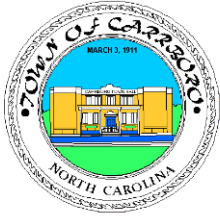


TOWN OF CARRBORO

NORTH CAROLINA

MEMORANDUM



DATE: October 3, 2009

TO: Steve Stewart, Town Manager
Mayor and Board of Aldermen

CC: Patricia McGuire, Planning Administrator
Roy Williford, Planning Director
Martin Roupe, Development Review Administrator
James Thomas, Planner/Zoning Development Specialist

FROM: Jeff Brubaker, Transportation Planner

RE: Homestead Road Traffic Near the Proposed Goddard School Site

1 Background

At the September 22, 2009, public hearing on a minor modification of the Conditional Use Permit for the Goddard School at Winmore, the Board discussed the school's potential traffic impacts and directed staff to analyze traffic on Homestead Rd. Specifically, the Board directed staff to assess the impact of a traffic control device prohibiting left turns from Winmore Ave. onto Homestead Rd. during certain peak hours. This memo presents a discussion of the impacts of the prohibited left turn alternative, a review of existing traffic data near the intersection of Homestead Rd. and Winmore Ave., and new traffic data and analysis.

A summary of the information provided in this memo is presented at the end of this memo.

2 Impact of restricting left turns from Winmore Ave. onto Homestead

2.1 Conditions for prohibiting left turns

Improved intersection safety and traffic operation are two primary purposes for prohibiting left turns. A report by the National Cooperative Highway Research Program (NCHRP) suggests prohibiting left turns at unsignalized intersections where there is inadequate storage of left-turning vehicles. NCHRP recommends that the following conditions should influence the decision to install a left-turn restriction at an intersection:

- “Left-turn related delay, conflicts, or crash frequency should be at unacceptable levels.
- An alternative route is available for the redirected left-turn vehicles.
- The alternative route is not expected to add more than a few minutes to the redirected motorist’s travel time.
- The intersection is in an urban or suburban area. (Note: in suburban settings, turn restriction is generally not found except where such treatments are part of an areawide circulation plan.)”¹

The report recommends that “all four of the above criteria should be satisfied before turn restriction is given further consideration”. Furthermore,

the potential benefits of turn restriction should be carefully weighed against the increased travel time and trip length that is likely to be incurred by redirected motorists...Turn restrictions at an intersection...can cause traffic to divert to other, local roads.²

The left-turn-related travel delay described in the report refers to delay “resulting from left-turn vehicles queued in a through lane because of nonexistent or inadequate bay storage [i.e. storage in a separate left-turn-only lane]”.³ However, since the Winmore/Homestead intersection is a T-intersection, no possible through vehicle movements exist on Winmore Ave. The speed limit on Winmore Ave. is 25 mph, and traffic must stop to make a turn movement. However, there may be safety issues with vehicles actually making left turns onto Homestead Rd. No intersections on Homestead Rd. were identified as “High Accident Intersections” in Carrboro from August 2001 through July 2004, and no pedestrian or bicycle accidents were reported on the roadway in the *2005 Mobility Report Card*. At the time of writing, staff is currently collecting more recent safety data for Homestead Rd.

2.2 Impact of prohibiting left turns

The advantages to left turn prohibitions of improving safety and traffic operations at intersections are mentioned above. Potential disadvantages include:

- Relocating the problem upstream or downstream of the installation
- Rerouting traffic onto residential streets

¹ National Cooperative Highway Research Program (NCHRP). (2001). *Report 457: Evaluating Intersection Improvements: An Engineering Study Guide*. <http://onlinepubs.trb.org/onlinepubs/nchrp/esg/esg.pdf>, p. 19.

² Ibid.

³ Ibid.

- Increased travel distances, travel times, gasoline consumption, and emissions⁴

On Wednesday, September 30, staff conducted a count and delay measurement of left-turning vehicles from Winmore Ave. onto Homestead Rd. between 7:05 a.m. and 9:05 a.m. This time period is similar to the typical AM peak period of 7:00-9:00 a.m., which was used in the *Carolina North Transportation Impact Analysis* and a 2004 traffic signal warrant analysis conducted for NCDOT at the Homestead/High School intersection. It should be noted that the data in Table 1 reflect only one day of AM peak traffic. Delay was measured with a stopwatch and relied on the data collector’s judgment to determine when the delay period started while a vehicle approached the intersection (i.e. when to start the stopwatch). Therefore delay statistics should be considered approximations.

