Earth Solutions NW LLC

• Geotechnical Engineering
• Construction Monitoring
• Environmental Sciences

May 6, 2013
ES-2804

Polygon Northwest Company
PO Box 1349
Bellevue, Washington 98009

Attention: Mr. Richard Rawlings

Subject: Steep Slope Assessment and Setback Reduction
Lakeside Apartments
Highlands Drive Northeast
Issaquah, Washington

Reference: Preliminary Grading and Utility Plan Sheet C4
Triad Associates
dated: March 4, 2013

Dear Mr. Rawlings:

In accordance with your request, Earth Solutions NW, LLC (ESNW) has prepared this letter providing a steep slope assessment; and steep slope setback reduction recommendations for the subject project. A representative of ESNW conducted a site visit on April 23, 2013 to ascertain the subsurface conditions; and observe current surface conditions of the sloped areas of the site.

Project Description

The subject site is located along the east side of Highlands Drive Northeast; and north of Northeast Ingram Street in the Highlands area of Issaquah, Washington. The site consists of an abandoned gravel borrow pit which at one point was filled with water. The pond area is in the process of being filled with soil (after being drained) placed in multiple lifts which were observed as being compacted during our site visit. A residential development is being proposed for the site consisting of multi-family residential structures and associated improvements.

Steep slope hazard areas have been delineated at the northeast and northwest portions of the subject site. A hammerhead road is being proposed for the northeast corner of the site; whereas two of the residential structures (denoted T7 and T9 on the referenced plans by Triad Associates) will encroach upon the 50 foot steep slope buffer as is being proposed. A retaining wall is being proposed on the slope under concern, to be located north of Building T7.

The other steep slope is located at the northwest corner of the subject site; and is sited to the east of Highlands Drive Northeast.

Geologic Map Review

Based on review of the Composite Geologic Map of Seattle, Troost, 2006, the site is underlain by firm glacially consolidated deposits.

Our field observations, where we excavated four test pits on the sloped area on the site, correlate with the geologic map designation. Logs of the test pits and a plan showing the location of the test pit are attached.

Steep Slope Hazard Area Assessment

We reviewed the City of Issaquah Municipal Code Chapter 18.10.580. Based on review of of the municipal code a buffer of 50 horizontal feet must be maintained from any steep slope. However the buffer can be reduced to a minimum of 10 feet, along with a building setback of 15 feet for buildings given the development will not reduce the level of protection to the proposed development and the critical area.

In our opinion, no adverse impacts to the stability of the slope areas along portions of the northeast and northwest site envelope will result from the proposed project provided Best Management Practices (BMPs) in accordance with the Lakeside Development Agreement Standards are incorporated into site designs. In essence, where foundations are to be sited on or near the sloped areas on-site they will be installed at depths which will enhance the overall global stability of the existing steep slopes as proposed.

We interpret the steep slope located at the northwest corner of the site to be a remnant of past grading activities associated with the construction of Highlands Drive Northeast. The excavation for the roadway created the slope. The soil in this area was also observed to be in a dense condition.

ESNW performed slope stability analyses of the slope located at the northeast corner of the site using the data obtained through our on-site observations. The data gathered from our fieldwork was used in our analysis employing GeoStudio Slope/W software. Soil strength parameters of 36 degrees (angle of internal friction) and 100 psf (cohesion) were used in the analysis. In addition, the groundwater table was conservatively modeled at the approximate midpoint of the slope, even though no groundwater was observed during our fieldwork. The stability analysis indicated acceptable factors of safety of at least 1.25 and 1.88 for seismic and static conditions, respectively. The results of the analysis are attached to this report for review. The results of our stability analysis show that the proposed retaining wall will not be located within the slip plane.

Pursuant with the Lakeside Development Agreement Critical Areas Standards Section 8.0, it is our opinion that construction of the proposed retaining wall and the buildings will not have an adverse impact on the Critical Areas, result in a lower level of slope stability; and does not promote adverse intrusion into the Critical Area or otherwise encourage activities that might have a detrimental impact to the Critical Area (i.e. the steep slope).

Based on the conditions observed at the time of the site visit and our understanding of the proposed project, in our opinion impacts to the steep slope areas mapped at the site will be negligible. The proposed structures, including the proposed retaining wall, will not result in instability of the slopes or adjacent structures given that the foundations for both the retaining wall and residential structures are seated on firm native soils present in the substrata.

In our opinion the proposed 10 foot buffer and 15 foot building setback area being proposed is suitable from a geotechnical standpoint, considering our findings based on data gleaned from our fieldwork and subsequent analysis and slope stability modeling.

LIMITATIONS

The recommendations and conclusions provided in this letter are professional opinions consistent with the level of care and skill that is typical of other members in the profession currently practicing under similar conditions in this area. Our recommendations are based on the information available at the time of this letter preparation. A warranty is not expressed or implied.

