Exhibit A

Celebrating over 20 years of design success!

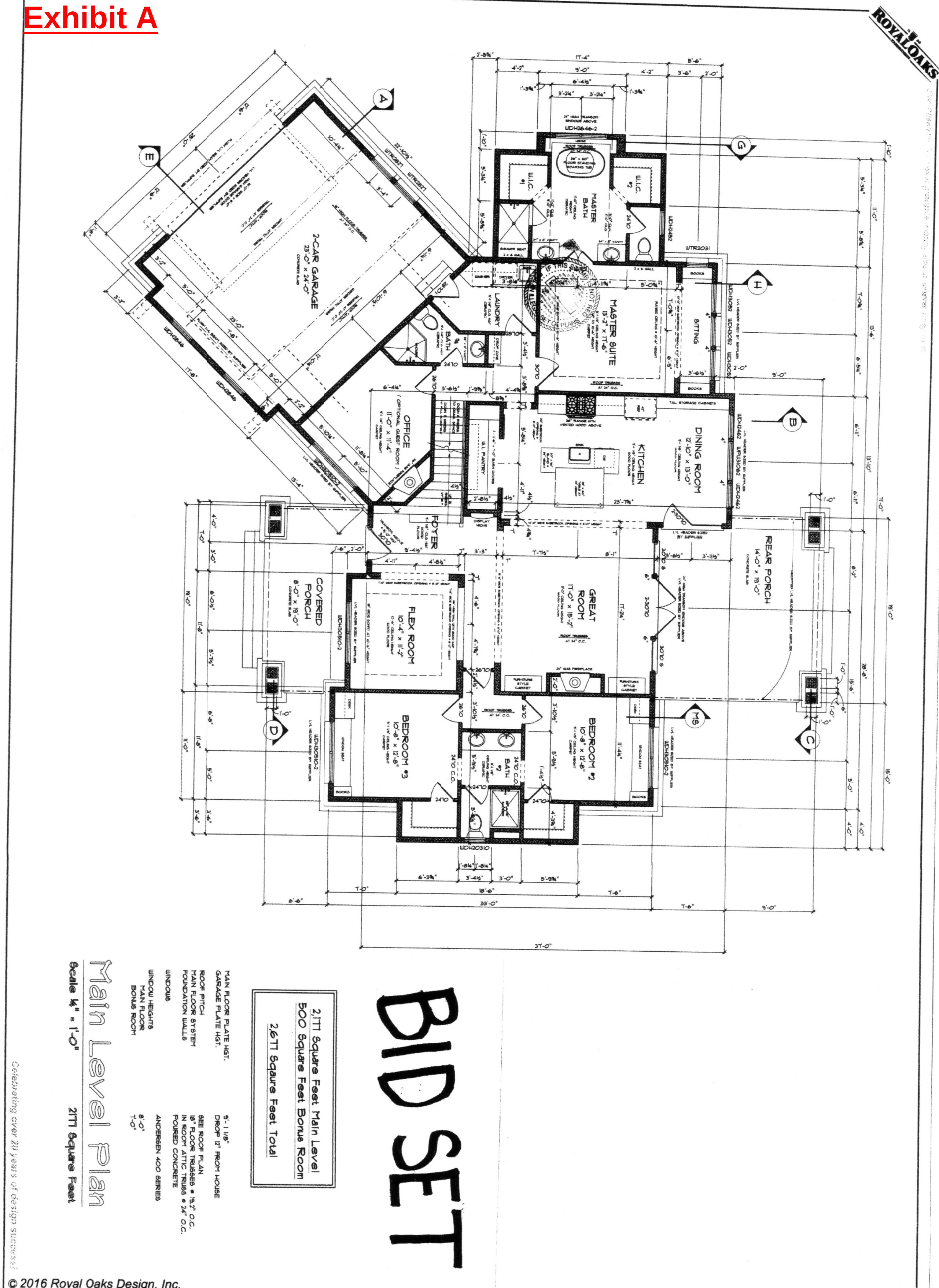
1988 ROYALOAKS DESIGN
EMAIL: www.RoyalOaksDesign.com
PHONE: 651-765-4751
kieran@royaloaksdesign.com

DATE:	4 - 11 - 16
DRAWN BY:	S. SCHOLLA
CHECKED BY:	KJL
REV BY:	DATE:

CL - 2139

PROJECT NO: CL-2139
SHEET NO: 1

Exhibit A



ROYAL OAKS DESIGN
EMAIL: www.RoyalOaksDesign.com
PHONE: 651-765-4751
kieran@royaloaksdesign.com

PROJECT NO. CL-2139
SHEET NO. 2

DATE: 4-11-16
DRAWN BY: S. SCHOLLA
CHECKED BY: K.L.
REV. BY: DATE:

CL - 2139

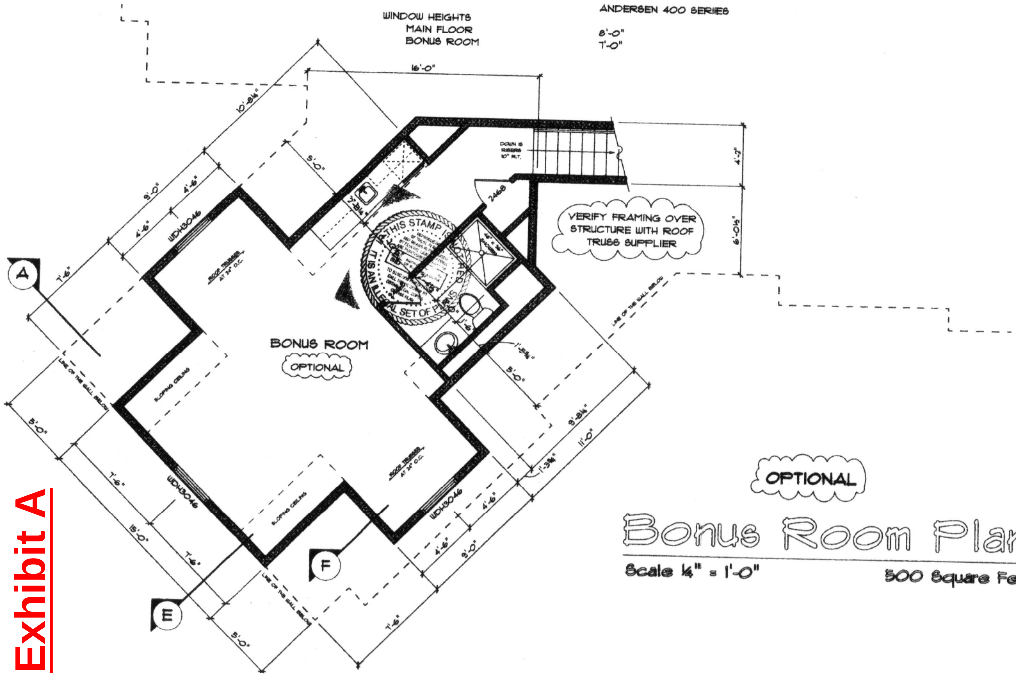
Exhibit A

BID SET

2,177 Square Feet Main Level
500 Square Feet Bonus Room

2,677 Square Feet Total

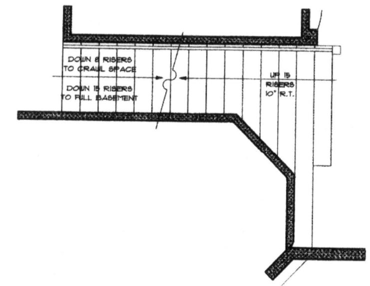
MAIN FLOOR PLATE HGT.	9'- 1 1/8"
GARAGE PLATE HGT.	DROP 12" FROM HOUSE
ROOF PITCH	SEE ROOF PLAN
MAIN FLOOR SYSTEM	18" FLOOR TRUSSES @ 19.2" O.C.
	IN ROOM ATTIC TRUSS @ 24" O.C.
FOUNDATION WALLS	POURED CONCRETE
WINDOWS	ANDERSEN 400 SERIES
WINDOW HEIGHTS	
MAIN FLOOR	8'-0"
BONUS ROOM	7'-0"

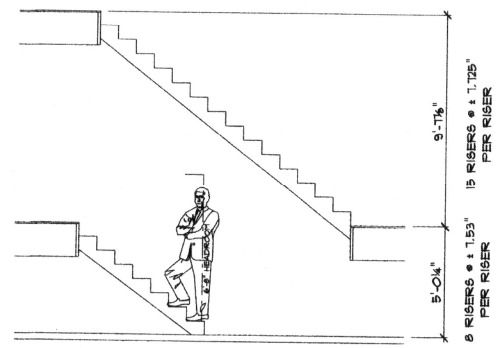


OPTIONAL

Bonus Room Plan

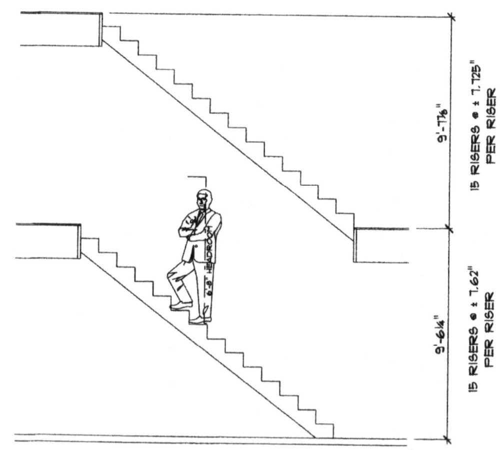
Scale ¼" = 1'-0" 500 Square Feet





2/3 STAIR SECTION: CRAWL SPACE

SCALE 3/8 = 1'-0"



2/3 STAIR SECTION: FULL BASEMENT

SCALE 3/8 = 1'-0"

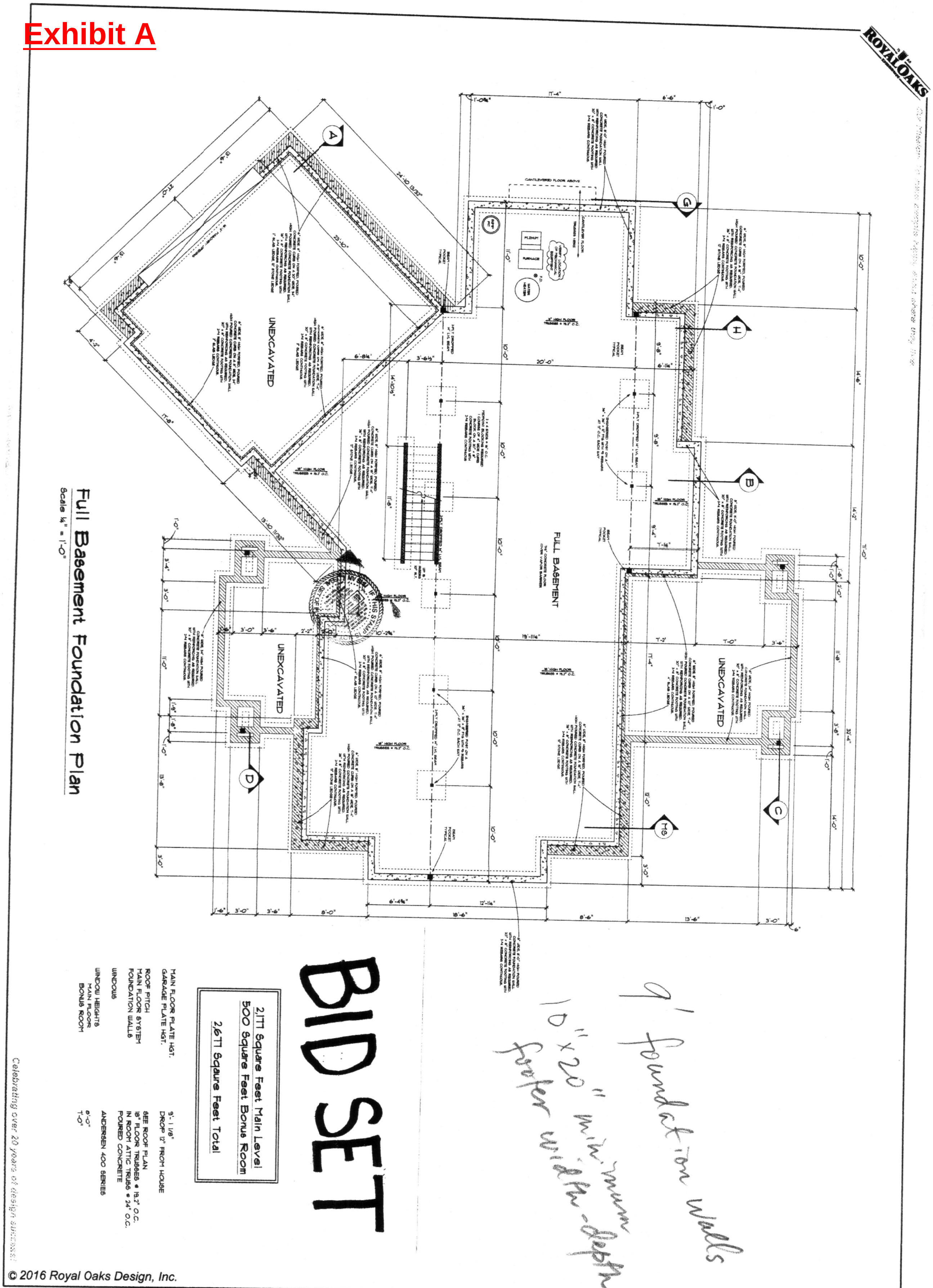
Celebrating over 20 years of design success!