Hour	Left turn count	Total delay (sec)	Average delay
7:05 a.m. – 8:05 a.m.	16	116.1	7.3
8:05 a.m. – 9:05 a.m.	23	322.3	14.0
Total	39	438.4	11.2

Table 1. Count and delay statistics for left-turning vehicles from Winmore Ave. onto Homestead Rd. during the AM peak traffic period.

During the count period, there were 39 vehicles making left turn movements – 16 from 7:05-8:05 a.m. and 23 from 8:05-9:05 a.m. Average delay in the second hour was nearly double that of the first hour. As Figure 1 shows, one left-turning vehicle was delayed for approximately 85 seconds. This delay occurred between 8:25 a.m. and 8:35 a.m. and may be associated with high-school-related traffic on Homestead Rd.

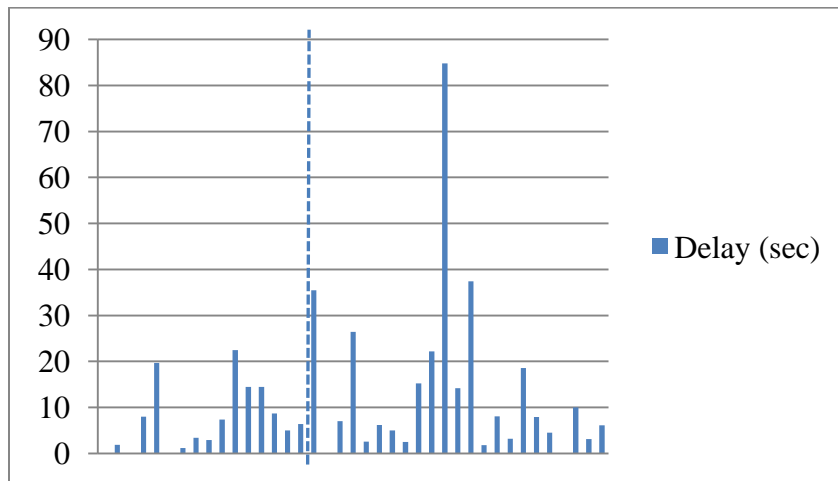


Figure 1. Delay per left-turning vehicle. Each bar represents a vehicle. Missing bars in The dashed line represents 8:05am, the halfway point of the count period.

Insofar as the data reflect current average AM peak hour traffic from Winmore, then a left turn prohibition installed today would affect an average of 39 vehicles per day. However, the number

⁴ Federal Highway Administration. (1981). Guidelines for Signalized Left-Turn Treatments. Cited in: Brich, Stephen C., and B.H. Cottrell, Jr. (1994). Guidelines for the Use of No U-Turn and No-Left Turn Signs. Virginia Transportation Research Council. http://www.virginiadot.org/vtrc/main/online_reports/pdf/95-r5.pdf, p. 4.

of left-turning vehicles is likely to increase as development of the Winmore subdivision progresses. If complying with the prohibition, these vehicles would be required to take another route.

Since vehicles aiming to enter Homestead Rd. heading eastbound will have different origins within the Winmore development, it is difficult to accurately predict the combined travel time and fuel use impacts of the left turn prohibition. Furthermore, it is uncertain how many motorists would already know about or remember the prohibition – and thus avoid traveling east on Winmore Ave. in the first place – and how many motorists would travel to the intersection and comply with the sign by making an alternative turn movement (such as a right turn followed by a U-turn on Homestead Rd.). It is possible that other motorists may fail to notice the sign or the time period in which it is effective, or choose not to comply with it.

Given these caveats, a basic analysis was conducted to determine the travel distance differences for vehicles turning left onto Homestead Rd. from Winmore Ave. and vehicles choosing an alternative route. Two common origins were selected: the corner of Atterbury St. and Winmore Ave. (Comparison 1) and the proposed future site of the Goddard School (Comparison 2). It is assumed that motorists desiring to turn left onto Homestead Rd. are desiring to travel eastbound on Homestead Rd.

