



Memorandum

To: Mark Cullinan
Town Manager
Nahant, Massachusetts

Date: July 16, 2007

Project No.: 10122.00

From: Laura Castelli, E.I.T
Heather Georgallas

Re: Traffic Assessment Study

1.0 Introduction

Vanasse Hangen Brustlin, Inc. (VHB) has been retained by the Town of Nahant, Massachusetts to prepare a preliminary traffic assessment for a proposed residential housing development. The parcel is located along Goddard Drive, which intersects with Gardner Street and Trimountain Road, and is located in front of the Kelley Greens Golf Course.

The Town is currently considering selling the approximately three acre parcel of land (which currently holds 12 single family homes) to an interested party for redevelopment as a more dense housing use. Goody Clancy Associates has been retained to develop design guidelines for the site. To understand the traffic impacts of such a project on the community, VHB was asked to provide this preliminary assessment, which will summarize potential impacts, solutions, and areas that would need further study by a project proponent. This memorandum describes the proposed development program and analyzes the project-related traffic impact on roadways adjacent to the site. A discussion of site access is also presented. The study area for this assessment includes Castle Road between Gardner Road to the east and Flash Road to the west.

Traffic impacts of the proposed development were quantified for the following intersections in the study area:

- Castle Road at Gardner Road;
- Gardner Road and Colby Way;
- Castle Road at Pearl Road; and
- Castle Road at Flash Road.

The impacts of increased traffic demand along Castle Road were also assessed.

2.0 Project Description/Study Methodology

The proposed site is located on the east side of Castle Road just north of the Gardner Road and Colby Way intersection. There are currently 12 single-family homes located on the site. A site location map is shown on Figure 1. The development program consists of razing the existing

buildings occupying the site and constructing a 30 unit residential housing development. Access to the proposed development will be provided from Gardner Road or Castle Road.

This assessment was conducted using a widely accepted methodology for traffic studies. The first stage involves a study of existing traffic conditions in the vicinity of the proposed project. The existing conditions assessment includes an inventory of roadway geometrics, assessment of recent crash trends, observation of traffic flow, and collection of peak period traffic counts. In the second stage of the study, future traffic conditions are projected and analyzed. The final stage of the assessment presents potential measures to address any projected traffic and safety issues. These measures should be further evaluated by the development proponent at the time a formal traffic study is completed.

3.0 Existing Conditions

Castle Road is the key roadway under the jurisdiction of the Town of Nahant that provides access to and egress from the site. Castle Road extends in a general north-south direction along the west edge of the Town. Traveling northbound and southbound, Castle Road provides one travel lane per direction. The posted speed limit within the study area is 30 miles per hour (mph). Observed speeds indicate the majority of vehicles are traveling at or below the speed limit. Land use in the vicinity of the project site consists of primarily residential development with the Nahant Elementary School located on the corner of Castle Road and Flash Road.

3.1 Key Intersections

The key intersections in the project study area that may be used by traffic related to the proposed project were identified and are described below. The descriptions of the intersections include physical characteristics, geometric conditions, and existing traffic control measures.

Castle Road, Gardner Road and Colby Way- Castle Road is intersected from the east and west by Gardner Road. Gardner Road is intersected from the south by Colby Way. The two intersections operate as one skewed-way intersection. All four approaches of the intersection have one travel lane. The intersection is under four-way stop control (i.e. a STOP sign is present on each leg of the intersection).

Castle Road and Pearl Road - Pearl Road intersects Castle Road from the west. The "T-type" unsignalized intersection consists of free movement north and south on Castle Road and a stop-controlled approach on Pearl Road from the west. The intersection is located approximately 120 feet south of the Castle Road at Flash Road intersection, and directly across from the Nahant Elementary School parking lot.

Castle Road and Flash Road - Flash Road intersects Castle Road from the east. The T-type unsignalized intersection consists of free movement north and south on Castle Road and a stop-controlled approach on Flash Road from the east. The Nahant Elementary School parking lot and playground is located immediately adjacent to this intersection.

