurance Agency
  2. Tri-City Co-op
  3. Direct Sign Co.
  4. CPA & Law Firm
  5. Pearl Vision

N E S W

Central Avenue Corridor Study - Existing Land Use and Zoning

Merry Street to Old Rollinsford Road - Dover, NH

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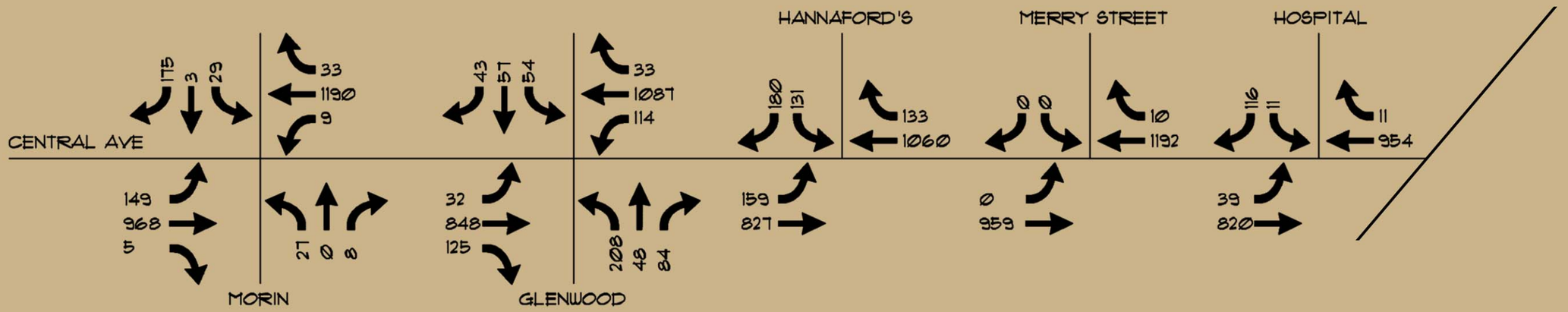
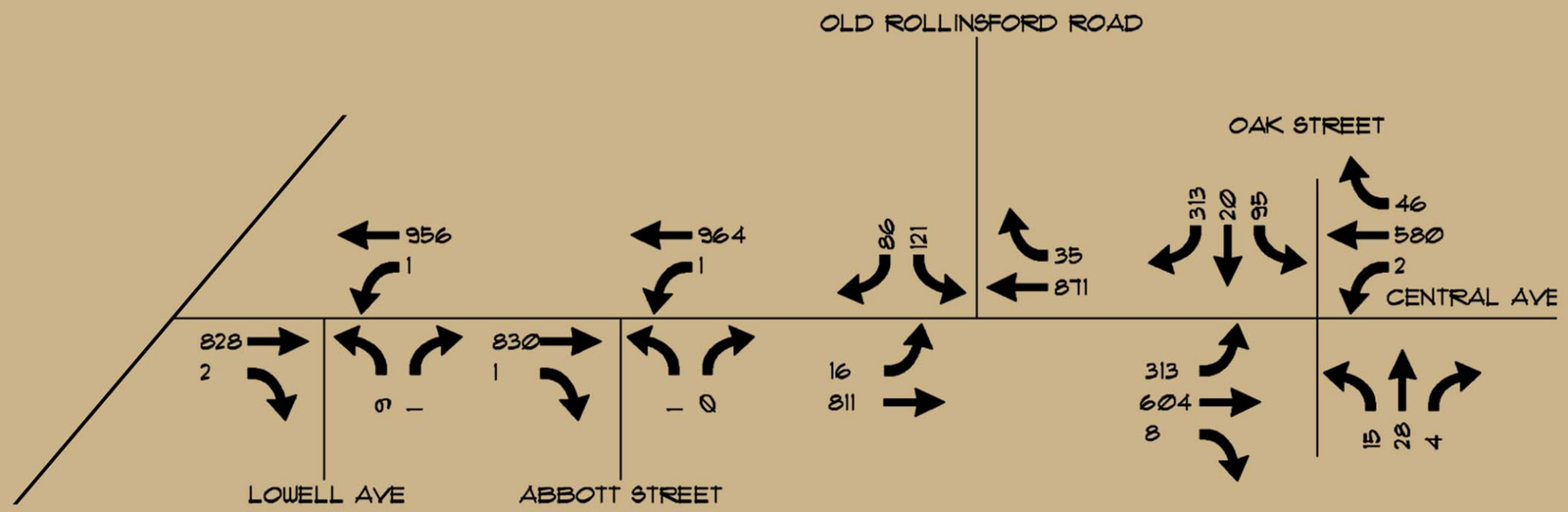
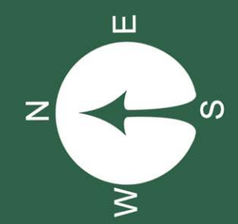
Figure 1







