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SENT VIA EMAIL TO J.HAGER@TOWN.SUTTON.MA.US

December 13, 2023

Jennifer S. Hager
Community Development Director
Town of Sutton
4 Uxbridge Road
Sutton, MA 01590

Dear Ms. Hager:

I am writing to comment on your email entitled "grading changes" sent to Jonathan Bruce on December 11, 2023. For your convenience, I will reference to unit numbers and not street addresses.

Units 69-78, ten of the twelve "Phase 2" units on the inside of Ariel Circle that face north, were originally proposed as "garage under" units. These units would have had their garages located essentially at the cellar elevation. This style of unit was eventually named "Nipmuc," as opposed to the "Putnam" units that have attached garages located essentially at the first floor elevations.

During the course of construction, certain updates were made to the layout of the buildings. For example, Units 69-74 (Nipmucs) were lowered to varying degrees in order to ensure their driveways were properly sloped to Ariel Circle. Units 75-78 were changed from Nipmucs to Putnams. This was possible because Ariel Circle rises to the west, so Nipmuc units were not necessary to ensure appropriate driveway sloping. Wherever possible, Putnam units are preferred because they can be made ADA accessible with a simple ramp or lift in the garage.

These updates changed the hill located behind Units 69-80. However, it is important to note a few things:

1. Following construction, the final product incorporated the same type of drainage system that was originally approved, utilizing open surface swales and inlets, conveying drainage to the appropriate drainage areas.

2. The yard behind Unit 75 is shallower than designed. That is, there is less horizontal distance from the rear wall of Unit 75 to the bottom of the hill. So, although Unit 75 may be lower than designed, the hill is also longer than designed, which alleviates much of the increase in slope that arises from a lower Unit 75. However, as described below, even a steeper hill has no practical effect in this scenario.

3. The quantity (volume) of runoff is dependent on the size of the drainage area, the drainage area's cover conditions, and rainfall totals. It is not dependent on the slope or length of the drainage path. Neither the drainage area's size or its cover conditions are appreciably different from what was approved by the Planning Board. Notably, the as-built footprint of Units 53-64 (the "Phase 1" fourplexes on top of the hill) are essentially the same as was approved. Therefore, despite the hill being nominally different than designed (again, not necessarily steeper), the actual quantity of runoff is as designed.

4. In general, the peak rate of runoff can be dependent on the slope of the drainage path. A drainage area's "time of concentration" is defined as the time it takes for water to reach a point of interest from the most hydrologically distant point in the drainage area. For a given drainage area, a shorter time of concentration would result in a higher peak rate of runoff. However, a minimum time of concentration of five (5) minutes is typically used for such a small drainage area and especially in a post-development analysis. Therefore, a minor modification of an already-steep hill to one slightly steeper (or slightly longer) would have no effect on the time of concentration, as the time of concentration is already assumed to be the minimum of five (5) minutes. Therefore, there is no actual effect on the peak rate.

In light of the above, it is clear the issues being discussed were caused by changes to the drainage patterns generally as Jonathan Bruce described to you on November 27, 2023. To wit:

1. The association planted raised shrubbery at the top of the hill. This raised area, essentially a berm along the top of the hill, prevents runoff from sheeting down the hill, across the entire width of the hill, as designed. Instead, the runoff is channelized along the hill until a channel was eventually eroded behind Unit 75. This inappropriately concentrated the runoff to that area. This was unmentioned by Jonathan but is worth bringing to your attention now.

2. The association filled in the functioning swales by raising the elevation / grades behind and between the Phase 2 units, which created a dam-like feature. They then installed underground pipes. As Mr. Vivenzio indicated in his letter to you of December 4, 2023, this also functioned until the association neglected its maintenance, writing:

   "This swale worked until the Summer of 2023 (experienced large amount of rainfall) when one of the underground 8 inch pipes was clogged with a plastic bottle(s) and possibly other construction debris."

   Swales do not clog as easily as pipes, which is one reason why they are generally preferable to pipes. Another reason is that swales also provide the opportunity for runoff to infiltrate into the ground during and after ordinary rainfall. Pipes do not have this benefit. But if one insists on using pipes, or if pipes are the only option for conveying runoff (e.g. under a road), it is good engineering practice to maintain emergency overland flow paths to mitigate potential clogging of inlets and pipes. Had the association maintained overland flow paths (e.g., the swales constructed by the developer), the issues being discussed would have almost assuredly

been avoided during maintenance failures. Regrettably, the swales were removed with seemingly no regard to where water would go if pipes became clogged.

Therefore, the landscaping and drainage changes completed by the association, as well as the association's lack of maintenance of their infrastructure, caused the issues now before us. The changes seem to have been made without engineering judgment. Had I been consulted by the association, I would have advised them to remove the berm at the top of the hill that channelized water down the hill and then continue to rely on the functioning swales. Had they insisted on installing pipes, I would have advised them to ensure overland flow paths were also provided instead of filling in the swales. Regardless, Mr. Vivenzio concedes that the association's ad hoc solution functioned until the association stopped maintaining it. This further supports my assertion that the nominal adjustment of the hill behind the area in question had no actual effect on the rate of runoff.

Please feel free to contact me at mbruce@elsaassocates.com if you have any questions.

Sincerely,

Michael Bruce, PE
Manager

cc via email: John Couture
Jonathan Bruce