We trust this letter meets your current needs. If you have any questions regarding the content of this letter, or if additional information is required, please call.

Sincerely,

EARTH SOLUTIONS NW, LLC

KYLE R. CAMPBELL
STATE OF WASHINGTON
27674
REGISTERED
PROFESSIONAL ENGINEER
5/6/13

Stephen H. Avril
Staff Geologist

Kyle R. Campbell, P.E.
Principal

Attachments: Test Pit Logs
Site Plan
Slope Stability Analysis Output

cc: Triad Associates
Attention: Mr. Rick Tomkins (Email only)

JOB NO. 2804	CLIENT Polygon Northwest		TEST PIT NO.
DATE 4-23-13	BY SA.	ELEVATION ±518'	1
CONTRACTOR N/A			SHEET 1 of 1

sample number	sample depth	moisture	depth in feet	USCS code	SURFACE CONDITIONS Bare Soil NOTE: DEPTH OF TOPSOIL & SOD 4"
			0	TPSL	Topsoil
			1	SM	Brown Silty Sand with Gravel, dense, moist (Native)
			2		
			3		
			4		
			5		
			6		
			7		
			8		
			9		
			0		
			1		
			2		
			3		
			4		
			5		
			6		
			7		
			8		
			9		
			0		

Test Pit terminated at 3 feet below existing grade. (NO) Groundwater (table / seepage) encountered at _____ feet during excavation.

Earth Solutions NW LLC

JOB NO. 2804	CLIENT Polygon Northwest		TEST PIT NO.
DATE 4-23-13	BY SA	ELEVATION ± 520'	2
CONTRACTOR N/A			SHEET 1 of 1

sample number	sample depth	moisture	depth in feet	USCS code	SURFACE CONDITIONS Field Grass NOTE: DEPTH OF TOPSOIL & SOD 4"
			0	TPSL	Topsoil
			1	SM	Brown Silty Sand with Gravel, dense, moist (Native)
			2		
			3		
			4		
			5		
			6		
			7		
			8		
			9		
			0		
			1		
			2		
			3		
			4		
			5		
			6		
			7		
			8		
			9		
			0		

Test Pit terminated at 3.5 feet below existing grade. (NO) Groundwater (table / seepage) encountered at _____ feet during excavation.

Earth Solutions NW LLC

JOB NO. 2804	CLIENT Polygon Northwest		TEST PIT NO.
DATE 4-23-13	BY SA.	ELEVATION ± 514'	3
CONTRACTOR N/A			SHEET 1 of 1

sample number	sample depth	moisture	depth in feet	USCS code	SURFACE CONDITIONS Field Grass NOTE: DEPTH OF TOPSOIL & SOD 4"
			0	TPSL	Topsoil
			1	SM	Brown Silty Sand with Gravel, dense, moist (Native)
			2		
			3		
			4		
			5		
			6		
			7		
			8		
			9		
			0		
			1		
			2		
			3		
			4		
			5		
			6		
			7		
			8		
			9		
			0		

Test Pit terminated at 3 feet below existing grade. (NO) Groundwater (table / seepage) encountered at _____ feet during excavation.

Earth Solutions NW LLC

JOB NO. 2804	CLIENT Polygon Northwest		TEST PIT NO. 4
DATE 4-23-13	BY SA.	ELEVATION ± 532'	
CONTRACTOR N/A			SHEET 1 of 1

