Hansen and Associates, Inc.
Consulting Engineers & Land Surveyors

December 21, 2015

Matt Rasmussen

Re: 6472 S. Bybee Drive – Addendum

Dear Matt,

This letter is an addendum to the report letter dated December 10, 2015 – the signature and stamp on this culminating letter encompasses the former letter that documented and substantiated various aspects (as well as advancing some preferential design solutions).

I hereby advance that (see attached drawing):

(1) Do not install on-site / off-site culverting system as previously advanced by others but allow natural debris flows to proceed unimpeded by means of open ditching. This will eliminate the possibility of culvert clogging.

(2) The house has a proposed basement – the proposed finish floor is at elevation 4952 and the nearby turnaround is at approximate elevation 4943. Location '1' shown in pink is the south side of the proposed house – I proposed a structurally sound stemwall to act as the channel barrier at this location. Footer depth, details, etc. can be handled with building permit plans by architect/structural engineer. There may well need to be some transitioning west of the southwest corner of house (shown as location '1A'). Windows are acceptable on the south wall as long as they're 6 inches above the top of 3-foot deep channel per detail 3/C1.0.

(3) Location '2' shows the transition area from the southeast corner of the proposed structure to the landscape retaining wall designed by others. This can be either a retaining wall or a cobble-lined north side installation (shown in orange/yellow) using 24-inch average minimum cobbles embedded for a depth of 48 inches on north side of channel and proceeding to one to two feet into channel flowline (shown in blue). There will be some transitioning from the stemwall to the landscape wall – the basic channel minimums shown in detail 3/C1.0 (3-foot depth, 20-feet wide) are to be effectuated.

(4) Location '3': the north side channel armoring continues with the cobble as advanced above to a practical termination point above the landscape wall, roughly the end of the disturbance for geologic trenching activities in the local area.

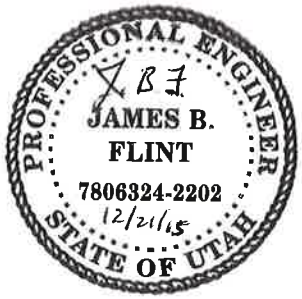
Should you have any questions, please do not hesitate to call.

Respectfully,

Hansen and Associates, Inc.

Jim Flint

Jim Flint, PE / PLS



Hansen and Associates, Inc.
Consulting Engineers & Land Surveyors

December 10, 2015

Matt Rasmussen

Re: 6472 S. Bybee Drive – Flow Substantiation

Dear Matt,

I have studied the geologic review reports you provided regarding the site at 6472 S. Bybee, known as proposed Lot 2R of the Dauphine'-Savoy-Piedmont Subdivision. The primary purpose of this letter is to ascertain flow substantiation for the drainage channel near the proposed residence on Lot 2R.

The first report dated September 4, 2015 is GeoStrata's responses to Simon Associates LLC's review. The primary flow findings are on pages 5 & 6 where a peak debris flow for the site is quantified as 193.6 cfs. The gradient of the stream channel is approximately 14.5%. A trapezoidal channel was recommended with a base of 1 foot and a 6-foot height with 2H:1V side slopes. The actual debris flow would only rise to 2.5 feet on the trapezoidal channel and have a top width of 11 feet. This meets the accepted depth-to-width ratio.

Another observation is a statement on page 5 of the report by Geostrata which states: "During our field investigation, we observed that the channel is heavily vegetated with scrub oak, grasses and some small cacti. Soils observed consisted mainly of a silty gravel with sand. The high fines content of the observed soil suggests that erosion of the existing stream channel is occurring at a very slow rate, which is a function of the heavy vegetation." My conclusions from the statement are three optimal aspects: (1) The presence of the heavy vegetation reveals that debris flow has not been an historical issue, or the vegetation in the path would have been noticeably hampered. (2) The heavy vegetation is a natural upstream impediment to downstream-rushing debris. (3) The very permeably soil greatly reduces channel runoff. These factors probably make the 193.6 cfs flow amount very conservative.

The second report dated September 8, 2015 is GeoStrata's responses to Taylor Geotechnical's review. The report reasserts the 193.6 cfs flow and the conservative assumptions behind the figure (Rational vs. SCS hydrograph. The report includes many particulars as follows:

(1) Depth of flow is substantiated at 2.5 feet and top of berm at 5.7 feet – with superelevation height, berm is to be 6 feet in height.
(2) Top of berm is to be at 4951 per grading plan.
(3) There are several re-iterative assertions that calculations and proposed channel are sufficient (i.e. 'all debris flow will be contained within the designed channel,' etc.).
(4) Rip-rap is to be 24-inch in size.

Two interesting statements on page 5 are that 'a maximum debris flow event would likely fill the pipe with sediment and then jump the channel.' Also, the preference is mentioned that the truck turnaround not encroach on the channel.

The third report dated October 9, 2015 are follow-up comments by Taylor Geotechnical. The first comment reiterates the preference that the fire truck turnaround does not encroach on the channel, but allows for a culvert design by a civil engineer. The second comment refers to channel improvements actually increasing debris flow parameters. This personally seems like a 'catch-22' situation – the channel is best left undisturbed, but owner had to clear channel for exploratory geologic work. The cleared channel stretch is very minimal in comparison to the overall channel length – channel improvements should not be disproportionately applied.