3.2 Existing Traffic Volumes

Existing traffic volumes within the study area were collected to establish base conditions. To quantify traffic turning movements, observers recorded vehicle turning movements at all study area intersections. Peak hour turning movement counts (TMC) were conducted by VHB on April 4, 2007, for the weekday morning peak commuter period from 7:00 to 9:00 AM, and for the weekday evening peak period from 4:00 to 6:00 PM. The data indicate that the peak periods of traffic along Castle Road were approximately from 7:30 AM to 8:30 AM and from 4:30 PM to 5:30 PM.

Traffic demands tend to fluctuate with the time of year and are often adjusted to reflect an average annual condition. Turning movement counts were taken in April, in good weather, and when the elementary school was in session. The volumes collected were slightly above annual average conditions and were therefore not adjusted down to reflect seasonality. These factors allow the traffic volumes collected to be more conservative by considering school pick-up and drop-off and additional pedestrian traffic noticed during better weather. The 2007 existing traffic volume networks for the morning and evening peak hour conditions can be found in the appendix.

In addition to the intersections studied as part of this assessment, the Town may wish to include the following two intersections in the traffic study ultimately completed by the project proponent:

- Castle Road at Nahant Road; and
- Flash Road at Marsh Road and Spring Road.

3.3 Safety

In order to identify crash trends and/or roadway deficiencies in the study area, crash data were collected from the Massachusetts Highway Department for the Town of Nahant for the three-year time period from January 1, 2003 to December 31, 2005 (the most recent data available). A summary of the crash data is provided below in Table 1.

The entire Castle Road corridor was evaluated with respect to safety. A total of four crashes occurred along the Castle Road corridor during the three-year period of 2003 to 2005. The highest number of crashes (two) was reported at the intersection of Castle Road and Wendell Road. The Castle Road and Wendell Road intersection is located approximately 280 yards north of the Castle Road and Flash Road intersection. Both crashes occurred during off-peak hours and while the roadways were covered in snow, indicating that poor weather is a contributing factor to crashes at this location. One crash involved a single car hitting a fixed object while the other was an angle-type crash.

There was one crash at the intersection of Castle Road and Nahant Road, the main roadway through Town. This crash occurred during off-peak hours on a clear dry day and was a rear-end type crash. Rear-end type crashes at an intersection such as this often occurs when a driver on the minor road stops before turning and a following driver fails to stop.

There was one crash at the intersection of Castle Road at Foxhill Road. The crash occurred off-peak hours during wet conditions. It is important to note that due to the geometry of Foxhill Road intersecting with Castle Road, the sideswipe most likely happened when a driver was merging from Foxhill Road onto Castle Road.

The number of crashes along Castle Road is relatively low (4 total accidents over 3 years). Again, the majority of crashes occur in poor weather conditions yielding only property damage. It is important to note that all the reported crashes were located outside the study area for the proposed residential development.

The MassHighway Department has prepared a list of the 1000+ high crash locations (HCL) through the entire state of Massachusetts. None of the study area intersections were designated as HCLs.¹

¹ High Crash Intersections Report. Prepared by the MassHighway Safety Management Unit. 2005.

Table 1
Intersection Accident Summary — 2003-2005

Scenario	Castle Road at		
	Foxhill Road	Nahant Road	Wendell Road
Year			
2003	1	1	1
2004	0	0	0
<u>2005</u>	<u>0</u>	<u>0</u>	<u>1</u>
Total	1	1	2
Type			
Angle	0	0	1
Rear-end	0	1	0
Sideswipe	1	0	0
<u>Single-vehicle crash</u>	<u>0</u>	<u>0</u>	<u>1</u>
Total	1	1	2
Severity			
Property Damage Only	1	0	1
<u>Unknown</u>	<u>0</u>	<u>1</u>	<u>1</u>
Total	1	1	2
Weather			
Clear	0	1	0
Rain	1	0	0
<u>Snow</u>	<u>0</u>	<u>0</u>	<u>2</u>
Total	1	1	2
Time			
Weekday, other time	0	1	2
<u>Weekend, other time</u>	<u>1</u>	<u>0</u>	<u>0</u>
Total	1	1	2
Pavement Condition			
Dry	0	1	0
Wet	1	0	0
<u>Snow</u>	<u>0</u>	<u>0</u>	<u>2</u>
Total	1	1	2

Source: Compiled by Vanasse Hangen Brustlin, (VHB) Inc. from data provided by the Massachusetts Highway Department.