SURFACE CONDITIONS Field Grass

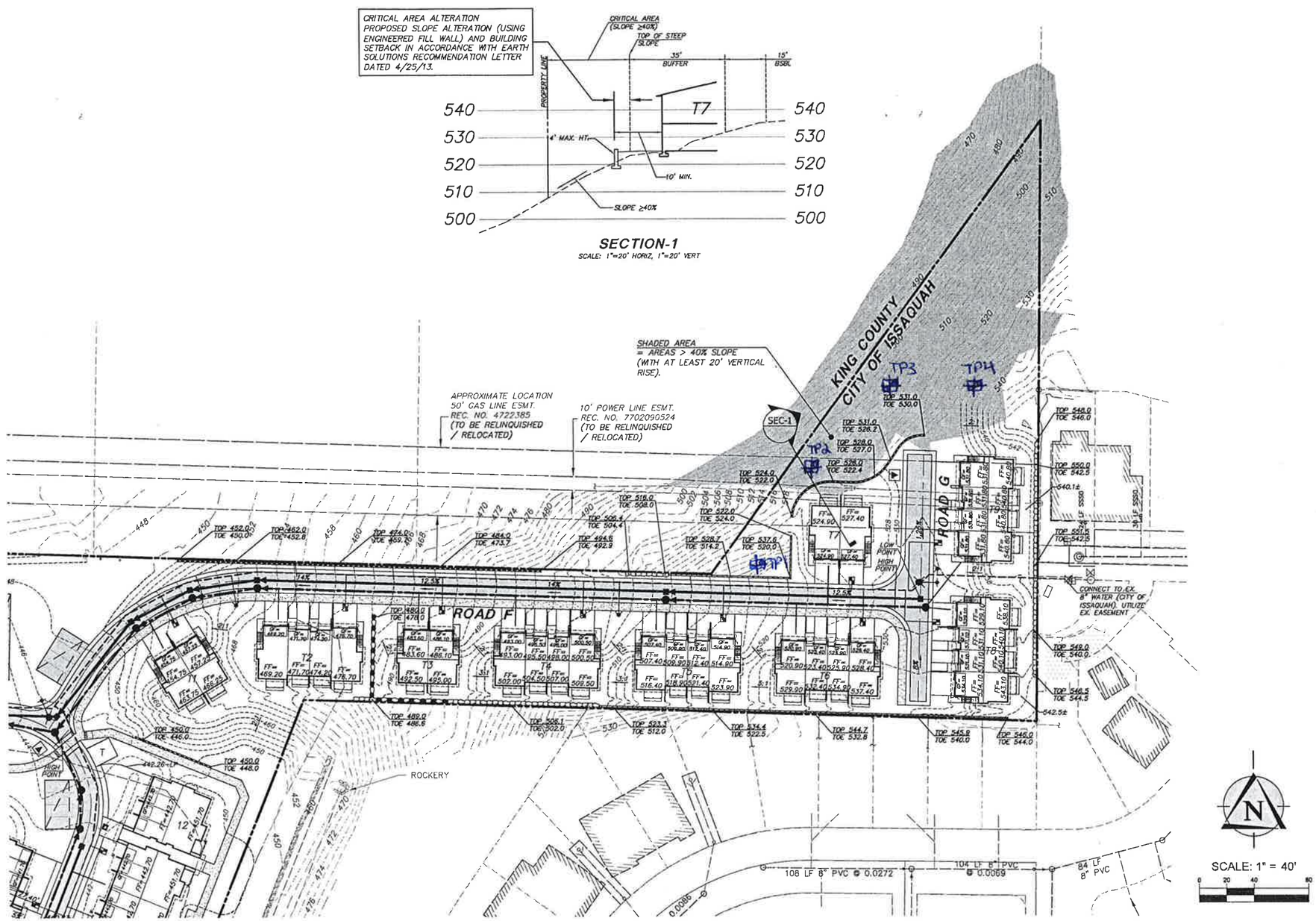
NOTE: DEPTH OF TOPSOIL & SOD 4"

sample number	sample depth	moisture	depth in feet	USCS code	
			0	TPSL	Topsoil
			1	SM	Brown Silty Sand with Gravel, dense moist
			2		
			3		
			4		
			5		
			6		
			7		
			8		
			9		
			0		
			1		
			2		
			3		
			4		
			5		
			6		
			7		
			8		
			9		
			0		

Test Pit terminated at 3 feet below existing grade. (NO) Groundwater (table / seepage) encountered at _____ feet during excavation.

Earth Solutions NW LLC

POR. SE 1/4, SEC. 22, TWP. 24 N., RGE 6 E., W.M.



TRIAD ASSOCIATES
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Kirkland, WA 98034-8629
425.821.8448
425.821.3481 fax
800.488.0758 toll free
www. triadassociates.net
Land Development Consultants

PRELIMINARY GRADING AND UTILITY PLAN

POLYGON NORTHWEST, CO.

LAKESIDE APARTMENTS

CITY OF ISSAQUAH, WASHINGTON

NO.	DATE	REVISION	BY	CK
	4/25/13	ADDED CRITICAL AREA ALTERATION SECTION	CAM	RAT

REVISED BY:

DATE:

RICHARD A. TOWNING, PE
PROJECT MANAGER

MARK S. HARRISON, PLS
PROJECT SURVEYOR

BRIAN K. HANSEN, PE
PROJECT ENGINEER

DENISE LIFTIN, PLA
PROJECT LANDSCAPE ARCHITECT

FIRST SUBMITTAL DATE: 3/4/13

SCALE: HORIZ: 1"=40' VERT: NA

PRELIMINARY

BRIAN K. HANSEN
STATE OF WASHINGTON
48816
REGISTERED PROFESSIONAL ENGINEER

4/25/13

STAMP NOT VALID UNLESS SIGNED AND DATED

JOB NUMBER 12-122

SHEET NUMBER C4 OF 15

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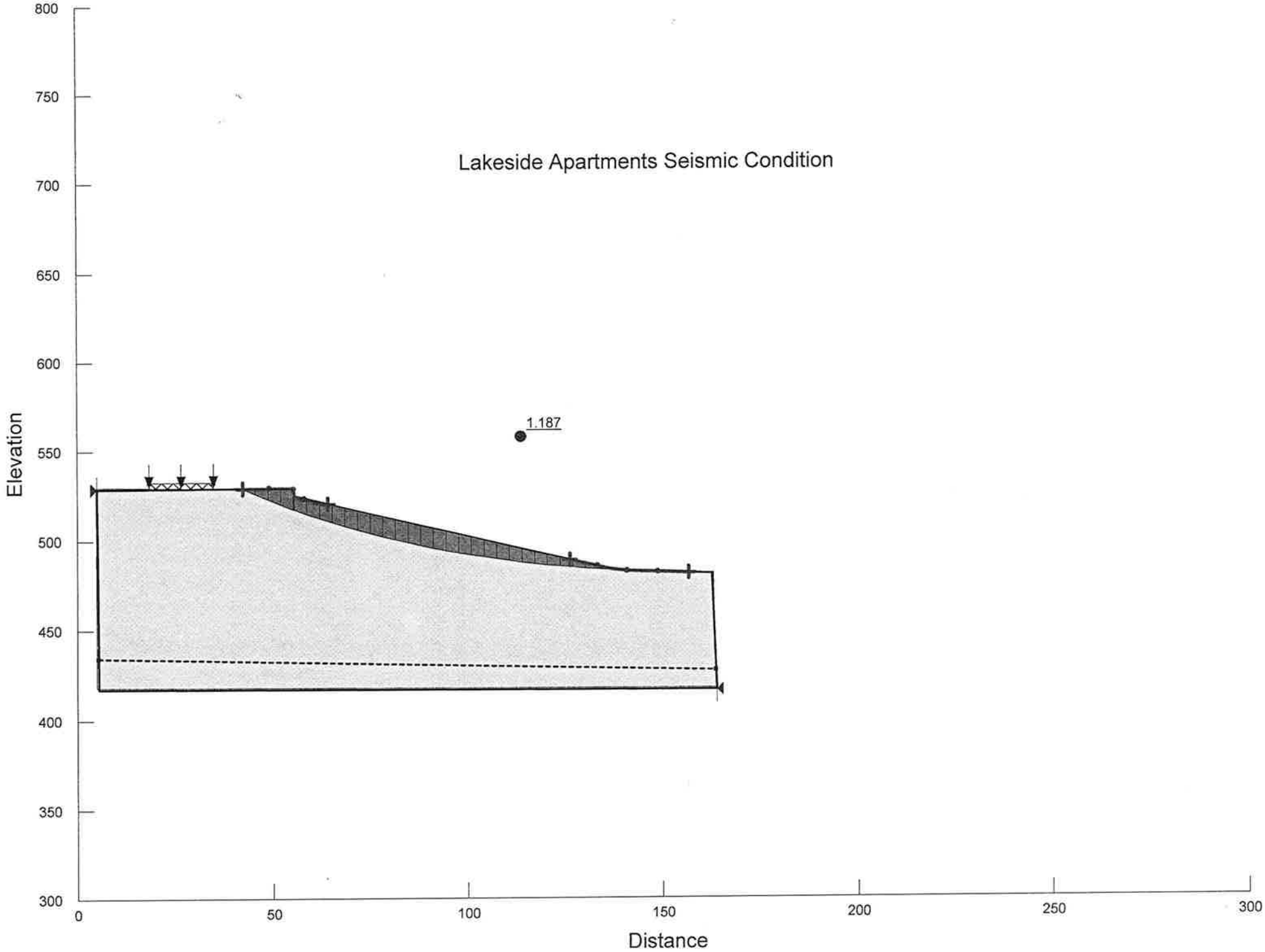
Lakeside Apartments Seismic Condition
1.187
Elevation
800
750
700
650
600
550
500
450
400
350
300
0
50
100
150
200
250
300
Distance

SLOPE/W Analysis

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File Information

Created By: Steve Avril
Revision Number: 2
Last Edited By: Steve Avril
Date: 5/3/2013
Time: 11:32:23 AM
File Name: Lakeside Apartments NE Slope Proposed Condition 1.0.gsz
Directory: C:\Users\steve.avril\Documents\

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

SLOPE/W Analysis

Description: Lakeside Apartments NE. Slope
Kind: SLOPE/W
Method: Morgenstern-Price
Settings
- Apply Phreatic Correction: No
- Side Function
  - Interslice force function option: Half-Sine
- PWP Conditions Source: Piezometric Line
- Use Staged Rapid Drawdown: No