CL - 2139

DATE: 4 - 11 - 16
DRAWN BY: S. SCHOLLA
CHECKED BY: KJL
REV BY: DATE:

1988 ROYAL OAKS DESIGN
EMAIL: www.RoyalOaksDesign.com
PHONE: 651-765-4751
kieran@royaloaksdesign.com

PROJECT NO. CL-2139
SHEET NO. 3



PROJECT NO.	SHEET NO.
CL-2139	4

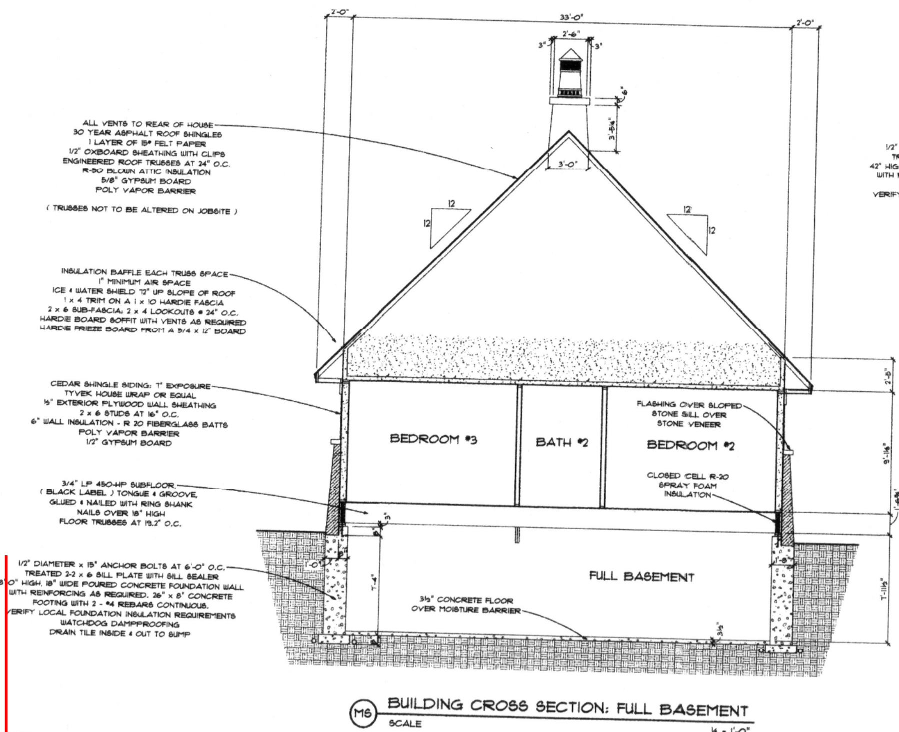
1988 ROYALOAKS DESIGN
EMAIL: www.RoyalOaksDesign.com
PHONE: 651-765-4751
kieran@royaloaksdesign.com

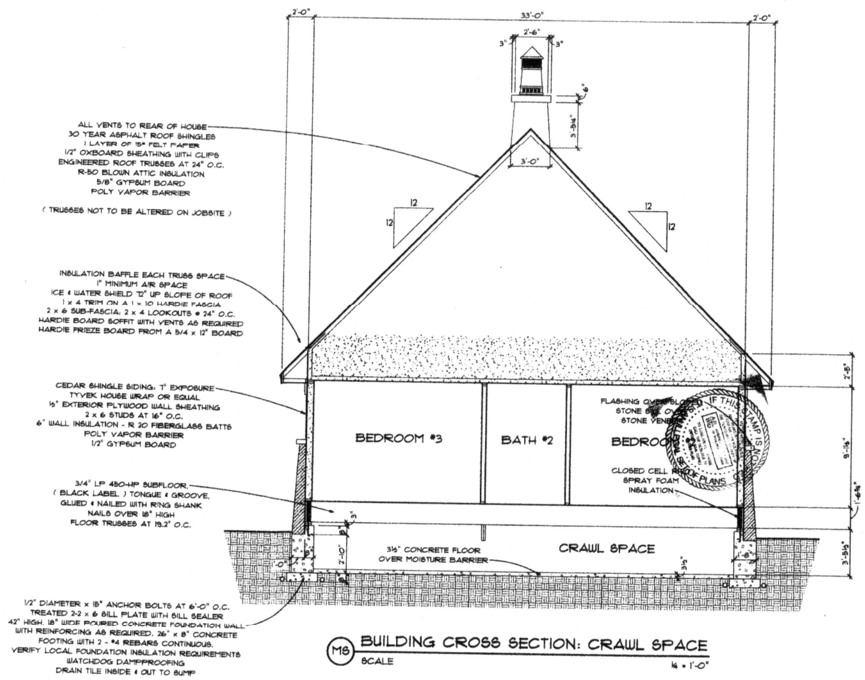
DATE:	4-11-16
DRAWN BY:	S. SCHOLLA
CHECKED BY:	K.L.
REV. BY:	DATE:

CL - 2139
Full Basement Plan

Exhibit A

Our Mission: To make people happy about where they live.





BID SET

Celebrating over 20 years of design success!

1988 ROYALOAKS DESIGN

EMAIL: www.RoyalOaksDesign.com
PHONE: 651-765-4751
kieran@royaloaksdesign.com

PROJECT NO: CL-2139

SHEET NO: 6

DATE: 4 - 11 - 16

DRAWN BY: S. SCHOLLA

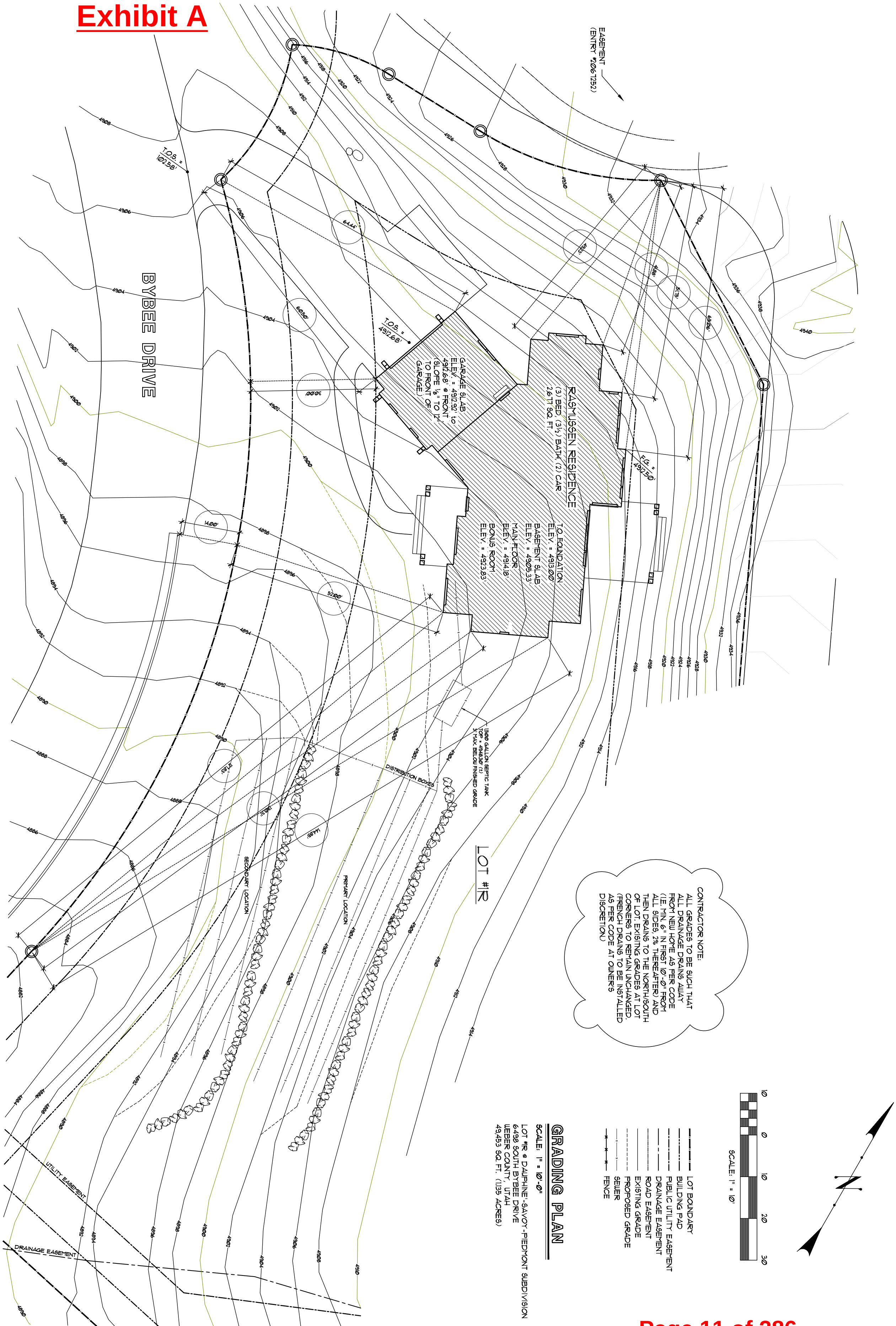
CHECKED BY: KJL

REV BY: DATE:

CL - 2139

MAIN BUILDING SECTIONS WITH NOTES

Exhibit A



SHEET NO.	NO. OF SHEETS:	DRAWN BY:	REVISIONS: date:	item:	RELEASE DATE:
GP	1 OF 1	JOE HUNTER	03/20/17	PERMIT SET	03/03/17

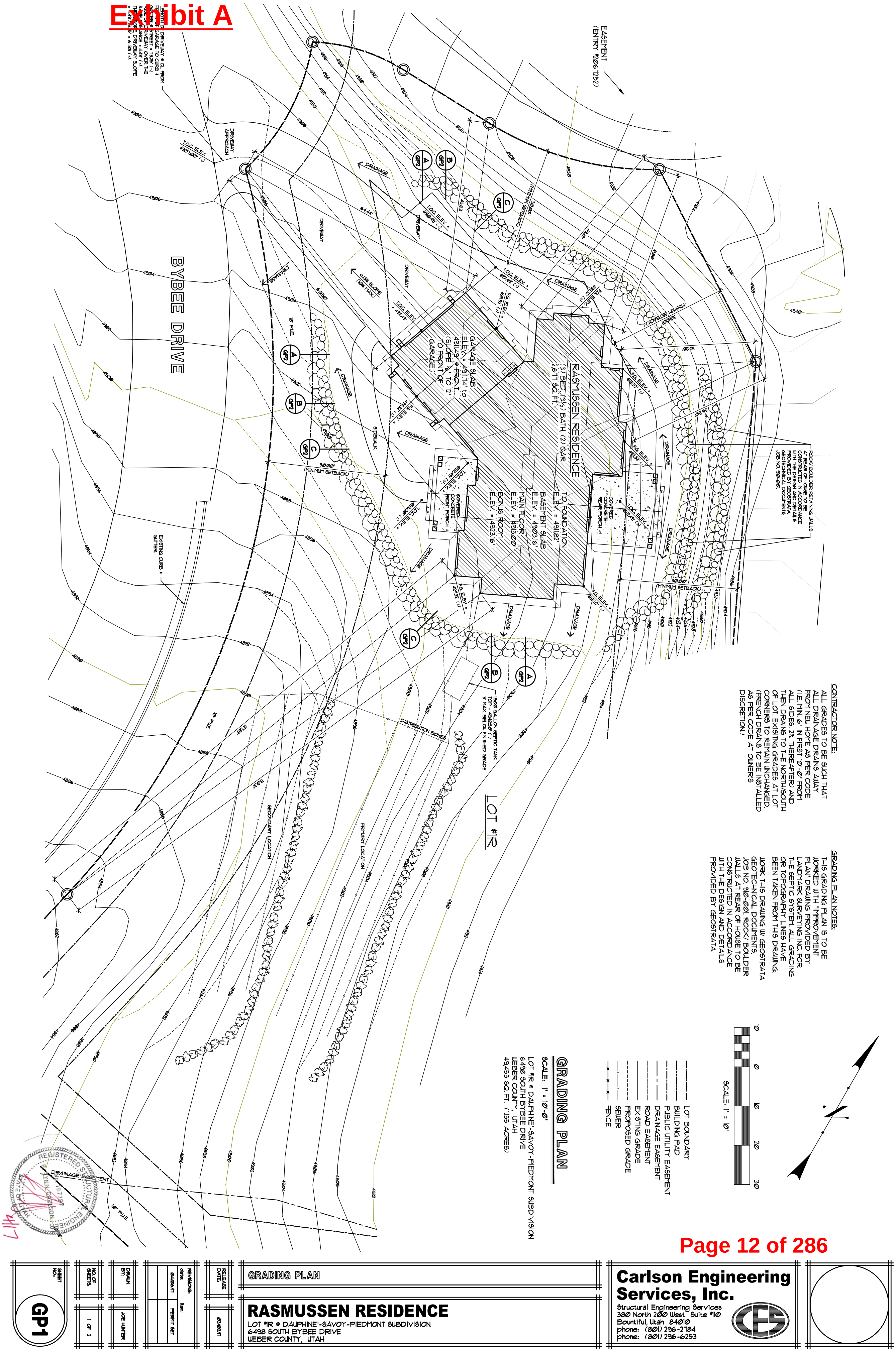
GRADING PLAN

RASMUSSEN RESIDENCE

LOT #1R @ DAUPHINE'-SAVOY-PIEDMONT SUBDIVISION
6498 SOUTH BYBEE DRIVE
WEBER COUNTY, UTAH

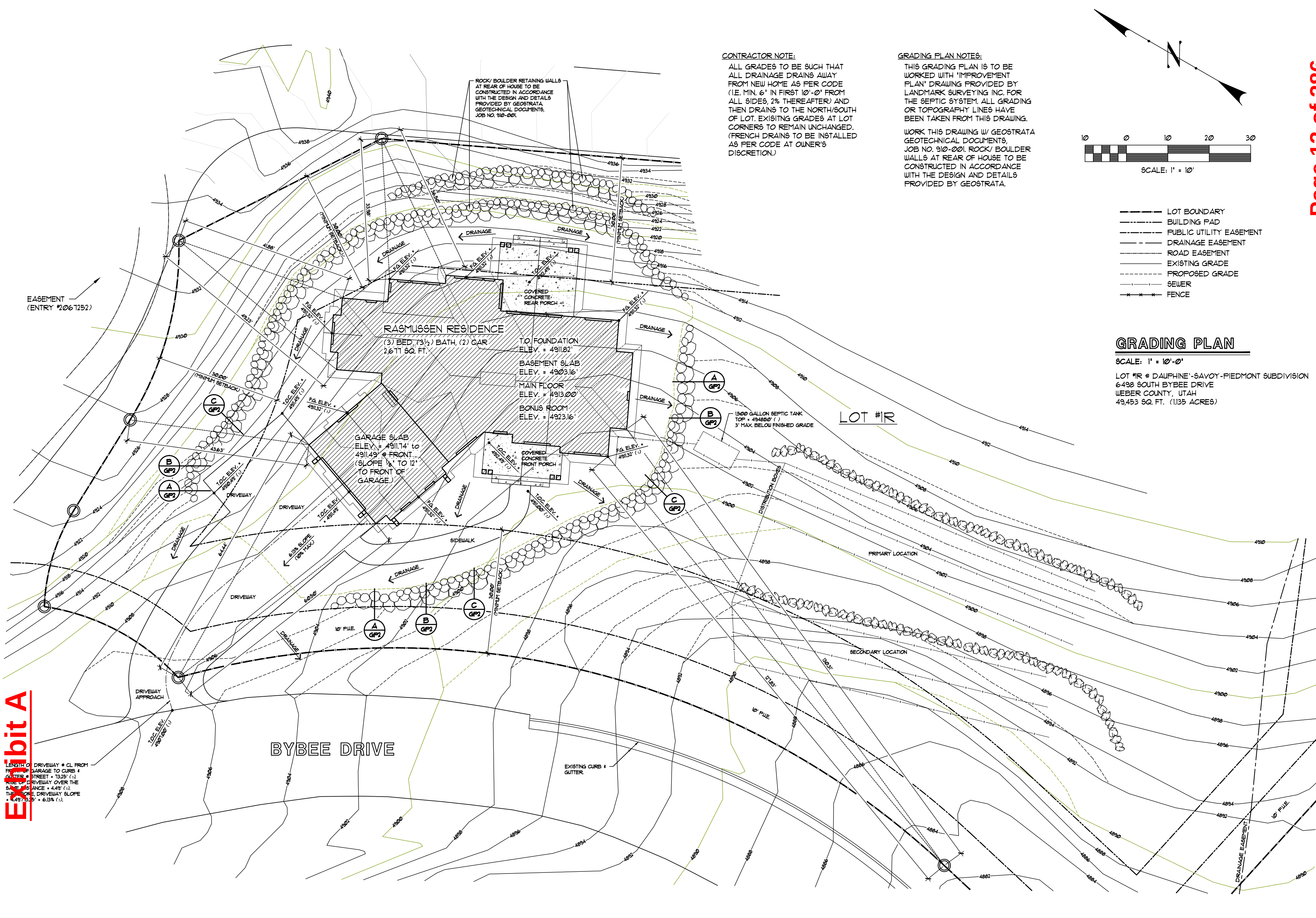
Carlson Engineering Services, Inc.
Structural Engineering Services
380 North 200 West Suite #110
Bountiful, Utah 84010
phone: (801) 296-2784
phone: (801) 296-6253

