Transportation
Land Development
Environmental
Services

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**Memorandum**

To: Ms. Barbara Thissell, P.E.
352 Nahatan Street
Norwood, Massachusetts 02062

Date: July 10, 2007

Project No.: 10173

From: Ana Fill, PE
Senior Traffic Engineer
Patrick Dunford, PE
Project Manager

Re: Traffic Study Peer Review
Glen Ellen Country Club – Senior Residential Community
Millis, Massachusetts

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*Vanasse Hangen Brustlin, Inc.* (VHB) has performed a professional and independent technical review of the traffic study prepared by *Earth Tech, Inc.* for the proposed Glen Ellen Country Club senior residential project, located on the northern side of Orchard Street, at the Glen Ellen Country Club site in Millis, Massachusetts. The development of this site includes constructing 341 age-restricted (55+) dwelling units, a 20,000 square foot wellness center, a 9,000 square foot club house and reducing the existing 18-hole golf course to a 12-hole golf course. The site would continue to use the two existing driveways as well as the existing maintenance driveway and provide two additional full-access driveways to access the residential component. The residential component can also be accessed via the golf course and wellness center driveways. This review included an analysis of the information presented in the traffic impact and access study that was submitted on behalf of the applicant.

## Submission Materials

As part of the technical analysis for the Town of Millis, VHB reviewed the following report:

- *Traffic Impact and Access Study, Glen Ellen Country Club Senior Residential Community, Millis, Massachusetts;* Prepared by Earth Tech, Inc.; February, 2007.

This information has been considered in the preparation of this memorandum. Other various sources of information were also referenced, as needed, and are footnoted in the memorandum.

## Overview & Recommendations

The traffic report has been prepared in a manner consistent with transportation engineering standards. There are a few areas, however, where VHB believes some additional information and/or clarification is required. The following includes a general review of the submission materials followed by specific and detailed comments to which the applicant should respond.

## Traffic Impact and Access Study Review

In general, the study has been prepared to industry standards using information and methods suitable for a traffic impact and access study.

**Existing Conditions**

*Study Area*
The study area includes intersections along Orchard Street starting at the Site Drives and ending at Ridge Street. It is unclear why the Orchard Street/Middlesex Street and Exchange (Route 115) intersection was referenced in certain sections of the study, but was not included in the study area. *VHB recommends that this location be included in the study.*

*Traffic Volumes*
The study notes traffic volumes were collected mechanically along Orchard Street in July and August 2006. It is mentioned that the bridge over Bogstow Brook was being reconstructed at the time, but that the traffic volumes in the vicinity of Glen Ellen Country Club would not be significantly impacted by the detour. It would be interesting to obtain current data at this location to validate this statement.

Review of Table 1: Orchard Street Traffic Volumes seem to indicate that the attendance at Glen Ellen events does not significantly impact daily or peak hour traffic volumes along Orchard Street. For instance, on the day of the 1,100 attendance event Orchard Street experienced a total daily traffic of 1,031 while on the day of the 40 person attendance event it experienced a total daily traffic of 1,112. Thus, it appears that changed in traffic due to events along Orchard Street is within typically observed variations in traffic volumes on roadways from day to day fluctuations. It is also mentioned in the study that "west of Glen Ellen, the AM and PM traffic volumes accounted for about 17 and 12 percent of the daily traffic volumes, and that this occurrence indicates that large events at Glen Ellen Country Club currently account for a large proportion of the overall traffic volume on Orchard Street". It should be noted that the volumes presented in the table actually represent the largest volumes observed during the morning and afternoon times and do not reflect typical commuter peak hour conditions – the reported morning volumes occurred between 9:00 and 10:00 AM and the reported evening volumes between 12 noon and 1:00 PM, both outside peak periods. The volumes observed during the peak periods are actually consistent with typical values – 8 and 6 percent respectively.

Counts were conducted manually at the two existing driveways in July 2006 and at the two off-site study intersections in October 2006. The driveway counts were conducted on a Friday when the West Driveway was closed during the morning peak hour. As described later in the report, the automatic data collected at this location on this day was not utilized for the calculation of average traffic volumes. Likewise, this data is not adequate to determine the existing conditions for the morning peak hour traffic volumes and analysis. *Therefore, the West Driveway/Orchard Street intersection should be recounted at a time the driveway is opened. It is advisable that the Main Driveway/Orchard Street intersection also be counted at this time for consistency purposes. Further, the morning and evening peak hour trip generation for the site should be determined based on manual counts at the driveway on a typical day at the Ellen Glen Country Club..*

*The existing conditions traffic volumes at the two driveways should be calculated using the overall peak hour for these intersections, and should be balanced, given the close proximity of these locations.* It also appears that some of the morning peak hour volumes at Orchard Street/Bullard Lane are higher than those on the count sheets. As this provides a conservative analysis, the results shown in the study should be adequate.

*Traffic Accidents*
Millis Police Department crash data from the years 2003-2005 were reviewed to determine a crash history at the study intersections. *VHB requests that backup of this data be provided. Further, crash rates should be calculated for these locations according to MassHighway guidelines to allow for comparison with other unsignalized locations in the area.*

**Future Conditions**

*No-Build Conditions*
The historic annual traffic growth rate of 1.0 percent seems reasonable. Volumes exiting the site driveways were also increased by 1.0 percent, which results in a conservative analysis, as these volumes are not necessarily susceptible to background area growth but are instead a function of the Glen Ellen Country Club activities.

No mention of any roadway improvements that may be planned in the area is made in the study.

