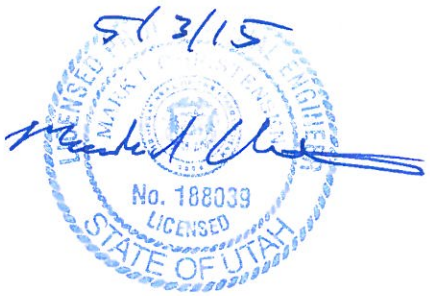
GeoStrata Engineering & Geosciences
14425 S. Center Point Way, Bluffdale, Utah 84065 ~ T: (801) 501-0583 ~ F: (801) 501-0584

MEMORANDUM

To: Matt Rasmussen

From: J. Scott Seal, P.E.
Mark I. Christensen, P.E.
Timothy J. Thompson, P.G.



Date: April 27, 2015

Subject: **Review Response for Geotechnical Review – 6472 and 6498 South Bybee Drive, Weber County Parcel Numbers: 07-753-0001 and 07-753-0002 Uintah, Utah**

GeoStrata has received review questions of our report titled **Geotechnical Investigation for Dauphine-Savory Piedmont Subdivision Lots 1R and 2R and adjacent 2-acre property, Weber County, Utah**, GeoStrata Job Number 910-001 and dated December 10, 2013. We understand that a second memorandum prepared by GeoStrata titled **"Review of Proposed Residential Development – Dauphine-Savory Piedmont Subdivision, GeoStrata Project #910-001**, dated May 8, 2014 was also reviewed. The reviews were completed by Mr. Alan Taylor, P.E. of Taylor Geotechnical. This memorandum was prepared in response to the review questions presented in a letter dated December 2, 2014.

Review Questions – TGE

1. TGE requests that "The location of the test pits be shown on the site plan for the proposed home."

GeoStrata Response: GeoStrata has completed an updated site plan containing the requested information. A site vicinity map and site exploration map may be found attached to the end of this letter as Plates A-1 and A-2, respectively. It should be noted that GeoStrata has completed additional field work in order to further assess the geologic nature of the site. This additional work included the excavation of an additional trench (Trench 3) as well as deepening the previously completed trenches (Trench1 and 2). While no additional geotechnical testing was completed as part of that investigation, the subsurface soils were observed and our geotechnical recommendations were re-evaluated. Updated hand logs of Trenches 1 and 3 have been attached to the end of this letter as Plates B-1 to B-4. Trench 2 was omitted as the Client wishes to focus on residential building lots 1R and 2R. The neighboring 2-acre parcel will be covered in a future report.

2. TGE requests that GeoStrata submit "Engineering calculations that substantiate the recommended allowable bearing capacity and settlement analysis."

GeoStrata Response: GeoStrata has attached our calculations for our bearing capacity recommendations to the end of this letter as Plate A-3. In our previous geotechnical report, a

soil friction angle (ϕ) of 28° and a cohesion value of 200 psf were assumed. GeoStrata has completed a direct shear test on a sample of the near-surface soils in order to complete a rockery design for the project, and in doing so has obtained a friction angle of 31° and a cohesion of 445 psf. Results of our laboratory testing have been attached to the end of this letter as Plate A-5. Due to the granular nature of the native, near-surface soils, GeoStrata was unable to obtain a suitable undisturbed sample for consolidation testing. As such, a Cc and Cr value could not be obtained. Due to the sandy nature of the soils observed, it is likely that the settlement involved with this project will be immediate settlement and is anticipated to be less than one inch as long as the foundations are constructed as described in our 2013 geotechnical report.

3. TGE requests that GeoStrata submit "Engineering calculations that substantiate the recommended lateral earth pressure coefficients and equivalent fluid densities for active, at-rest and passive conditions."

GeoStrata Response: GeoStrata has attached the requested information to the end of this letter as Plate A-4. As discussed above, our previously assumed soil strengths have been updated using laboratory-obtained soil strengths, and as a result these values will differ from the values originally stated in our 2013 geotechnical report.