Exhibit A



BYBEE DRIVE
RASMUSSEN RESIDENCE
(3) BED (3½) BATH, (2) GAR.
2,611 SQ. FT.
GARAGE SLAB
MAIN FLOOR
BONUS ROOM
BASEMENT SLAB
COVERED CONCRETE FRONT PORCH
COVERED CONCRETE REAR PORCH
DRIVEWAY
SIDEWALK
DRAINAGE
(MINIMUM SETBACK)
LOT #1R
DISTRIBUTION BOXES
PRIMARY LOCATION
SECONDARY LOCATION
EXISTING CURB & GUTTER
DRIVEWAY APPROACH
EASEMENT (ENTRY #206 7252)
CONTRACTOR NOTE:
ALL GRADES TO BE SUCH THAT ALL DRAINAGE DRAINS AWAY FROM NEW HOME AS PER CODE (I.E. MIN. 6" IN FIRST 10'-0" FROM ALL SIDES, 2% THEREAFTER) AND THEN DRAINS TO THE NORTH/SOUTH OF LOT. EXISTING GRADES AT LOT CORNERS TO REMAIN UNCHANGED. (FRENCH DRAINS TO BE INSTALLED AS PER CODE AT OWNER'S DISCRETION)
GRADING PLAN NOTES:
THIS GRADING PLAN IS TO BE WORKED WITH "IMPROVEMENT PLAN" DRAWING PROVIDED BY LANDMARK SURVEYING INC. FOR THE SEPTIC SYSTEM. ALL GRADING OR TOPOGRAPHY LINES HAVE BEEN TAKEN FROM THIS DRAWING.
WORK THIS DRAWING W/ GEOSTRATA GEOTECHNICAL DOCUMENTS.
ROCK/BOULDER RETAINING WALLS AT REAR OF HOUSE TO BE CONSTRUCTED IN ACCORDANCE WITH THE DESIGN AND DETAILS PROVIDED BY GEOSTRATA.
SCALE: 1" = 10'
LOT BOUNDARY
BUILDING PAD
PUBLIC UTILITY EASEMENT
DRAINAGE EASEMENT
ROAD EASEMENT
EXISTING GRADE
PROPOSED GRADE
SEWER
FENCE
GRADING PLAN
SCALE: 1" = 10'-0"
LOT #1R @ DAUPHINE'-SAVOY-PIEDMONT SUBDIVISION
6498 SOUTH BYBEE DRIVE
WEBER COUNTY, UTAH
49,453 SQ. FT. (1.135 ACRES)
DRAINAGE EASEMENT
GRADING PLAN
RASMUSSEN RESIDENCE
LOT #1R @ DAUPHINE'-SAVOY-PIEDMONT SUBDIVISION
6498 SOUTH BYBEE DRIVE
WEBER COUNTY, UTAH
Carlson Engineering Services, Inc.
Structural Engineering Services
380 North 200 West Suite #110
Bountiful, Utah 84010
phone: (801) 296-2784
phone: (801) 296-6253
DRAWN BY: JOE HUNTER
NO. OF SHEETS: 1 OF 2
SHEET NO. GP1
PERMIT SET

Exhibit A



CONTRACTOR NOTE:

ALL GRADES TO BE SUCH THAT ALL DRAINAGE DRAINS AWAY FROM NEW HOME AS PER CODE (I.E. MIN. 6" IN FIRST 10'-0" FROM ALL SIDES, 2% THEREAFTER) AND THEN DRAINS TO THE NORTH/SOUTH OF LOT. EXISITNG GRADES AT LOT CORNERS TO REMAIN UNCHANGED. (FRENCH DRAINS TO BE INSTALLED AS PER CODE AT OWNER'S DISCRETION.)

GRADING PLAN NOTES:

THIS GRADING PLAN IS TO BE WORKED WITH "IMPROVEMENT PLAN" DRAWING PROVIDED BY LANDMARK SURVEYING INC. FOR THE SEPTIC SYSTEM. ALL GRADING OR TOPOGRAPHY LINES HAVE BEEN TAKEN FROM THIS DRAWING.

WORK THIS DRAWING W/ GEOSTRATA GEOTECHNICAL DOCUMENTS, JOB NO. 910-001. ROCK/ BOULDER WALLS AT REAR OF HOUSE TO BE CONSTRUCTED IN ACCORDANCE WITH THE DESIGN AND DETAILS PROVIDED BY GEOSTRATA.

GRADING PLAN

SCALE: 1" = 10'-0"

LOT #1R @ DAUPHINE'-SAVOY-PIEDMONT SUBDIVISION
6498 SOUTH BYBEE DRIVE
WEBER COUNTY, UTAH
49,453 SQ. FT. (1.135 ACRES)

Page 13 of 286

Carlson Engineering Services, Inc.
Structural Engineering Services
380 North 200 West Suite #110
Bountiful, Utah 84010
phone: (801) 296-2784
phone: (801) 296-6253

GRADING PLAN

RASMUSSEN RESIDENCE
LOT #1R @ DAUPHINE'-SAVOY-PIEDMONT SUBDIVISION
6498 SOUTH BYBEE DRIVE
WEBER COUNTY, UTAH

RELEASE DATE:	03/03/11
REVISIONS: date:	Item:
04/06/11	PERMIT SET
DRAWN BY:	JOE HUNTER
NO. OF SHEETS:	1 OF 2
SHEET NO.:	GP1

Exhibit A

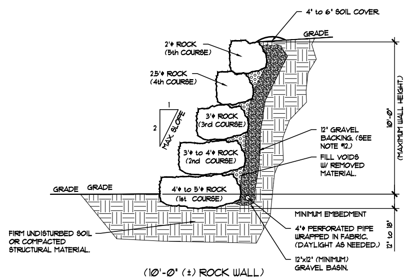
FRONT ELEVATION

SCALE: 1/4" = 1'-0"

RETAINING WALL NOTES:

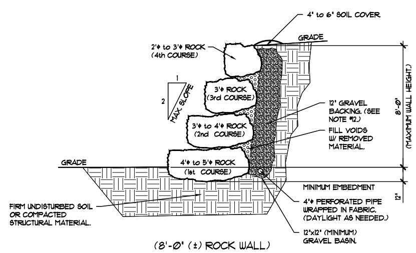
THESE ROCK/ BOULDER RETAINING WALL DETAILS ARE APPLICABLE FOR FRONT SIDE AND SIDE YARD LANDSCAPING RETAINING WALLS ONLY!

ALL REAR ROCK/ BOULDER RETAINING WALLS ARE TO BE CONSTRUCTED IN ACCORDANCE WITH THE DESIGN AND DETAILS PROVIDED BY GEOSTRATA GEOTECHNICAL DOCUMENTS, JOB NO. 910-001.



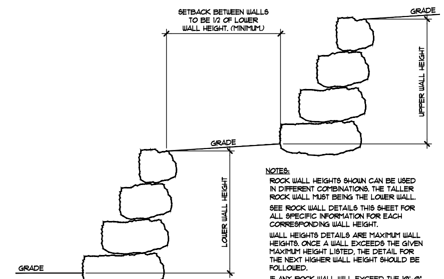
D/GP2 SECTION THRU ROCK WALL

SCALE: NONE



C/GP2 SECTION THRU ROCK WALL

SCALE: NONE



NOTES:

ROCK WALL HEIGHTS SHOWN CAN BE USED IN DIFFERENT COMBINATIONS. THE TALLER ROCK WALL MUST BEING THE LOWER WALL.

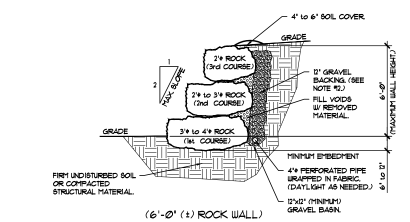
SEE ROCK WALL DETAILS THIS SHEET FOR ALL SPECIFIC INFORMATION FOR EACH CORRESPONDING WALL HEIGHT.

WALL HEIGHTS DETAILS ARE MAXIMUM WALL HEIGHTS. ONCE A WALL EXCEEDS THE GIVEN MAXIMUM HEIGHT LISTED, THE DETAIL FOR THE NEXT HIGHER WALL HEIGHT SHOULD BE FOLLOWED.

IF ANY ROCK WALL WILL EXCEED THE 10'-0" LISTED MAXIMUM HEIGHT, CONTACT ENGINEER FOR FURTHER DIRECTION AND/OR DESIGN.

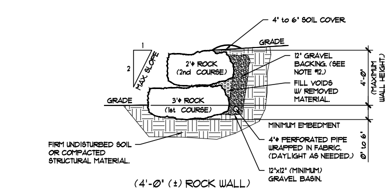
E/GP2 SECTION THRU TWO TIER ROCK WALL

SCALE: NONE



B/GP2 SECTION THRU ROCK WALL

SCALE: NONE



A/GP2 SECTION THRU ROCK WALL

SCALE: NONE

ROCK WALL NOTES:

1. SOIL SLOPES SHALL BE FREE DRAINING (SANDY GRAVELS) WITH MINIMAL AMOUNTS OF CLAY. FABRIC REQUIRED FOR ALL WALLS OVER 4'-0" EXCEPT FOR WELL GRADED GRAVEL WITH FINES.
2. ROCKS SHALL BE ANGULAR GRANITE OR DOLOMITE STONES OR SIMILAR HARDNESS, EACH ARE TO BE NON-SOLUBLE, HARD AND DURABLE.
3. ROCKS SHALL BE KEYED TOGETHER AND INTERLOCKED WITH LOWER ROCKS.
4. BASE ROCKS SHALL BE BURIED TO THE DEPTHS SHOWN.
5. EARTH SHALL BE THROUGHLY COMPACTED BEFORE PLACEMENT OF ROCKS.
6. THE BUILDING OFFICIAL SHALL REQUIRE A SOILS REPORT PREPARED BY A LICENCED GEOTECHNICAL ENGINEER WHERE WATER IS ENCOUNTERED OR WHERE FINE GRAINED (CLAY) SOILS EXIST. NO CLAY SOILS MAY BE PLACED WITHIN 24" BEHIND ROCK WALLS.
7. BASE ROCK DIAMETERS SHALL NOT BE LESS THAN 3'-6", EXCEPT FOR WALLS LESS THAN 4'-0" IN HEIGHT. UPPER ROCKS SHALL NOT BE LESS THAN 2'-0" DIAMETER.
8. STEPPED ROCK WALLS SHALL BE ENGINEERED AND ARE REQUIRED TO HAVE A SPECIAL INSPECTION BY CES.
9. ESTABLISHED VEGETATION IS REQUIRED ALONG THE TOP OF ALL WALLS TO PREVENT WASHING AND EROSION.
10. A MINIMUM SET BACK OF 1 1/2 TIMES THE WALL HEIGHT IS REQUIRED FROM ALL STRUCTURES. REQUIRED FROM ALL STRUCTURES.
11. ALL WORK SHALL COMPLY WITH CURRENT APPLICABLE CODES.
12. 12" OF GRAVEL BACKING NOT REQUIRED AS SHOWN IF NO WATER CONCERNS ARE PRESENT AND FREE DRAINING SOIL IS INSTALLED INSTEAD.

Carlson Engineering Services, Inc.
Structural Engineering Services
380 North 200 West Suite #10
Bountiful, Utah 84010
phone: (801) 296-2784
phone: (801) 296-6253

GRADING PLAN DETAILS

RASMUSSEN RESIDENCE
LOT #1R @ DAUPHINE'-SAVOY-PIEDMONT SUBDIVISION
6498 SOUTH BYBEE DRIVE
WEBER COUNTY, UTAH

RELEASE DATE:	03/03/11
REVISIONS: date:	item:
04/06/11	PERMIT SET
DRAWN BY:	JOE HUNTER
NO. OF SHEETS:	2 OF 2
SHEET NO.:	GP2

HOLDOWN SCHEDULE:

	MARK:	SIMPSON MODEL NO.:	MINIMUM REQUIRED ATTACHMENT:	COMMENTS:
SHEARWALL TO FOUNDATION HOLDOWNS	H1 *	LSTHD8/8RJ	(24) 16d SINKERS	MIN. DISTANCE FROM CENTER OF STRAP TO EDGE OF FOUNDATION IS 1 1/2" ON ALL CORNER INSTALLATIONS.
	H2 *	STHD10/ STHD10RJ	(28) 16d SINKERS	MIN. DISTANCE FROM CENTER OF STRAP TO EDGE OF FOUNDATION IS 2" ON ALL CORNER INSTALLATIONS.
	H3 *	STHD14/ STHD14RJ	(38) 16d SINKERS	MIN. DISTANCE FROM CENTER OF STRAP TO EDGE OF FOUNDATION IS 2" ON ALL CORNER INSTALLATIONS.
	H4	HTT5	(26) 16d COMMON NAILS	5/8"ϕ THREADED ROD EPOXY INSTALLED IN A PRE- DRILLED 3/4"ϕ HOLE AT 12" DEEP (MINIMUM) IN FOUNDATION WALL.
	H5	HDU11	(30) SIMPSON SDS 1/4" x 2 1/2" WOOD SCREWS	1"ϕ THREADED ROD EPOXY INSTALLED IN A PRE- DRILLED 1 1/8"ϕ HOLE AT 18" DEEP (MINIMUM) IN FOUNDATION WALL.
	H6	HDU14	(36) SIMPSON SDS 1/4" x 2 1/2" WOOD SCREWS	1"ϕ THREADED ROD EPOXY INSTALLED IN A PRE- DRILLED 1 1/8"ϕ HOLE AT 24" DEEP (MINIMUM) IN FOUNDATION WALL.
UPPER TO LOWER WALL TIE ANCHORS	H7	MST48	(34) 16d SINKERS	CENTER STRAP SO EQUAL LENGTHS ARE ON UPPER AND LOWER WALLS.
	H8	MST72	(48) 16d SINKERS	CENTER STRAP SO EQUAL LENGTHS ARE ON UPPER AND LOWER WALLS.
	H9	HDU8	(20) SIMPSON SDS 1/4" x 2 1/2" WOOD SCREWS	7/8"ϕ THREADED ROD BETWEEN FLOORS. INSTALL ON A 4x (MINIMUM) POST AT BOTH FLOORS.
OPT.	* ADVANCED SYSTEMS AHPAHD22L MAY BE SUBSTITUTED FOR SIMPSON MODEL AT MARKS H1, H2, & H3.			

