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April 27, 2018

Nelson Rutherford
17090 Fernwood Drive
Lake Oswego, Oregon 97034

Phone: 503-297-1072
E-mail: nrutherford@altensakai.com

Subject: **Supplemental Geotechnical Review #2**
Potential Impacts from Proposed Development of New Single Family Residence at 1923 Mapleleaf Court
Lake Oswego, Clackamas County, Oregon
EEI Report No. 18-061-3

Dear Mr. Rutherford:

Per your request, **Earth Engineers, Inc. (EEI)** is issuing this report so that you may submit it to be considered by the City of Lake Oswego Development Review Commission (DRC) and City of Lake Oswego engineering staff for LU 17-0065 (a request for a minor partition creating 2 parcels).

EEI previously issued Report No. 18-061-1 dated March 30, 2018. You submitted that report to DRC and City staff for their consideration at a public hearing held on April 2 (note that EEI Principal Geotechnical Engineer Troy Hull attended the hearing). In part, that EEI report identified concerns related to the lack of a complete geotechnical analysis to evaluate the potential impact of the applicant's stormwater disposal system on the safety and security of the adjacent, neighboring lots as it pertains to long term slope stability.

Based on the concerns raised in our report, as well as other public testimony from the neighbors, DRC requested that the applicant, Ottbone Investments, ask their geotechnical consultant, Rapid Soil Solutions (RSS), to more thoroughly evaluate the impact of the proposed stormwater disposal system on the neighboring lots, especially as it pertains to slope stability and water intrusion in basements.

RSS issued an undated addendum geotechnical report titled "Addendum for rear lot at Mapleleaf Court" to address the City's concerns (reference Exhibit F-12, received by the City of Lake Oswego on April 20, 2018). The following are our review comments of the addendum geotechnical report submitted by RSS.

1. **The applicant's geotechnical consultant did not properly model the slope at the proposed unlined rain garden location.** Consistent with City of Lake Oswego Municipal Code Section 50.06.006.2.d.vi(3), Section 50.06.006.2.d.iii(1) and Section 50.06.006.2.d.iii (2), the City recommended to the applicant at the end of the April 2

public hearing that they have RSS re-evaluate the impact of the unlined rain garden (and the overflow drywell) on the neighboring slopes located at 17080 and 17090 Fernwood Drive.

Section 50.06.006.2.d.vi(3) states that the applicant's consultant should verify that the "design and construction of the project will not cause erosion or land slippage." Section 50.06.006.2.d.iii(1) and (2) of the City code requires a registered civil engineer experienced in soils engineering (i.e. a geotechnical engineer) to certify the contemplated project will be safe, where it is known to be within an existing landslide hazard area. The applicant has previously acknowledged the project is located in a known landslide hazard area in their application paperwork and RSS acknowledged in their August 31, 2017 report that the neighboring slopes are mapped as a slide area.

Generally consistent with the standard of practice for geotechnical engineering, RSS has submitted quantitative slope stability calculations using XSTABL computer software in their undated addendum report. Unfortunately, the analysis by RSS was incomplete and presents results that don't reflect the actual slope conditions. They only modeled the upper portion of the slope at the unlined rain garden, which is less steep (averages about 27 percent according to RSS and verified by EEI). They did not include in their model the lower portion of the neighbor's slope that is most critical (i.e. the most steep at about 42 percent as verified by EEI).

EEI Principal Geotechnical Engineer Troy Hull was on site on April 24 and measured the actual slope angle with a hand held angle finder and measuring tape. The results are shown in Figure 1 (which also superimposes the slope modeled by RSS). As is shown, the slope modeled by RSS at the proposed unlined rain garden is much shallower than the actual slope in question. The slope stability calculations that show the slope will be stable, are un-conservative, and do not reflect the actual conditions at the neighbor's property. **We recommend the City not accept the slope stability analysis performed by RSS.**