For Comparison 1, without a left turn prohibition, vehicles are assumed to travel on east on Winmore Ave. and turn left onto Homestead Rd. (Route 1). With a left turn prohibition, vehicles are assumed to take the following route (Route 2): east on Winmore Ave., right on Sharp St., right on Jewell Dr., left on Camellia Dr., left on Claremont Dr., and left onto Homestead Rd.

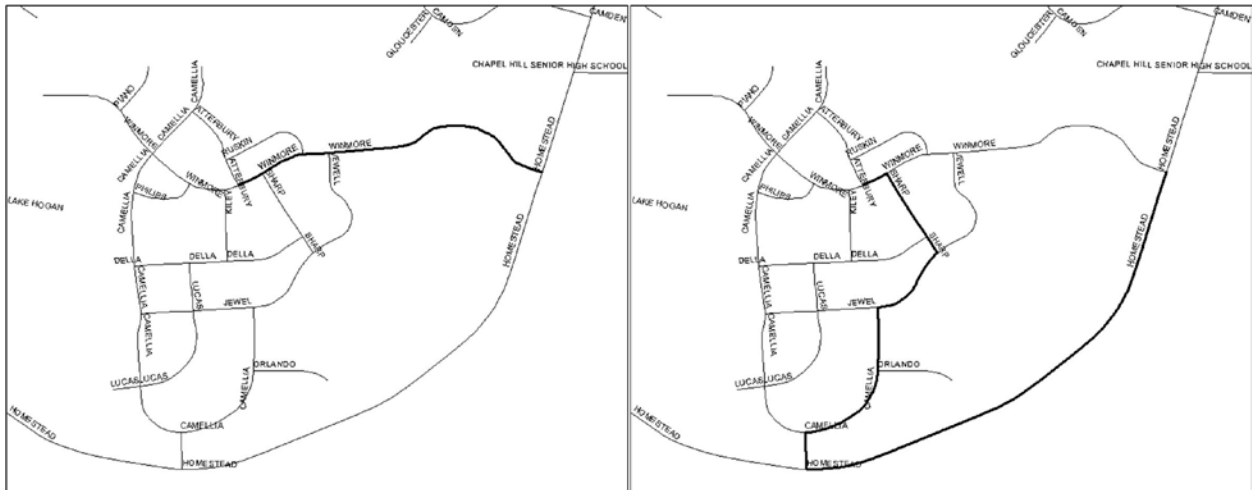


Figure 2. Comparison 1: Route 1 (left), without left turn prohibition. Route 2 (right), with prohibition.

A basic GIS analysis determined the distance difference between the two routes.

Segment name	Length (ft)	Length (mi)	Segment travel time (sec)	Fuel consumed	CO2 (lbs)
<u>Route 1</u>					
<i>Total</i>	1799	0.3	49.1	0.016	0.312
<u>Route 2</u>					

<i>Total</i>	<i>4959</i>	<i>0.9</i>	<i>114.0</i>	<i>0.044</i>	<i>0.860</i>
Difference (Route 2 - Route 1)	3160	0.6	64.9	0.028	0.548

Table 2. Comparison (1) of distance, segment travel time, fuel consumption, and CO2 emissions for Routes 1 and 2 with and without a left turn prohibition. Note: Fuel consumption and CO2 emissions figures based on basic formulas from the U.S. EPA: 0.0465 gal. of gasoline per mile and 0.916 lbs. of CO2 per mile. Since gasoline consumption and CO2 emissions vary based on vehicle fuel efficiency, vehicle type, fuel type, speed, and driving cycle, these figures should be considered rough approximations.

As Table 2 indicates, Route 2 is three times longer than Route 1. The actual travel time is not estimated here because of variations in travel time for turning movements and intersection delay. However, the time it takes to travel Route 2 segments at the speed limit (assuming complete lack of impedance) is 114.0 seconds, longer than the estimated travel time of Route 1 plus the average AM peak period delay measured for left-turning vehicles at Winmore/Homestead. Furthermore, this does not take into account any delay incurred for left-turning vehicles from Claremont Dr. onto Homestead Rd. (which was not measured). Route 2 leads to more fuel consumed – 0.028 gallons per trip – and greater CO2 emissions – 0.548 lbs. per trip.