NOTES:
1. ALL HOLDOWN TYPES SHOWN IN THIS SCHEDULE MAY NOT BE USED FOR THIS PLAN.
2. ALL FOUNDATION 'HOLDOWNS' AND BETWEEN LEVEL TIES SHALL BE ATTACHED TO A MINIMUM OF (2) 2x OR A 4x MEMBER.
3. USE STANDARD WASHERS WHEN BOLTING HOLDOWNS TO THE STUDS OPPOSITE THE HOLDOWN. HOLDOWNS MUST BE LOCATED ON THE STUDS TO PROVIDE A MINIMUM OF (7) BOLT DIAMETERS BETWEEN THE HOLE AND THE END OF THE STUDS.
4. FOUNDATION WALL CONCRETE STRENGTH SHALL BE 2,500 PSI (MINIMUM). INSTALL A MINIMUM OF (1) #4 HORIZONTAL REBAR IN SHEAR CONE ON ALL FOUNDATION HOLDOWNS.
5. 16d SINKERS MAY BE REPLACED W/ 10d COMMON NAILS W/ NO REDUCTIONS (16d SINKERS = 0.148"ϕ x 3 1/4" LONG, 10d COMMON = 0.148"ϕ x 3"). 'GUN NAILS' MAY NOT BE USED UNLESS SPECIFICALLY NOTED.
6. REFER TO ATTACHED CONCRETE SECTIONS AND DETAILS SHEET OR TO SIMPSON CATALOG C-2011 FOR APPLICABLE DETAILS AND ADDITIONAL INSTALLATION INSTRUCTIONS.
7. 'RJ' AFTER MODEL NUMBER INDICATES STHD's FOR RIM JOIST APPLICATIONS. USE 'RJ' MODELS AT ALL RIM JOIST APPLICATIONS.

SHEARWALL SCHEDULE:

WALL NO.:	PLYWOOD THICKNESS:	EDGE NAILING AND SPACING:	A.B. SPACING:	SOLE PLATE NAILING AND SPACING:	COMMENTS:
1	7/16" (ONE SIDE)	8d's @ 6" O.C.	32" O.C.	16d's @ 6" O.C.	
2	7/16" (ONE SIDE)	8d's @ 4" O.C.	32" O.C.	16d's @ 4" O.C.	
3	7/16" * (ONE SIDE)	8d's @ 4" O.C.	24" O.C.	16d's @ 4" O.C.	DOUBLE STUDS OR 3" NOMINAL MEMBERS AT ALL PANEL EDGES AND SEAMS.
4	7/16" * (ONE SIDE)	8d's @ 3" O.C.	18" O.C.	16d's @ 3" O.C.	
5	15/32" * (ONE SIDE)	10d's @ 3" O.C.	16" O.C.	16d's @ 2" O.C. (STAGGERED)	FRAMING AT ADJOINING PANEL EDGES SHALL BE 3" NOMINAL MEMBERS (MINIMUM) AND NAILS ARE TO BE STAGGERED.
6	15/32" * (ONE SIDE)	10d's @ 2" O.C.	12" O.C.	16d's @ 2" O.C. (STAGGERED)	

WALL NO.:	SHEETROCK THICKNESS:	COMMENTS:
S	5/8" (ONE SIDE)	UNBLOCKED, FASTEN W/ 5d COOLER NAILS @ 7" O.C. TO ALL STUDS, TOP & BOTTOM PLATES.

NOTES:
1. ALL SHEARWALL TYPES SHOWN IN THIS SCHEDULE MAY NOT BE USED FOR THIS PLAN.
2. SHEATHING SHALL BE APA RATED OSB. SHEATHING PANEL EDGES SHALL BE BLOCKED. (SHEATHING SHALL EXTEND TO FOUNDATION SILL PLATE. SHEATHING SEAMS ARE TO BE MADE IN WALL AREA, NOT AT WALL TO FLOOR INTERFACE.)
3. ANCHOR BOLTS SHALL BE A.S.T.M. A307, 5/8"ϕ x 10" LONG, WITH A MINIMUM EMBEDMENT OF 7" INTO CONCRETE FOUNDATION WALL. ANCHOR BOLT SPACING TO BE AS SHOWN ABOVE UNLESS OTHERWISE SHOWN ON FOUNDATION PLAN DRAWING.
4. DOUBLE STUDS TO BE NAILED TOGETHER W/ 16d NAILS @ 8" O.C., STAGGERED ONE FACE.
5. SILL PLATE NAILS MAY BE 16d SINKER NAILS OR 16d COMMON NAILS.
* 6. FRAMING AT ADJOINING PLYWOOD PANEL EDGES SHALL BE 3" NOMINAL OR WIDER.
7. MAXIMUM STUD SPACING TO BE @ 16" O.C.
8. PROVIDE NAILS @ 12" ON CENTER AT INTERMEDIATE SUPPORTS. NAILS TO BE SAME SIZE AS THOSE USE FOR EDGE NAILING.
9. ALL SHEATHING SHALL SPAN ACROSS MAIN FLOOR JOISTS AND NAIL INTO SILL PLATE OR ACROSS UPPER FLOOR JOISTS AND INTO MAIN FLOOR WALLS. BLOCK PANEL EDGES AT MAIN AND UPPER FLOOR WALLS.
10. 1 1/2" 16 GAGE (W/ 7/16" CROWN (MIN.)) STAPLES INSTALLED W/ CROWN PARALLEL TO LONG DIMENSION OF FRAMING MEMBERS MAY BE USED IN LIEU OF 8d NAILS FOR SHEARWALLS 1, 2, & 3. SPACE STAPLES @ 4" O.C. FOR 1, @ 3" O.C. FOR 2, & @ 2" O.C. FOR 3. STAPLES ARE NOT PERMISSIBLE FOR SHEARWALLS 4, 5, & 6.
11. ALL FLOOR SHEATHING SHALL BE CONTINUOUSLY GLUED AND NAILED TO FLOOR JOISTS.
12. PANEL PORTIONS ABOVE AND/OR BELOW OPENINGS IN SHEARWALLS SHOULD BE CONSTRUCTED AS SHEARWALL.

FOOTING SCHEDULE:

MARK:	WIDTH:	LENGTH:	THICKNESS:	CROSSWISE REINFORCEMENT: NO.:	SIZE:	LENGTH:	SPACE:	LENGTHWISE REINFORCEMENT: NO.:	SIZE:	LENGTH:	SPACE:	REMARKS:
F-1	1'-8"	CONT.	1'-0"	NONE	—	—	—	(2)	#4	CONT.	1'-2"	PERIMETER FTG.
F-2	1'-8"	CONT.	1'-0"	NONE	—	—	—	(2)	#4	CONT.	1'-2"	INTERIOR FTG.
F-3	2'-0"	CONT.	1'-0"	NONE	—	—	—	(3)	#4	CONT.	0'-10"	PERIMETER FTG.
F-4	4'-0"	CONT.	1'-0"	NONE	—	—	—	(6)	#4	CONT.	0'-8"	PERIMETER FTG.
F-5	2'-0"	2'-0"	1'-0"	(3)	#4	2'-0"	0'-8"	(3)	#4	2'-0"	0'-8"	SPOT FTG.
F-6	3'-6"	3'-6"	1'-0"	(5)	#4	3'-0"	0'-8"	(5)	#4	3'-0"	0'-8"	SPOT FTG.
F-7	4'-0"	4'-0"	1'-0"	(6)	#4	3'-6"	0'-8"	(6)	#4	3'-6"	0'-8"	SPOT FTG.
F-8	4'-6"	4'-6"	1'-0"	(7)	#4	4'-0"	0'-8"	(7)	#4	4'-0"	0'-8"	SPOT FTG.
F-9	5'-0"	5'-0"	1'-0"	(8)	#4	4'-6"	0'-8"	(8)	#4	4'-6"	0'-8"	SPOT FTG.
F-10	6'-0"	6'-0"	1'-0"	(12)	#4	5'-6"	0'-6"	(12)	#4	5'-6"	0'-6"	SPOT FTG.

NOTE:
ALL FOOTING TYPES SHOWN IN THIS SCHEDULE MAY NOT BE USED FOR THIS PLAN.

CONCRETE NOTES:

1. ALL PHASES OF WORK PERTAINING TO THE CONCRETE CONSTRUCTION SHALL CONFORM TO THE "BUILDING CODE REQUIREMENTS FOR REINFORCED CONCRETE" (ACI 318-LATEST APPROVED EDITION) WITH MODIFICATIONS AS NOTED IN THE DRAWINGS OR SPECIFICATIONS.
2. REINFORCED CONCRETE DESIGN IS BY THE "ULTIMATE STRENGTH DESIGN METHOD", A.C.I. 318 (LATEST EDITION).
3. SCHEDULE OF STRUCTURAL CONCRETE 28-DAY STRENGTHS AND TYPES:
7. LOCATION IN STRUCTURE / STRENGTH (PSI)
   - FOOTINGS 3,000 (MINIMUM)
   - SLABS ON GRADE 3,500 (MINIMUM)
   - FOUNDATION WALLS 3,000 (MINIMUM)
4. UNLESS OTHERWISE SHOWN, MAKE ALL CONCRETE SLABS ON EARTH A MINIMUM OF 4" THICK.
5. PROVIDE 2" x 4" x CONTINUOUS KEY IN ALL WALL FOOTINGS WHERE GROUND WATER IS PRESENT.
6. LARGE AREAS OF SLAB ON GRADE SHALL BE PLACED IN STRIPS DIVIDED BY CONTRACTION OR CONSTRUCTION JOINTS INTO SQUARES (ROUGHLY) WHOSE SIDES SHALL NOT EXCEED 25'-0" IN EITHER DIRECTION.
7. PLACE STEEL IN CENTER OF WALL AND DOWEL TO FOOTING OR TO STRUCTURE ABOVE AND BELOW WITH THE SAME DOWEL SIZE AND SPACING AS VERTICAL REINFORCEMENT. ALL DOWELS SHALL HAVE AT LEAST 30 DIAMETERS EMBEDMENT. PROVIDE CORNER BARS AT ALL INTERSECTING CORNERS. USE SAME SIZE BAR AND SPACING AS HORIZONTAL WALL REINFORCEMENT.
8. ADD (2) #5 BARS AROUND ALL OPENINGS AND EXTEND 24" BEYOND THE CORNER OF THE OPENINGS, FOR UP TO 6'-0" WIDE OPENINGS.
9. PLACE FOOTINGS AS TO PROVIDE 36" MINIMUM FROST PROTECTION.
10. PORTLAND CEMENT SHALL CONFORM TO A.S.T.M. C-150, TYPE "I/II" WHERE IN CONTACT WITH SOIL AND TYPE "II" ELSEWHERE.
11. AGGREGATE FOR HARDROCK CONCRETE SHALL CONFORM TO ALL REQUIREMENTS AND TESTS OF A.S.T.M. C-33 AND PROJECT SPECIFICATIONS. EXCEPTIONS MAY BE USED ONLY WITH PERMISSION OF THE STRUCTURAL ENGINEER.
12. CONCRETE MIXING OPERATIONS, ETC., SHALL CONFORM TO A.S.T.M. C-94.
13. PLACEMENT OF CONCRETE SHALL CONFORM TO ACI STANDARD 614 AND PROJECT SPECIFICATIONS.
14. CLEAR COVERAGE OF CONCRETE OVER OUTER REINFORCING BARS SHALL BE AS FOLLOWS:
   - CONCRETE POURED DIRECTLY AGAINST EARTH .... 3" CLEAR
   - FORMED CONCRETE WITH EARTH BACKFILL .... 2" CLEAR
15. ALL REINFORCEMENT BARS, ANCHOR BOLTS AND OTHER CONCRETE INSERTS SHALL BE WELL SECURED IN POSITION PRIOR TO POURING CONCRETE.
16. PROVIDE SLEEVES FOR PLUMBING AND ELECTRICAL OPENINGS IN CONCRETE BEFORE POURING. DO NOT CUT ANY REINFORCING WHICH MAY CONFLICT. CORING IN CONCRETE IS NOT PERMITTED EXCEPT AS SHOWN. NOTIFY STRUCTURAL ENGINEER IN ADVANCE OF CONDITIONS NOT SHOWN ON THE DRAWINGS.
17. CONDUIT OR PIPE SIZE (O.D.) SHALL NOT EXCEED 30% OF SLAB THICKNESS AND SHALL BE PLACED BETWEEN THE TOP AND BOTTOM REINFORCING, UNLESS SPECIFICALLY DETAILED OTHERWISE. CONCENTRATIONS OF CONDUITS OR PIPES SHALL BE AVOIDED EXCEPT WHERE DETAILED OPENINGS ARE PROVIDED.
18. MODULES OF ELASTICITY OF CONCRETE, WHEN TESTED IN ACCORDANCE WITH A.S.T.M. C469, SHALL BE AT LEAST THE VALUE GIVEN BY THE EQUATIONS IN SECTION 8.5.1 OF A.C.I. 318 FOR THE SPECIFIED 28-DAY STRENGTH.
19. SHRINKAGE OF CONCRETE, WHEN TESTED IN ACCORDANCE WITH A.S.T.M. C-157, SHALL NOT EXCEED 0.0004 INCHES PER INCH.

EQUIVALENT FASTENERS SCHEDULE:

TABLE OF EQUIVALENT FASTENERS FOR STAPLES, NAILS AND T-NAILS (USED FOR SHEARWALLS AND DIAPHRAGMS)

COMMON NAIL SPACING NOTED ON PLANS:		EQUIVALENT SPACING OF APPROVED FASTENERS: STAPLES:			NAILS AND T-NAILS:	
	GAUGE:	16	15	14	13	131
	PENETRATION (MIN.):	1"	1"	1"	1 1/4"	1 1/2"
8d @	3"	2"	2 1/2"	3"	2 1/2"	3"
	4"	2 1/2"	3 1/2"	4"	3 1/2"	4"
	6"	4"	5"	6"	5"	6"
	8"	5 1/2"	6 1/2"	8"	6 1/2"	8"
	10"	6 1/2"	8"	10"	8"	10"
	12"	8"	10"	12"	9 1/2"	12"
10d @	3"	1 1/2"	2"	2"	2"	2 1/2"
	4"	2"	2 1/2"	3"	2 1/2"	3 1/2"
	6"	3 1/2"	4"	5"	4"	5"
	8"	4 1/2"	5 1/2"	6 1/2"	5 1/2"	7"
	10"	5 1/2"	7"	8"	6 1/2"	8 1/2"
	12"	6 1/2"	8"	9 1/2"	8 1/2"	10"

NOTES:
PENETRATION IS THE DEPTH OF EMBEDMENT OF THE STAPLE OR NAIL INTO THE MAIN MEMBER REQUIRED TO ATTAIN ITS FULL CAPACITY (SHEAR VALUE) TO LATERAL LOADING.

SPECIAL INSPECTIONS:

1. SPECIAL INSPECTION IS REQUIRED ON ALL FIELD (OR SITE) WELDING. INSPECTOR TO VERIFY WELD PROCEDURE, ACTUAL WELDS AND THAT WELDING WAS PERFORMED WITH E70 ELECTRODES.
2. SPECIAL INSPECTION IS REQUIRED ON BOLTED CONNECTIONS WITH BOLTS SPECIFIED AS A325 OR A490. INSPECTOR TO VERIFY BOLT SIZE, MATERIAL TYPE AND INSTALLATION.
3. SPECIAL INSPECTION IS REQUIRED FOR ALL I.C.B.O. STUCCO SYSTEMS.
4. CONTRACTOR TO ENGAGE A CERTIFIED INSPECTION AGENCY FOR ALL SPECIAL INSPECTIONS.

