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December 18, 2014

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RECEIVED

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PLANNING BOARD
GRAFTON, MA

**Subject: The Village at Institute Road
Preliminary Plan Review**

Dear Joe:

We received the following documents in our office November 7, 2014:

- Correspondence from Greenman-Pedersen, Inc. to Guerriere & Halnon, Inc. dated November 5, 2014 regarding "Traffic Impact and Access Study, Proposed Residential Development, Institute Road – Grafton, Massachusetts".
- Plans entitled "The Village at Institute Road", A Preliminary Conventional Subdivision in Grafton, Massachusetts dated October 15, 2014, prepared by Guerriere & Halnon, Inc. for D&F Afonso Builders Inc. (20 sheets)
- Plans entitled "The Village at Institute Road", A Preliminary Flexible Subdivision in Grafton, Massachusetts dated October 15, 2014, prepared by Guerriere & Halnon, Inc. for D&F Afonso Builders Inc. (20 sheets)

Graves Engineering, Inc. (GEI) has been requested to review and comment on the plans' conformance with applicable "Rules and Regulations Governing the Subdivision of Land, Grafton, Massachusetts" revised through April 27, 2009; "Grafton Zoning By-Law" amended through October 14, 2013; and standard engineering practice.

This letter is a follow-up to our previous review letters dated January 14, 2010, March 9, 2010 and August 12, 2010. For clarity, comments from our previous letter are *italicized* and our latest comments to the Applicant's responses are depicted in **bold**. For brevity, comments previously addressed by the design engineer and acknowledged by GEI have been omitted. Previous comment numbering has been maintained.

Our comments follow:

Zoning By-Law

Both Conventional and Flexible Plans

1. *We are concerned about pedestrian traffic outside the project limits, specifically along Institute Road. Currently there are no sidewalks along Institute Road. One particular area of concern is approximately 280 feet south of the northern project entrance where there is a horizontal curve and vertical curve in Institute Road with an embankment on the west side of the road. This area does not accommodate*

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pedestrian traffic. Currently there is little development in the area that generates significant pedestrian traffic. The project proposes approximately 50 dwelling units, which is likely to increase pedestrian traffic along Institute Road. The plans propose sidewalks along the project roads; with the proposed sidewalks terminating at Institute Road.

Consideration should be given to creating a "looped" sidewalk/walking path system. Ideally, connecting the sidewalks at northern and southern entrances by way of a sidewalk along Institute Road might be preferable. However, the vernal pool on the west side of Institute Road would add complexity to sidewalk design and permitting. An alternative may be to connect the sidewalk at the cul-de-sac of Road C (on both the conventional and flexible plans) to Institute Road north of the vernal pool via the existing gravel road (with any necessary improvements to the gravel road) and constructing a sidewalk on the western side of Institute Road from the gravel road to the northern entrance. Either alternative would provide a sidewalk on Institute Road at the horizontal curve located approximately 280 feet south of the northern entrance. The Planning Board, DPW or other Town departments may have opinions relative to a sidewalk system; therefore we defer further discussion to the Town. (§5.3.13.j & SR&R §4.1.2.1.c)

March 9, 2010:

The plans were revised to provide a walking path from the end of the sidewalk at the cul-de-sac through the woods, across the existing gravel road and connecting to a new sidewalk on the west side of Institute Road. A new sidewalk on Institute Road would be constructed from the walking path to the northern project entrance. As proposed, the walking path would connect to the Institute Road sidewalk approximately 150 feet (conventional plan) to 190 feet (flexible plan) north of where the gravel road intersects Institute Road. In either case the walking trail passes over a hill and will have a significant down-gradient slope toward Institute Road - 3 horizontal : 1 vertical (or 33%). A slope this steep must be avoided, especially near Institute Road. Sections 4.10 and 5.6 of the "Rules and Regulations Governing the Subdivision of Land" have specific requirements for trails, bikeways and walkways, including maximum slope. As an alternative, it appears the walking trail could be routed south of the hill along or near the gravel road, thereby eliminating a steep down-slope at the approach to Institute Road. Again, we defer further discussion to the Town.

The proponent has re-graded the walking path near Institute Road to provide a slope of 8% for a distance of approximately 100 feet. The 8% grade addresses our concern about the slope steepness and is much improved compared to the previous proposal of a 33% slope.

In our initial comments of March 9, 2010 we commented about constructing a sidewalk along the west side of Institute Road to provide direct pedestrian access between the two project entrances (please see comments above). With the re-filing of the special permit application and preliminary plans, we again defer further discussion of the sidewalk layout to the Planning Board.

Flexible Plans

3. The proponent should specify which Design Guidelines are being addressed for the bonus provision (i.e. increase from 46 conventional lots to 51 flexible lots). (§5.3.5.2)

March 9, 2010:

The design engineer cited specific sections of the Design Guidelines for which the bonus provision was applied. As noted in comment #1 above, we are concerned about the slope of the walkway near the intersection of Institute Road and therefore question whether the bonus provision of §5.3.13.j would apply. We understand the Planning Board will consider any applicability and/or approval of the bonus provision.