4. "On page 3 of the geotechnical report, GeoStrata states, "Due to the geologic hazards identified during the literature review, a geologic hazards investigation was performed and is presented in a separate report." The geologic hazards report should be reviewed by a licensed geologist to confirm the documented is in compliance with Section 104-24 of the Weber County Code of Ordinances. A review by Weber County consultant of the geologic hazards report will be completed as a separate review."

GeoStrata Response: GeoStrata has received the geologic review referenced above, and has completed a response in a separate letter.

5. "Based on Plate A-2 of the subject report, it is not clear if the trenches excavated for the fault study confirm if the proposed building lot is free from active faults. Therefore, a site plan should be submitted that contains the location of the home and locations of the trenches used for the geologic study."

GeoStrata Response: GeoStrata has prepared a plate showing the location of the proposed residences as well as the area cleared by the trenches. This plate has been attached to the end of this letter as Plate A-6.

6. "On page 2 of the May 8, 2014 document, GeoStrata states: "The plans submitted to GeoStrata do not appear to include proposed grading plans, and as such it is not possible to assess if the proposed development will meet the recommendations made in our geologic report." A grading plan was completed by Silverpeak Engineering on October 29, 2014 for the subject property. GeoStrata should review the grading plan to assess if the proposed development meets the recommendations in their geotechnical report and geologic hazards

report."

GeoStrata Response: GeoStrata has obtained the referenced grading plan. Upon review, the proposed site plan meets the recommendations made in our original geotechnical and geological hazards reports.

Closure

The conclusions and recommendations contained in this memorandum which include professional opinions and judgments, are based on the information available to us at the time of our evaluation, the results of our field observations, our limited subsurface exploration and our understanding of the proposed site development. This memorandum was prepared in accordance with the generally accepted standard of practice at the time the report was written. No warranty, expressed or implied, is made. Development of property in the immediate vicinity of active faults involves a certain level of inherent risk.

This memorandum was written for the exclusive use of Matt Rasmussen and only for the proposed project described herein. It is the Client's responsibility to see that all parties to the project including the Designer, Contractor, Subcontractors, etc. are made aware of this memorandum in its entirety. We are not responsible for the technical interpretations by others of the information described or documented in this memorandum. The use of information contained in this memorandum for bidding purposes should be done at the Contractor's option and risk.