*Trip Generation*
Trip generation for the proposed site was determined for each separate land use using a combination of empirical data and data established by the *Institute of Transportation Engineers* (ITE)[1]. This is typically an accepted practice; VHB, however, has the following comments:

Senior Housing
The senior housing component of the project was calculated using ITE Land Use Code (LUC) 251, "Senior Adult Housing – Detached" and LUC 252, "Senior Adult Housing – Attached". As mentioned in the study, these rates were developed from a limited number of studies with an average number of units several times higher than the proposed project. Over the past years in Massachusetts, age-restricted (55+) developments have been proposed and constructed with increasing frequency. During this time, a number of trip generation data has been collected from age-restricted developments around the state for the commuter peak hours. Although ITE data is typically used to determine trip generation, trip generation rates for LUC 251 and LUC 252 were determined from few data points. In these situations, it is preferable to use local empirical data to estimate trip generation. VHB has provided backup empirical information collected from a number of studies performed by other traffic consultants in the region. *It is recommended that at a minimum a sensitivity analysis be conducted utilizing these data.*

Golf Course and Club House
The traffic study estimated the trip generation of the current golf course as well as the proposed smaller golf course using ITE LUC 430, "Golf Course". The trip generation rates for this ITE land use code were also determined using a limited number of studies. *Given that the golf course is currently active, VHB recommends that empirical data be used at this location*. This is particularly relevant due to the fact that the number of event trips was derived by subtracting the observed trip generation of the Glen Ellen Country Club from the estimated number of golf related trips. By conducting counts on a non-event, typical day, the actual trip generation for this particular golf course can be determined.

The trip generation for this component of the project also indicated that a 45 percent trip reduction credit was used due to the estimated number of members living on-site. However, no backup was provided to support this claim. *VHB would like to obtain backup to support this assumption*. Further, if this credit is taken, *the Town may wish to include a requirement for the proposed project to maintain this mix of members in its order of conditions*.

Wellness Center
ITE trip generation rates for LUC 492, "Health/Fitness Club", were used to determine this project's components trip estimates. In addition, it was assumed that 40 percent of the Wellness Center members will live on-site. Once again, *VHB would like to obtain backup in support of this assumption.*

[1] Trip Generation; Seventh Edition; Institute of Transportation Engineers (ITE); Washington, DC; 2003.

Also, if this credit is taken, *the Town may wish to include a requirement for the proposed project to maintain this mix of members in its order of conditions*.

Event Traffic

Existing event traffic was determined by subtracting ITE based trip generation for the golf course from observed volumes at the Site Driveways. As previously mentioned, however, use of ITE rates to calculate the trip generation associated with the golf course portion of the existing site instead of actual empirical data may result in an over-estimation of event related trips. Inspection of Table 2: Glen Ellen Existing Driveway Traffic Volumes provides mixed results failing to establish a direct correlation between the event's attendance numbers and trip generation, especially during the peak hours. For instance, a 125 person attendance event, coupled with the golf course use, yielded a total of 161 morning peak hour trips and 83 evening peak hour trips. A much smaller 40 person attendance event, coupled with the golf course use, yielded a fairly similar number of peak hour trips – 103 during the morning peak hour and 84 during the evening peak hour. Therefore, the exact effect of the event attendance on trip generation cannot be determined using this data; additional information regarding the nature of the event, e.g., golf tournament versus wedding, as well as the time of the event is needed. VHB would like to obtain this additional event information to determine the impact of an event in the existing peak hour trip generation. This is particularly relevant since the total number of events projected for the future is actually larger than those which happened in the year the counts were conducted (2006).

*VHB recommends that the existing event traffic be recalculated by utilizing time/nature of each event as well as actual empirical data to determine the mix between event and golf related trips.*

Summary

VHB recommends that:

- Empirical data be utilized to determine the trip generation associated with the senior housing component of project;
- Empirical data be utilized to determine the trip generation associated with the golf course component of project;
- Backup be provided to support the mix between members living on site and others both for the golf club as well as the wellness center;
- If credit is taken for on-site members, that the Town consider including a mention of the proposed mix in its order of conditions; and
- Existing event trips be recalculated using empirical data for golf course trips as opposed to ITE estimates as well as based on the nature and time of event occurrence.

By-Right Comparison

A trip generation comparison for the by-right, 100 single family homes use is presented in the study. This trip generation was determined based on ITE LUC 210 (Single Family Detached Housing) rates. The comparison indicates that the proposed project, as currently calculated, generates somewhat more daily and evening peak hour trips, and less morning peak hour trips. The proposed senior residential community trip generation numbers will likely change based on the comments provided above, possibly resulting in higher trips.

*Trip Distribution*

The report indicates that the trip distribution for the senior component of the proposed development was estimated based on journey to work data, however no backup is provided. *VHB requests that backup of this data be provided.* Further, based on the location of the housing units, it appears that too much traffic is assigned to the West Residential Driveway. *VHB recommends that this distribution pattern be reconsidered.*

The trip distribution used for the golf course/wellness center project components was based on the existing travel patterns at the Main Site Driveway/Orchard Street intersection. While the trip distribution numbers presented in the report correspond fairly well with the morning peak hour traffic volumes, there is a discrepancy with relation to the evening peak hour exiting volumes. Volumes turning right from the driveway during the evening peak hour account for approximately 67 percent of the traffic exiting the site. *VHB would like to know whether there is a reason for this anomaly. Alternatively, if this driveway is recounted as suggested, these new volumes could be used to determine the trip distribution.*

*Site Generated Traffic Volumes*
A figure depicting project trips is presented in the report. This figure, however, contains total project trips, and makes difficult to discern the net new trips associated with the project. *VHB requests that the net project trip volumes be provided for each major component of the site; i.e., senior housing, golf course, wellness center and event trips.*

## Capacity and Queue Analyses

The methodology for analyzing the existing and future conditions is sound and it appears to have been performed correctly with the following exceptions. First, it appears that the peak hour factors for the West Residential Site Driveway and the West Site Driveway have been switched for the Build conditions scenarios. *VHB requests that these peak hour factors be confirmed.* Also, the Orchard Street/Ridge Street intersection is currently described as a four-way stop location, but it is analyzed as a two-way stop. *VHB requests that this location be reanalized as a four-way stop.*

## Sight Distance
A sight distance safety evaluation was conducted based on vehicle speeds measured along Orchard Street and American Association of State Highway and Transportation Officials (AASHTO) standards[2]. The results presented indicate that, three of the site driveways meet both stopping and intersection sight distances. The fourth driveway, Club House West Driveway, fails to meet the intersection sight distance to the west (looking right). The presented intersection sight distance of this driveway to the west, however, is higher than the minimum stopping sight distance.