The proponent has re-graded the walking path near Institute Road, providing a slope of 8%. We understand the Planning Board will consider any applicability and/or approval of the bonus provision.

Subdivision Rules & Regulations

Both Conventional and Flexible Plans

6. *Based upon measurements made during our site visit, in the vicinity of the project Institute Road generally has a paved width of approximately 21 feet; the width varied between 20.5 feet and 22 feet. Although the Traffic Impact and Access Study presented "future build" traffic estimates in vehicles per hour during peak times, it did not present a "future build" estimate for vehicles per day (vpd). Using the Study's estimated background growth of 5.6% over five years and the estimated project-generated traffic of 560 vpd (75% northbound and 25% southbound), we estimated that under "future build" conditions traffic flow along Institute Road would be approximately 1,700 vpd north of the project and approximately 1,400 vpd south of the project. Grafton Subdivision Rules and Regulations identify certain road design parameters (e.g. road width) based in part upon traffic flow. The existing width of Institute Road doesn't meet the minimum requirement for any of the street widths specified in the Rules and Regulations. In short, the existing width of Institute Road is less than current Town standards and the project would result in increased traffic and turning movements on Institute Road. Therefore, we defer to the Town if improving (e.g. widening) Institute Road should be considered beyond the intersections at the new project entrances.*

An updated Traffic Impact and Access Study was submitted. The Study indicated that the existing weekday traffic volume is approximately 1,400 vehicles per day along Institute Road. Again, we defer further consideration of this issue to the Planning Board.

Conventional Plans

7. *There are several isolated areas within the rights-of-way where the proposed cut is greater than 6'. These areas include Road A between STA 1+58± & STA 2+05± (left side only) and between STA 6+25± & STA 8+25±, Road B between STA 15+50± & STA 15+85± (right side only), and Road C between STA 2+35± & STA 3+20± (§4.1.2.1.b)*

March 9, 2010:

No further comment – the areas were listed above to aid the Planning Board in identifying the areas where cuts exceed 6 feet. We defer any further consideration of this issue to the Planning Board.

Acknowledged. The plans were revised to eliminate cuts in excess of six feet.

8. *There are abutting properties to the west of the project owned by the Town of Grafton. The conventional plans do not provide any type of access from the proposed roads to the Town's parcels, whether for vehicular or pedestrian access. We defer to the Town of Grafton what type of access, if any, is needed. As part of the access, consideration should be given to maintaining or re-routing the path on Lot 7 so it can connect to Road B. (§4.1.2.1.d & §4.1.2.1.e; GZBL §5.3.13.i)*

The plans show a path along the property line of Lots 6 and 7. Sections 4.10 and 5.6 of the "Rules and Regulations Governing the Subdivision of Land" have specific requirements for trails, bikeways and walkways. These requirements must be incorporated into the plans during definitive plan design. This new path would also require relocating a portion of the path on the Town-owned property. We understand the issue of connecting the subdivision sidewalk/trail system to the abutting land will be further addressed by the Town.

Flexible Plans

10. *There are abutting properties to the west of the project owned by the Town of Grafton. The flexible development plans propose open space contiguous to the abutting land, but Lot FL-8 is proposed over an existing path. Consideration should be given to re-routing the path so it connects to Road A. (§4.1.2.1.d & §4.1.2.1.e; GZBL §5.3.13.i)*

The plans show a walkway or trail west of Lot 8. Sections 4.10 and 5.6 of the "Rules and Regulations Governing the Subdivision of Land" have specific requirements for trails, bikeways and walkways. These requirements must be incorporated into the plans during definitive plan design.

11. *There are several isolated areas within the rights-of-way where the proposed cut or fill is greater than 6'. There are excessive cuts along Road A between STA 0+47± & STA 2+07±, 12+05± & STA 13+20± (left side), and STA 15+18± & STA 16+75. There is an excessive fill on Road A between STA 13+38± & STA 14+45±. There is an excessive cut on Road C between STA 0+07 & STA 3+80. (§4.1.2.1.b)*

March 9, 2010:

No further comment – the areas were listed above to aid the Planning Board in identifying the areas where cuts or fills exceed 6 feet. We defer any further consideration of this issue to the Planning Board.

The plans were revised to minimize cuts and fills. Fill in excess of six feet is proposed on Road A between STA 13+25± & STA 14+75± (right side of the right-of-way only).

General Comments

General Comments were previously addressed.

Additional Comments, August 12, 2010

20. Both the Flexible and Conventional Development Plans were revised to include vertical alignment revisions on Institute Road. Changes to the vertical alignment are proposed between station 9+32.90 and station 12+09.05. The existing grades in this area are proposed to be lowered approximately 2.4'. Vertical road re-alignment would require lowering the existing water main accordingly. The k-values for the two vertical curves in this area correspond to design speeds of 30 MPH (k=19 for crest and k=37 for sag vertical curves per Exhibits 4-26 and 4-27 in MassHighway Project Development & Design Guide, 2006 Edition). The proposed revisions are certainly an improvement compared to existing conditions.