0 750 1,500 3,000 4,500 6,000 Feet

1:24,000

Base Map: Utah AGRC Hybrid Basemap

All Locations are Approximate

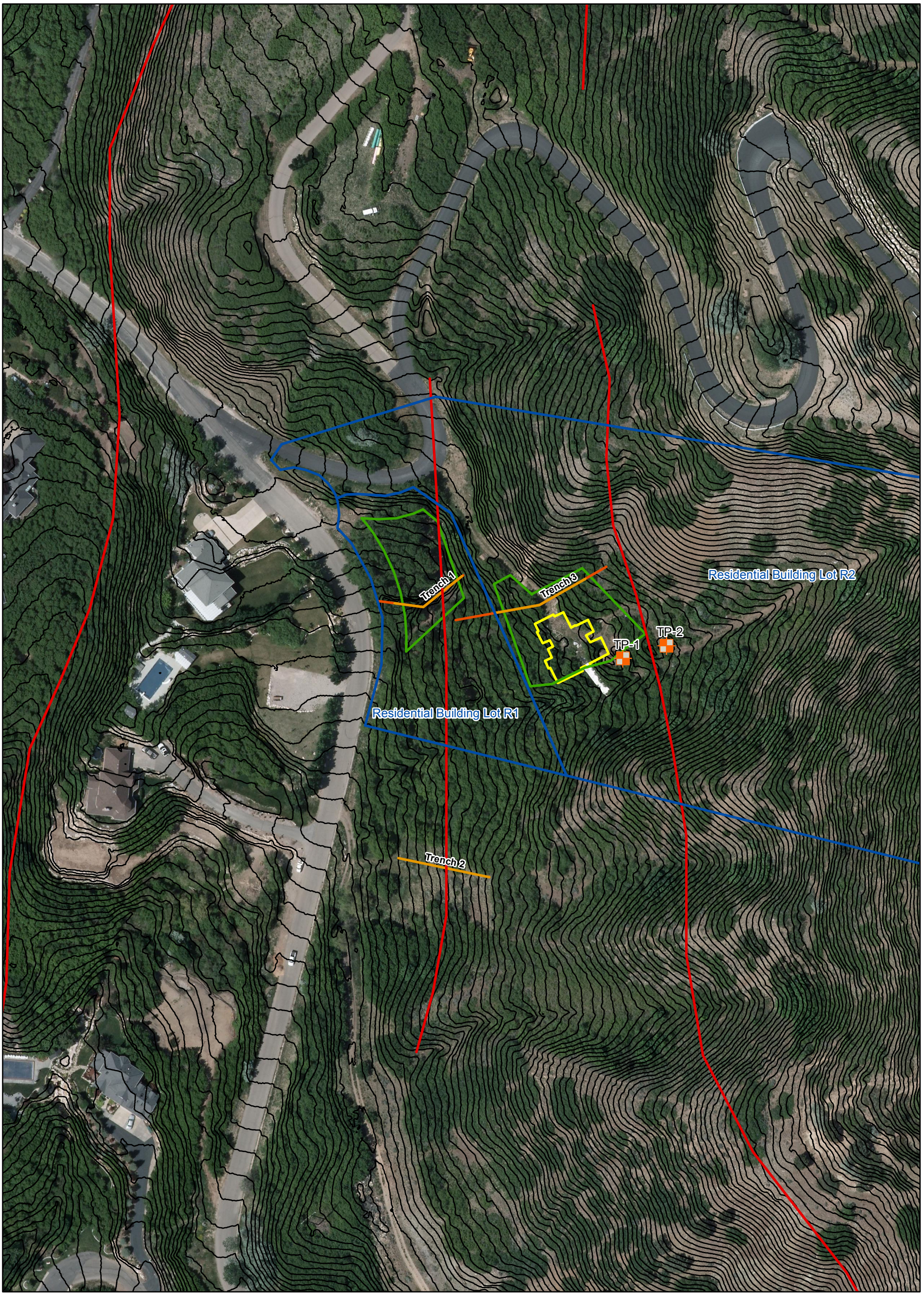
N

GeoStrata

Matt Rassmusen
Dauphine-Savory Piedmont Subdivision
South Weber, Utah
Project Number: 910-001

Site Vicinity Map

Plate A-1



Legend

- Site Boundary
- Fault
- Logged Portion of Trench
- Excavated Trench
- Test Pit
- Buildable Area
- Proposed Building

0 25 50 100 150 200 Feet

1:1,200

Base Map: 2012 HRO 6 inch Orthophotography obtained from the State of Utah AGRC.

All Locations are Approximate

N

GeoStrata

Matt Rassmusen
Dauphine-Savory Piedmont Subdivision
South Weber, Utah
Project Number: 910-001

Exploration Location Map

Plate A-2

The Ultimate Meyerhof q_{ULT} Calcultimator!!

Wednesday, December 04, 2013

910-001 - Dauphine-Savory Piedmont Subdivision - Weber County, Utah - Geotechnical Investigation

Input only the shaded cells

Units of computation (enter **SI** or **US**):	us
Is load **vertical** or **inclined**?	vertical
Specified factor of safety (S.F.):	3.00

