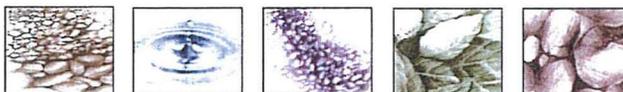


Associated Earth Sciences, Inc.



Technical Memorandum

Date: March 11, 2013

Page 1 of 2

To: Pete Lymberis, Quadrant Homes

Project Name: Slocum Property
Woodinville, Washington

From: Jennifer H. Saltonstall, L.G., L.Hg.

Project No: KE110151A

Subject: Draft Comment response to City of Woodinville's additional information request, regarding stormwater treatment

As requested, the following provides the supplemental information regarding soil characteristics suitable to provide adequate water quality treatment at the Slocum Property.

Reference: Erin Martindale, Senior Planner at the City of Woodinville, February 25, 2013, Additional Information Request for Slocum Subdivision (PPA12002/SEP12033)

Comment No. 19: "The Subsurface Exploration and Infiltration Testing report prepared by Associated Earth Sciences, Inc. dated November 20, 2012 included cation exchange capacity data for only four locations. The report notes that the results will be summarized in an addendum when they are available. The cation exchange capacity for the four locations that were available at the time of the report does not meet the 2009 KCSWDM minimum requirement of 5.0 meq/100g. Provide the additional data demonstrating that the existing soils meet the requirements for infiltration facilities. If this criteria cannot be met, pre-treatment will need to be provided for any pollution generating impervious surface that is directed to the proposed infiltration facilities."

Response

The target receptor horizon at the subject site is Vashon recessional outwash and Vashon advance outwash. In the exploration pits completed by Associated Earth Sciences, Inc. (AESI), the receptor horizon consisted primary of medium dense to dense sand and stiff to very stiff silt with variable gravel content. The advance outwash was highly stratified and the sand/silt layers were interbedded. Short-term infiltration rates of 5 and 10 inches per hour (iph) were measured during the constant head and falling head tests, respectively, at the site. Samples were obtained from the receptor soils for grain size analysis, organic content determination, and cation exchange testing to determine the suitability of the receptor horizon soils for storm water treatment.

To demonstrate that the native soil at the site has properties that reduce the risk of groundwater contamination from typical stormwater runoff, we compared the native soil characteristics to (1) the 2009 KCSWDM requirements for water quality treatment by native soils and (2) the soil characteristics of a water quality

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treatment liner. The manual allows that if a thicker layer of treatment soil is available, the organic content and CEC requirements can be reduced by 1/2 unit for each additional foot of soil thickness provided, and gives the following example:

Example

If the treatment liner will be 3 feet thick, 2 feet more than the required 1 foot, the organic content may be reduced by $1/2 \times 2 = 1$ unit. The organic content could then be 4%, and the CEC requirement could be 4 milliequivalents/100 grams and still meet the groundwater protection criteria.

A summary of laboratory testing of organic content, cation exchange capacity (CEC) and grain size is provided in Attachment A. Given that the depth to ground water beneath the infiltration facilities is a minimum of 3 feet or greater, it is our opinion that the native soil with a CEC of 2.9 to 7.7, an organic content of 0.6 to 1.5 percent, and having a gradation consistent with the KCSWDM requirements has characteristics to adequately control the target pollutants.