However, consideration should be given to designing for a speed greater than 30 MPH. Per Table 3 of the Traffic Impact Report, the 85th percentile observed travel speeds were 40 MPH and 37 MPH in the southbound and northbound lanes, respectively. In a conceptual manner, we evaluated the potential for utilizing crest vertical curves for 35 MPH (Alternate 1) and 40 MPH (Alternate 2) design speeds. For comparison, the following table shows pertinent information associated with existing conditions, the proposed alterations and potential options for vertical re-alignment.

Table 1 – Institute Road Vertical Curve Data

Design Option	Crest Vertical Curve "k"	Design Speed, MPH*	Approximate Length of New Vertical Curve, Feet	Approximate Depth of Deepest Earth Cut, Feet	Approximate Length of Water Main Alterations, Feet
Existing	7.8+/-	21 to 22	NA	NA	NA
Proposed	19	30	226	2.5	160
Alternate 1	29	35	365	4.0	300
Alternate 2	44	40	524	7.5	470

* Per MassHighway Project Development & Design Guide, 2006 Edition

In evaluating Alternate 1, it appears feasible to revise the crest vertical curve to achieve a "k" of 29. Please note, a "k" of 28 is required for Minor Streets per Grafton Subdivision Rules and Regulations §4.1.5.3. By our estimate, the vertical curve would extend from station 8+38+/- to station 12+04+/- . This alternate would require an earth cut of up to approximately 4 feet and re-laying approximately 300 feet of the existing water main in order to maintain minimum cover requirements.

The feasibility of constructing Alternate 2 is more questionable than Alternate 1. The vertical curve would extend from station 7+39+/- to station 12+63+/- (almost to the culvert from the vernal pool). Depending upon findings during final design, runoff from the road near the vernal pool area may be directed farther north instead of to its current discharge point near the culvert. Finally, earth excavation would be deep – approximately 7.5 feet - and approximately 470 feet of water main alterations would be required.

In summary, the design engineer has proposed improvements to the vertical alignment of Institute Road. The proposed work is an improvement compared to

existing conditions, but meets a design speed which is less than observed 85th percentile speeds. To understand the feasibility of constructing improvements to meet a greater design speed, we evaluated two alternatives to the proposed vertical alignment. The construction of Alternate 1 appears to be feasible and would accommodate a design speed of 35 MPH. The feasibility of constructing Alternate 2 appears to be questionable primarily because of the extent of earth excavation. We defer further consideration of this comment to the Planning Board and would be glad to answer any questions you may have relative to our evaluation.

The plans were revised to provide a vertical curve with a “k” of 29. The proposed revision and the overall proposed enhancements to Institute Road (vertical realignment as discussed herein, roadway widening to 22 feet at the vertical realignment section and at the northern project entrance, construction of a two-foot wide shoulder on the west side of the road) are significant improvements compared to existing conditions. Our concerns relative to the vertical realignment have been addressed. We defer any further consideration of the proposed off-site improvements to the Planning Board.

Additional Comments, December 18, 2014

21. On the Flexible Development Plans, the dwelling on Lot FL-1 would be located within 50 feet of an adjacent tract of land if Lot ANR-3 is considered an adjacent tract of land (i.e. not part of the flexible development subdivision). Because Lot ANR-3 is proposed as what appears to be an ANR lot, we defer to the Planning Board whether Lot ANR-3 is part of the subdivision and whether the proposed dwelling on Lot FL-1 satisfies the required minimum fifty-foot buffer from adjacent tracts of land. (GZBL §5.3.6.h)
22. GEI performed a cursory review of the Traffic Impact and Access Study, with emphasis on sight distance measurements at the project intersections and changes to intersection levels of service between future “no-build” and “build” conditions. The Study Indicates that the Institute Road northbound approach to the North Site Roadway will have a stopping sight distance of 350 feet and an intersection sight distance of 370 feet. Based upon our review of the existing and proposed vertical alignments on Institute Road (see Sheet 20 of either plan set), the stopping sight distance and intersection sight distance appear to be less than those reported in the Study. We estimate approximately 290 feet of stopping sight distance and approximately 328 feet of intersection sight distance if Institute Road is improved as shown on Sheet 20 of the plans. Nevertheless, the plans propose significant improvements to the vertical alignment of Institute Road in this location. (See also comment #20.) In addition to the vertical re-alignment, during the preparation of definitive plans (If the project is approved) appropriate intersection warning sign(s) in conformance with Manual on Uniform Traffic Control Devices (MUTCD) should be incorporated into the plans to warn northbound drivers on Institute Road of the North Site Roadway.
23. The Traffic and Impact Access Study recommended a STOP AHEAD sign be posted at the Institute Road northbound approach to the intersection of Westboro Road. This sign should also be incorporated into the definitive plans.

We trust this letter addresses your review requirements. Feel free to contact this office if you have any questions or comments.

Very truly yours,
Graves Engineering, Inc.



Jeffrey M. Walsh, P.E.
Vice President

cc: Mike Weaver, Guerriere & Halnon, Inc.