Conclusions / Recommendations

Our scope is limited to the specifics of the channel meeting geologic report parameters, using the plans prepared by Silverpeak Engineering dated October 24, 2014 (sheet C1.0 in particular). Our analysis is as follows:

(1) Design culvert capacity: The 15-inch RCP piping at a slope of 24.47% has a calculated open flow capacity of 31.9 cfs, which is less than the 193.6 cfs figure in the reports. The outlet structure is a clever dissipation appurtenance. Although from a practical standpoint the design is sound for common storm events, it does not meet the peak debris flow figure of 193.6 cfs. If the culvert size were increased to 30 inches it would mathematically be sufficient.

(2) The berm shown is mathematically adequate to match the flow rate per the geologic reports (i.e. 2.5 feet deep, 11-foot wide at peak flow). I re-confirm that a trapezoidal channel with a 1-foot bottom, 2.5 feet deep at 2H:1V slopes at a 14.5% grade does exceed 193.6 cfs. So the channel shown on the Silverpeak plans is mathematically sufficient from a civil engineering standpoint. If from a geologic standpoint the berm actually needs to be six feet in height, perhaps due to a depth-to-width ratio, such would need to be considered/adopted.

(3) Rip rap: The 24-inch rip rap is more appropriate for the high velocities than the 12 to 18-inch size shown on the plans. However, the outlet box acts as a clever dissipation structure and internally handles much of the initial flow forces. Recommendation: Use 24-inch average size cobbles for 48-inch depth for a length of 15 feet. Utilize same concept as Silverpeak shows on plans (outlet structure flows bubble-up out of box).

(4) Height recommendation: The proposed house finish floor is at 4952 and the top of the truck turnaround is at 4943, which well meets either a 2.5 foot depth or 6-foot top of berm requirement.

The four primary questions appear to be:

(1) Is it really advantageous to purposely try to trap and convey flows through a culvert rather than let flows pass through a general channel?

(2) Is there really any harm in fire turnaround acting as the drainage channel?

(3) Does channel sizing need to be based on a 6-foot or 2.5-foot depth?

(4) To what extent do erosion-control improvements need to take place in existing channel stretch that was cleared along south side of house?

Convey or culvert: From a concept standpoint I don't see an advantage to piping the channel. Culverts are typically sized for water-carrying purposes. It is true that a conservative flow rate has been quantified (193.6 cfs), but a flow with a debris-carrying aspect has to be contemplated in a different light. I advance appropriate channel geometry over trying to force a culvert situation.

Fire turnaround: It is assumed that the fire turnaround area will be paved. Because a catastrophic debris flow settlement area cannot be accurately forecast (wills flows tend to settle upstream, at the turnaround location or downstream?), I feel it is appropriate to allow the fire turnaround to be in the

channel path. The purpose of the turnaround is not to serve as a paved route to dealing with a regional debris flow. From a practical perspective, the turnaround is for fire fighting purposes and is actually at a questionable location – fire fighting personnel tend to fight fires from a safe distance in front of a structure, not at a precarious behind-the-house location. The likelihood of a structure fire happening at the same time as a rainfall-induced debris flow seems nil. Further, even if a debris flow deposited sediment at the turnaround location, such could be readily dealt with by a backhoe. The paved turnaround acts in essence as a rip rap-provided, erosion-deterring element. The primary related aspect is assuring that the house is built above the channel-carrying debris pathway, and particularly that the north side channel slopes are well armored.

Channel Depth: I concur that a 1-foot bottom, 11-foot top width, 2.5 feet deep channel at 2H:1V slopes is sufficient for the stipulated flowrate. If GeoStrata says that a 6-foot deep channel is necessary for geologic purposes, then a below-the-structure channel can be advanced with those parameters.

Erosion-Control in limited cleared area: The heavy vegetation upstream of the area acts as a significant deterrent. Due to the historical conditions, I don't see a need for creating a fully-lined rip-rap channel, but rather a heavily-armored north-side channel with 24-inch rip rap for an embedded depth of 48 inches.

Summarizing: I recommend adopting the paved turnaround shown, transitioning above the turnaround to a 6-foot deep channel (per GeoStrata) with 24-inch average cobble size for an embedment of 48 inches on the north side of the channel (extending 1 to 2 feet into channel bottom) - extend cobble work eastward to wall as shown on grading plans. The south side of the channel is to be kept as natural as possible. The plans show a significant elevation change between the turnaround location (end of turnaround at 4943.40 and house only four feet away at finish floor = 4952) – the south wall of the house can have an exposed stemwall to act as the channel armoring.

If the above is not desired but the culvert concept still preferred, install 30-inch smooth-walled culverting, utilize 'bubble-up' box concept as shown on plans, provide 24-inch minimum rip rap at outlet location for a depth 48 inches for a length of 15 feet.

Should you have any questions, please do not hesitate to call.

Respectfully,

Hansen and Associates, Inc.

Jim Flint

Jim Flint, PE / PLS