OVERBUILD SCHEDULE:

SPAN:	FRAMING MEMBER SIZE AND SPACING:
0' TO 8'	2x8's @ 24" O.C.
8' TO 10'	2x10's @ 24" O.C.
10' TO 12'	2x12's @ 24" O.C.
12' TO 14'	2x12's @ 16" O.C.

NOTE:
FOR RIDGE AND HIP BEAMS USE (1) MEMBER ONE SIZE LARGER THAN MEMBER USED FOR RAFTERS. (I.E. FOR 2x8 RAFTER, USE A 2x10 FOR RIDGE AND HIP BEAMS)

PLYWOOD NOTES:

1. ALL PLYWOOD SHALL BE C-D EXTERIOR SHEATHING WITH EXTERIOR GLUE AND SHALL BEAR THE STAMP OF AN APPROVED TESTING AGENCY.
2. LAY UP FLOOR AND ROOF PLYWOOD WITH THE FACE GRAIN PERPENDICULAR TO SUPPORTS, USING A MINIMUM OF (5) PLY PLYWOOD. STAGGER JOINTS.
3. ALL NAILING TO BE DONE WITH COMMON NAILS.
4. ALL PLYWOOD SHALL BE OF THE SPAN/INDEX RATIO AND SHALL BE NAILED AS SHOWN ON THE PLANS.
5. AT ALL LOCATIONS ON DRAWINGS WHERE PLYWOOD IS INDICATED, CONTRACTOR MAY SUBSTITUTE ORIENTED STRAND BOARD AS AN ALTERNATE.
6. ORIENTED STRAND BOARD SHALL COMPLY WITH THE AMERICAN PLYWOOD ASSOCIATION STRUCTURAL USE PANELS QUALITY ASSURANCE POLICY AND ALL SHEETS SHALL BE MARKED WITH THE A.P.A. VALIDATION MARK.
7. ALL THICKNESSES AND NAILING OF ORIENTED STRAND BOARD SHALL BE AS SHOWN ON DRAWINGS FOR PLYWOOD. THE SPAN INDEX SHALL BE AS SHOWN FOR PLYWOOD.

WOOD TRUSS NOTES:

1. TRUSSES SHALL BE DESIGNED TO SUPPORT THE WEIGHT PLUS LIVE LOAD AND SUPERIMPOSED DEAD LOADS STATED IN THE GENERAL STRUCTURAL NOTES OR LOCATED ON THE PLANS.
2. BRIDGING SIZE AND LOADS STATED IN THE GENERAL STRUCTURAL NOTES OR LOCATED ON THE PLANS. BRIDGING SIZE AND SPACING BY TRUSS MANUFACTURER (UNLESS NOTED OTHERWISE).
3. CONTRACTOR SHALL SUBMIT SHOP DRAWINGS AND ERECTION DRAWINGS FOR REVIEW PRIOR TO MANUFACTURE. CALCULATIONS AND SHOP DRAWINGS SHALL SHOW ANY SPECIAL DETAILS REQUIRED AT BEARING POINTS.
4. ALL CONNECTIONS SHALL HAVE CURRENT I.C.B.O. APPROVAL.
5. ADDITIONAL TRUSSES SHALL BE SUPPLIED AS REQUIRED TO SUPPORT MECHANICAL EQUIPMENT.

FRAMING NOTES:

1. ALL BEARING HEADERS, JOISTS AND BEAMS SHALL BE Fb-850 PSI (DOUG FIR NO. 2 OR BETTER). ALL BEARING COLUMNS SHALL BE Fc-625 PSI (DOUG FIR NO. 2 OR BETTER). ALL BEARING STUDS & TRIMMERS SHALL BE Fc-405 PSI (DOUG FIR NO. 2 OR BETTER). FOR MAXIMUM HEIGHTS ALLOWED SEE STUD WALL HEIGHT SCHEDULE. GLU-LAMINATED MEMBERS SHALL HAVE A MINIMUM ALL ALLOWABLE BENDING STRESS OF 2,400 PSI (24F-V4). LAMINATED VENEER LUMBER SHALL HAVE A MINIMUM ALLOWABLE BENDING STRESS OF 2,800 PSI.
2. PROVIDE SOLID BLOCKING (MINIMUM 2x THICKNESS) AT FULL DEPTH OF JOISTS AT ENDS AND AT EACH SUPPORT OF JOISTS. PROVIDE SOLID BLOCKING AT BEARING ENDS OF TRUSSES.
3. LAMINATED BUILT-UP BEAMS OF 2x MEMBERS SHALL BE SPIKED TOGETHER WITH NOT LESS THAN (2) ROWS 16d NAILS @ 12" O.C., STAGGERED TOP AND BOTTOM. USE (2) 20d COMMON NAILS AT ALL SUPPORTS.
4. ALL STRUCTURAL SHEATHING SHALL BE A.P.A. RATED AND SHALL NOT EXCEED MAXIMUM SPAN RATING. ROOF SHEATHING SHALL BE 7/16" STRUC II WITH A SPAN RATING OF 32/16. ROOF SHEATHING SHALL BE FASTENED TO TRUSSES/ RAFTERS AND BLOCKING WITH 8d NAILS @ 6" O.C. AT BOUNDARY AND EDGES, AND W/ 8d NAILS @ 12" O.C. AT FIELD. FLOOR SHEATHING SHALL BE 3/4" STRUCT II T&G WITH A SPAN RATING OF 40/20. FLOOR SHEATHING SHALL BE FASTENED TO FLOOR JOISTS AND BLOCKING WITH 8d NAILS @ 6" O.C. AT BOUNDARY AND EDGES, AND W/ 8d NAILS @ 12" AT FIELD.
5. TRUSSES TO BE DESIGNED AND ENGINEERED BY MANUFACTURER AND GUARANTEED TO WITHSTAND LOADS AS SHOWN IN DESIGN BASIS TABLE BELOW. TRUSS MANUFACTURER TO DESIGN TRUSSES FOR ALL APPLICABLE SNOW LOADING CONDITIONS AS PER 2006 EDITION OF THE INTERNATIONAL BUILDING CODE.
6. PROVIDE FIRE BLOCKING IN ANY STUD CAVITIES GREATER THAN 10'-0".
7. PROVIDE SIMPSON H2.5 ANCHORS @ 24" O.C. ON BEARING ENDS OF ALL TRUSSES & RAFTERS.
8. PROVIDE JOIST HANGERS WHERE SHOWN OR WHERE APPLICABLE.
9. PROVIDE TRIMMERS/ STUDS UNDER BEARING ENDS OF GIRDER TRUSSES AND BEAMS EQUIVALENT TO THE WIDTH OF THE MEMBER SUPPORTED.
10. PROVIDE GABLE END TRUSSES AS REQUIRED.
11. PROVIDE CROSS BRIDGING IN SPANS GREATER THAN 8'-0".
12. FRAMING TO INCLUDE ALL FURR DOWNS, PLANT SHELVES AND CEILING RAFTERS AS PER PLAN.
13. ALL HEADERS TO BE (2) 2x8's MINIMUM (UNLESS NOTED OTHERWISE).
14. ALL NON-BEARING INTERIOR FRAMING @ 16" O.C.
15. ALL WOOD BEAMS AND HEADERS SHALL BEAR ON MINIMUM OF (1) TRIMMER STUD AT EACH END (UNLESS SHOWN OTHERWISE).
16. PROVIDE SOLID BLOCKING IN FLOORS TO TRANSFER COLUMN POINT LOADS THROUGH FLOOR. USE 1¾" x 9½", 11⅞" AND 14" L.V.L.'s TO MATCH FLOOR SYSTEM.
17. HOT TUBS OR OTHER OWNER INSTALLED ITEMS THAT IMPOSE HEAVY LOADS ON STRUCTURAL MEMBERS WILL REQUIRE ADDITIONAL ENGINEERING IF NOT SHOWN ON ORIGINAL PLANS USED FOR DESIGN. STRUCTURAL MEMBERS MAY NEED TO BE INCREASED FOR THE ADDITIONAL IMPOSED LOADING.

DESIGN BASIS TABLE:
- GOVERNING BUILDING CODE .... 2015 I.B.C./ I.R.C.
- SEISMIC DESIGN AS PER SECTION .... 1613.5.2 (ASCE7) CATEGORY B
- WIND DESIGN (BASIC WIND SPEED) .... 115 M.P.H., EXPOSURE C
- DESIGN SOIL BEARING PRESSURE .... 1500 PSF
- ROOF LIVE LOAD .... 60 PSF
  DEAD LOAD .... 17 PSF
- FLOOR LIVE LOAD .... 40 PSF
  DEAD LOAD .... 15 PSF
- EXTERIOR BALCONY/ DECK LIVE LOAD .... 60 PSF
  DEAD LOAD .... 15 PSF

BEARING WALL HEIGHT SCHEDULE:

STUD SIZE AND SPACING:	LUMBER TYPE:	TRUSSES OR RAFTERS PERPENDICULAR TO WALL:	TRUSSES OR RAFTERS PARALLEL TO WALL:
2x4's @ 16" O.C.	DOUGLAS FIR	10'-0" MAXIMUM STUD HEIGHT	12'-0" MAXIMUM STUD HEIGHT
2x4's @ 12" O.C.	DOUGLAS FIR	12'-0" MAXIMUM STUD HEIGHT	14'-0" MAXIMUM STUD HEIGHT
2x6's @ 16" O.C.	DOUGLAS FIR	14'-0" MAXIMUM STUD HEIGHT	18'-0" MAXIMUM STUD HEIGHT
2x6's @ 12" O.C.	DOUGLAS FIR	16'-0" MAXIMUM STUD HEIGHT	20'-0" MAXIMUM STUD HEIGHT
1¾x5½ @ 16" O.C.	L.V.L. STUDS	18'-6" MAXIMUM STUD HEIGHT	22'-0" MAXIMUM STUD HEIGHT
1¾x5½ @ 12" O.C.	L.V.L. STUDS	21'-6" MAXIMUM STUD HEIGHT	24'-0" MAXIMUM STUD HEIGHT

NOTES:
1. DOUGLAS FIR LUMBER MUST BE NO. 2 OR BETTER. (E = 1,600,000 PSI)
2. LAMINATED VENEER LUMBER (L.V.L.) SHALL HAVE A MINIMUM ALLOWABLE BENDING STRESS OF 2,800 PSI.
3. 17'-0" MAXIMUM TRUSS OR RAFTER BEARING LOAD.
4. SCHEDULE REFLECTS UN-BRACED WALL HEIGHTS.
5. FULL HEIGHT STUD WALLS WHICH ARE BRACED LATERALLY (TRUSSES OR RAFTERS) MAY HAVE REDUCED WALL HEIGHTS TO THE POINT AT WHICH THE FIRST LATERAL BRACE OCCURS. SPECIAL STUD SPACING CONDITIONS WILL BE NOTED ON THE FLOOR PLANS AND SECTIONS AS DESIGNATED BY THE STRUCTURAL ENGINEER.

DISCLAIMERS:

1. VISITS TO THE JOB SITE BY REPRESENTATIVES OF THE ENGINEER DO NOT CONSTITUTE APPROVAL OF THE WORK PERFORMED BY THE CONTRACTOR OR HIS SUBCONTRACTORS AND ARE MERELY FOR THE PURPOSE OF OBSERVING THE WORK BEING PERFORMED.
2. CONTRACTORS SHALL NOTIFY ENGINEER OF ANY DISCREPANCIES, OMISSIONS OR CONFLICTS BETWEEN THE VARIOUS ELEMENTS OF THE WORKING DRAWINGS AND/OR SPECIFICATIONS BEFORE PROCEEDING WITH ANY WORK INVOLVED. IN ALL CASES, UNLESS OTHERWISE DIRECTED, THE MOST STRINGENT REQUIREMENTS SHALL GOVERN AND BE PERFORMED.
3. CONTRACTOR SHALL VERIFY ALL CONDITIONS, DIMENSIONS AND ELEVATIONS, ETC. AT THE SITE AND SHALL COORDINATE WORK PERFORMED BY ALL TRADES. DO NOT SCALE OFF ANY DRAWINGS.
4. TEMPORARY BRACING SHALL BE PROVIDED WHEREVER NECESSARY TO TAKE CARE OF ALL THE LOADS TO WHICH THE STRUCTURE MAY BE SUBJECTED, INCLUDING WIND. SUCH BRACING SHALL BE LEFT IN PLACE AS MAY BE REQUIRED FOR SAFETY, OR UNTIL ALL THE STRUCTURAL ELEMENTS ARE COMPLETE.
5. CONTRACTOR AND ALL SUBCONTRACTORS SHALL PERFORM THEIR TRADES AND DUTIES IN A MANNER CONFORMING TO THE PROCEDURES AND REQUIREMENTS AS STATED IN THE 2015 INTERNATIONAL BUILDING CODE/ INTERNATIONAL RESIDENTIAL CODE, (OR LATEST ACCEPTED CODE ADOPTED BY THE LOCAL BUILDING OFFICIALS).
6. ANY SPECIAL INSPECTIONS REQUIRED BY THE BUILDING OFFICIAL OR THE INTERNATIONAL BUILDING CODE/ INTERNATIONAL RESIDENTIAL CODE ARE THE RESPONSIBILITY OF THE OWNER OR CONTRACTOR.
7. DESIGN OF MASONRY FIREPLACES SHALL BE THE RESPONSIBILITY OF THE CONTRACTOR. DESIGN OF REINFORCING AND ANCHORAGE SHALL CONFORM TO THE PROCEDURES AND REQUIREMENTS AS STATED IN THE 2015 INTERNATIONAL BUILDING CODE/ INTERNATIONAL RESIDENTIAL CODE, (OR LATEST ACCEPTED CODE ADOPTED BY THE LOCAL BUILDING OFFICIALS).