Field observations by VHB indicate that the available sight distances presented in the report may be actually obstructed by vegetation and/or horizontal/vertical curves on Orchard Street. Further, due to the heavy vegetation, VHB was unable to confirm intersection sight distance for the proposed residential driveways. *VHB requests that a plan be provided showing both the stop and the intersection sight distance triangles for all driveways, as well as profiles where appropriate (i.e., a vertical curve is present on Orchard Street in the vicinity of the driveway). The applicant should make a commitment to maintain these sight triangles as clear and unobstructed in perpetuity.*

## Site Design
The study mentions site design elements including roadway widths and parking supply. These elements are being reviewed separately as part of the site plan review. Overall, the project circulation appears to be adequate; however, a detailed review of roadway design to ensure appropriate dimensions should be conducted.

VHB briefly reviewed the proposed roadway widths within the site. The two residential roadways, 26 and 22 feet wide respectively, appear to be adequate. However, the roadways classified as a

[2] A Policy on Geometric Design of Highways and Streets; American Association of State Highway and Transportation Officials (AASHTO); Washington, DC; 2004.

driveway access are only 16 feet wide. These roadways, which on some areas provide access to over 25 residential units, appear to be too narrow to adequately accommodate the site traffic. Many concerns arise from the proposed 16-foot roadway width, including emergency service access such as fire trucks. Based on the large number of units and the limited parking provided, it is not unreasonable to assume that on-street parking would occur occasionally, regardless of parking restrictions, which would potentially impede navigation of fire trucks. Further, day to day use of these roadways would be constrained given the proposed 16-foot width. Snow, curb-side trash, and other normal occurrences such as delivery trucks, UPS, etc, would create problems on roadways this narrow. Therefore, VHB would recommend that the minimum width of these roadways should be 18 feet. It should be noted that VHB has not reviewed the horizontal and/or vertical alignment of these roadways as this current review is focused solely on traffic circulation.

It should also be noted that, based on observations provided in the study, the current parking supply is expected to reach capacity during certain events. The parking demand for the site should be estimated to determine whether sufficient parking is provided regardless of zoning requirements, for the applicant's benefit.

## Peer Review Recommendations

VHB recommends that the following issues be addressed by applicant:

1. The Orchard Street/Middlesex Street/Exchange (Route 115) intersection should be included in the study area.
2. The Site Driveways should be recounted at least during the morning peak hour, but preferably during both peak hours.
3. The existing traffic volumes at the Site Driveways intersections should be determined using a single peak hour and balanced.
4. Back up accident data from the Millis Police Department should be provided for the years 2003-2005 and the intersections' crash rates should be calculated.
5. The trip generation for the project should be revised in the following manner:
    a) Empirical data be utilized to determine the trip generation associated with the senior housing component of project;
    b) Empirical data be utilized to determine the trip generation associated with the golf course component of project;
    c) Backup be provided to support the mix between members living on site and others both for the golf club as well as the wellness center;
    d) If credit is taken for on-site members, that the Town consider including a mention of the proposed mix in its order of conditions; and
    e) Existing event trips be recalculated using empirical data for golf course trips as opposed to ITE estimates as well as based on the nature and time of event occurrence.
6. Backup data for the journey to work trip distribution should be provided, and the golf course trip distribution should be reviewed based either on new volumes conducted at the Site Driveways or accounting for the discrepancy in directionality for vehicles exiting during the evening peak hour.
7. Project related net trips should be provided for each component of the project separately.
8. The peak hour factors for the West Residential and West Golf Course Driveways should be confirmed for the Build conditions scenario.
9. The Orchard Street/Ridge Street intersection should be reanalyzed as a four-way stop.

10. Plans showing stopping and intersection sight distances for the driveways should be provided.
11. The minimum roadway width within the site should be 18 feet.

The preceding information was prepared for use by the Town of Millis to assist them in the review of the proposed Glen Ellen Country Club Senior Residential Community development project, located on the northern side of Orchard Street in Millis, Massachusetts.

**TRIP RATES**

| | The Village at Orchard Meadows | Carriage Hill | Data form VAI | Walker Meadow | Data from MS Transportation | ITE Paper 2/2007 | Total Weighted Average |
|---|---|---|---|---|---|---|---|
| Daily | | | | | 5.24 | | 5.24 |
| Morning Peak Hour | | | | | | | |
| In | 0.05 | 0.13 | 0.11 | 0.08 | 0.09 | 0.04 | 0.09 |
| Out | 0.3 | 0.11 | 0.16 | 0.22 | 0.25 | 0.14 | 0.22 |
| Total | 0.35 | 0.25 | 0.27 | 0.3 | 0.34 | 0.18 | 0.31 |
| Evening Peak Hour | | | | | | | |
| In | 0.37 | 0.16 | 0.23 | 0.19 | 0.26 | 0.22 | 0.25 |
| Out | 0.16 | 0.17 | 0.1 | 0.11 | 0.14 | 0.11 | 0.13 |
| Total | 0.53 | 0.33 | 0.33 | 0.3 | 0.4 | 0.33 | 0.38 |
| # locations | 1 | 1 | 3 | 1 | 9 | 1 | |
| | BSC | HSH | VAI - in BSC memo | BCA | MS | | |

BSC GROUP

# MEMORANDUM

To: File

Date: May 3, 2006

From:

Proj. No: 8.9363.00

Re: Trip Generation Comparison

15 Elkins Street
Boston, MA 02127

Tel: 617-896-4300
800-288-8123
Fax: 617-896-4301

Trip Generation Rate Comparison

| | Empirical Data | | | | | ITE Data | |
|---|---|---|---|---|---|---|---|
| | The Village at Orchard Meadows[a] | HSH Carriage Hill[b] | Data from Abend[c] | Data from VAI[d] | Overall Weighted Average | LUC 251 Senior Adult Housing – Detached | LUC 230 Residential Condominium/ Townhouse |
| *Weekday Morning Peak Hour* | | | | | | | |
| Entering | 0.05 | 0.13 | 0.09 | 0.11 | 0.10 | 0.08 | 0.07 |
| Exiting | 0.30 | 0.11 | 0.26 | 0.16 | 0.22 | 0.12 | 0.37 |
| Total | 0.35 | 0.24 | 0.35 | 0.27 | 0.32 | 0.20 | 0.44 |
| *Weekday Afternoon Peak Hour* | | | | | | | |
| Entering | 0.37 | 0.16 | 0.27 | 0.23 | 0.26 | 0.16 | 0.35 |
| Exiting | 0.16 | 0.17 | 0.14 | 0.10 | 0.13 | 0.10 | 0.17 |
| Total | 0.53 | 0.33 | 0.41 | 0.33 | 0.39 | 0.26 | 0.52 |