Central Avenue Corridor Study - 2008 PM Peak Hour Volumes

Morin Street to Oak Street - Dover, NH

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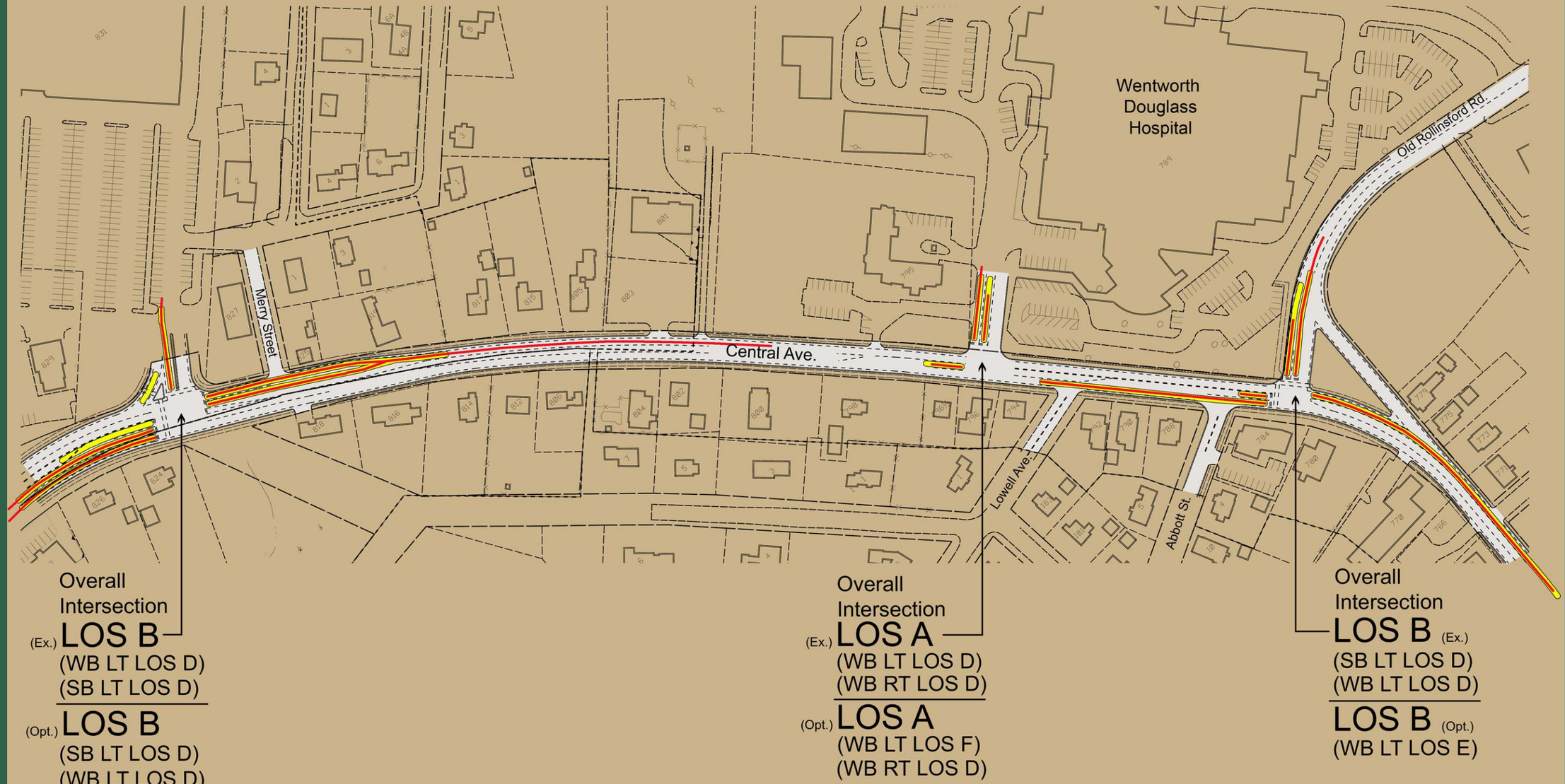
Figure 2



Overall Intersection
(Ex.) LOS B
(WB LT LOS D)
(SB LT LOS D)

(Opt.) LOS B
(SB LT LOS D)
(WB LT LOS D)

Overall Intersection
(Ex.) LOS A
(WB LT LOS D)
(WB RT LOS D)

(Opt.) LOS A
(WB LT LOS F)
(WB RT LOS D)

Overall Intersection
LOS B (Ex.)
(SB LT LOS D)
(WB LT LOS D)

LOS B (Opt.)
(WB LT LOS E)

95th Percentile Queues During PM Peak Hour / Existing 2008 Queues

Optimized 2008 Queues

LOS - Level of Service

*In the optimized condition, the NB Queue length at Hannaford can be reduced back to existing length if NB thru lanes are restriped.