$q = \gamma' D$ = 360.00 psf

use γ' = 120.00 pcf

Φ_{ps}* = 31 °

*use Φ_{ps} only if L'/B' ≥ 2.0

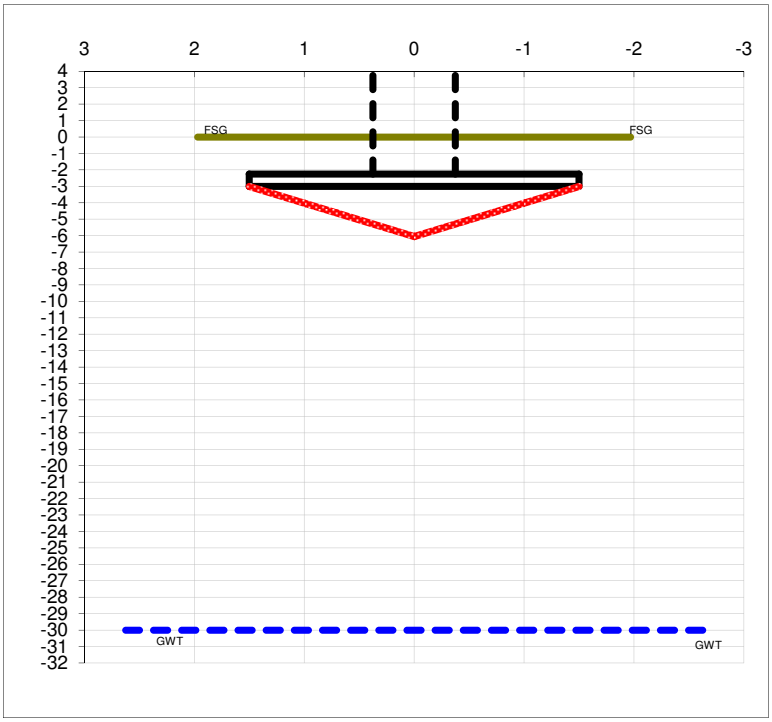
use Φ = 31 °

Footing Data:		
B =	3.00	ft
L =	20.00	ft
D =	3.00	ft
Soil Data:		
γ =	120.0	pcf
Φ_{tr} =	31.0	°
c =	445.0	psf
z_{GWT}=	30.00	ft
V =	120.000	**k**
H_B =	0.000	**k**

Eccentric Offsets:		
B-dir., e_B =	0.0000	ft
L-dir., e_L =	0.00	ft

M_B =	0.00	kip*ft	B' =	3.000	ft
M_L =	0.00	kip*ft	L' =	20.00	ft
θ =	0.00	°	L'/B' =	6.67	
			D/B' =	1.000	

$K_p = \tan^2(45+\Phi/2)$ = 3.124



Shape Factors	**Depth Factors**	**Inclination Factors**
$s_c = 1+ 0.2K_pB'/L'$ = **1.094**	$d_c = 1+ 0.2(\sqrt{K_p})D/B'$ = **1.353**	for all Φ if θ = 0, i_i = 1.0
$s_q = s_\gamma$ = 1 for Φ = 0	$d_q = d_\gamma$ = 1 for Φ = 0	$i_c=i_q= (1-(\theta^\circ/90^\circ))^2$ for all Φ = **1.000**
$s_q=s_\gamma=1+0.1K_pB'/L'$ for Φ > 10°	$d_{q,\gamma}=1+0.1(\sqrt{Kp})D/B'$ for Φ>10°	for Φ=0 when θ>0 i_γ = 0
Therefore $s_q = s_\gamma$ = **1.047**	Therefore $d_q = d_\gamma$ = **1.177**	for Φ>0 when θ>0 $i_\gamma = (1-(\theta^\circ/\Phi^\circ)^2)$
		Therefore i_γ = **1.000**

Reduction Factor for Wide Footing	**Bearing Capacity Factor**	
$r_\gamma = 1- 0.25\log(B'/\kappa)$	$N_q = e^{\pi\tan\Phi} \cdot\tan^2(45+\Phi/2)$ =	20.63
for B'>κ , where κ = 6 ft or 2 m	$N_c = (N_q -1)/\tan\Phi$ =	32.67
r_γ = **1.000**	$N_\gamma = (N_q -1)\cdot\tan(1.4\Phi)$ =	18.56