[a] *based on counts by BSC Group, 5/2/06 at The Village at Orchard Meadows, Shrewsbury, MA*
[b] *based on counts by Howard/Stein-Hudson, 4/6/05 and 4/7/05, at Carriage Hill, Southborough, MA*
[c] *average of data from Abend Associates at five similar locations, counted between Sept 1997 and Sept 2002*
[d] *average of data from Vanasse & Associates, Inc. at three similar locations*

cc:

THE ADULT RESIDEN
MARSHFIELD, MA 2/14/0

# Trip Generation Projections
## Age-Qualified Development
## 84 Units

| | Peak Hour Volumes | | | | Average Daily Volumes | |
|---|---|---|---|---|---|---|
| | Morning | | Evening | | | |
| | In | Out | In | Out | In | Out |
| Based on rates from ITE Condominium/Townhouse [1] | 8 | 37 | 36 | 17 | 281 | 281 |
| Based on rates from Westbrook Crossing [2] | 9 | 21 | 16 | 13 | n/a | n/a |
| Based on rates from Southborough Meadows [3] | 10 | 26 | 50 | 11 | n/a | n/a |
| Based on rates from Marlborough East [4] | 6 | 18 | 18 | 16 | 218 | 218 |
| **For Comparison:** | | | | | | |
| Based on rates from ITE Elderly Housing [5] | 4 | 2 | 5 | 3 | 146 | 146 |
| Based on rates from ITE Retirement Community [6] | 6 | 8 | 11 | 9 | n/a | n/a |
| **Used for this Analysis:** | **10** | **25** | **30** | **15** | **250** | **250** |

1 ITE Land Use Code #230, ***Condominium/Townhouse***, trips per person assumed at two persons per unit. The number of people are applied to both the rate and the ITE equation and the two projections are then averaged.

2 Westbrook Crossing is located along Main Street in Shrewsbury, MA. The count was done in September 1997. Peak hour volumes: 0.11/unit in, 0.25/unit out during the AM; 0.19/unit in, 0.15/unit out during the PM for 73 units.

3 Southborough Meadows is located along Route ~~20~~ 30 in Southborough, MA. The count was done in October 2000. Peak hour volumes: 0.12/unit in, 0.31/unit out during the AM; 0.60/unit in, 0.13/unit out during the PM for 52 units. This may be high since some final construction was being completed but it is 100 percent occupied.

4 Marlborough East is located on Route 20 in Marlborough, MA. The count was for a 48-hour period in November 2000. Peak hour volumes: 0.07/unit in, 0.22/unit out during the AM; 0.22/unit in, 0.19/unit out during the PM; 2.60/unit in, 2.60/unit out on a 24-hour basis for 100 units.

5 ITE Land Use Code #253, ***Elderly Housing -- Attached***; typically related to over 65 years old.

6 ITE Land Use Code #250, ***Retirement Communities***; these are usually "self-contained villages" with other recreational amenities.

The MS Study noted that 60% of the accidents at this intersection involved angle type collisions. After further reviewing this data, BC&A discovered the majority (78%) of these angle accidents involved a vehicle on Westminster Street (Route 2A) eastbound colliding with a vehicle traveling on Westminster Street (Route 2A/Route 31) in a southwest direction, most likely someone taking a left turn onto Princeton Road (Route 31).

## FUTURE CONDITIONS

The study followed standard traffic engineering guidelines by analyzing a five-year future condition for the proposed development. The study analyzed a five-year condition assuming a 2.5% annual traffic growth rate in addition to adding specific background projects. The 2.5% annual traffic growth rate is acceptable to both to BC&A and the City of Fitchburg planning department. Future (2007) conditions' analysis was also performed correctly.

## PROJECTED TRIP GENERATION, DISTRIBUTION

For ease of reviewing, and to be consistent with EOEA/EOTC guidelines, figures showing the site generated vehicle trips throughout the study area should be included. Presently anyone reviewing the report has to subtract No Build volumes from Build volumes to know the number of proposed trips at each intersection.

Over 55 housing is a relatively new type of land use, and the Institute of Transportation Engineers (ITE) has not, to date, compiled trip generation data to be used in estimating trips. Accordingly, agencies and consultants have performed studies at existing facilities and have shared the information. MS Transportation conducted several studies and used data from other consultants to develop the data for Westminster Hill Estates. The numbers used in the MS Study are 23% -26% lower than typical condominium developments.

To verify the use of the lower rate, BC&A reviewed the results of one of the earlier ITE studies[1] and performed a traffic count at an existing 55+ development in Westborough, Massachusetts. Walker Meadow is a 100-unit over 55 condominium development with no vacancies. Table 1 below summarizes the trip generation data information assembled from various sources. Since the MS Study trip generation figures are in line with the data presented by BC&A, the assumed trip generation used in the study is acceptable.

[1] *Senior Housing Trip Generation and Parking Demand Characteristics*, Stephen B. Corcoran, P.E. Institute of Transportation Engineers 66th Annual Meeting

Table 1 Trip Generation Rate Comparison

| Source | AM Peak Hour | | | PM Peak Hour | | |
|---|---|---|---|---|---|---|
| | In | Out | Total | IN | Out | Total |
| Standard Condominiums ITE Land Use #230 | 0.07 | 0.37 | 0.44 | 0.36 | 0.18 | 0.54 |
| Proposed Westminster Hill Estates | 0.09 | 0.25 | 0.34 | 0.26 | 0.14 | 0.40 |
| Senior Housing ITE Study | | | 0.38 | | | 0.47 |
| BC&A Study (Walker Meadow Westborough, MA) | 0.08 | 0.22 | 0.30 | 0.19 | 0.11 | 0.30 |

The traffic study states that trip distribution was based on existing traffic patterns, however only Journey-to-work data is included in the Appendix and no backup calculations are included. It is unclear which method was used to determine the trip distribution. The proposed vehicle trips were distributed according to the following distribution; 35% to/from Princeton Road (Route 31), 5% to/from Westminster Street (Route 2A) to the west, 50% to Westminster Street to the east, 5% to Westminster Hill Road to the east, and 5% to Ashburnham Street to the north. BC&A believes that trip distribution using Ashburnham Street (Route 12) to the north was understated in the MS Study. In addition, the study assumes all vehicles destined to Route 12 to the north will use Sanborn Street, a street that was not studied. Backup calculations, showing why only 5% of project traffic was assigned to the major route to the north should be included. It was also noted that the intersection of River Street (Route 12)/Westminster Street (Route 2A)/Ashburnham Street (Route 12) to the east was not studied, even though 50% of site generated traffic is expected to travel through this intersection. Since a large percentage of site-generated traffic will be distributed through the River Street (Route 12)/Westminster Street (Route 2A)/Ashburnham Street (Route 12) intersection, it should be included as a study area intersection.