GENERAL NOTES & REQUIREMENTS:

1. THE CONTRACTOR SHALL VERIFY ALL DIMENSIONS PRIOR TO STARTING CONSTRUCTION. THE ARCHITECT/ DESIGNER SHALL BE NOTIFIED OF ANY DISCREPANCIES OR INCONSISTENCIES.
2. DIMENSIONS SHOWN SHALL ALWAYS TAKE PRECEDENCE OVER SCALE SHOWN ON DRAWINGS.
3. NOTES AND DETAILS ON DRAWINGS SHALL TAKE PRECEDENCE OVER GENERAL NOTES AND TYPICAL DETAILS.
4. ALL WORK SHALL CONFORM TO THE MINIMUM STANDARDS OF THE FOLLOWING CODES:
   - THE 2015 EDITION OF THE INTERNATIONAL BUILDING CODE/ INTERNATIONAL RESIDENTIAL CODE, AND ANY OTHER REGULATING AGENCIES WHICH HAVE AUTHORITY OVER ANY PORTION OF THE WORK, AND THOSE CODES AND STANDARDS LISTED IN THE NOTES AND SPECIFICATIONS.
5. SEE ARCHITECTURAL DRAWINGS FOR THE FOLLOWING:
   - SIZE AND LOCATION OF ALL DOOR AND WINDOW OPENINGS (EXCEPT AS NOTED).
   - SIZE AND LOCATION OF ALL INTERIOR AND EXTERIOR NONBEARING PARTITIONS.
   - SIZE AND LOCATION OF ALL CONCRETE CURBS, FLOOR DRAINS, SLOPES, DEPRESSED AREAS, CHANGES IN LEVEL, CHAMFER, GROOVES, INSERTS, ETC.
   - SIZE AND LOCATION OF ALL FLOOR AND ROOF OPENINGS (EXCEPT AS SHOWN).
   - FLOOR AND ROOF FINISHES.
   - STAIR FRAMING AND DETAILS (EXCEPT AS SHOWN).
   - DIMENSIONS NOT SHOWN ON THE STRUCTURAL DRAWINGS.
6. SEE MECHANICAL, PLUMBING AND ELECTRICAL DRAWINGS FOR THE FOLLOWING:
   - PIPE RUNS, SLEEVES, HANGERS, TRENCHES, WALL AND SLAB OPENINGS, ETC. (EXCEPT AS SHOWN OR NOTED).
   - ELECTRICAL CONDUIT RUNS, BOXES, OUTLETS IN WALLS AND SLABS.
   - CONCRETE INSERTS FOR ELECTRICAL, MECHANICAL OR PLUMBING FIXTURES.
   - SIZE AND LOCATION OF MACHINE OR EQUIPMENT BASES, ANCHOR BOLTS FOR MOUNTS.
7. THE CONTRACT STRUCTURAL DRAWINGS AND SPECIFICATIONS REPRESENT THE FINISHED STRUCTURE. THEY DO NOT INDICATE THE METHOD OF CONSTRUCTION. THE CONTRACTORS SHALL PROVIDE ALL MEASURES NECESSARY TO PROTECT THE STRUCTURE DURING CONSTRUCTION. SUCH MEASURES SHALL INCLUDE, BUT NOT BE LIMITED TO, BRACING, SHORING FOR LOADS DUE TO CONSTRUCTION EQUIPMENT, ETC.. OBSERVATION VISITS TO THE SITE BY THE STRUCTURAL ENGINEER SHALL NOT INCLUDE INSPECTION OF THE ABOVE ITEMS.
8. OPENINGS, POCKETS, ETC., LARGER THAN 6 INCHES SHALL NOT BE PLACED IN SLABS, DECKS, BEAMS, JOISTS, COLUMNS, WALLS, ETC., UNLESS SPECIFICALLY DETAILED ON THE STRUCTURAL DRAWINGS. NOTIFY THE STRUCTURAL ENGINEER WHEN DRAWINGS BY OTHERS SHOW OPENINGS, POCKETS, ETC., NOT SHOWN ON THE STRUCTURAL DRAWINGS, BUT WHICH ARE LOCATED IN STRUCTURAL MEMBERS.
9. ASTM SPECIFICATIONS NOTED SHALL BE THE LATEST EDITION.
10. CONTRACTOR SHALL INVESTIGATE SITE DURING CLEARING AND EARTHWORK OPERATIONS FOR FILLED EXCAVATIONS OR BURIED STRUCTURES SUCH AS CESSPOOLS, CISTERNS, FOUNDATIONS, ETC. IF ANY SUCH STRUCTURES ARE FOUND, THE STRUCTURAL ENGINEER SHALL BE NOTIFIED IMMEDIATELY.
11. CONSTRUCTION MATERIALS SHALL BE SPREAD OUT IF PLACED ON FLOORS OR ROOF. LOAD SHALL NOT EXCEED THE DESIGN LIVE LOAD PER SQUARE FOOT. PROVIDE ADEQUATE SHORING AND/ OR BRACING WHERE STRUCTURE HAS NOT ATTAINED DESIGN STRENGTH.

EXCAVATION & SOIL NOTES:

1. FOOTING DESIGN IS BASED ON AN MINIMUM ALLOWABLE SOIL BEARING PRESSURE OF 2,500 PSF (REF: GEOSTRATA GEOTECHNICAL DOCUMENTS, JOB NO. 910-001). ALL FOOTING EXCAVATIONS SHOULD BE OBSERVED BY THE GEOTECHNICAL ENGINEER PRIOR TO ANY FOOTING PLACEMENT.
2. CONTRACTOR TO CONTRACT WITH GEOSTRATA ON ASSESSING EXCAVATIONS AND SOIL CONDITIONS IN ORDER TO EVALUATE THEIR COMPATIBILITY WITH THE SOIL REPORTS RECOMMENDATIONS.
3. ANY PLACEMENT OF STRUCTURAL FILL AND/OR COMPACTION TO BE PERFORMED PER THE GEOTECHNICAL REPORT SECTION 6.2.4.

REINFORCING STEEL NOTES:

1. ALL STEEL REINFORCING BARS SHALL CONFORM TO THE REQUIREMENTS OF A.S.T.M. A615-68 GRADE 60, WITH A MINIMUM YIELD STRENGTH OF 60,000 PSI.
2. ALL REINFORCING BAR BENDS SHALL BE MADE COLD.
3. ALL REINFORCING BARS SHALL BE DETAILED, BOLSTERED AND SUPPORTED IN ACCORDANCE WITH A.C.I. 315.
4. ALL REINFORCEMENT BARS SHALL BE SECURELY ANCHORED TO THE FOUNDATION WALL FORMS AND SPACED FROM THEM AS FOLLOWS:
   - FOR CONCRETE NOT EXPOSED DIRECTLY TO THE GROUND OR WEATHER, 3/4" IN WALLS AND SLABS.
   - FOR CONCRETE EXPOSED TO THE GROUND OR WEATHER, 2" IN WALLS, 3" ABOVE BOTTOM OF FOOTINGS.
5. ALL REINFORCING BARS SHALL BE MARKED SO THEIR IDENTIFICATION CAN BE MADE WHEN THE FINAL IN-PLACE INSPECTION IS MADE.
6. ALL REINFORCING BAR SPLICES SHALL BE MADE IN A REGION OF COMPRESSION (UNLESS SHOWN OTHERWISE). ALL SPLICES IN CONTINUOUS REINFORCING BARS SHALL BE:
   - 36 BAR DIAMETERS IN CONCRETE ('CLASS 'C')
   - 52 BAR DIAMETERS IN C.M.U. WALLS (UNLESS NOTED OTHERWISE).
7. MINIMUM LAP OF WELDED WIRE FABRIC SHALL BE 6" OR ONE FULL MESH AND ONE HALF, WHICH EVER IS GREATER.
8. DOWELS BETWEEN FOOTINGS AND WALLS OR COLUMNS SHALL BE THE SAME GRADE, SIZE, AND SPACING OR NUMBER AS THE VERTICAL REINFORCING, RESPECTIVELY.

STRUCTURAL STEEL NOTES:

1. ALL PHASES OF WORK PERTAINING TO STRUCTURAL STEEL CONSTRUCTION SHALL CONFORM TO THE BUILDING CODE REQUIREMENTS FOR STRUCTURAL STEEL (LATEST EDITION OF THE INTERNATIONAL BUILDING CODE AND THE MANUAL OF STEEL CONSTRUCTION).
2. ALL STRUCTURAL STEEL SHALL BE A.S.T.M. A992 (F_y = 50,000 PSI).
3. ALL STRUCTURAL STEEL PIPE COLUMNS SHALL BE ASTM A53, GRADE B.
4. ALL ANCHOR BOLTS SHALL BE A307 (UNLESS NOTED OTHERWISE).
5. ALL BOLTS FOR STRUCTURAL STEEL CONNECTIONS SHALL BE ASTM A325 (UNLESS NOTED OTHERWISE).
6. ALL WELDING SHALL BE PERFORMED BY WELDERS HOLDING VALID CERTIFICATES AND HAVING CURRENT EXPERIENCE IN THE TYPE OF WELDING SHOWN ON THE DRAWINGS OR NOTES.
7. ALL WELDING SHALL BE DONE USING E70XX SERIES ELECTRODES (LOW HYDROGEN RODS) AND SHALL BE IN ACCORDANCE WITH THE LATEST EDITION OF "THE AMERICAN WELDING SOCIETY" STANDARDS.

GLUE LAMINATED MEMBER NOTES:

1. GLUE-LAMINATED BEAMS SHALL BE 24F-V8 AND HAVE THE FOLLOWING MINIMUM PROPERTIES:
   F_b = 2400 PSI F_v = 165 PSI F_c (PERPENDICULAR) = 450 PSI E = 1,800,000 PSI
2. ALL BEAMS SHALL BE FABRICATED USING WATERPROOF GLUE.
3. FABRICATION AND HANDLING PER LATEST A.I.T.C. STANDARDS.
4. BEAMS TO BEAR GRADE STAMP, A.I.T.C. STAMP AND CERTIFICATE.
5. MOISTURE CONTENT SHALL BE LIMITED TO 12% OR LESS.
6. ALL GLUE LAMINATED TIMBER MEMBERS SHALL HAVE A MINIMUM BENDING STRESS OF 2,400 PSI.

LUMBER NOTES:

1. FRAMING LUMBER SHALL BE DOUGLAS FIR-LARCH (NORTH) NO. 2 GRADE FOR 4x LUMBER, NO. 1 GRADE FOR 6x LUMBER AND STUD GRADE FOR 2x LUMBER (UNLESS NOTED OTHERWISE).
2. BOLT HOLES SHALL BE 1/16" MAXIMUM LARGER THAN THE BOLT SIZE. RETIGHTEN ALL NUTS PRIOR TO CLOSING IN.
3. STANDARD CUT WASHERS SHALL BE USED UNDER BOLT HEADS AND NUTS AGAINST WOOD.
4. ALL SILLS OR PLATES RESTING ON CONCRETE OR MASONRY SHALL BE PRESSURE TREATED DOUGLAS FIR. ANCHOR BOLTS SHALL BE PLACED 9" FROM THE END OF A PLATE, OR FROM A NOTCH GREATER THAN 1/2 THE WIDTH OF A PLATE, AND PLACED AT INTERVALS NOTED.
5. DO NOT NOTCH JOISTS, RAFTERS, OR BEAMS, EXCEPT WHERE SHOWN IN DETAILS. OBTAIN ENGINEERS APPROVAL FOR ANY HOLES OR NOTCHES NOT DETAILED. HOLES THRU SILLS, PLATES, STUDS, AND DOUBLE PLATES IN INTERIOR BEARING AND SHEAR WALLS SHALL NOT EXCEED 1/3 THE PLATE WIDTH. USE BORED HOLES LOCATED IN THE CENTER OF THE STUD OR PLATE.
6. APPROVED CROSS-BRIDGING OR SOLID BLOCKING SHALL BE SPACED AS FOLLOWS:
   - FOR RAFTERS MORE THAN 8 IN. IN DEPTH, AT 10 FT. O.C. MAXIMUM.
   - FOR FLOOR JOIST MORE THAN 4 IN. IN DEPTH, AT 8 FT. O.C. MAXIMUM.
7. NAILING SCHEDULE PER 2015 EDITION OF THE INTERNATIONAL BUILDING CODE, TABLE 2304.9.1 (UNLESS NOTED OTHERWISE).

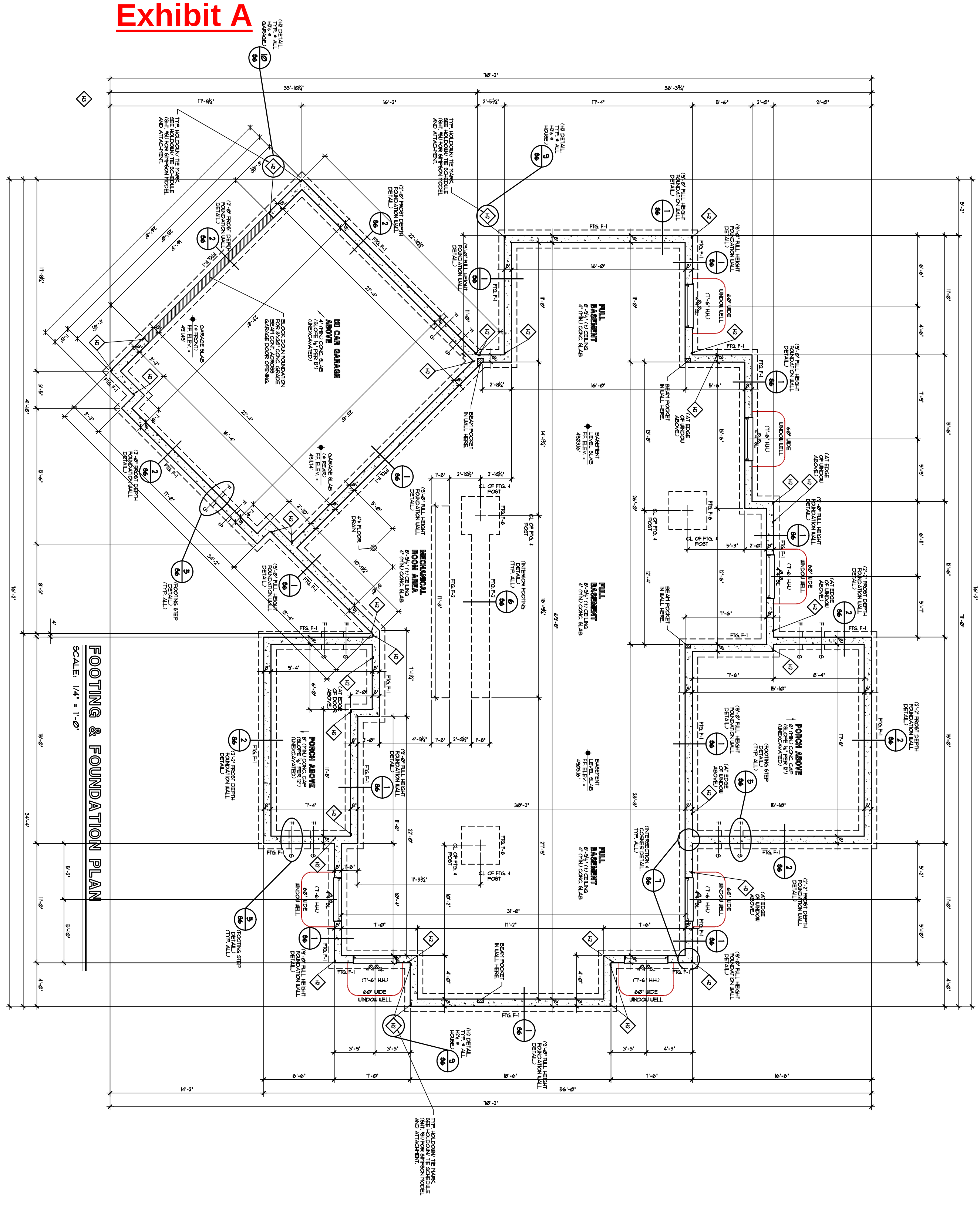
Carlson E[...] Services, Inc.
Structural Engineering Services
380 North 200 West Suite 110
Bountiful, Utah 84010
phone: (801) 296-2184
phone: (801) 296-6253

STRUCTURAL NOTES & SCHEDULES

RASMUSSEN RESIDENCE
LOT #1R @ DAUPHINE'-SAVOY-PIEDMONT SUBDIVISION
6498 SOUTH BYBEE DRIVE
WEBER COUNTY, UTAH

RELEASE DATE:	03/03/17
REVISIONS: date:	Item:
04/06/17	PERMIT SET
DRAWN BY:	JOE HUNTER
NO. OF SHEETS:	S1 OF 1
SHEET NO.:	S1