Central Avenue Corridor Study - (2008) Existing Traffic Operational Performance

Merry Street to Old Rollinsford Road - Dover, NH

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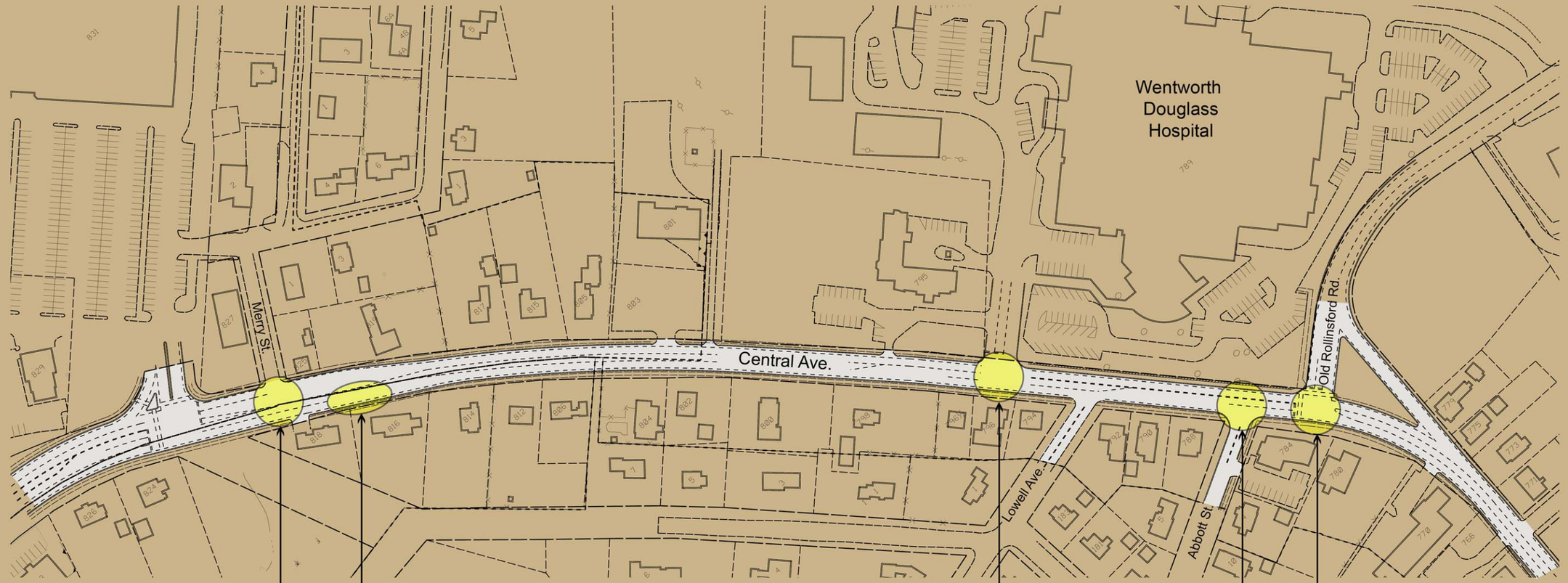
Figure 3



Total Number of Reported Crashes = 51

Number Of Injuries = 0 Fatalities, 1 Confirmed, 11 Possible

Percentage of Rear End Crashes Due To Driver Inattention = 59% (30 Crashes)

Central Avenue Corridor Study - Crash Data (2005-2007)

Merry Street to Old Rollinsford Road - Dover, NH

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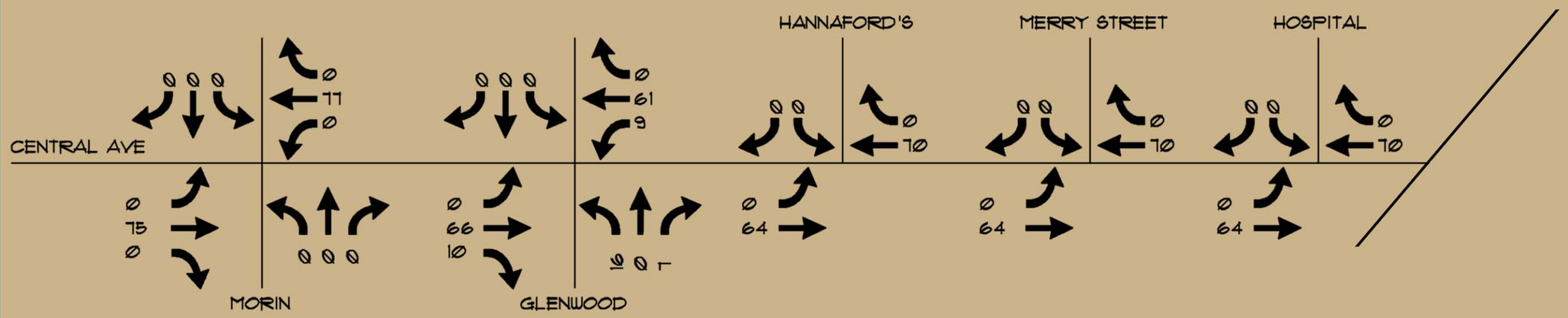
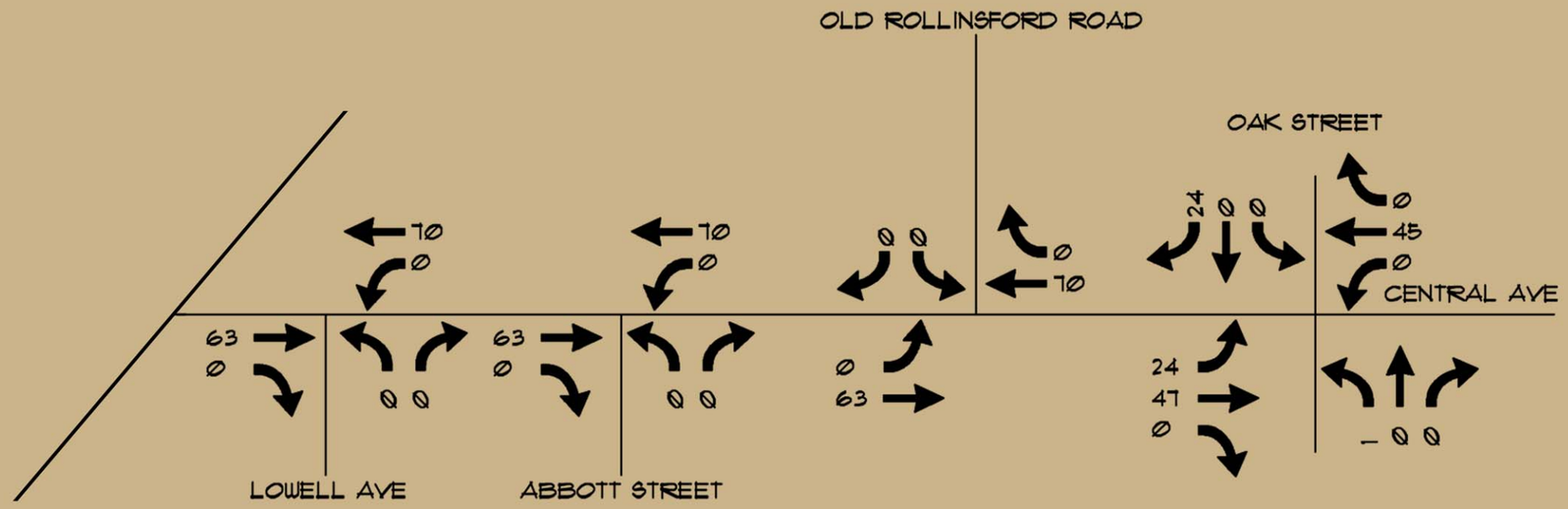
Figure 4