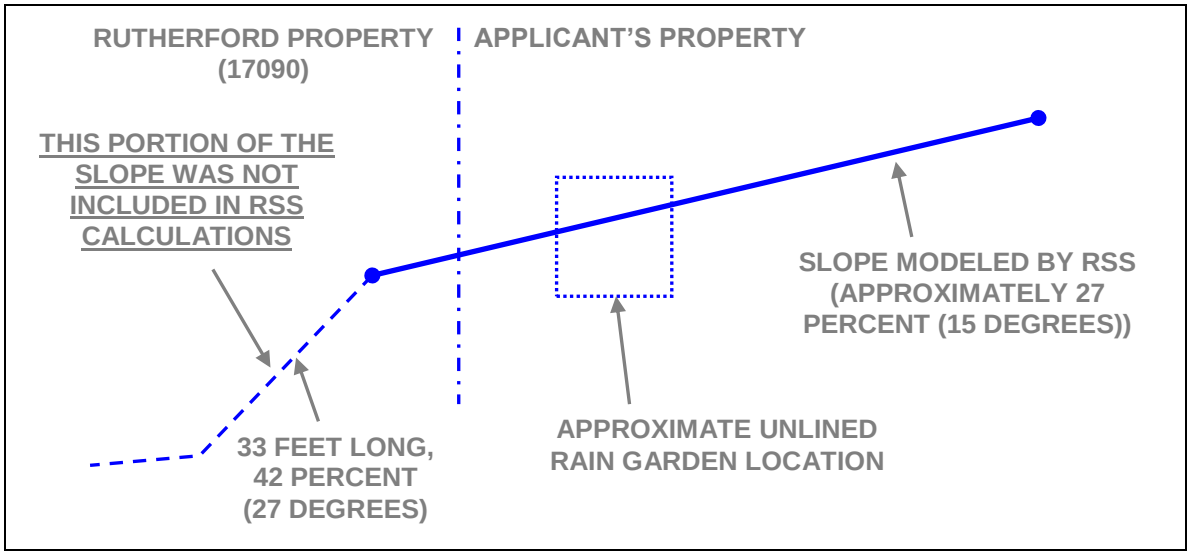


FIGURE 1: Cross-section (not to scale) of Rutherford residence slope based on EEI's field measurements; RSS did not analyze the steepest portion of the slope

2. **The applicant's geotechnical consultant did not properly model the slope at the proposed overflow drywell location.** The RSS addendum report states that they performed slope stability calculations for the overflow drywell's location. The report also states that their calculations demonstrate that the slope will be stable. However, we reviewed the report and RSS did not perform a slope stability analysis of the slope below the overflow drywell. Figure 2 below is the applicant's drawing that shows where the overflow drywell will be located. Figure 3 below shows that only one cross-section was modeled by RSS and it was at the proposed unlined rain garden. **We recommend the City not accept the RSS addendum report because their conclusion that the slope at the overflow drywell was not supported by actual slope stability calculations.**