Loading is VERTICAL

For vertical load use: $q_{ULT} = cN_cs_cd_c + qN_qs_qd_q + 0.5\gamma B'N_\gamma s_\gamma d_\gamma r_\gamma$

For inclined load use: $q_{ULT} = cN_cd_ci_c + qN_qd_qi_q + 0.5\gamma B'N_\gamma d_\gamma i_\gamma r_\gamma$

q_{ULT} =	34788.0	psf	=	34.8	ksf
$q_a = q_{ULT}$ /SF =	11596.0	psf			
$V_{ULT}=q_{ult}*(B'\cdot L')$=	2087282.4	lbs	=	**2.087E+03**	**kips**
$V_a = V_{ULT}$ /SF =	695760.8	lbs	=	696	kips

Plate A-3

Lateral Earth Pressure Coefficients

Input Parameters:

Wall Inclination (θ) =		degrees
Friction Angle of Backfill (φ) =	31	degrees
Backfill Slope Inclination (β) =	0	degrees
Backfill/Wall Friction Angle (δ) =	0	degrees (typically 2/3 x phi of backfill)
Peak Ground Acceleration =	0.57	Fraction of g (PGA with 2% probability of exceedence from USGS NEHRP)
Friction Angle of Subgrade =		degrees

Couloumbs Equation:

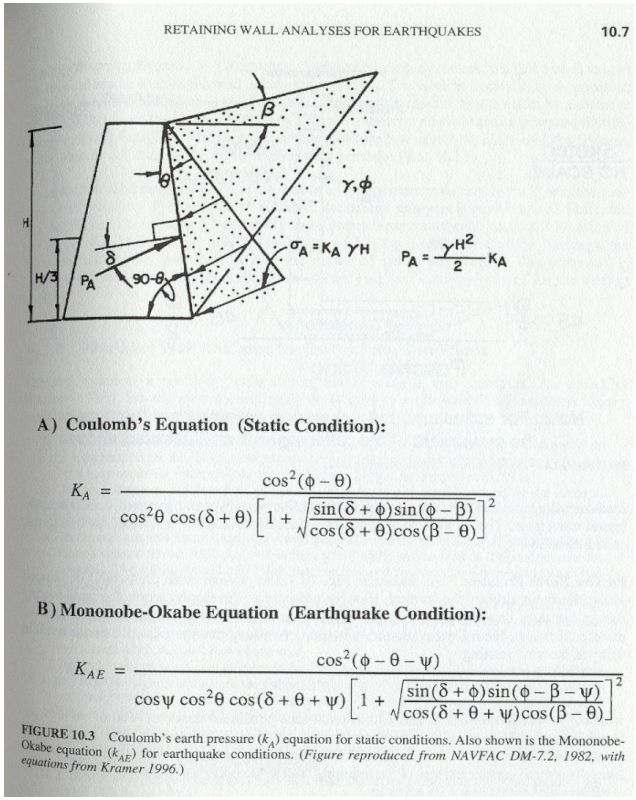
K_a =	0.3201		
K_{ah} =	0.3201		
K_p =	3.1240		44.52
K_{ph} =	3.1240		-87.18

Mononobe-Okabe Equation:

ψ =	29.6831	degrees	
K_{ae} =	1.0618	K_e (K_{ae}-K_a)=	0.7418
K_{pe} =	1.9537	K_e (Kp_e-Kp)=	-1.1704

General Notes:

- 0 Planter Block θ (for any wall) =	-4.8	degrees
- 1 Planter Block θ (for 9-ft wall) =	-12.2	degrees
- 2 Planter Block θ (for 12-ft wall) =	-15.9	degrees
- 3 Planter Block θ (for 15-ft wall) =	-18	degrees
- 4 Planter Block θ (for 18-ft wall) =	-19.4	degrees