3.4 Sight Distance

Two locations within the study area have been observed to have limited sight lines due to roadway geometry and grades: Castle Road at Gardner Road; and Gardner Road at Goddard Drive (existing residential site access). At the first location, as motorists travel in a northeast direction on Gardner Road and approach its intersections with Castle Road and Colby Way, the roadway grades increase to the northeast and sight lines are limited by this incline. Vehicles stopped on Gardner Road at the Castle Road intersection have approximately 165 feet of visibility. A similar situation exists at the intersection of Gardner Road at Goddard Drive. As vehicles exit the existing residential area via Goddard Drive and travel southbound, visibility is limited by the steep grade on Trimountain Road. Both of these situations present a potential safety issue as drivers do not have adequate,

unobstructed lines of sight to perform maneuvers. Sight distance measurements are provided in the appendix.

Additional sight distance measurements were taken to identify any potential safety problems caused by vehicles exiting the minor street approaches of the intersection of Gardner Street at Castle Road as roadway geometry at this location limits sight lines. Intersection sight distance (ISD) is the distance that is based on the time required for a motorist on a minor street approach to complete a desired maneuver, usually a left turn. ISD includes the time for a driver to turn left and clear the near-half of the intersection without conflicting with vehicles approaching from the left and to accelerate to the operating speed of the roadway without causing approaching vehicles on the major street to unduly reduce their speed. ISD guidelines are set by the American Association of State Highway and Transportation Officials (AASHTO), are based on roadway design speeds and roadway grades, and are the desirable sight distance to achieve in design of a new roadway or section of roadway.

If ISD can not be achieved, it is sufficient to meet stopping sight distance (SSD), which is the minimum sight distance required. SSD is the distance traversed by the vehicle from the instant the driver sights an object necessitating a stop to the instant the breaks are applied plus the distance needed to stop the vehicle from the instant the breaks are applied. For design, AASHTO assumes wet pavement conditions. Table 2 compares the measured sight distances to desired and required sight distances.

Table 2
Intersection Sight Distance Requirements – Castle Road at Gardner Road

Location	Direction	Measured Sight Distance (ft)	AASHTO Sight Distance (ft) ¹		Sight Distance Shortfall (ft)
			Desirable (ISD)	Minimum Required (SSD)	
#1: Gardner Road northeast-bound	Looking Northwest	50	280	155	105
#2: Castle Road southwest-bound	Looking Southwest	25	240	155	130

Source: A Policy on Geometric Design of Highways and Streets; AASHTO; 2004.
 1 Sight distance computed using a 25-MPH operating speed.

As indicated, AASHTO recommends that for an operating speed of 25 MPH, the minimum safe sight distance is 155 feet. Based on AASHTO design guidelines, the alignment of the intersection of Gardner Road at Castle Road does not provide adequate safe intersection sight distance or stopping sight distance for the operating speed of the roadway.

4.0 Future Conditions

Traffic growth on area roadways is a function of the expected land development, economic activity, and changes in demographics. A frequently used procedure is to estimate an annual percentage increase and apply that increase to study-area traffic volumes. An alternative procedure is to identify estimated traffic generated by specific planned major developments that would be expected to affect the project study area roadways. For the purpose of this assessment, *both* methods were assessed. Future conditions were projected to the year 2012 -- a 5-year planning horizon. The future traffic volumes were estimated by adjusting existing volumes to account for:

- **External traffic growth** - External traffic growth accounts for general increases in traffic not attributable to specific developments which are proposed or have been approved ; and

- **Background development-related traffic growth** – Development-related traffic growth accounts for traffic generated by planned projects in the nearby area.