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Central Avenue Corridor Study - Background Growth (2008 - 2018)

Morin Street to Oak Street - Dover, NH

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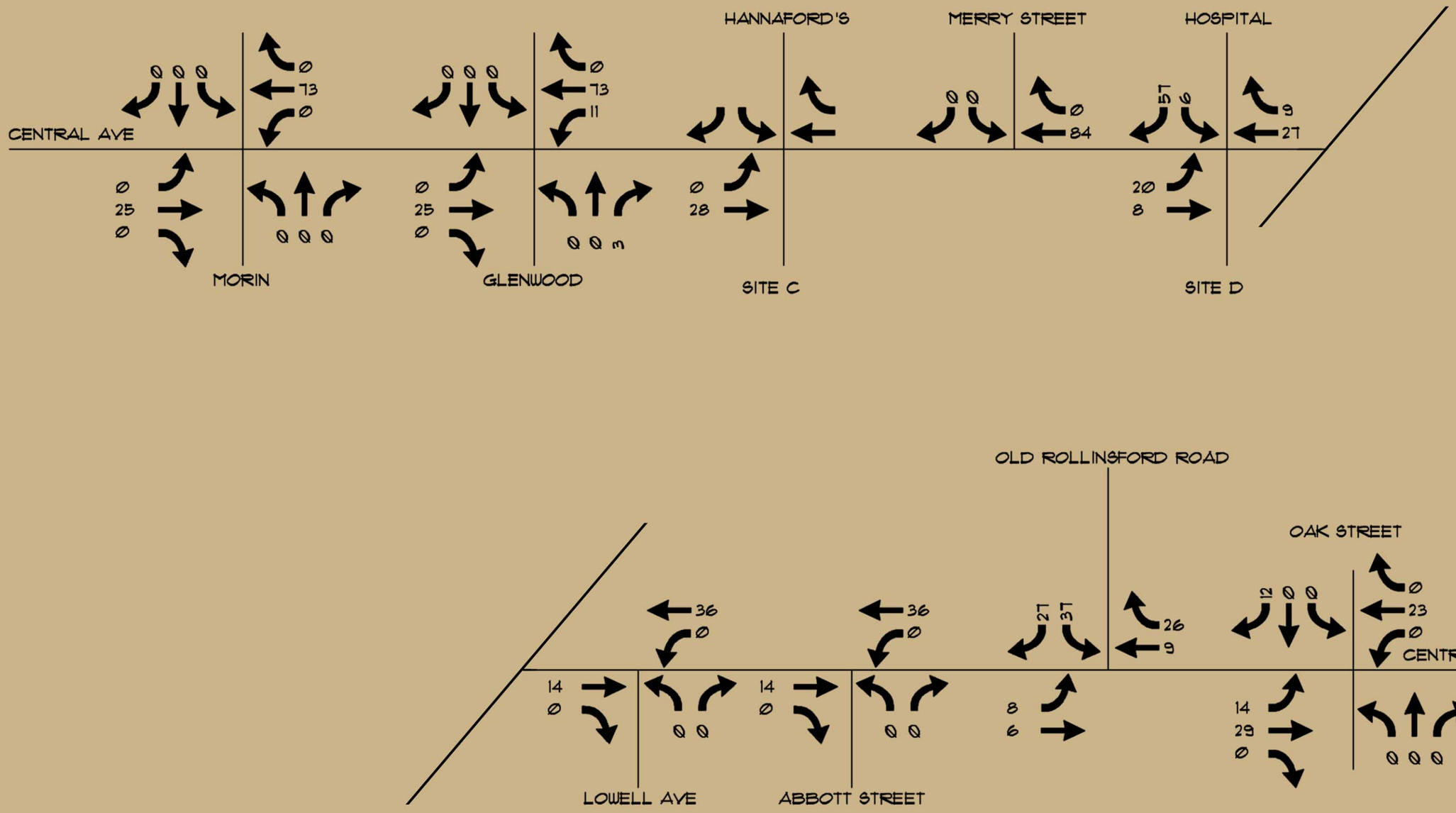
Figure 5