RETAINING WALL ANALYSES FOR EARTHQUAKES 10.7

A) Coulomb's Equation (Static Condition):

$$K_A = \frac{\cos^2(\phi - \theta)}{\cos^2\theta \cos(\delta + \theta)\left[1 + \sqrt{\frac{\sin(\delta + \phi)\sin(\phi - \beta)}{\cos(\delta + \theta)\cos(\beta - \theta)}}\right]^2}$$

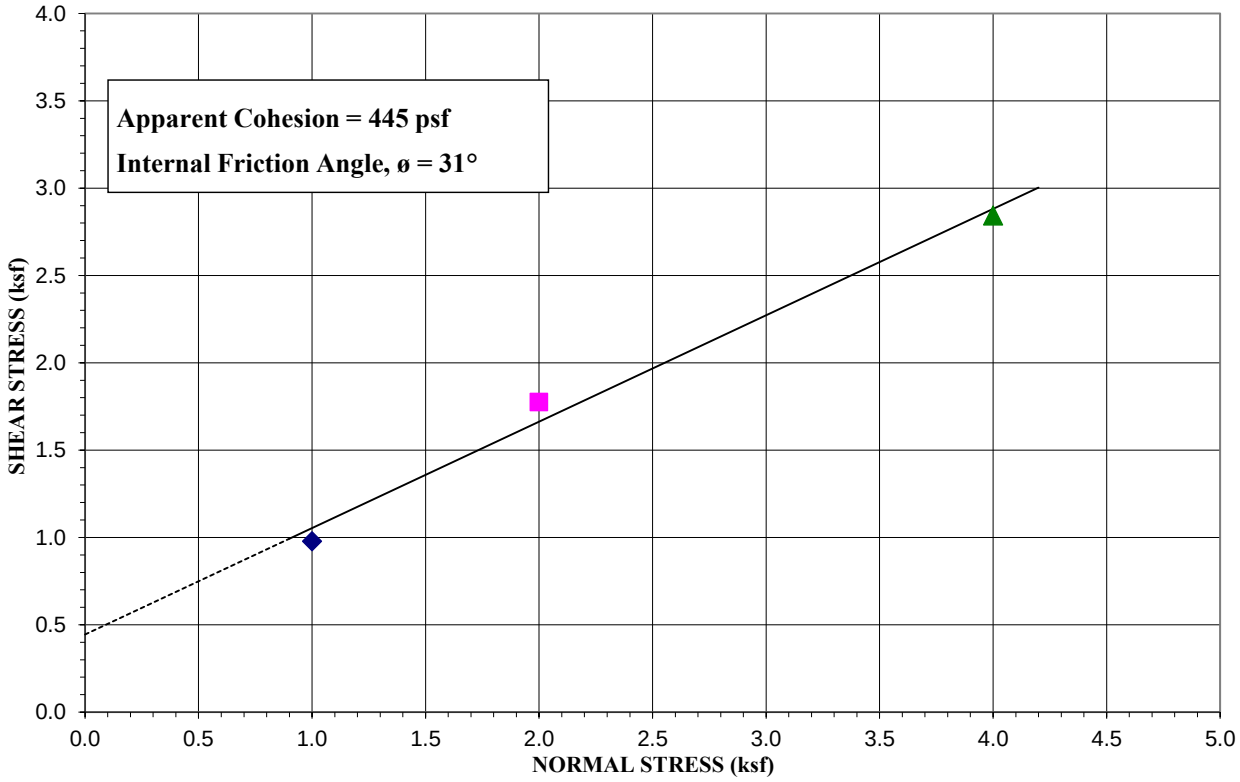
B) Mononobe-Okabe Equation (Earthquake Condition):