Exhibit A



FOOTING & FOUNDATION PLAN

RASMUSSEN RESIDENCE

LOT #1R @ DAUPHINE'-SAVOY-PIEDMONT SUBDIVISION
6498 SOUTH BYBEE DRIVE
WEBER COUNTY, UTAH

Carlson Engineering Services, Inc.
Structural Engineering Services
380 North 200 West Suite #10
Bountiful, Utah 84010
phone: (801) 296-2784
phone: (801) 296-6253

SHEET NO. S2

DRAWN BY: JOE HUNTER

Exhibit A

FLOOR BEAM SCHEDULE:

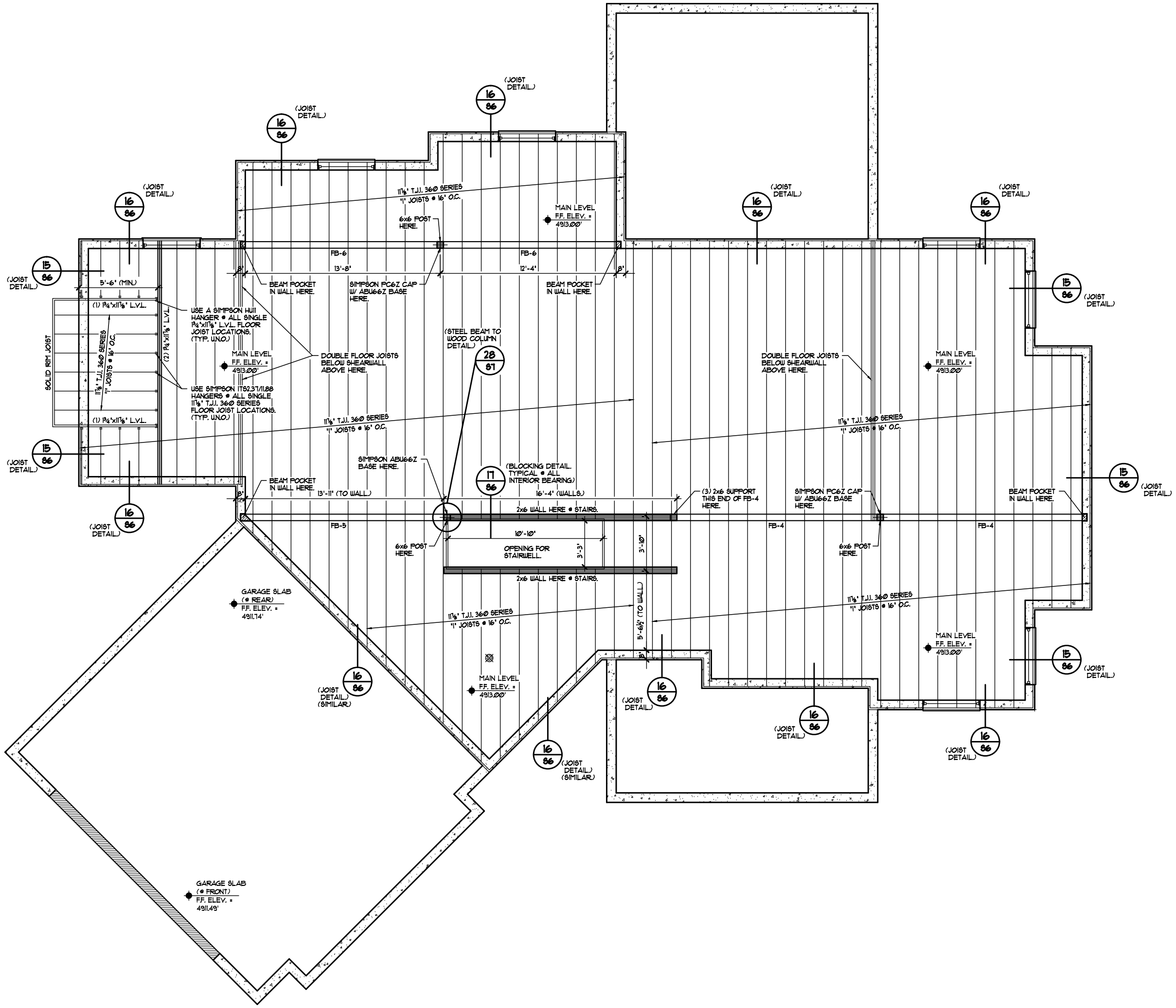
(** NOTE: BOLT (2) 2x PLATES TO TOP & BOTTOM FLANGES OF BEAM W/ ½"φ CARRIAGE BOLTS @ 16" O.C. STAGGERED)

MARK:	BEAM TYPE:	BEAM SIZE:	DESCRIPTION/ NOTES:
FB-1	G.L.B.	5⅛"x15"	(OPTION: (3) 1¾"x16" L.V.L.'s) BEAM OVER GARAGE BAY AREA. (T.O. BEAM = B.O. TRUSSES.)
FB-2	L.V.L.	(3) 1¾"x11⅞"	HEADER OVER GARAGE DOOR OPENING. (B.O. BEAM = T.O. DOOR OPENING.)
FB-3	L.V.L.	(3) 1¾"x11⅞"	BEAM IN CEILING OVER LAUNDRY/ ¾ BATH/ HALL AREA. (T.O. BEAM = T.O. JOISTS.)
FB-4	L.V.L.	(2) 1¾"x14"	(OPTION: (3) 1¾"x11⅞") BEAM OVER UNFINISHED BASEMENT AREA. (T.O. BEAM = B.O. JOISTS.)
FB-5	STEEL	W-12x26 (SEE NOTE **.)	BEAM OVER UNFINISHED BASEMENT AREA. (T.O. BEAM = 1½" BELOW B.O. JOISTS.)
FB-6	L.V.L.	(3) 1¾"x11⅞"	BEAM OVER UNFINISHED BASEMENT AREA. (T.O. BEAM = B.O. JOISTS.)

FLOOR DIAPHRAGM:

USE 3/4" A.P.A. RATED O.S.B. T&G SHEETING NAILED AND GLUED W/ 10d NAILS @ 6" O.C. AT DIAPHRAGM BOUNDARIES AND PANEL SUPPORTED EDGES. FIELD NAIL W/ 10d NAILS @ 12" O.C.

NOTE:
ALL INTERIOR BEARING HEADERS ARE TO BE (2) 2x8's (MIN.). ALL EXTERIOR BEARING HEADERS ARE TO BE (2) 2x10's (MIN.) TYPICAL ALL U.N.O.



MAIN LEVEL FLOOR FRAMING PLAN

SCALE: 1/4" = 1'-0"

Carlson Engineering Services, Inc.
Structural Engineering Services
380 North 200 West Suite #110
Bountiful, Utah 84010
phone: (801) 296-2784
phone: (801) 296-6253

MAIN LEVEL FLOOR FRAMING PLAN

RASMUSSEN RESIDENCE
LOT #1R @ DAUPHINE'-SAVOY-PIEDMONT SUBDIVISION
6498 SOUTH BYBEE DRIVE
WEBER COUNTY, UTAH

RELEASE DATE: 03/03/11

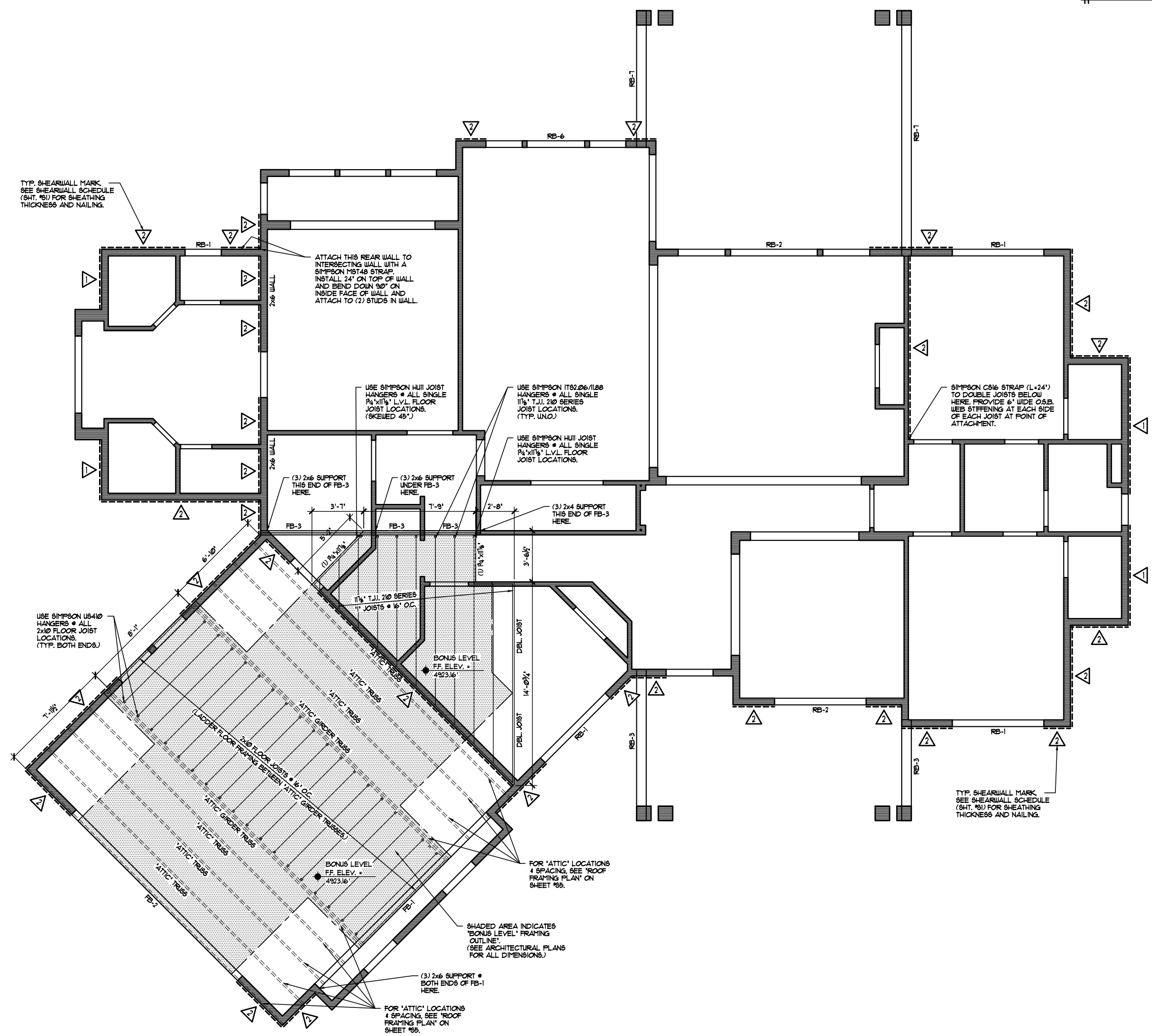
REVISIONS: date: 04/06/11 item: PERMIT SET

DRAWN BY: JOE HUNTER

NO. OF SHEETS: S3 OF 7

SHEET NO.: S3

Exhibit A



BONUS LEVEL FLOOR FRAMING PLAN

SCALE: 1/4" = 1'-0"

FLOOR BEAM SCHEDULE:

(** NOTE: BOLT (2) 2x PLATES TO TOP & BOTTOM FLANGES OF BEAM W/ ½"ϕ CARRIAGE BOLTS @ 16" O.C. STAGGERED)

MARK:	BEAM TYPE:	BEAM SIZE:	DESCRIPTION/ NOTES:
FB-1	G.L.B.	5⅛"x15"	(OPTION: (3) 1¾"x16" L.V.L.'s) BEAM OVER GARAGE BAY AREA. (T.O. BEAM = B.O. TRUSSES.)
FB-2	L.V.L.	(3) 1¾"x11⅞"	HEADER OVER GARAGE DOOR OPENING. (B.O. BEAM = T.O. DOOR OPENING.)
FB-3	L.V.L.	(3) 1¾"x11⅞"	BEAM IN CEILING OVER LAUNDRY/ ¾ BATH/ HALL AREA. (T.O. BEAM = T.O. JOISTS.)
FB-4	L.V.L.	(2) 1¾"x14"	(OPTION: (3) 1¾"x11⅞") BEAM OVER UNFINISHED BASEMENT AREA. (T.O. BEAM = B.O. JOISTS.)
FB-5	STEEL	W-12x26 (SEE NOTE **.)	BEAM OVER UNFINISHED BASEMENT AREA. (T.O. BEAM = 1½" BELOW B.O. JOISTS.)
FB-6	L.V.L.	(3) 1¾"x11⅞"	BEAM OVER UNFINISHED BASEMENT AREA. (T.O. BEAM = B.O. JOISTS.)

FLOOR DIAPHRAGM:

USE 3/4" A.P.A. RATED O.S.B. T&G SHEETING NAILED AND GLUED W/ 10d NAILS @ 6" O.C. AT DIAPHRAGM BOUNDARIES AND PANEL SUPPORTED EDGES. FIELD NAIL W/ 10d NAILS @ 12" O.C.

NOTE:
ALL INTERIOR BEARING HEADERS ARE TO BE (2) 2x8's (MIN.). ALL EXTERIOR BEARING HEADERS ARE TO BE (2) 2x10's (MIN.). TYPICAL ALL U.N.O.

SEE SHEET #S5 FOR SIZE & SUPPORT OF ALL ROOF BEAMS (I.E. RB's) SHOWN HERE.