For Comparison 2, without a left turn prohibition, vehicles are assumed to travel east on Winmore Ave. and turn left onto Homestead Rd. (Route 3). With a left turn prohibition, vehicles are assumed to take the following route (Route 4): west on Winmore Ave., left on Jewell Dr., left on Camellia Dr., left on Claremont Dr., and left on Homestead Rd.

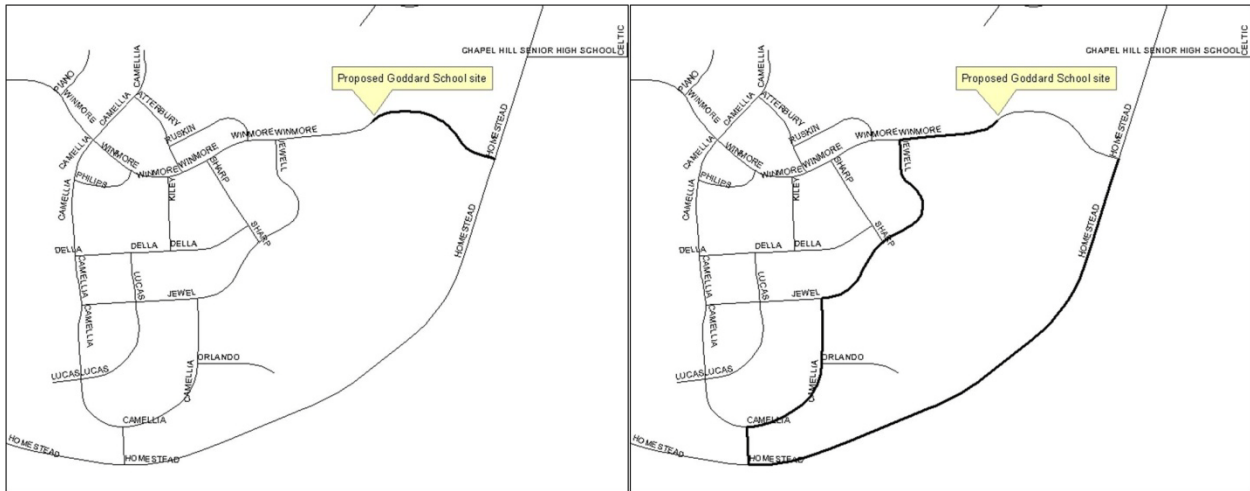


Figure 3. Comparison 2: Route 3 (left), without left turn prohibition. Route 4 (right), with prohibition.

As Table 3 indicates, Route 4 is 7.5 times longer than Route 3. The time it takes to travel Route 4 segments at the speed limit (assuming complete lack of impedance) is 129.4 seconds, significantly longer than the estimated travel time of Route 3 plus the average AM peak period delay (11.2 seconds) measured for left-turning vehicles at Winmore Ave. Route 4 leads to more fuel consumed and greater CO2 emissions per trip.

Segment name	Length (ft)	Length (mi)	Segment travel time (sec)	Fuel consumed	CO2 (lbs)
<u>Route 3</u>					
<i>Total</i>	<i>737</i>	<i>0.1</i>	<i>20.1</i>	<i>0.006</i>	<i>0.128</i>

Route 4					
<i>Total</i>	<i>5524</i>	<i>1.0</i>	<i>129.4</i>	<i>0.049</i>	<i>0.958</i>
Difference (Route 4 - Route 3)	4787	0.9	109.3	0.042	0.831

Table 3. Comparison of distance, segment travel time, fuel consumption, and CO₂ emissions for Routes 3 and 4 with and without a left turn prohibition. Note: Fuel consumption and CO₂ emissions figures based on basic formulas from the U.S. EPA: 0.0465 gal. of gasoline per mile and 0.916 lbs. of CO₂ per mile. Since gasoline consumption and CO₂ emissions vary based on vehicle fuel efficiency, vehicle type, fuel type, speed, and driving cycle, these figures should be considered rough approximations.

3 Existing traffic data

3.1 NCDOT 2007 AADT counts

NCDOT has conducted annual average daily traffic (AADT) counts in the Chapel Hill-Carrboro area every odd year from 1997-2007. Figure 4 shows how traffic has changed for selected locations near the present day location of the Winmore/Homestead intersection. Traffic on the Winmore-HS segment of Homestead has increased nearly consistently from 1997-2007, with the exception of a small decrease from 2003-2005. Overall, traffic on this segment has increased 55% from 1997 to 2007.