SlipSurface
- Direction of movement: Left to Right
- Allow Passive Mode: No
- Slip Surface Option: Entry and Exit
- Critical slip surfaces saved: 1
- Optimize Critical Slip Surface Location: No
- Tension Crack
  - Tension Crack Option: (none)

FOS Distribution

FOS Calculation Option: Constant

Advanced

Number of Slices: 30
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 0.1 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1

Materials

Native SM

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 100 psf
Phi: 36 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (42.17376, 529.13763) ft
Left-Zone Right Coordinate: (63.976812, 520.40891) ft
Left-Zone Increment: 4
Right Projection: Range
Right-Zone Left Coordinate: (126.16651, 488.84963) ft
Right-Zone Right Coordinate: (156.65764, 481.40321) ft
Right-Zone Increment: 4
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (4.95764, 528.71961) ft
Right Coordinate: (163.73089, 416.46944) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
	5.3381568	434.78029
	163.53594	427.31994

Surcharge Loads

Surcharge Load 1

Surcharge (Unit Weight): 300 pcf
Direction: Vertical

Coordinates

	X (ft)	Y (ft)
	18.349706	532.66316
	34.70348	532.66316

Seismic Loads

Horz Seismic Load: 0.2
Ignore seismic load in strength: No

Regions

	Material	Points	Area (ft^2)
Region 1	Native SM	1,2,3,4,5,6,7,8	14431.199

Points

	X (ft)	Y (ft)
Point 1	4.95764	528.71961
Point 2	55.113504	529.28297
Point 3	55.371044	524.77607
Point 4	136.68922	483.50969
Point 5	141.19616	482.52381

Point 6	162.57196	480.97456
Point 7	163.73089	416.46944
Point 8	5.4083345	417.45532

SLOPE/W Analysis

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File Information

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Directory: C:\Users\steve.avril\Documents\
Last Solved Date: 5/6/2013
Last Solved Time: 8:10:50 AM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

Analysis Settings

SLOPE/W Analysis

Description: Lakeside Apartments NE. Slope
Kind: SLOPE/W
Method: Morgenstern-Price
Settings
- Apply Phreatic Correction: No
- Side Function
  - Interslice force function option: Half-Sine
- PWP Conditions Source: Piezometric Line
- Use Staged Rapid Drawdown: No

SlipSurface
- Direction of movement: Left to Right
- Allow Passive Mode: No
- Slip Surface Option: Entry and Exit
- Critical slip surfaces saved: 1
- Optimize Critical Slip Surface Location: No
- Tension Crack

Tension Crack Option: (none)
FOS Distribution
FOS Calculation Option: Constant
Advanced
Number of Slices: 30
Optimization Tolerance: 0.01
Minimum Slip Surface Depth: 0.1 ft
Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
Starting Optimization Points: 8
Ending Optimization Points: 16
Complete Passes per Insertion: 1

Materials

Native SM

Model: Mohr-Coulomb
Unit Weight: 125 pcf
Cohesion: 100 psf
Phi: 36 °
Phi-B: 0 °
Pore Water Pressure
Piezometric Line: 1

Slip Surface Entry and Exit

Left Projection: Range
Left-Zone Left Coordinate: (57.977789, 523.45323) ft
Left-Zone Right Coordinate: (68.148582, 518.29187) ft
Left-Zone Increment: 4
Right Projection: Range
Right-Zone Left Coordinate: (136.89556, 483.46455) ft
Right-Zone Right Coordinate: (155.19117, 481.50949) ft
Right-Zone Increment: 4
Radius Increments: 4

Slip Surface Limits

Left Coordinate: (4.95764, 528.71961) ft
Right Coordinate: (163.73089, 416.46944) ft

Piezometric Lines

Piezometric Line 1

Coordinates

	X (ft)	Y (ft)
	5.3381568	434.78029
	163.53594	427.31994

Surcharge Loads

Surcharge Load 1

Surcharge (Unit Weight): 300 pcf
Direction: Vertical

Coordinates

	X (ft)	Y (ft)
	18.349706	532.66316
	34.70348	532.66316

Seismic Loads

Horz Seismic Load: 0.2
Ignore seismic load in strength: No

Regions

	Material	Points	Area (ft^2)
Region 1	Native SM	1,2,3,4,5,6,7,8	14431.199

Points

	X (ft)	Y (ft)
Point 1	4.95764	528.71961
Point 2	55.113504	529.28297
Point 3	55.371044	524.77607
Point 4	136.68922	483.50969
Point 5	141.19616	482.52381

Point 6	162.57196	480.97456
Point 7	163.73089	416.46944
Point 8	5.4083345	417.45532