Vehicles destined to Princeton Road (Route 31) or Westminster Street to the south will connect to Westminster Street via a number of neighborhood roads. The study shows approximately half of the trips using Philips Street while the other half "disappear" into the neighborhood and reappear at the other end. BC&A believes the majority of these vehicles will use Colony Street, which was not included in the study area.

## LEVEL OF SERVICE

The intersection of Westminster Street (Route 2A)/Princeton Road (Route 31) will operate at LOS F during both peak hours, under both the No Build and Build conditions. This does not represent a change in LOS F, but the MS Study concluded that "the approach would continue to operate with similar delays in the future independent of the proposed Westminster Hill Estates project" for the No Build and Build conditions. During the AM peak hour the delays for Princeton Road (Route 31) are so great that the analysis program is unable to show a difference. During the PM peak hour, however, the Build condition

2nd Access was for Construction

# Trip Generation Summary - 55+ Development

| | Trip Generation Observations<br>Oak Point, Middleborough, MA | | Daily In | Daily Out | Daily Total | Morning Peak Hour In | Morning Peak Hour Out | Morning Peak Hour Total | Evening Peak Hour In | Evening Peak Hour Out | Evening Peak Hour Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| 1 | November 1999 (52 Units Occupied) | | | | | 0.12 | 0.27 | 0.38 | 0.21 | 0.12 | 0.33 |
| 2. | December 2000 (158 Units Occupied) | | | | | 0.12 | 0.23 | 0.35 | 0.30 | 0.16 | 0 46 |
| 3 | July 2001 (230 Units Occupied) | | | | | 0.09 | 0.17 | 0.26 | 0 21 | 0.14 | 0.35 |
| 4. | October 2001 (230 Units Occupied) | | 2.45 | 2 45 | 4.90 | 0.06 | 0.27 | 0 33 | 0.23 | 0.14 | 0.37 |
| 5 | December 2001 (230 Units Occupied) | | 2.82 | 2.82 | 5.65 | 0.02 | 0.27 | 0.29 | 0.28 | 0 10 | 0.38 |
| | Average Trip Rate | | 2.64 | 2.64 | 5.28 | 0.08 | 0.24 | 0.32 | 0 24 | 0 13 | 0.38 |
| | | | 50% | 50% | | 25% | 75% | | 65% | 35% | |

| | Other Observations | | Daily In | Daily Out | Daily Total | Morning Peak Hour In | Morning Peak Hour Out | Morning Peak Hour Total | Evening Peak Hour In | Evening Peak Hour Out | Evening Peak Hour Total |
|---|---|---|---|---|---|---|---|---|---|---|---|
| | *Southborough Meadows, Southborough, MA* | *DO* | | | | *0.12* | *0.31* | *0.43* | *0.60* | *0.13* | *0 73* |
| | *October 2000 (52 Units Occupied)* | *NOT* | | | | *28%* | *72%* | | *82%* | *18%* | |
| | *Note: Count may be high due to construction traffic* | *USE* | | | | | | | | | |
| 6 | Marlborough East, Marlborough, MA | | 2.60 | 2.60 | 5.20 | 0.07 | 0.22 | 0.29 | 0.22 | 0.19 | 0.41 |
| | November 2000 (100 Units Occupied) | | | | | 24% | 76% | | 54% | 46% | |
| 7 | Meadow Woods Ret. Community, South Carver, MA | Obs. Trips | | | | 6 | 10 | 16 | 14 | 6 | 20 |
| | December 1999 (57 Units Occupied) | Rate | | | | 0.11 | 0.18 | 0.28 | 0.25 | 0.11 | 0 35 |
| | | | | | | 38% | 63% | | 70% | 30% | |
| 8 | Westbrook Crossing, Shrewsbury, MA | Obs. Trips | | | | | | | | | |
| | September 1997 (73 Units Occupied) | Rate | | | | 0.11 | 0.26 | 0.37 | 0.19 | 0.15 | 0 34 |
| | | | | | | 31% | 69% | | 56% | 44% | |
| 9 | Meadow Woods, North Chelmsford, MA | Obs. Trips | | | | 8 | 28 | 36 | 30 | 8 | 38 |
| | September 2002 (71 Units Occupied) | Rate | | | | 0.11 | 0.39 | 0.51 | 0.42 | 0.11 | 0 54 |
| | | | | | | 22% | 78% | | 79% | 21% | |

| | Overall Average<br>(Average of 9 Observations) | Daily In | Daily Out | Daily Total | Morning Peak Hour In | Morning Peak Hour Out | Morning Peak Hour Total | Evening Peak Hour In | Evening Peak Hour Out | Evening Peak Hour Total |
|---|---|---|---|---|---|---|---|---|---|---|
| | 55+ Development Trip Rate | 2 62 | 2.62 | 5.24 | 0.09 | 0.25 | 0.34 | 0.26 | 0.14 | 0 40 |
| | | | | | 26% | 74% | | 65% | 35% | |

From MS Transportation

# Trip Generation Characteristics of Age-Restricted Housing

**"AGE-RESTRICTED" HOUSING, ESSENTIALLY FOR PERSONS 55 AND OLDER, HAS BECOME A POPULAR COMPONENT OF MANY NEW RESIDENTIAL DEVELOPMENTS. THIS FEATURE PRESENTS STUDY METHODOLOGY AND FINDINGS OF A TRAFFIC DATA COLLECTION EFFORT TO QUANTIFY PEAK-HOUR TRIP GENERATION CHARACTERISTICS OF AGE-RESTRICTED HOUSING. THESE FINDINGS WILL STRENGTHEN THE DATABASE FOR THIS INCREASINGLY IMPORTANT LAND USE.**

**BY THOMAS E. FLYNN, P.E., PTOE AND ANDREW E. BOENAU, E.I.T.**

THIS FEATURE PRESENTS THE results of a study involving the collection of peak-hour vehicle trip generation information for age-restricted housing. The study was undertaken to provide additional statistically valid traffic data for this increasingly popular land use type.