Nearby counts on Seawell School Rd. and High School Rd. show overall increases (52% and 35%, respectively), but with year-to-year variations. The significant increase in traffic from 1999-2003 for the three segments mentioned above may be attributed in part to the opening of Smith Middle School in August 2001. The decrease in traffic for all segments from 2003 to 2005 may be attributed in part to the introduction by Chapel Hill Transit of the HS route serving the schools between 2003 and 2004.

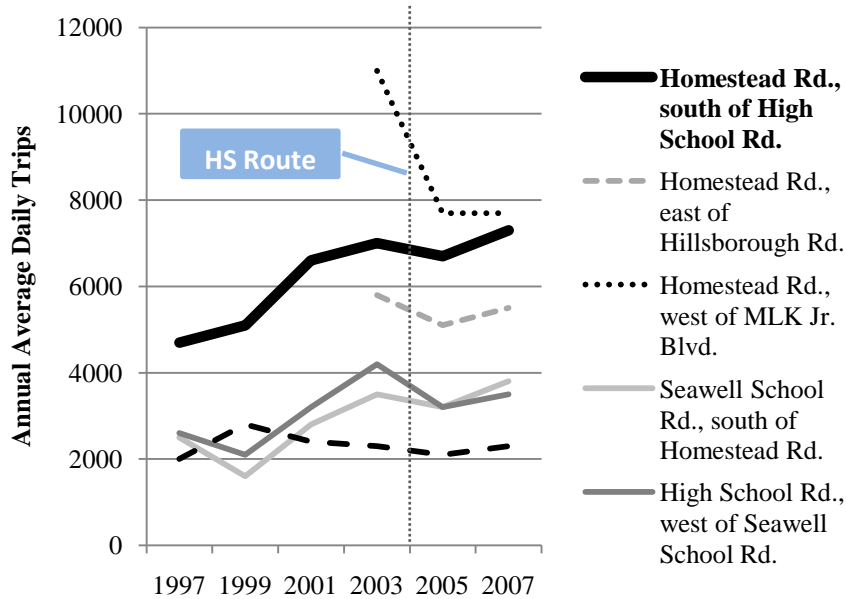


Figure 4. Annual average daily traffic on segments near the intersection of Homestead Rd. and Winmore Ave., 1997-2007. Source: NCDOT Traffic Survey Unit.

3.2 Carolina North Transportation Impact Analysis

The *Transportation Impact Analysis for the Carolina North Development* (“Carolina North TIA”)⁵, submitted to the Town of Chapel Hill on May 1, 2009, provides level-of-service (LOS) and volume-to-capacity (v/c) data and projections for the Homestead/High School intersection.⁶ The data from this intersection were collected through traffic counts taken during peak hours on March 26, 2009. LOS and v/c analysis was conducted by the consultant using traffic analysis software.

Intersection	AM peak LOS	Midday peak LOS	PM peak LOS
<i>Homestead Rd./High School Rd.</i>	<i>B</i>	<i>A</i>	<i>A</i>
• <i>Northbound approach</i>	<i>C</i>	<i>A</i>	<i>A</i>
Homestead Rd./Rogers Rd.	C	B	E
Homestead Rd./Seawell School Rd.	E	A	A

Table 4. 2009 LOS at selected Homestead Rd. intersections. Source: Carolina North TIA.

The existing conditions (2009) analysis found adequate levels of service (C or better) for all peak periods and all approaches at the Homestead/High School intersection. Average delay was longest at the AM peak hour at 19.9 seconds.

Nearby intersections were found to operate at lower levels of service. In the AM peak hour, the Homestead/Seawell School signalized intersection was estimated to operate at an overall LOS E. Specifically, the eastbound approach lane was estimated at LOS F. V/C ratios on Seawell School Rd. exceeded 1.0 for both the AM and PM peak periods.

3.3 Additional information

Several other studies present information on Homestead Rd. traffic in the vicinity of Winmore Ave. In 2004, a consulting firm conducted a traffic signal warrant analysis for the intersection of Homestead Rd. and High School Rd. The study found that a traffic signal would be warranted in 2005 and beyond due to “increases in background traffic and to the addition of Winmore project trips”.⁷ A traffic signal was subsequently installed.