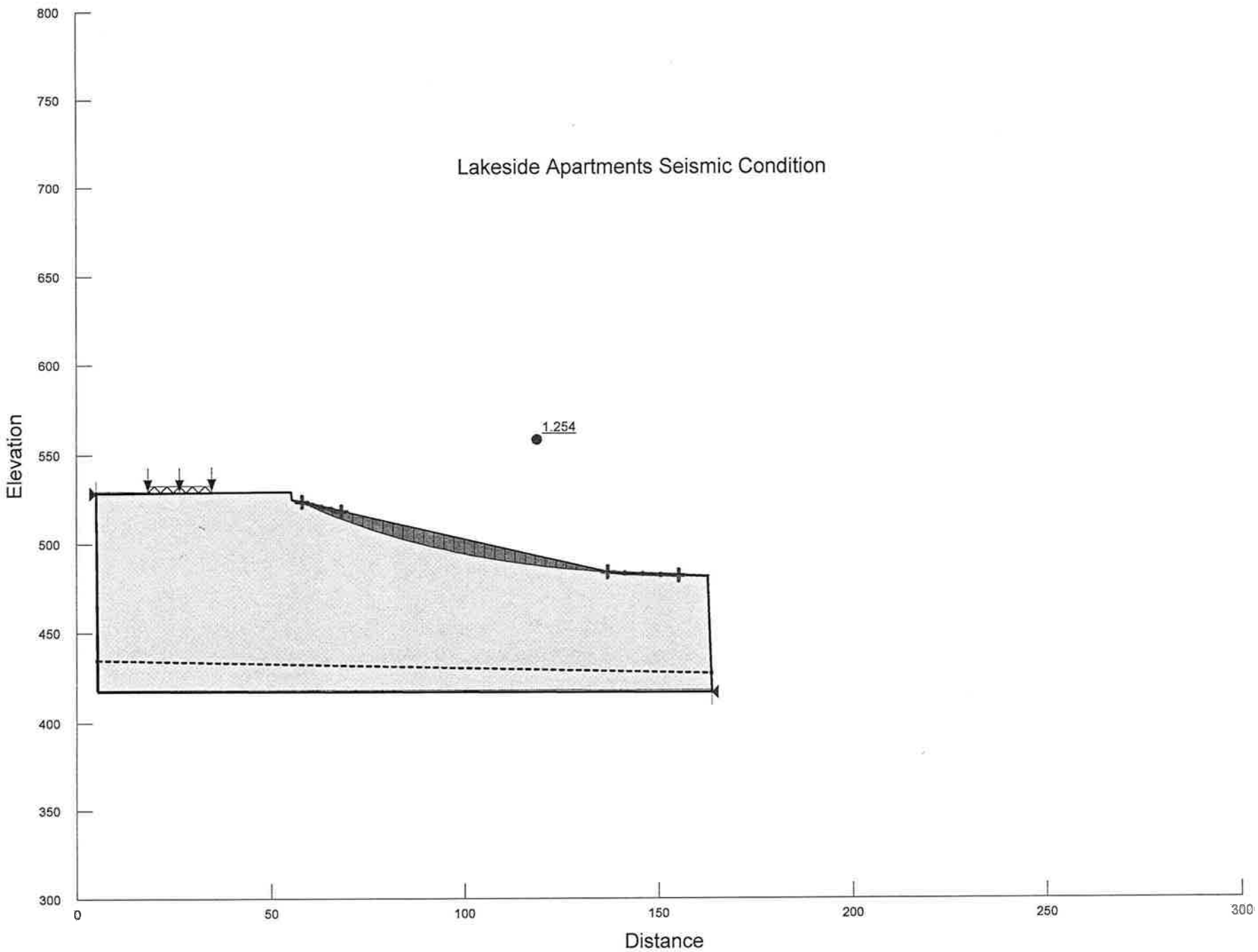
Critical Slip Surfaces

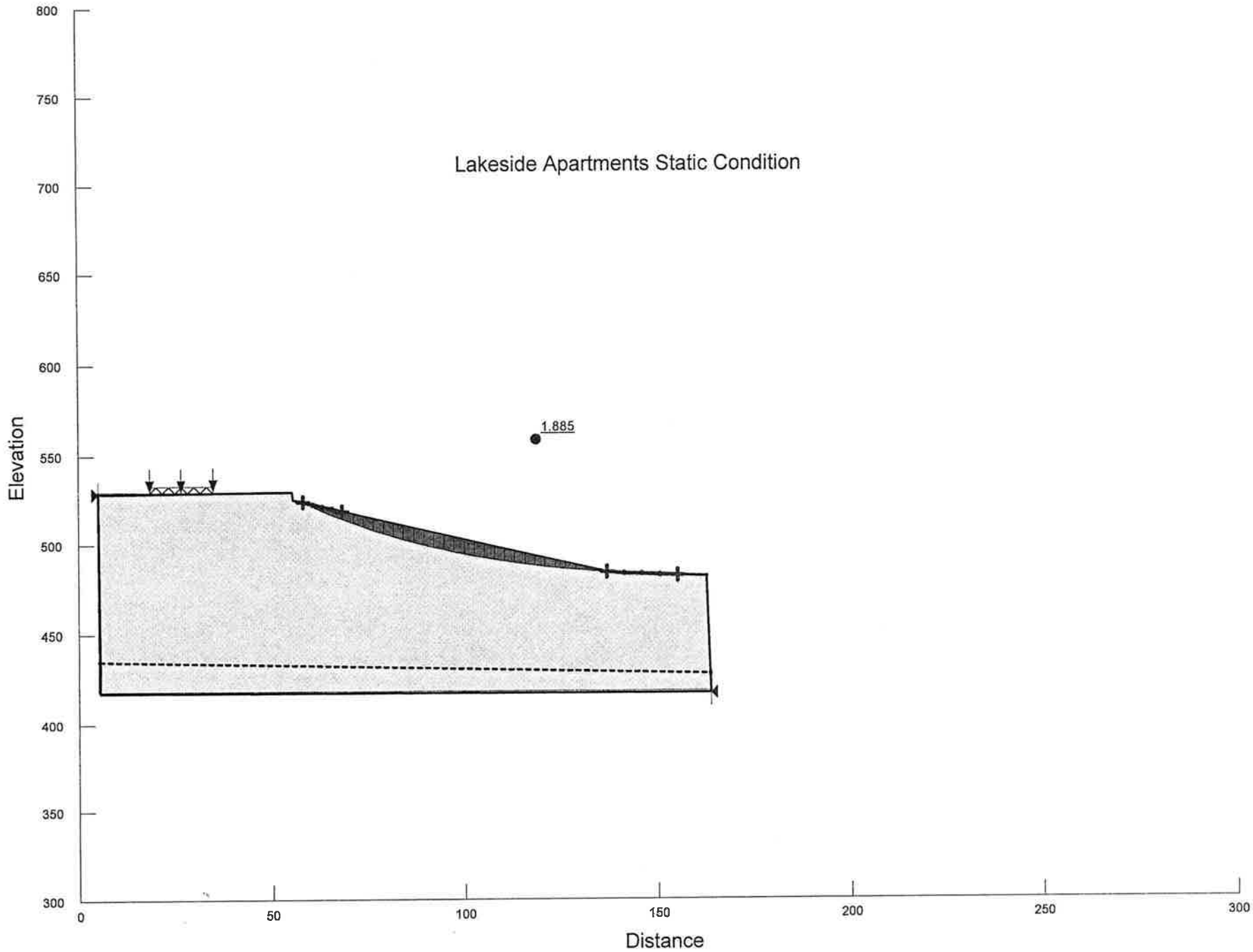
	Number	FOS	Center (ft)	Radius (ft)	Entry (ft)	Exit (ft)
1	2	1.254	(154.922, 616.907)	134.655	(57.9778, 523.453)	(136.896, 483.465)

Slices of Slip Surface: 2

	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	2	59.289645	522.1295	-5609.4705	4.3412494	3.1541023	100
2	2	61.91336	519.5525	-5456.3368	106.53898	77.405099	100
3	2	64.537075	517.11105	-5311.7785	193.10037	140.29563	100
4	2	67.16079	514.7954	-5174.8667	267.14314	194.09085	100
5	2	69.784505	512.5972	-5045.3095	331.23592	240.65698	100
6	2	72.408215	510.5091	-4922.8161	387.56071	281.57934	100
7	2	75.03193	508.5247	-4806.6052	437.86219	318.12551	100
8	2	77.655645	506.6385	-4696.7202	483.59332	351.35111	100
9	2	80.27936	504.84545	-4592.5878	525.96836	382.13838	100
10	2	82.903075	503.14115	-4493.9992	565.88	411.13589	100
11	2	85.52679	501.5217	-4400.5324	603.91779	438.77196	100
12	2	88.150505	499.98355	-4312.2351	640.43095	465.30032	100