## THE ESTABLISHMENT OF AGE-RESTRICTED HOUSING

The increasing average population age, increasing income and change in culture and lifestyle have contributed to the increased demand for housing for senior citizens. However, the development of age-restricted housing projects has been limited, partly due to the Civil Rights Act of 1968 (Fair Housing Act), which prohibits discrimination in housing for a variety of reasons. This act was modified in 1988 to, among other things, prohibit discrimination based on familial status (the presence of children under age 18).

However, the Housing for Older Persons Act of 1995 (HOPA) eliminates the requirement for 55 and older housing to have "significant facilities and services designed for the elderly" and establishes a "good faith reliance" immunity from certain damages relating to discrimination.

HOPA further states that the intent of the housing must be demonstrated to serve persons 55 and older. That is, property will not violate the Fair Housing Act if it excludes families with children, but it does not have to do so as long as 80 percent of occupied units have one occupant aged 55 or older.

## CURRENT SENIOR HOUSING TRIP GENERATION

The Institute of Transportation Engineers (ITE) is the industry standard source for providing trip generation information for various land uses. Due to the relative newness of age-restricted developments, there are limited empirical data documenting trip generation characteristics for these land use types.

A paper presented at the ITE 1996 Annual Meeting and Exhibit entitled "Senior Housing Trip Generation and Parking Demand Characteristics" includes trip generation data for senior housing.[1] A variety of housing types, including nursing homes, are contained in this single land use category.

Perhaps a more appropriate source of senior housing trip generation is ITE's *Trip Generation* Code 251, Senior Adult Housing-Detached. This database includes assisted housing.

## THE FOUR SEASONS AT HISTORIC VIRGINIA

The development studied was the Four Seasons at Historic Virginia, an age-restricted, 55-plus, active adult community located in Prince William County in suburban northern Virginia (see Figure 1). The Four Seasons at Historic Virginia has the following characteristics:

- It is situated along State Route 234, an arterial providing a direct connection to Interstate 95. No transit, bike, or pedestrian facilities connect the development with other area land uses.
- In addition to requiring at least one resident to be age 55 or older, no person under 19 may reside for more than 90 days in any consecutive 12 months.
- At full development, it will have approximately 800 detached residential units. It currently has approximately 460 age-restricted residential units that are fully built and occupied (full time or seasonally).
- The only non-residential development is the 12,000-square-foot community clubhouse.
- It is estimated by the developer that perhaps half of the residences include at least one adult who is still work-

Figure 1. The Four Seasons at Historic Virginia, an age-restricted, 55-plus, active adult community located in Prince William County, VA, USA.

ing, either part time or full time. The authors' opinion is that this is high compared to the typical age-restricted community, which often is a more retirement oriented environment—mountain area or water oriented—where the job market is not as strong. Along the same lines, it is estimated that perhaps only several percent of the units are seasonal or second homes—again, a characteristic more common with resort related retirement communities.

- Residences sell in the general range of $300,000–$650,000. Because the development is only several years old, a relatively high percentage of the additional site work is being undertaken by the owners. This includes patios and additional landscaping. The month prior to the study included 50 site work applications to the homeowners association. This activity contributes to a higher level of traffic generation as compared to normal conditions at full development.
- A fairly small staff of employees works at the clubhouse, with a significant development sales staff of about 30. Once the lots are sold, this sales activity will be eliminated. Currently, additional traffic is generated by these sales personnel, which is reflected in the trip generation data presented herein.

**Table 1. a.m. peak vehicle trip data.**

| a.m. Monday (time ending) | Vehicle trips: Entering: Cars | Entering: Delivery vehicles | Exiting: Cars | Exiting: Delivery vehicles |
|---|---|---|---|---|
| 7:15 | 2 | 1 | 10 | |
| 7:30 | 3 | | 12 | |
| 7:45 | 6 | | 17 | |
| 8:00 | 2 | | 16 | |
| 8:15 | 9 | | 12 | |
| 8:30 | 4 | | 11 | |
| 8:45 | 6 | | 19 | |
| 9:00 | 3 | 2 | 10 | 1 |
| Peak-hour total 7:45–8:45 | 21 | | 58 | |

| a.m. Tuesday (time ending) | Vehicle trips: Entering: Cars | Entering: Delivery vehicles | Exiting: Cars | Exiting: Delivery vehicles |
|---|---|---|---|---|
| 7:15 | 1 | | 17 | 1 |
| 7:30 | 3 | | 10 | |
| 7:45 | 4 | | 14 | |
| 8:00 | 2 | | 14 | 1 |
| 8:15 | 3 | | 18 | |
| 8:30 | 2 | | 17 | 1 |
| 8:45 | 5 | | 21 | |
| 9:00 | 2 | | 13 | |
| Peak-hour total 7:45–8:45 | 12 | | 72 | |

Source: Draper Aden Associates.

* Notes: weather = fair. Counts taken Monday, September 12 and Tuesday, September 13, 2005. Construction vehicles destined to new homes under construction are not included in the data.

## Table 2. p.m. peak vehicle trip data.

| p.m. Monday (time ending) | Vehicle trips: Entering: Cars | Entering: Delivery vehicles | Exiting: Cars | Exiting: Delivery vehicles |
|---|---|---|---|---|
| 4:15 | 14 | | 9 | |
| 4:30 | 30 | | 23 | |
| 4:45 | 24 | | 10 | 1 |
| 5:00 | 24 | 1 | 14 | |
| 5:15 | 33 | | 10 | |
| 5:30 | 27 | | 10 | |
| 5:45 | 18 | | 11 | |
| 6:00 | 29 | | 17 | |
| Peak-hour total 5:00–6:00 | 107 | | 49 | |

| p.m. Tuesday (time ending) | Vehicle trips: Entering: Cars | Entering: Delivery vehicles | Exiting: Cars | Exiting: Delivery vehicles |
|---|---|---|---|---|
| 4:15 | 14 | | 16 | 1 |
| 4:30 | 33 | 1 | 15 | |
| 4:45 | 22 | | 8 | |
| 5:00 | 28 | | 8 | 1 |
| 5:15 | 28 | | 11 | |
| 5:30 | 26 | | 18 | |
| 5:45 | 22 | | 11 | |
| 6:00 | 18 | | 12 | |
| Peak-hour total 5:00–6:00 | 94 | | 52 | |

Source: Draper Aden Associates.