Central Avenue Corridor Study - Additional Generated Hospital Trips (Proposed 2009 Expansion)

Morin Street to Oak Street - Dover, NH

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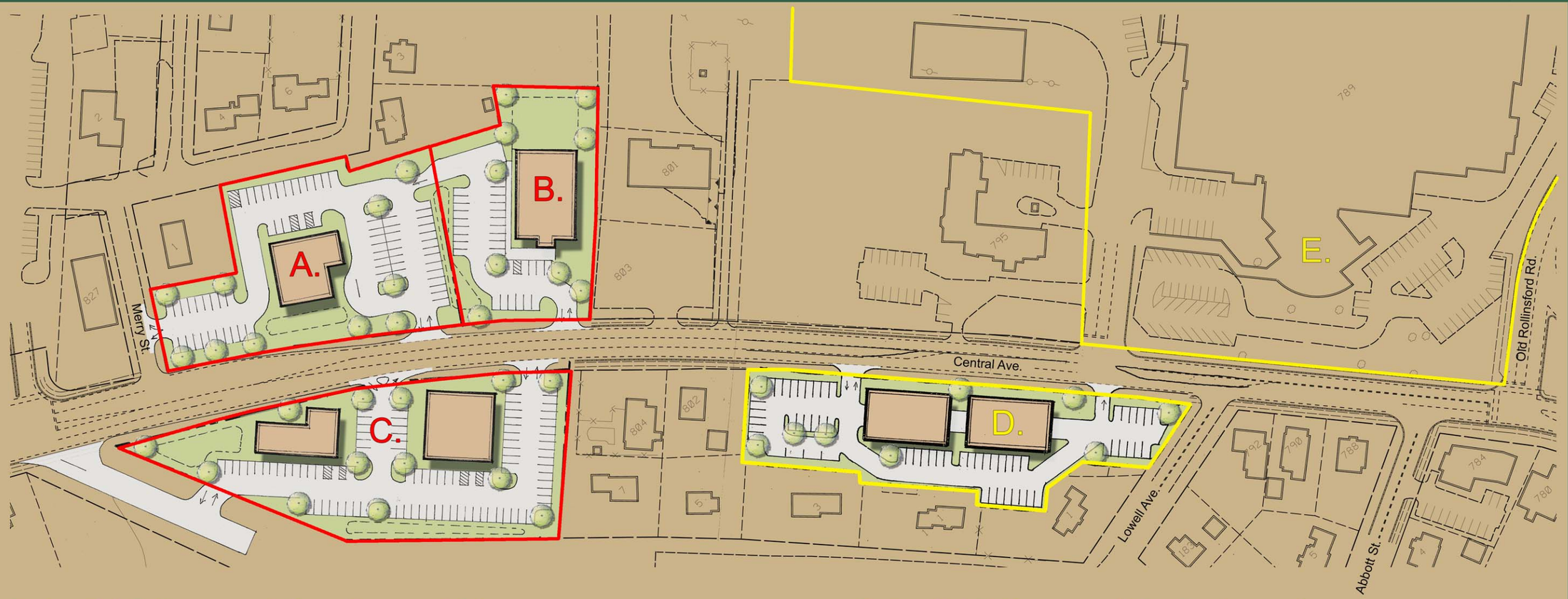
Figure 6



Potential & Proposed Development Programs

A. Potential Parcel 1 (4 Lots)
Potential Medical Office Building - 17,000 SF (3-Story) - 71 Parking Spaces

B. Potential Parcel 2 (2 Lots)
Potential Day Care Facility - 8,250 SF (1-Story) - 31 Parking Spaces

C. Potential Parcel 3 (5 Lots)
Potential Office 1 - 9,600 SF (2-Story) - 38 Parking Spaces
Potential Office 2 - 12,800 SF (2-Story) - 52 Parking Spaces

D. Proposed Development (Appledore Engineering Inc. Plan)
Proposed Medical Offices & Residential Condominiums - 35,482 SF (4-Story) - 93 Parking Spaces