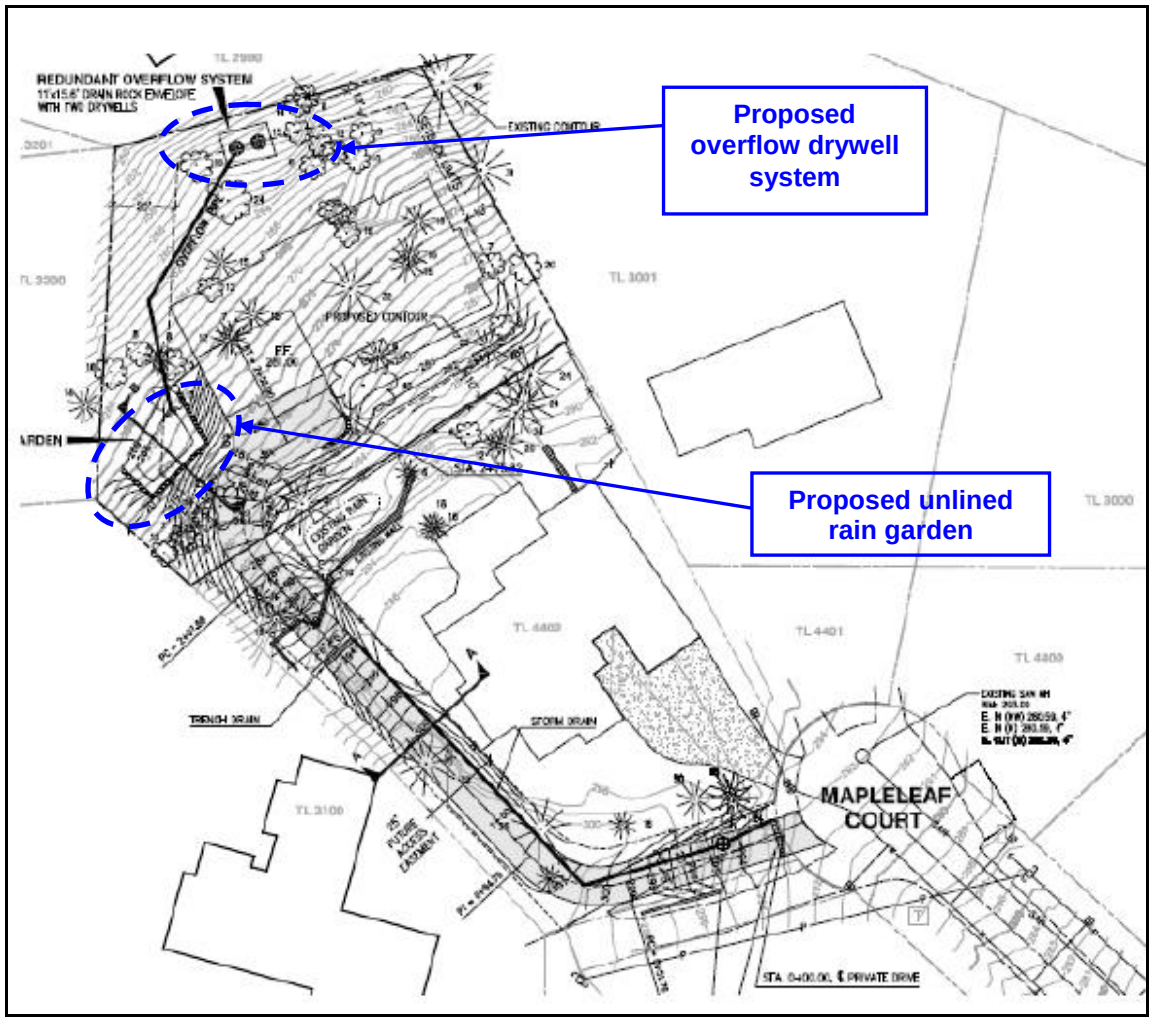


FIGURE 2: Applicant's site plan showing location of unlined rain garden and overflow drywells (base drawing source: RSS revised geotechnical investigation report dated February 12, 2018).