* Notes: weather = fair. Counts taken Monday, September 12 and Tuesday, September 13, 2005. Construction vehicles destined to new homes under construction are not included in the data.

## Table 3. Calculations and summary of vehicle trip data.

*Calculated peak-hour trip rate*

Total completed—sold, finished and occupied or seasonal residence—units as of September 13, 2005: 460

a.m. peak (7:45–8:45 a.m.) trips = (79 + 84) / 2 = 81.5 trips per unit = 0.177, say, 0.18 (20 percent enter, 80 percent exit)

p.m. peak (5:00–6:00 p.m.) trips = (156 + 146) / 2 = 151 trips per unit = 0.328, say, 0.33 (67 percent enter, 33 percent exit)

*Trip rate comparisons*

| Source | Vehicle trips per dwelling unit: a.m. peak | p.m. peak |
|---|---|---|
| ITE senior housing trip generation paper | 0.164 | 0.247 |
| Senior Adult Housing—Detached ITE *Trip Generation* Code 251 | 0.20 | 0.26 |
| Four Seasons | 0.18 | 0.33 |

## STUDY METHODOLOGY

The Four Seasons at Historic Virginia has one entrance to the entire development. Entering and exiting entrance roadway counts by direction were collected by traffic counting field personnel for the 7:00 a.m. to 9:00 a.m. and 4:00 p.m. to 6:00 p.m. highway rush hours. Counts were collected on a Monday and Tuesday in September on normal days (no unusual traffic activities) and in fair weather conditions (see Tables 1 and 2).

Because of the ongoing new home-building, construction vehicles were observed within the normal development vehicle mix. It was easy to discern construction vehicles from other vehicles, and these vehicle counts were not included in the final summation. Delivery vehicles (such as Federal Express, florists and trash collection) as well as the clubhouse and sales staff were included in the counts.

Finally, the two-day counts were averaged, the peak hour of the two-hour count periods was determined, and these data were summarized, as presented below.

## STUDY

Tables 1 and 2 detail vehicles entering and exiting the development for each of the four time periods observed and break them into 15-minute increments. Delivery vehicles were combined with other vehicles ("cars").

Table 3 summarizes the mathematical calculations and the final trip rate results. The total trips for each peak period were compared to the total active residences (460), resulting in vehicle trip rates per residential unit, expressed in terms of a.m. and p.m. peak hour and percent entering and exiting for each.

Table 3 also compares the Four Seasons vehicle trip rates to other related ITE vehicle trip rates. The Four Seasons rates are somewhat higher overall and, perhaps, can be explained by several factors:

- The senior housing rate also included some housing generators such as nursing homes, which have very low trip rates.
- The Four Seasons has, arguably, a relatively high percentage of working residents due to its proximity in northern Virginia compared to a more resort oriented location, which has limited area employment opportunities.

**Table 4. Four Seasons trip rates.**

| Time period | Vehicle trips per dwelling unit | Percent enter/exit |
|---|---|---|
| a.m. peak hour | 0.18 | 20/80 |
| p.m. peak hour | 0.33 | 67/33 |
| 24 hour | 3.71 | 50/50 |

- At the time of full development, the Four Seasons trip rate no doubt will lower somewhat, perhaps being very close, coincidentally, to the senior housing research paper. Again, this would be due to the reduction in sales personnel and level of activity of ongoing home improvement projects.

## CONCLUSION

The trip rates generated by the Four Seasons are very much in line with similar data sources. Furthermore, the mathematical differences even can be accounted for. Accordingly, it is the opinion of the authors that the Four Seasons trip rates summarized in Table 4 are appropriate for use on other age-restricted residential projects, with perhaps the actual values being marginally on the high side. Until actual 24-hour data for age-restricted developments are obtained, the 3.71 trips of Code 251 is recommended.

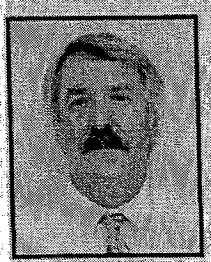

## ACKNOWLEDGMENTS

The authors wish to thank the developers of the Four Seasons at Historic Virginia, K. Hovnanian Companies for permission to conduct the study and Republic Properties Inc. for funding the effort. ■



*References*

1. Corcoran, S.B. "Senior Housing Trip Generation and Parking Demand Characteristics." Presented at the ITE 1996 Annual Meeting and Exhibit, Minneapolis, MN, USA.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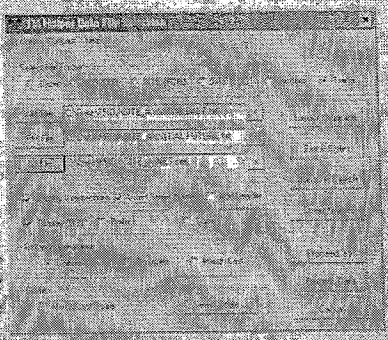

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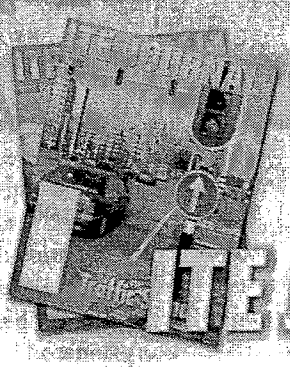

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**Memorandum**

To: Ms. Barbara Thissell, P.E.
352 Nahatan Street
Norwood, Massachusetts 02062

Date: November 1, 2007

Project No: 10173

From: Ana Fill, PE
Senior Traffic Engineer

Patrick Dunford, PE
Project Manager

Re: Review of Response to Comments
Glen Ellen Country Club – Senior Residential Community
Millis, Massachusetts

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*Vanasse Hangen Brustlin, Inc.* (VHB) has performed a professional and independent technical review of the response to comments prepared by *Earth Tech, Inc.* This response was in regard to engineering review comments on the traffic study *Earth Tech, Inc.* prepared for the redevelopment of the Glen Ellen Country Club site in Millis, Massachusetts.