E. Proposed Development (160,501 SF)
Proposed Wentworth Douglass Hospital Expansion

Potential & Proposed Traffic Impacts

A. Existing Curb Cuts = 3
Potential Curb Cuts = 2 (1 Exit only to Merry Street)

B. Existing Curb Cuts = 2
Potential Curb Cuts = 1

C. Existing Curb Cuts = 5
Potential Curb Cuts = 3 (1 Right In/Right Out)

D. Existing Curb Cuts = 5 (1 on Lowell Avenue)
Proposed Curb Cuts = 2 (1 Exit Only)

E. Existing Curb Cuts = 1
Proposed Curb Cuts =1

Central Avenue Corridor Study

Potential & Proposed Redevelopment Projects - Dover, NH

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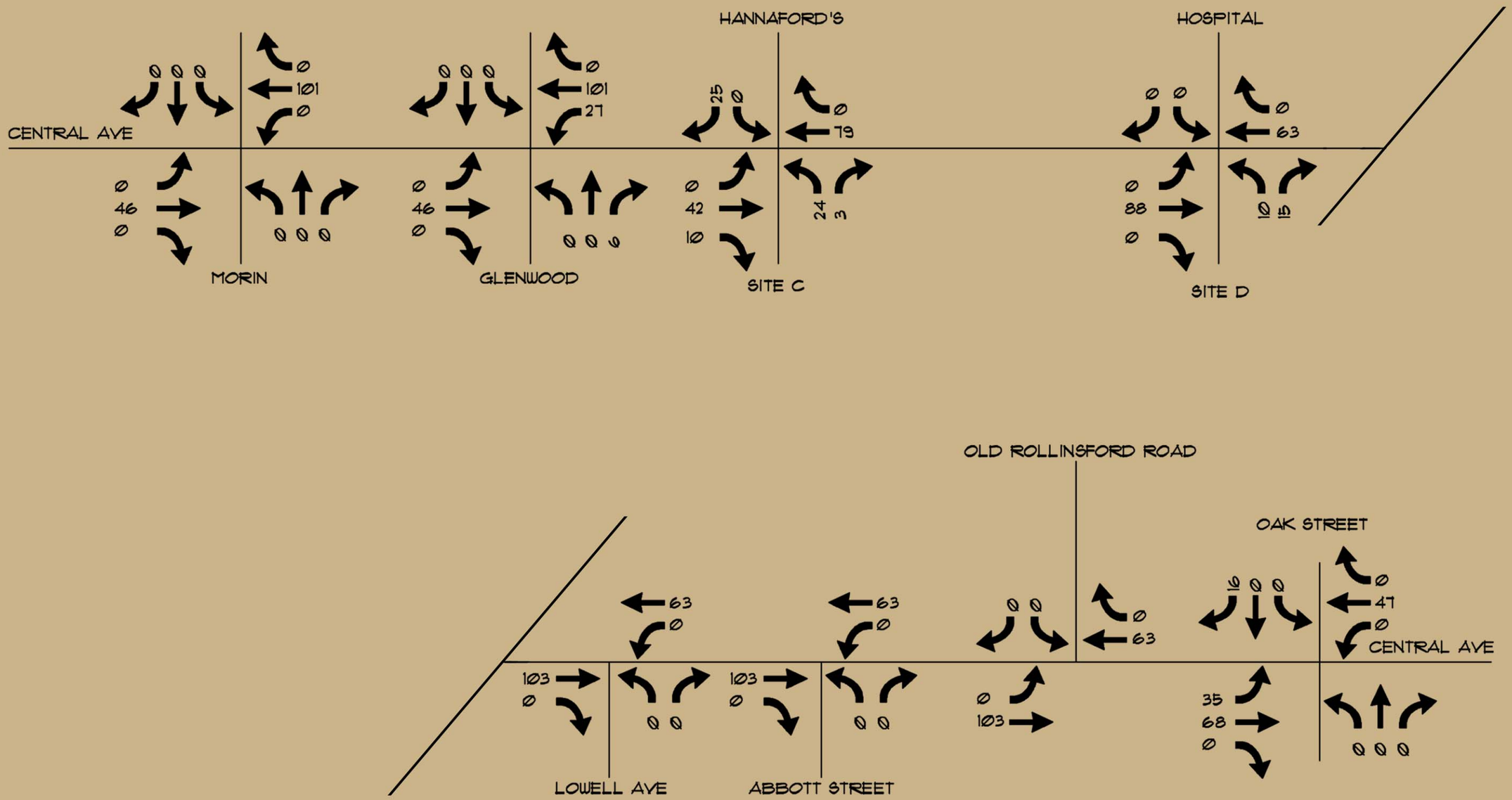
Figure 7