EXHIBIT 13
PAGE 2 OF 5

ATTACHMENT A

Summary of Laboratory Testing Data

**Table 1
Summary of Laboratory Testing**

AESI Pit and Depth	CEC	% OM	Sieve Results - KC Req. #8							Of weight passing #10, % sand (retained #270)	USDA Class	
			Of weight passing #4, Percent Passing				75% passes #4	50% pass #40 + 2% on #100	25% pass #40 + 5% on #200			KC SWDM 2009
			#4	#40	#100	#200						
EP-1 at 2.5-3.5 ft	NT	NT	99	86.2	18.5	8.6	Yes	Yes	Yes	Meets grain size criteria	94	sand
EP-2 at 3-4 ft	3.0	1.2	100	80.7	25.9	12.9	Yes	Yes	Yes	Meets grain size criteria	91	sand
EP-3 at 3-4 ft	NT	NT	83.6	19	1.9	1.2	Yes	No	No	Does not meet grain size criteria	99	sand
EP-4 at 3-4 ft	3.8	1.5	94.2	84.1	37.9	20.8	Yes	Yes	Yes	Meets grain size criteria	83	loamy sand/ sandy loam
EP-5 at 3-4 ft	3.8	1.4	96	85.8	34.5	16.3	Yes	Yes	Yes	Meets grain size criteria	89	sand/ loamy sand
EP-7 at 3-4 ft	2.9	1.2	94.7	80.9	13.8	5.0	Yes	Yes	Yes	Meets grain size criteria	97	sand
EP-8 at 3-4 ft	NT	NT	72.4	41.1	10.8	7.0	No	No	Yes	Nearly meets grain size criteria	93	sand
EP-10 at 15 ft	3.6	0.7	85.8	42.6	7.4	2.3	Yes	No	No	Nearly meets grain size criteria	99	sand
EP-10 at 18 ft	3.6	0.6	77.2	56.3	10.3	4.3	Yes	Yes	No	Meets grain size criteria	97	sand
EP-11 at 13 ft	6.6	1.3	100	98.8	88.8	80.8	Yes	Yes	Yes	Meets grain size criteria	23	Too fine-grained
EP-11 at 17.5 ft	4.1	0.8	98.8	69.9	21.5	11.5	Yes	Yes	Yes	Meets grain size criteria	90	sand
EP-12 at 16 ft	7.7	1.0	100	99.2	94.3	77.7	Yes	Yes	Yes	Meets grain size criteria	27	Too fine-grained
EP-13 at 13 ft	4.8	1.0	99.1	45.0	21.0	17.4	Yes	No	Yes	Meets grain size criteria	84	loamy sand/ sandy loam
EP-13 at 15 ft	4.8	0.6	100	29.1	3.2	1.4	Yes	No	No	Does not meet grain size criteria	99	sand

AESI Pit and Depth	CEC	% OM	Sieve Results - KC Req. #8							Of weight passing #10, % sand (retained #270)	USDA Class	
			Of weight passing #4, Percent Passing				75% passes #4	50% pass #40 + 2% on #100	25% pass #40 + 5% on #200			KC SWDM 2009
			#4	#40	#100	#200						
EP-14 at 3 ft	4.2	1.1	87.2	63.1	25.8	12.7	Yes	Yes	Yes	Meets grain size criteria	88	sand/ loamy sand
EP-14 at 5 ft	3.8	0.8	90.1	92.9	34.3	19.6	Yes	Yes	Yes	Meets grain size criteria	82	loamy sand/ sandy loam
IT-1 at 14.5 ft	NT	NT	99.7	96.5	38.3	24.3	Yes	Yes	Yes	Meets grain size criteria	83	loamy sand/ sandy loam
IT-2 at 14 ft	3.2	0.6	92.1	84.2	13.1	4.2	Yes	Yes	No	Meets grain size criteria	97	sand
IT-2 at 17 ft	4.9	0.9	61.1	54.7	21.9	11.9	No	Yes	Yes	Does not meet grain size criteria	88	sand/ loamy sand
PD-1 at 16 ft	3.8	0.7	91.2	53.4	3.9	0.8	Yes	Yes	No	Meets grain size criteria	99	sand

EP - exploration pit

IT - infiltration test pit

CEC - cation exchange capacity

OM - organic matter content, percent by weight

mcq/100g - milliequivalents per 100 grams

KC Req. #8 - King County Core Requirement #8 for in-situ water quality treatment, KCSWDM page 5-62

USDA - U.S. Department of Agriculture soil textural classification

NT - not tested