## Submission Materials

As part of the technical analysis for the Town of Millis, VHB reviewed the following report:

- *Glen Ellen – Special Permit Application, Response to July 10, 2007 Comment Letter from VHB, Senior Residential Community, Orchard Street, Millis, Massachusetts;* Prepared by Earth Tech, Inc.; September 24, 2007.

This information has been considered in the preparation of this memorandum.

## Response to Comments Review

*Study Area*
Earth Tech has included and analyzed the Orchard Street/Middlesex Street and Exchange (Route 115) intersection as requested.

*Traffic Volumes*
Earth Tech provided the requested traffic volume data along with a comparison of the new counts with the information provided in the previously submitted Traffic Impact and Access Study. Comparison of the data indicates that the closure of the bridge over Bogstow Brook did have some impact on traffic volumes in the vicinity of the Glen Ellen Country Club. Earth Tech, however, performed new counts at the driveways when the detour was no longer in place, as requested. Therefore, the new analysis provided is indicative of typical traffic conditions in the vicinity of the site.

*Traffic Accidents*
Earth Tech provided the requested data and calculated crash rates for the study intersections. As reported the calculated crash rates are lower than the MassHighway District average.

*No-Build Conditions*
Earth Tech provided the requested information.

*Trip Generation*

Senior Housing
As requested, Earth Tech revised the trip generation estimates for the senior housing component of the project utilizing available empirical data for similar projects in Massachusetts.

Golf Course and Club House/ Wellness Center
As requested, Earth Tech revised the trip generation estimates for the golf course and club house component of the project utilizing actual data from the Glen Ellen Country Club. Although VHB concurs that some trip sharing will occur between the housing and golf course uses, we still believe that the internal shared trip rate of 45 percent utilized is overly aggressive. Likewise, the 40 percent trip sharing between the housing and wellness center also appears overly aggressive. Further, the report mentions that accepted level of service is reported on local roadways even without the trip sharing credit, however, no data are provided to support this assertion. Nevertheless, given the apparent available excess capacity at most of the study intersections, VHB agrees that the study intersections should be able to accommodate the additional project trips. The one potential exception is the westbound approach of the Middlesex Street at Exchange Street/Orchard Street intersection, which is projected to operate at LOS E under the weekday evening Build conditions with a delay of 48 seconds. A delay of 50 seconds or more is the equivalent of LOS F. Without additional information, VBH is not able to form an opinion whether the project will have a significant impact at that intersection. While there may not be any appropriate capacity enhancing measures that are warranted, the non-standard geometry of this location could benefit from further review by the applicant.

Event Traffic
Earth Tech indicates that site generated traffic volumes are approximately 40 percent higher, on average, when an event is taking place. Earth Tech also indicates that in the future, events will be held only on Friday evenings, Saturdays and Sundays, which occur outside the commuter peak hours.

Summary
Table 5 summarizes the revised trip generation for the project, and it includes the shared trip rates credit of 45 percent for the golf course and 40 percent for the wellness center. If the worst case scenario is considered, when no trip sharing occurs, an additional 429 daily trips, 11 morning peak hour trips and 46 evening peak hour trips could occur. As previously mentioned, with the possible exception of the westbound approach of the Middlesex Street at Exchange Street/Orchard Street intersection, the roadway network should be able to accommodate these additional trips.

By-Right Comparison
Table 7 provides a by-right trip generation comparison for a typical day during the summertime. It should be noted that the appropriate comparison is between the by-right – 100 family homes trips and the proposed senior residential community PLUS the existing conditions trips. Therefore, the comparison is 1,040 daily by-right trips versus 2,384 daily proposed trips, 79 morning peak hour trips versus 122 morning peak hour trips and 107 evening peak hour trips versus 90 evening peak hour trips. As mentioned in the report, for some part of the year, there should be no trip generation associated with the golf course portion of the project, thus reducing the overall project's trip generation.

*Trip Distribution*
Earth Tech provided the requested backup used to determine the trip distribution for the housing component of the site, and revised the golf course and wellness center trip distribution based on the updated driveway counts.

*Site Generated Traffic Volumes*
Earth Tech provided the requested site-generated traffic volume figures.

*Capacity and Queue Analyses*

Earth Tech revised the analyses as requested. It appears the sufficient capacity exists to accommodate the project trips. It should be noted, however, that the westbound approach of the Middlesex Street at Exchange Street/Orchard Street intersection is projected to operate at a borderline LOS E during the evening peak hour, and a small amount of additional traffic may push it to LOS F.

*Sight Distance*
As requested, Earth Tech provided sight triangles for the site driveways. Some of the sight triangles shown, however, encompass areas outside the control of the applicant; in other words, they traverse other properties. Therefore, the applicant cannot guarantee that these areas will remain clear. Nevertheless, given the low speeds on Orchard Street, it appears that sufficient stopping sight distance is available for the driveways, although they may be less than shown on the figures. Similarly, the minimum required intersection sight distance – at least the same amount as the stopping sight distance – appear to be available, although once again they may be less than shown on the figures. As mentioned in the report, the applicant needs to maintain the sight triangles clear of vegetation and other obstructions higher than 3.5 feet and/or lower than 7.6 feet. It should be noted that this may require that the trees and the sign along the site frontage be removed.

*Site Design*
As requested, the access roadways will be changed from 16-feet wide to 18 feet. Earth Tech also supplied a parking evaluation for the site, indicating that the proposed 313 amenity on-site parking spaces should accommodate site demand.

## Summary and Recommendations

The applicant has sufficiently addressed all of the comments in the engineering review memorandum. It should be noted, however, that the westbound approach of the Middlesex Street at Exchange Street/Orchard Street intersection is projected to operate at a borderline LOS E, and a small amount of additional traffic may push it to LOS F. Given the aggressive trip sharing credit assumed for the golf course and the wellness center, it is possible that this approach will operate at LOS F during the evening peak hour. Care should also be taken that the required sight distance at the proposed site driveways be maintained which may require vegetation, signage and/or other obstructions removal.