Central Avenue Corridor Study - Other Development Trips - Possible

Central Ave. Redevelopment From Merry St. To Old Rollinsford Rd. - Dover, NH

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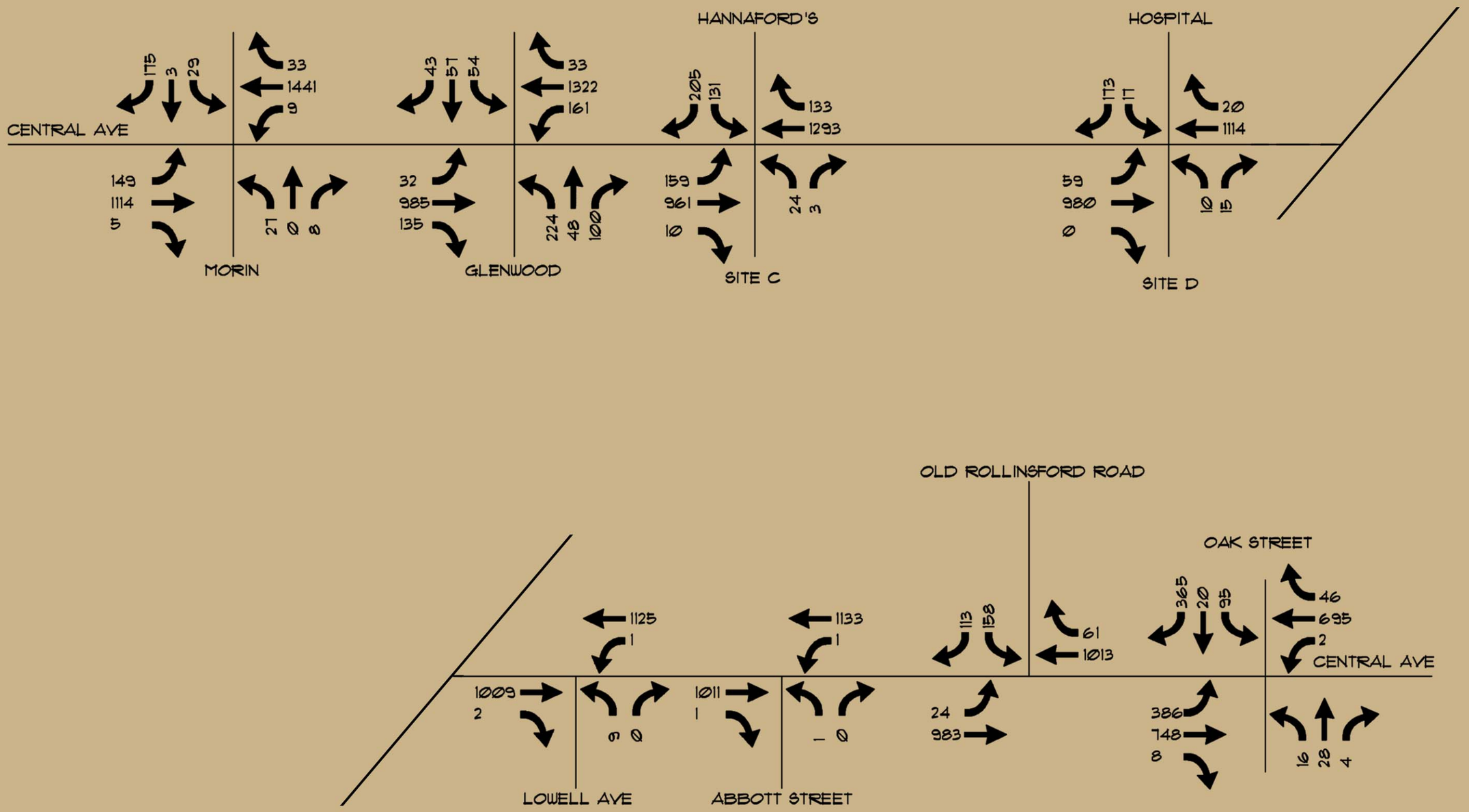
Figure 8



Central Avenue Corridor Study - 2018 Forecasted Volumes

Between Morin Street and Oak Street - Dover, NH

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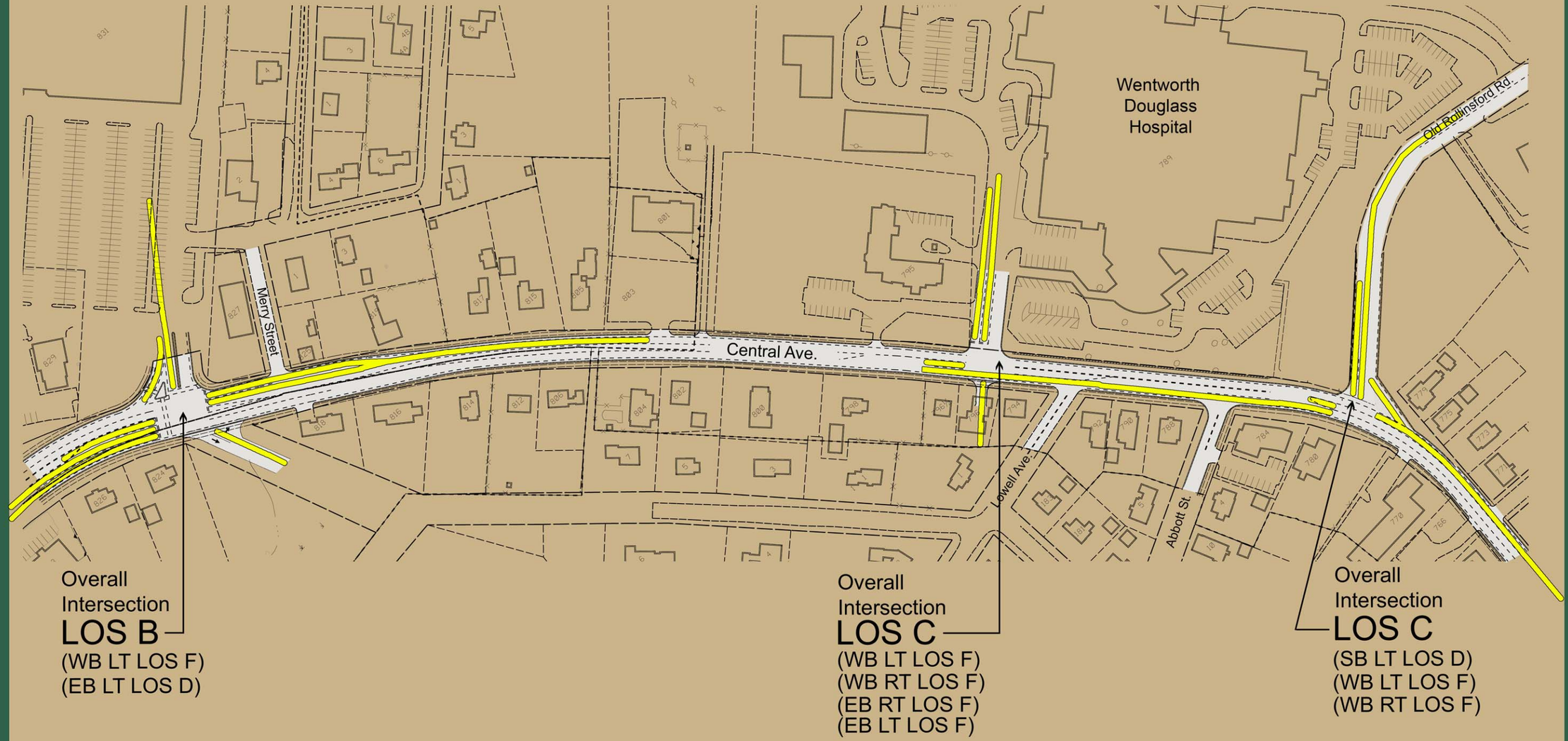
Figure 9