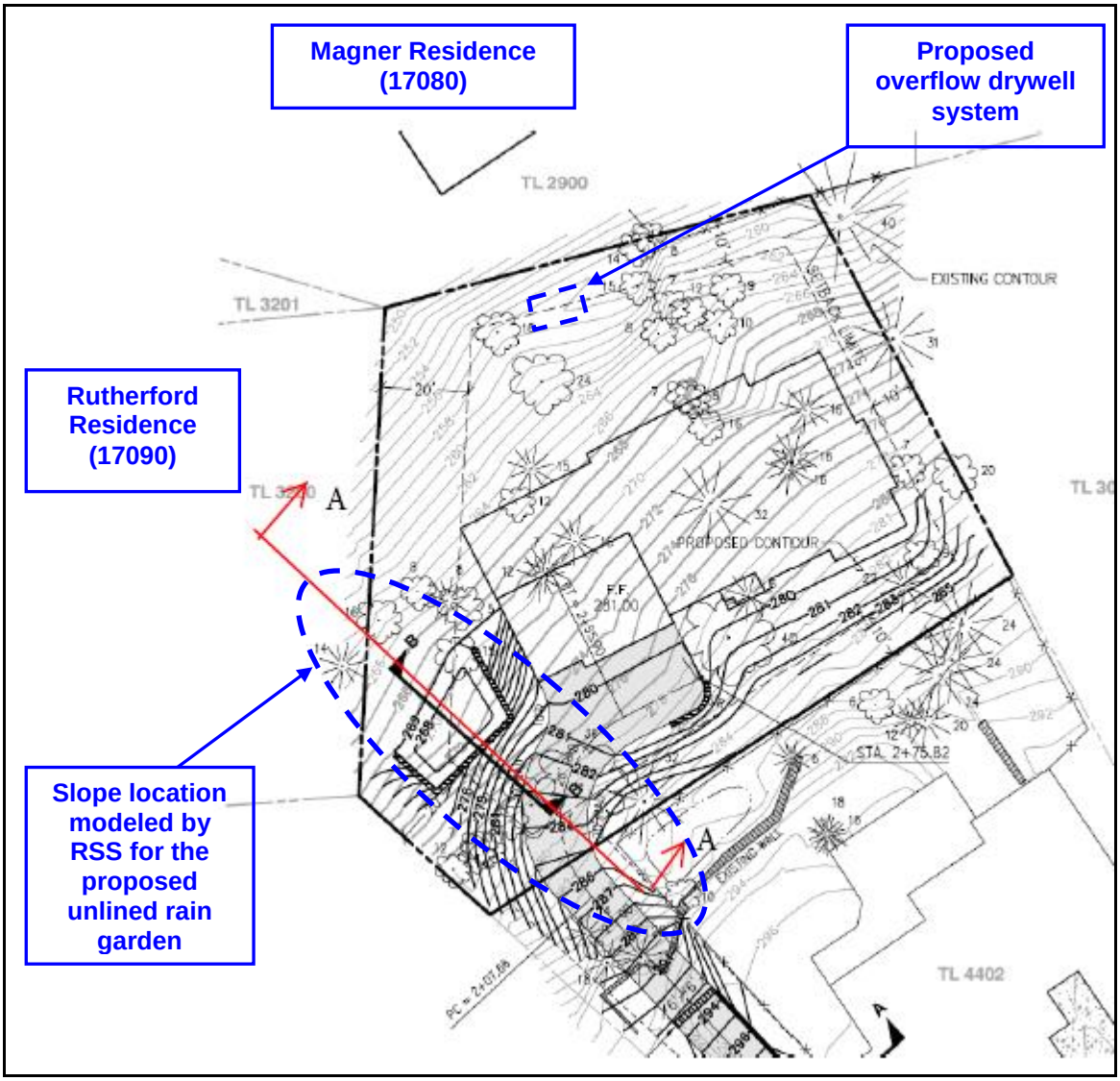


FIGURE 3: Site plan showing the slope stability cross-section modeled by RSS (base drawing source: RSS undated addendum geotechnical report).

3. **The applicant's geotechnical consultant did not collect soil data to justify the soil parameters used in their slope stability calculations.** On April 25, 2018, RSS was on site at the Rutherford and Magner residences to investigate the subsurface soil conditions on their slopes as recommended by the City. RSS performed one 3 to 4 foot deep hand auger boring on the slope of each of the 2 properties. However, no undisturbed soil samples were obtained that would be necessary to test in the lab (i.e. unit weight, shear strength, and cohesion) and the borings were too shallow to model the slope stability calculations (the slope stability failure curves in the addendum report extended roughly 25 deep but the hand auger borings were only 3 feet deep). **We recommend the City not accept the RSS addendum report because the applicant's geotechnical engineer did not perform a subsurface investigation that is as deep as the soil conditions that are modelled in the slope stability analysis, did not collect soil strength readings in the borings, did not collect undisturbed soil samples, and did not perform lab testing to confirm the soil strength parameters**

that were entered into the XSTABL slope stability calculations (i.e. they did not meet the standard of care of typical, quantitative slope stability studies).