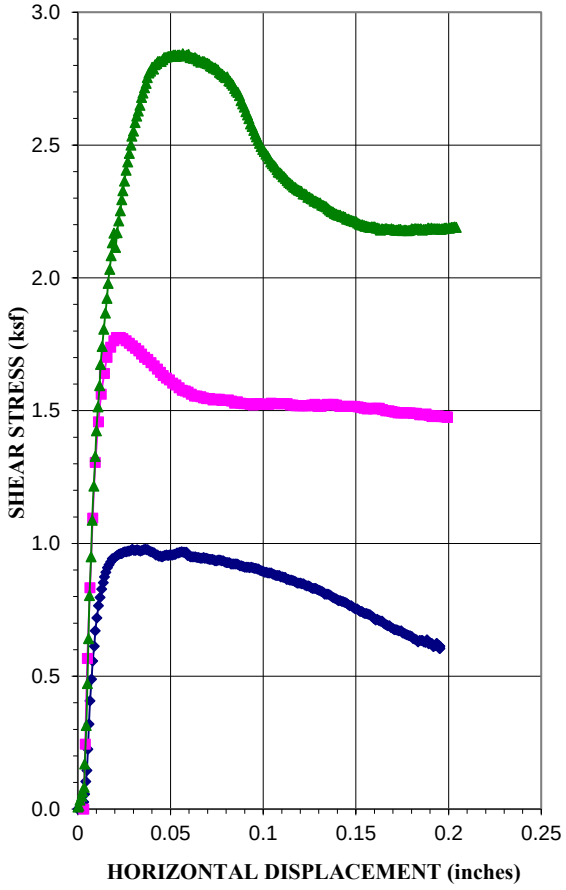
$$K_{AE} = \frac{\cos^2(\phi - \theta - \psi)}{\cos\psi \cos^2\theta \cos(\delta + \theta + \psi)\left[1 + \sqrt{\frac{\sin(\delta + \phi)\sin(\phi - \beta - \psi)}{\cos(\delta + \theta + \psi)\cos(\beta - \theta)}}\right]^2}$$

FIGURE 10.3 Coulomb's earth pressure (k_A) equation for static conditions. Also shown is the Mononobe-Okabe equation (k_{AE}) for earthquake conditions. (*Figure reproduced from NAVFAC DM-7.2, 1982, with equations from Kramer 1996.*)

Plate A-4

DIRECT SHEAR TEST





Sample Location:	Lot 2R
Type of Test:	Consolidated Drained/Saturated

Test No. (Symbol)	**1 (◆)**	**2 (■)**	**3 (▲)**
Sample Type	Remolded		
Initial Height, in.	1	1	1
Diameter, in.	2.5	2.5	2.5
Dry Density Before, pcf	101.2	103.3	103.1
Dry Density After, pcf	102.9	104.9	104.7
Moisture % Before	8.4	7.3	8.8
Moisture % After	15.6	14.9	17.1
Saturation, % Before	35.2	32.2	38.7
Saturation, % After	68.0	68.2	78.2
Normal Load, ksf	1.0	2.0	4.0
Shear Stress, ksf	0.98	1.78	2.84
Strain Rate	0.00333 IN/MIN		