The future conditions analyses were conducted with and without the proposed project. The future No-Build analysis assumes that the project is not built, but assumes that other planned developments in the area have occurred. This scenario also includes external traffic growth. The future Build scenario adds traffic from the proposed project to the No-Build scenario.

4.1 Future No-Build Scenario

The No-Build traffic volumes were developed by applying a 1.0 percent annual growth rate over the five-year study horizon to the Existing traffic volumes. For the purposes of this preliminary assessment, no background development traffic growth was included in the No-Build traffic projections. When the development proponent begins the formal traffic study process, the Town should be contacted to ensure that this assumption is still valid. Future 2012 No-Build traffic volume networks can be found in the appendix.

4.2 Future Build Scenario

The project-generated trips were estimated and distributed based on the proposed development program and existing travel patterns. This section addresses site access/egress; trip generation; and trip distribution and assignment.

4.2.1 Site Access/Egress

Access to and egress from the residential properties on the site is currently provided via Gardner Road, Castle Road, and along an access road at the intersection of Gardner Road at Goddard Drive and Trimountain Road. The roadway grade on Trimountain Road limits adequate sight lines, as identified previously. As the development of this site progresses, the location of a primary site access driveway should be examined further as to provide adequate sight distance for entering and existing vehicles. A potential location for this primary access to the site could be along Castle Road, where adequate sight lines are present.

4.2.2 Trip Generation

In order to provide an assessment of the traffic impacts related impacts, the amount of traffic generated by the proposed development was projected. This was done using trip generation rates for the most similar land use code (LUC) published in *Trip Generation* by the Institute of Transportation Engineers (ITE)². The ITE *Trip Generation* manual is the standard reference guide used by the transportation engineering community when attempting to forecast the number of vehicle trips a proposed development may generate once constructed and occupied.

Although it is likely that the development proposal for this site would include a mix of residential uses (single family homes, townhouses, apartments, etc.), the single-family detached housing land use (ITE LUC 210) typically generates more trips than other types of residential uses, and therefore, allows for conservative trip generation projections. This conservative analysis was completed to provide the Town with the necessary “worst-case” information needed to make informed decisions. Table 3 presents the expected number of trips generated by 30 single-family detached homes during both the morning and evening peak hours.

² Trip Generation, 7th Edition, Institute of Transportation Engineers, Washington, D.C., (2003).

Table 3
Trip Generation Projection

Period/Direction	ITE Trip Generation Rates ¹	
	Single-Family Detached Housing	
Morning Peak Hour ²		
Enter		8
<u>Exit</u>		<u>23</u>
Total		30
Evening Peak Hour ²		
Enter		23
<u>Exit</u>		<u>13</u>
Total		36

1 Based on ITE LUC 210 (Single-Family Detached Housing – regression equations) for 30 housing units.

2 expressed in vehicles per hour

4.2.3 Trip Distribution and Assignment

The directional distribution of site generated traffic is a function of population density existing travel patterns, and traffic conditions on area roadways. In consideration of these factors, the directional distribution of new site-generated trips to and from the proposed residential development is expected to reflect existing trip patterns observed along Castle Road. As such, site-generated trips were assigned to the study area intersections based on existing travel patterns. The site-generated traffic was added to the No-Build peak hour traffic volumes to develop the Build peak hour traffic volumes. Future 2012 -Build traffic volume networks can be found in the appendix.

5.0 Traffic Operations Analysis

Measuring existing traffic volumes and projecting future traffic volumes quantifies traffic flow within the study area. To assess quality of flow, intersection capacity analyses were conducted for Existing, No-Build, and Build traffic volume conditions. Capacity analyses provide an indication of how well the roadway facilities serve the traffic demands placed upon them. VHB conducted capacity analyses using the evaluation criteria recommended in the 2000 Highway Capacity Manual [HCM]³ to determine the traffic capacity impacts due to the proposed project. Level-of-service analyses were conducted for the weekday morning and evening peak hours during the Existing, No-Build, and Build conditions at the study-area intersections.