4. **The applicant's geotechnical consultant assumed what may be an un-conservative shear strength value in their slope stability calculations.** RSS states that they assumed the entire slope was saturated to model a worst case scenario, which seems reasonable to us. However, they assumed a saturated soil shear strength value of 500 pounds per square foot (psf), which in our professional opinion is un-conservative (i.e. too high) for saturated fine-grained soils. Typically, a shear test would be performed in the lab to verify the soil cohesion if such a high value was going to be used. **We recommend the City not accept the RSS addendum report because they did not perform lab testing to verify their high shear strength value that was assumed.**

5. **The applicant's geotechnical consultant is un-conservatively justifying the argument that the overflow drywell system will not be needed.** The RSS addendum report points to the fact that the unlined rain garden has been designed for a 10 year storm event and that even after the wettest February on record (2017), there was not a single rain event that equaled the 10 year storm event. It's our professional opinion that this is not a valid argument. Two of the winters with the most landslides on record in the greater Portland area (1995-1996 and 2016-2017), were not caused by a single day storm event. They were caused by a buildup of snow and ice, followed by several days of very heavy rainfall. The combination of the melting snow and ice, and the heavy rainfall represented more than a single day storm event.

6. **The applicant's geotechnical consultant did not submit infiltration test data in their addendum geotechnical report that is in accordance with City requirements.** As we presented in our April 20, 2018 report, the City requires infiltration testing follow their specified test procedure. We have previously pointed out the deficiencies with the testing performed to date (i.e. the PIT test procedure was not used, the tests were stopped prematurely before a constant infiltration rate was achieved, and it was not clear whether the previous testing was performed at the drywell locations and at the correct depths). **We recommend that the applicant's geotechnical consultant be required to perform new infiltration testing for both the unlined rain garden and overflow drywell in accordance with City requirements.**

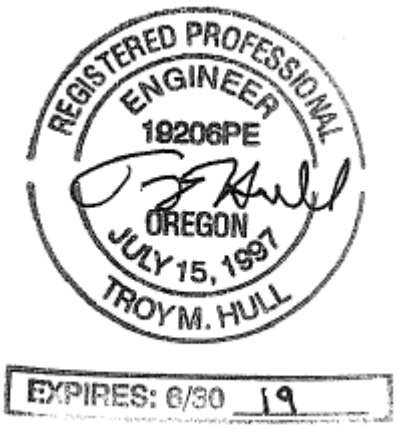
7. **The applicant's geotechnical consultant still has not established the depth to the seasonal groundwater level.** The City of Lake Oswego SWMM requires that the "bottom of drywells must be at least 5 feet above seasonal groundwater or impermeable layer." It is not clear that RSS met this requirement by extending their soil borings at least 5 feet below the bottom of the planned infiltration system. **We recommend that the applicant's geotechnical consultant perform additional soil explorations to confirm this, so that they comply with City requirements.**

8. **We still have concern about the discussion by City staff, the applicant, and their Civil Engineering consultant (Theta) at the April 2 public hearing regarding whether an overflow drywell is required.** Theta explained in the public hearing that because the primary stormwater disposal system (i.e. the unlined rain garden) has been designed to handle the full capacity of a 10-year storm as required by the City, an

overflow drywell is not required. We would like to point out that the Lake Oswego Stormwater Management Manual (SWMM) requires that rain gardens must have an overflow that outlets to an approved discharge location (reference SWMM Section 4.6 – Rain Gardens). **Based on the City's code, it appears that deleting the currently proposed overflow drywell system would not be acceptable, unless another approved overflow discharge point can be identified.**

We also still stand by the comments and recommendations we made in our March 30, 2018 and April 20, 2018 reports, which we understand continue to be part of the public record. If you have any questions pertaining to this report, or if we may be of further service, please contact Troy Hull at 360-567-1806 (office) or 360-903-2784 (cell).

Sincerely,
Earth Engineers, Inc.



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