95th Percentile Queues During PM Peak Hour / 2018 Queue Lengths

LOS - Level of Service

*In the optimized condition, the NB Queue length at Hannaford can be reduced back to existing length if NB thru lanes are restriped.

Central Avenue Corridor Study (2018) - Full-Build Traffic Operational Performance

Merry Street to Old Rollinsford Road - Dover, NH

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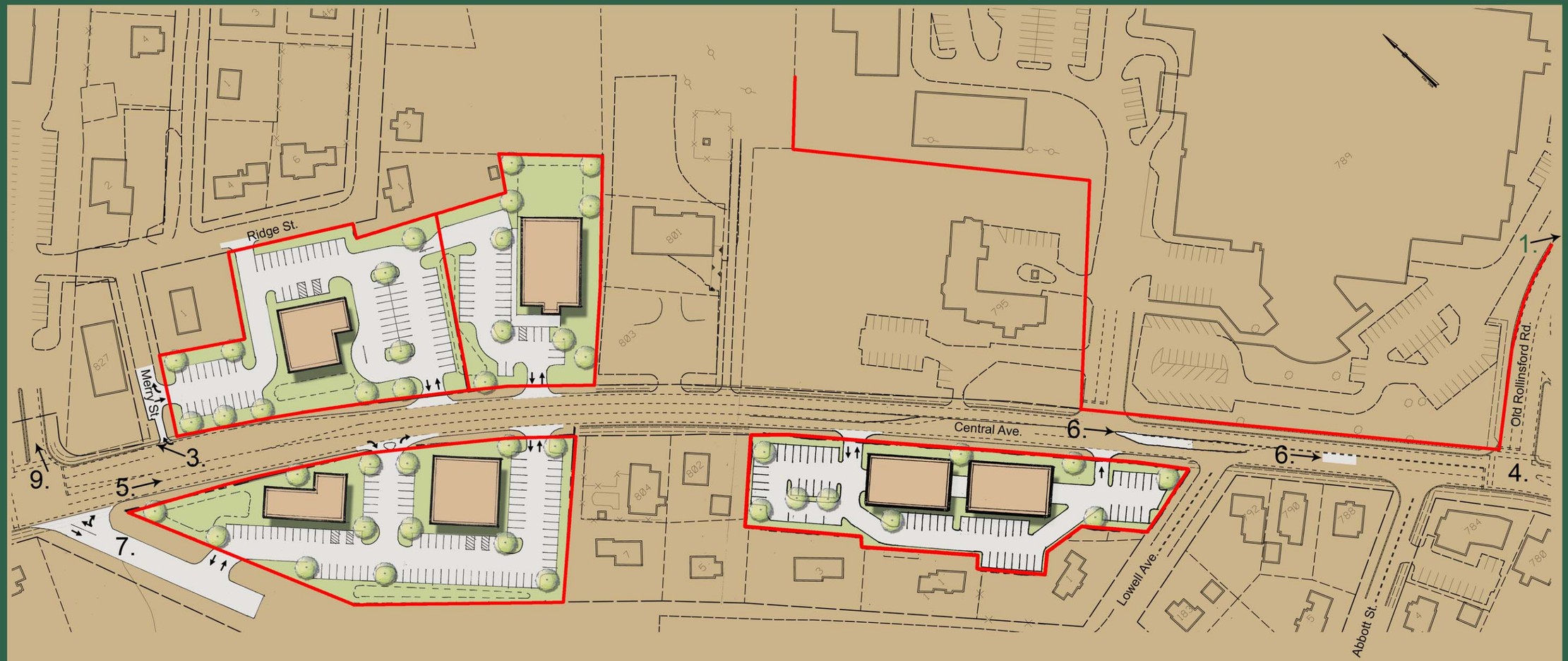
Figure 10



Short Term Actions (2008)

1. Retime Traffic Signals - Morin Street To Oak Street
2. Fully Implement Traffic Signal Management System
3. Convert Merry Street to “In-Only”
4. Upgrade Old Rollinsford Road Traffic Signal Equipment
5. Install Overhead Lane End Signage
6. Install Raised Median Islands To Restrict Access To The Center Turn Lane
7. Develop Rear Access Drive In Page Street Right Of Way
8. Review Current Zoning Provisions To Target Low Traffic Generating Uses
9. City to obtain access rights to Hannaford traffic signal

Intermediate Term Actions (2009-2013)

1. Make Corridor More Transit Friendly
2. Strategically Locate Access For New Development
3. Consolidate Curb Cuts
4. Maintain Optimal Traffic Signal Programming

Long Term Actions (2008-2018)

1. Upgrade Shady Lane in Rollinsford To A Class V Roadway

Central Avenue Corridor Study

Recommended Study Area Improvement Actions - Dover, NH

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Figure 11