Table 4 presents a summary of the capacity analyses for the unsignalized intersections in the study area. The capacity analyses worksheets are included in the appendix to this memorandum.

³ Highway Capacity Manual, Transportation Research Board, Washington D.C. [2000].

Table 4
Unsignalized Intersection Capacity Analysis

Location	Critical Movement	Period	Existing			No-Build			Build		
			Dem ^a	Del ^b	LOS ^c	Dem	Del	LOS	Dem	Del	LOS
Castle Road at Flash Road	SB-LR	morning	87	16	C	91	17	C	95	18	C
		evening	64	10	B	67	10	B	73	11	B
Castle Road at Pearl Road	NB-LR	morning	11	15	B	11	15	C	11	16	C
		evening	6	10	B	6	10	B	6	11	B
Castle Road/Colby Way at Gardner Road	EB-Approach	morning	49	7	A	51	7	A	59	7	A
		evening	88	7	A	92	7	A	115	8	A
	WB-Approach	morning	7	7	A	7	7	A	7	7	A
		evening	4	7	A	4	7	A	4	7	A
	NB-Approach	morning	81	8	A	85	8	A	85	8	A
		evening	31	8	A	33	8	A	33	8	A
	SB-Approach	morning	11	7	A	12	7	A	35	7	A
		evening	22	7	A	23	7	A	36	7	A

a demand in vehicles per hour for unsignalized intersections; the demand applies to only the most critical street approach or lane group
 b delay of critical approach only, rounded to the nearest whole second
 c level of service of the critical movement
 LR shared left-right

The analyses indicate that the minor street approaches to all study area intersections are anticipated to operate at LOS C or better during the Existing, No-Build, and Build conditions. In general, LOS D or better operations are typically considered acceptable. Project-related traffic is expected to slightly increase delay on the minor street approaches to study area intersections. As shown, the increase in delay does not degrade the level-of-service to unacceptable LOS D or worse under the Build condition.

6.0 Additional Considerations

In addition to traffic impacts, local residents have expressed concern about the project's impact as it relates to the Nahant Elementary School. Castle Road currently serves as the main pick-up/drop-off area for the school and can become fairly congested during the early afternoon. Field observations indicate about a 20 minute period (beginning at 2:00 pm) where traffic and pedestrian activity is heaviest. Two crossing guards are provided to help direct pedestrians safely across the street. A circulation road is currently planned through the school to facilitate pick-up and drop-off. This circulation road will help reduce the current Castle Road congestion at the end of the school day. The proposed residential development is unlikely to have a transportation impact on the school's dismissal plan.

Outside of school dismissal time, very little pedestrian or bicycle activity was noticed in the study area. Existing crosswalk locations, 12 to 15 foot travel lanes and a low traffic volume along Castle Road are sufficient to handle any existing demand. As the project moves forward, the proponent should consider the needs of pedestrians and bicyclists and contribute to any necessary improvements that may be required for their continued safety.

7.0 Summary

This memorandum presented a traffic assessment of the proposed residential development at Castle Road and Gardner Road. The proposed project is estimated to generate approximately 30 total vehicle trips (8 entering and 23 exiting) during the weekday morning peak hour and 36 total vehicle trips (23 entering and 13 exiting) during the weekday evening peak hour period. The existing and projected traffic volumes at study area intersections can be accommodated without any

infrastructure improvements or traffic signal installation and no noticeable impacts to the transportation network are expected.

The most critical transportation issue to be faced by a proponent is the ability to provide adequate intersection sight distance from the main access roadway. It is recommended that as the development program continues to progress, the locations of proposed site driveways be further examined to provide adequate sight distance and to minimize impacts to the Castle Road corridor. The proponent should also work with the Town to ensure that traffic circulation related to the elementary school remains unimpeded.

Finally, Pedestrians and bicyclists also appear to have adequate transportation infrastructure to serve their needs under both existing and future conditions. The proponent selected to develop the site should work with the Town to ensure that their needs continue to be met through and after construction.

DRAFT



Vanasse Hangen Brustlin, Inc.

Site Location Map
Nahant, Massachusetts

Figure 1