13	2	90.774215	498.52355	-4229.017	675.43635	490.73323	100
14	2	93.39793	497.1388	-4150.3271	708.62717	514.84777	100
15	2	96.021645	495.82675	-4076.174	739.35278	537.17124	100
16	2	98.64536	494.58505	-4006.4777	766.49725	556.89285	100
17	2	101.26906	493.41155	-3940.7376	788.70683	573.02906	100
18	2	103.89275	492.30435	-3879.4222	804.24208	584.31607	100
19	2	106.5165	491.2617	-3822.255	811.25558	589.41168	100
20	2	109.14025	490.282	-3768.8996	807.7596	586.8717	100
21	2	111.76395	489.36375	-3719.3269	791.91842	575.36241	100
22	2	114.38765	488.5057	-3673.4721	762.31724	553.85589	100
23	2	117.01135	487.70665	-3631.2329	717.98131	521.64396	100
24	2	119.63505	486.96545	-3592.6963	658.6144	478.51137	100
25	2	122.25875	486.28115	-3557.7041	584.65585	424.77734	100
26	2	124.8825	485.65285	-3526.217	497.22224	361.2531	100
27	2	127.50625	485.0798	-3498.1756	398.19333	289.30439	100
28	2	130.12995	484.56125	-3473.537	289.64686	210.44076	100
29	2	132.75365	484.0965	-3452.2738	174.02909	126.43954	100
30	2	135.37735	483.68505	-3434.3088	53.650351	38.979261	100
31	2	136.7924	483.4786	-3425.6032	-8.595822	-6.2452303	100


Lakeside Apartments Seismic Condition
1.254
Elevation
800
750
700
650
600
550
500
450
400
350
300
0
50
100
150
200
250
300
Distance


Lakeside Apartments Static Condition
1.885
Elevation
800
750
700
650
600
550
500
450
400
350
300
0
50
100
150
200
250
300
Distance

SLOPE/W Analysis

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File Information

Created By: Steve Avril
Revision Number: 7
Last Edited By: Steve Avril
Date: 5/6/2013
Time: 8:27:51 AM
File Name: Lakeside Apartments NE Slope Proposed Condition 1.0.gsz
Directory: C:\Users\steve.avril\Documents\
Last Solved Date: 5/6/2013
Last Solved Time: 8:31:44 AM

Project Settings

Length(L) Units: feet
Time(t) Units: Seconds
Force(F) Units: lbf
Pressure(p) Units: psf
Strength Units: psf
Unit Weight of Water: 62.4 pcf
View: 2D

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  - Interslice force function option: Half-Sine
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FOS Calculation Option: Constant
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Optimization Tolerance: 0.01
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Optimization Maximum Iterations: 2000
Optimization Convergence Tolerance: 1e-007
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Ending Optimization Points: 16
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Piezometric Line 1

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	Slip Surface	X (ft)	Y (ft)	PWP (psf)	Base Normal Stress (psf)	Frictional Strength (psf)	Cohesive Strength (psf)
1	2	59.289645	522.1295	-5609.4705	22.250345	16.165822	100
2	2	61.91336	519.5525	-5456.3368	136.44562	99.133548	100
3	2	64.537075	517.11105	-5311.7785	235.70929	171.25282	100
4	2	67.16079	514.7954	-5174.8667	322.72461	234.47315	100
5	2	69.784505	512.5972	-5045.3095	399.6504	290.36301	100
6	2	72.408215	510.5091	-4922.8161	468.18707	340.15782	100
7	2	75.03193	508.5247	-4806.6052	529.68685	384.84003	100
8	2	77.655645	506.6385	-4696.7202	585.1938	425.16818	100
9	2	80.27936	504.84545	-4592.5878	635.3746	461.62667	100
10	2	82.903075	503.14115	-4493.9992	680.78211	494.61715	100
11	2	85.52679	501.5217	-4400.5324	721.63113	524.29571	100
12	2	88.150505	499.98355	-4312.2351	757.92604	550.6655	100
13	2	90.774215	498.52355	-4229.017	789.50587	573.60959	100
14	2	93.39793	497.1388	-4150.3271	815.99595	592.85576	100
15	2	96.021645	495.82675	-4076.174	836.86153	608.01549	100

16	2	98.64536	494.58505	-4006.4777	851.39815	618.57696	100
17	2	101.26906	493.41155	-3940.7376	858.8312	623.97739	100
18	2	103.89275	492.30435	-3879.4222	858.20622	623.52332	100
19	2	106.5165	491.2617	-3822.255	848.67078	616.59542	100
20	2	109.14025	490.282	-3768.8996	829.33713	602.54869	100
21	2	111.76395	489.36375	-3719.3269	799.39174	580.79209	100
22	2	114.38765	488.5057	-3673.4721	758.35554	550.97755	100
23	2	117.01135	487.70665	-3631.2329	705.76627	512.76921	100
24	2	119.63505	486.96545	-3592.6963	641.69479	466.21855	100
25	2	122.25875	486.28115	-3557.7041	566.38998	411.50641	100
26	2	124.8825	485.65285	-3526.217	480.57757	349.16004	100
27	2	127.50625	485.0798	-3498.1756	385.13292	279.81545	100
28	2	130.12995	484.56125	-3473.537	281.39018	204.44193	100
29	2	132.75365	484.0965	-3452.2738	170.72084	124.03595	100
30	2	135.37735	483.68505	-3434.3088	54.619504	39.683392	100
31	2	136.7924	483.4786	-3425.6032	-5.618018	-4.081729	100