The Board should consider two additional options for addressing traffic at the Homestead/High School intersection:

1. Technical assistance from NCDOT is available through the Municipal and School Transportation Assistance (MSTA) program to address traffic and safety issues near schools. The Board should consider collaborating with Chapel Hill-Carrboro City Schools to request MSTA assistance in addressing traffic management near the intersection.
2. The Board should consider working with the Town of Chapel Hill and NCDOT to review signal timing at the Homestead/High School intersection. Staff is in the process of contacting the Town to obtain more information on this signal.

⁵ University of North Carolina at Chapel Hill. (2009). *Transportation Impact Analysis for the Carolina North Development*. May 1, 2009. http://research.unc.edu/cn/TIA2009_ch1.pdf.

⁶ LOS has a grade scale from A-F, much like school grades, where A represents free flow traffic and F represents significant congestion. For an explanation of each LOS grade, see the Carolina North TIA, Ch. 2, p. 2-8. A v/c ratio of 1.0 is considered the threshold between more congested conditions (>1.0) and more free-flow conditions (<1.0).

⁷ Hall Planning and Engineering. (2004). *Winmore Traffic Signal Warrant Analysis*. Submitted to Robert Chapman, III, Winmore Land Management, LLC. March 3.

Town staff discussed a potential left-turn prohibition with NCDOT staff, who had no specific recommendation, but felt that prohibiting left turns would have limited effects on Homestead Rd. traffic reduction. The owner of the Winmore development has expressed a willingness to install a left-turn control sign at Winmore/Homestead.

Summary of key points and recommendations

1. At least four conditions influence the decision to install a left turn prohibition at Winmore Ave. and Homestead Rd.: left-turn-related safety and traffic flow concerns; the presence of an alternative route; the travel time impact of that alternative route; and whether the intersection is in an urban or suburban area.
2. A traffic count on September 30, 2009, found that 39 vehicles turned left from Winmore Ave. onto Homestead Rd. during a two-hour AM peak period. With a left turn prohibition during these hours, these vehicles would be required to travel on an alternative route. Two alternative routes were analyzed for vehicles desiring to travel eastbound on Homestead Rd. from two different locations in the Winmore development. These routes were found to be 3 and 7.5 times longer in distance than the Winmore Ave. route that would likely be taken if left turns were not prohibited. Consequently, travel times, fuel use, and CO₂ emissions are estimated to be higher for these routes.
3. There is currently adequate capacity and level of service at the intersection of Homestead Rd. and High School Rd.
4. In considering whether to control left turns at the Winmore/Homestead intersection, the Board should consider the overall impacts on driving behavior in the Winmore subdivision and nearby streets.
5. **Recommended actions.**
 - a. If a left turn restriction is desired, then the Board should consider adding the following condition to the Winmore Conditional Use Permit:

“That, prior to the acceptance of E. Winmore Ave., a sign will be installed prohibiting left turns from E. Winmore Ave. onto Homestead Rd. from Monday to Friday during 8:30 a.m. to 8:45 a.m. At the time E. Winmore Ave. is accepted by the Town, this prohibition will be reevaluated.”

This time period is proposed due to peak traffic occurring on Homestead Rd. between 8:00 a.m. and 9:00 a.m., as noted in the 2004 traffic signal warrant study⁸, and the Chapel Hill High School morning start time of 8:45 a.m.

In general, the Board should consider the following options for addressing traffic at the Homestead/High School Rd. intersection:

 - b. Technical assistance from NCDOT is available through the Municipal and School Transportation Assistance (MSTA) program to address traffic and safety issues near schools. The Board should consider collaborating with Chapel Hill-Carrboro City Schools to request MSTA assistance in addressing traffic management near the intersection.
 - c. The Board should consider working with the Town of Chapel Hill and NCDOT to review signal timing at the Homestead/High School Rd. intersection. Staff is in the process of contacting the Town to obtain more information on this signal.

⁸ Hall Planning and Engineering. (2004). Winmore Traffic Signal Warrant Analysis. Submitted to Robert Chapman, III, Winmore Land Management, LLC. March 3, Attachment B.