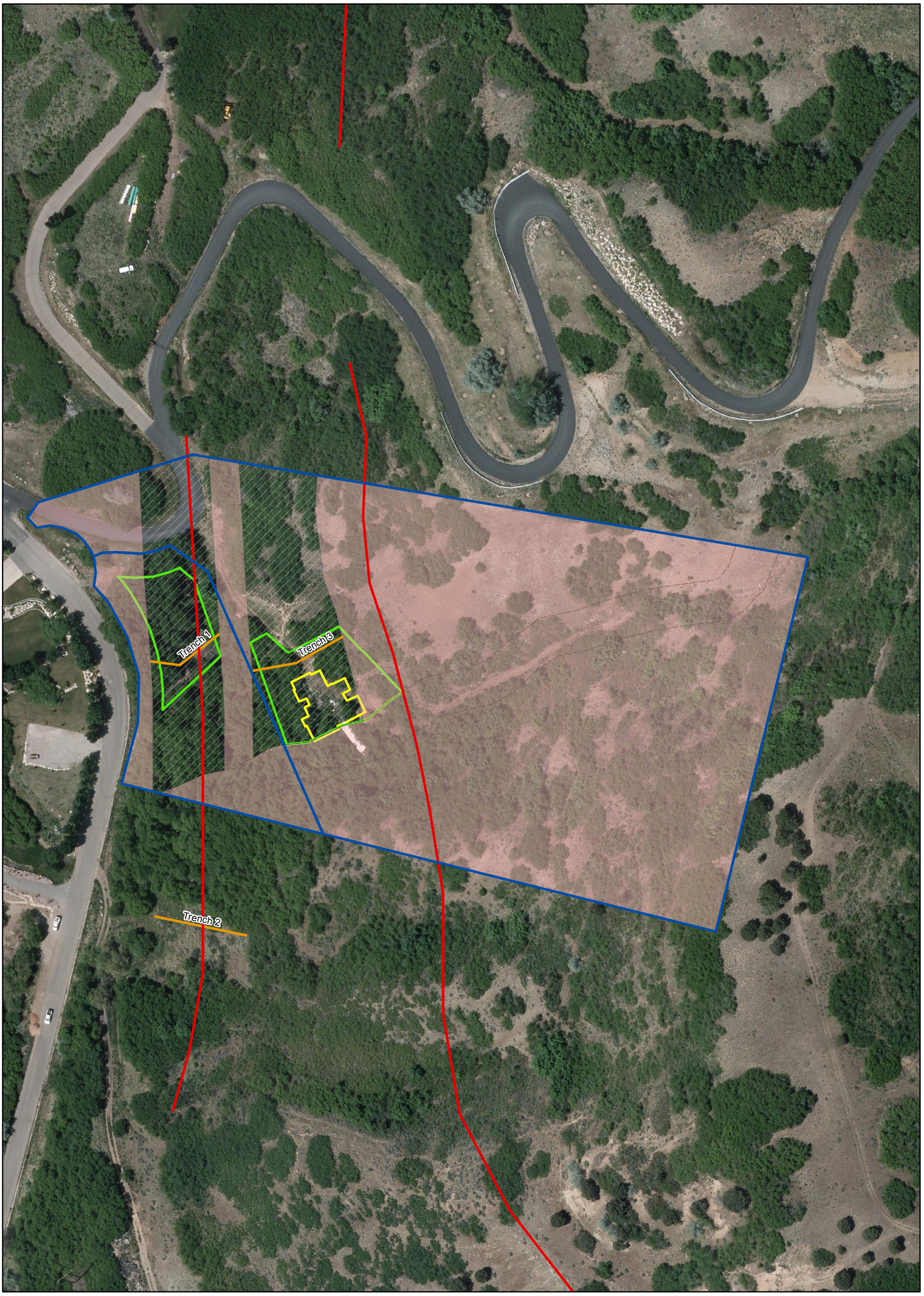
Sample Properties	
Cohesion, psf	445
Friction Angle, ϕ	31
Liquid Limit, %	---
Plasticity Index, %	---
Percent Gravel	---
Percent Sand	---
Percent Passing No. 200 sieve	---
Classification	SM

PROJECT: Dauphine-Savory Piedmont Subdivision

PROJECT NO.: 910-001

GeoStrata

Plate
A-5



Site Boundary
Fault
Logged Portion of Trench
Buildable Area
Non-Buildable Area
Drainage Setback
Proposed Buildable Area
Proposed Building Footprint

0 25 50 100 150 200 Feet

1:1,200

Base Map: 2012 HRO 6 inch Orthophotography obtained from the State of Utah AGRC.

All Locations are Approximate

N

GeoStrata

Matt Rassmusen
Dauphine-Savory Piedmont Subdivision
South Weber, Utah
Project Number: 910-001

Site Geologic Setback Map

Plate A-6