Carlson Engineering Services, Inc.
Structural Engineering Services
380 North 200 West Suite #10
Bountiful, Utah 84010
phone: (801) 296-2784
phone: (801) 296-6253

BONUS LEVEL FLOOR FRAMING PLAN

RASMUSSEN RESIDENCE
LOT #1R @ DAUPHINE'-SAVOY-PIEDMONT SUBDIVISION
6498 SOUTH BYBEE DRIVE
WEBER COUNTY, UTAH

RELEASE DATE: 03/03/11

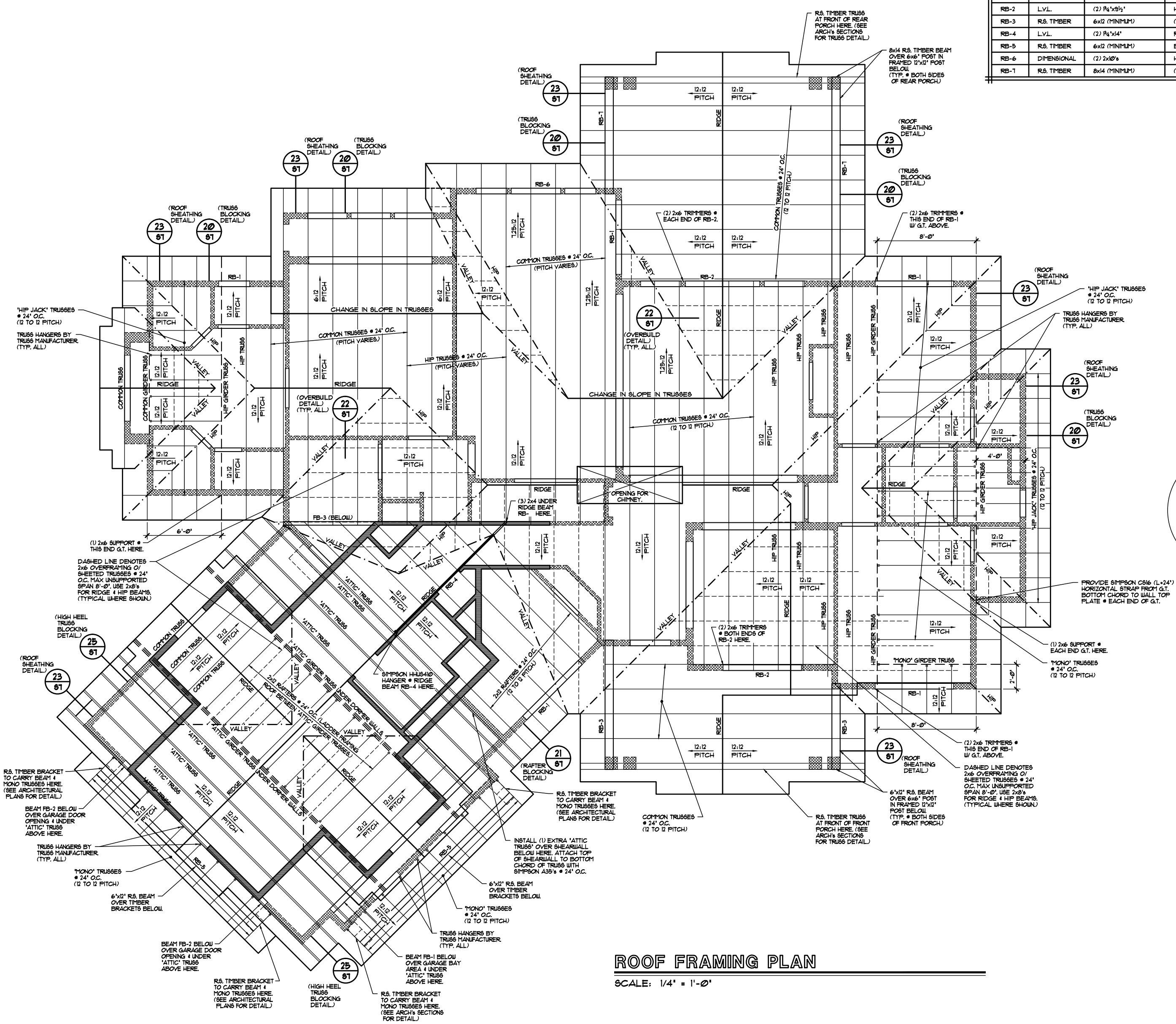
REVISIONS: date:	item:
04/06/11	PERMIT SET

DRAWN BY: JOE HUNTER

NO. OF SHEETS: S4 OF 7

SHEET NO.: S4

Exhibit A



ROOF FRAMING PLAN

SCALE: 1/4" = 1'-0"

ROOF BEAM SCHEDULE:

MARK:	BEAM TYPE:	BEAM SIZE:	DESCRIPTION/ NOTES:
RB-1	DIMENSIONAL	(3) 2x10's	HEADER OVER EXTERIOR WINDOW OR DOOR. (B.O. BEAM = HEADER HEIGHT.)
RB-2	L.V.L.	(2) 1¾"x9½"	HEADER OVER EXTERIOR WINDOW OR DOOR. (B.O. BEAM = HEADER HEIGHT.)
RB-3	R.S. TIMBER	6x12 (MINIMUM)	(OPTION: (2) 1¾"x11⅞") BEAM @ FRONT PORCH ROOF. (T.O. BEAM = 12" ABOVE PLATE.)
RB-4	L.V.L.	(2) 1¾"x14"	RIDGE BEAM OVER BONUS ROOM AREA @ STICK FRAMED PORTION OF ROOF.
RB-5	R.S. TIMBER	6x12 (MINIMUM)	BEAM @ GARAGE FACADES W/ SHED ROOF & BRACKETS. (T.O. BEAM = T.O. GARAGE PLATE.)
RB-6	DIMENSIONAL	(2) 2x10's	HEADER OVER EXTERIOR WINDOW OR DOOR. (B.O. BEAM = HEADER HEIGHT.)
RB-7	R.S. TIMBER	8x14 (MINIMUM)	(OPTIONS: 6x16 R.S. or (3) 1¾"x14") BEAM @ REAR PORCH ROOF. (T.O. BEAM = 12" ABOVE PLATE.)

ROOF DIAPHRAGM:

USE 15/32" (32/16) A.P.A. RATED O.S.B. SHEETING NAILED W/ 8d NAILS @ 6" O.C. AT DIAPHRAGM BOUNDARIES AND PANEL SUPPORTED EDGES. FIELD NAIL W/ 8d NAILS @ 12" O.C. PROVIDE 'H' CLIPS AT ALL UNSUPPORTED EDGES.

NOTE:
ALL INTERIOR BEARING HEADERS ARE TO BE (2) 2x8's (MIN.). ALL EXTERIOR BEARING HEADERS ARE TO BE (2) 2x10's (MIN.). TYPICAL ALL U.N.O.

SEE SHEET S4 FOR SIZE & SUPPORT OF ALL FLOOR BEAMS (I.E. FB's) SHOWN HERE.

SEE ARCHITECTURAL SECTIONS FOR ALL TRUSS CONFIGURATIONS, SPANS, HEEL HEIGHTS AND PLATE HEIGHTS. ALL SPANS, PITCHES AND PLATE HEIGHTS SHOULD BE VERIFIED ON SITE BY TRUSS MANUFACTURER BEFORE TRUSS PRODUCTION BEGINS. NOTIFY ENGINEER IF SPANS OR POINT LOAD LOCATIONS CHANGE FROM WHAT IS SHOWN HERE.

Carlson Engineering Services, In
Structural Engineering Servic
380 North 200 West Suite #1
Bountiful, Utah 84010
phone: (801) 296-2784
phone: (801) 296-6253

ROOF FRAMING PLAN

RASMUSSEN RESIDENCE
LOT #R @ DAUPHINE'-SAVOY-PIEDMONT SUBDIVISION
6498 SOUTH BYBEE DRIVE
WEBER COUNTY, UTAH

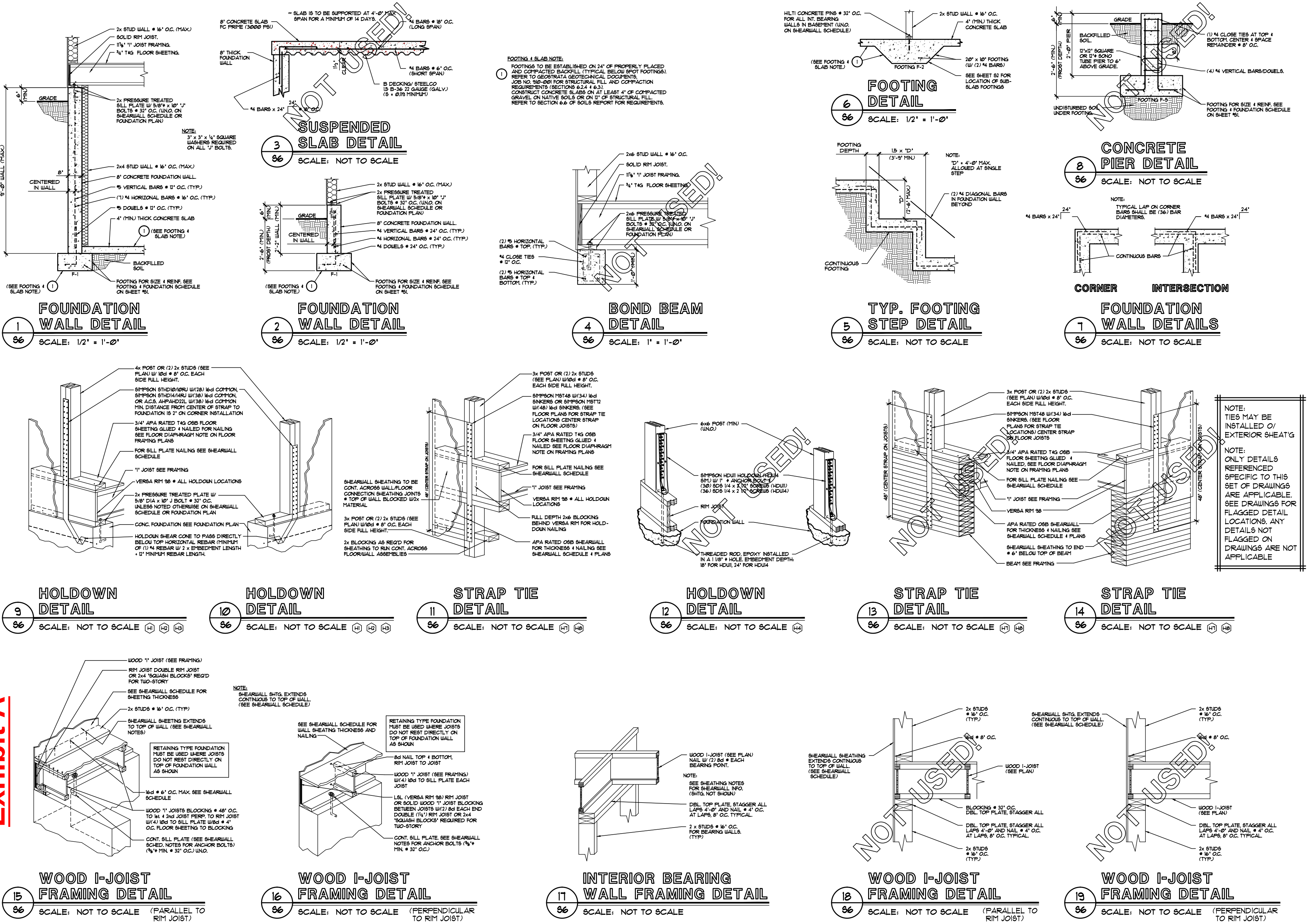
RELEASE DATE: 03/03/11

REVISIONS: date: 04/06/11 item: PERMIT SET

DRAWN BY: JOE HUNTER

NO. OF SHEETS: S5 OF 7

SHEET NO.: S5



Carlson Engineering Services, Inc
Structural Engineering Services
380 North 200 West Suite 110
Bountiful, Utah 84010
phone: (801) 296-2784
phone: (801) 296-6253

STRUCTURAL DETAILS

RASMUSSEN RESIDENCE

LOT 1R @ DAUPHINE'-SAVOY-PIEDMONT SUBDIVISION
6498 SOUTH BYBEE DRIVE
WEBER COUNTY, UTAH

RELEASE DATE: 03/03/11

REVISIONS: date	item
04/06/11	PERMIT SET

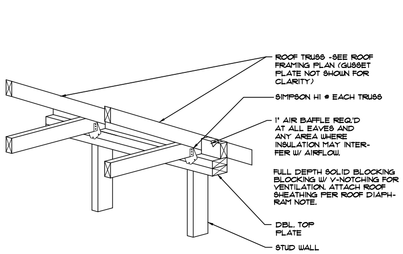
DRAWN BY: JOE HUNTER

NO. OF SHEETS: S6 OF 7

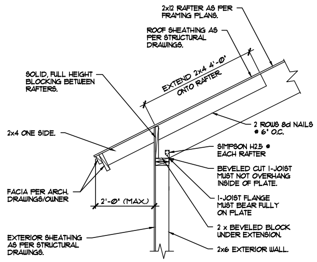
SHEET NO.: S6

Exhibit A

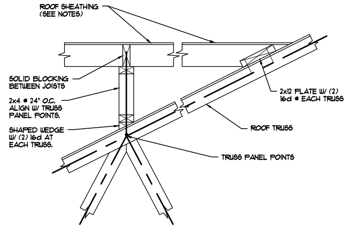
NOTE:
FOR PANEL SPLICE (IF NEEDED)
PANEL EDGES SHALL BE BLOCKED AND OCCUR W/ 24" OF MIDHEIGHT. ONE ROW OF TYP SHEATHING TO FRAMING NAILING IS REQ'D. IF 2x4 BLOCKING IS USED, THE 2x4's MUST BE NAILED TOGETHER W/ (3) 16d NAILS.



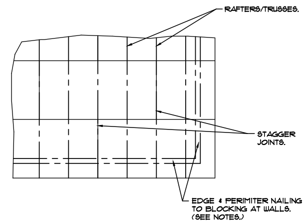
TRUSS TO WALL BLOCKING DETAIL
20 / S7
SCALE: NOT TO SCALE
(SIMILAR DETAIL TO BEAM BELOW.)



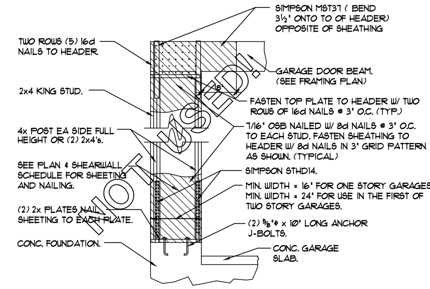
2x12 RAFTER BLOCKING DETAIL
21 / S7
SCALE: NOT TO SCALE



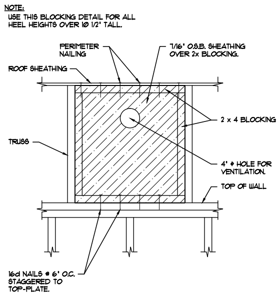
OVERBUILD DETAIL
22 / S7
SCALE: NOT TO SCALE



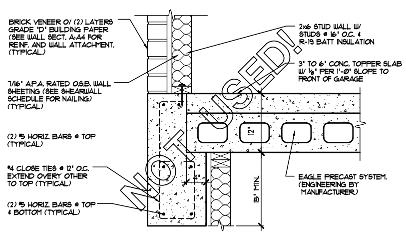
HORIZONTAL ROOF SHEATHING DETAIL
23 / S7
SCALE: NOT TO SCALE



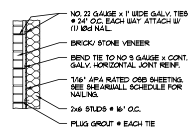
GARAGE RETURN SHEARWALL DETAIL
24 / S7
SCALE: NOT TO SCALE



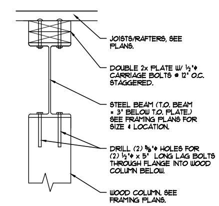
HIGH HEEL TRUSS BLOCKING DETAIL
25 / S7
SCALE: NOT TO SCALE



FOUNDATION WALL NOTCHING FOR PRECAST SLAB DETAIL
26 / S7
SCALE: NOT TO SCALE



BRICK/STONE VENEER DETAILS
27 / S7
SCALE: 1/2" = 1'-0"



STEEL BEAM TO WOOD COLUMN DETAIL
28 / S7
SCALE: NOT TO SCALE

Carlson Engineering Services, Inc
Structural Engineering Services
380 North 200 West Suite #110
Bountiful, Utah 84010
phone: (801) 296-2784
phone: (801) 296-6253

Page 21 of 286

STRUCTURAL DETAILS

RASMUSSEN RESIDENCE
LOT #1R @ DAUPHINE'-SAVOY-PIEDMONT SUBDIVISION
6498 SOUTH BYBEE DRIVE
WEBER COUNTY, UTAH

RELEASE DATE:	03/03/11
REVISIONS: date:	item:
04/06/11	PERMIT SET
DRAWN BY:	JOE HUNTER
NO. OF SHEETS:	S1 OF 7
SHEET NO.:	S7

Exhibit A

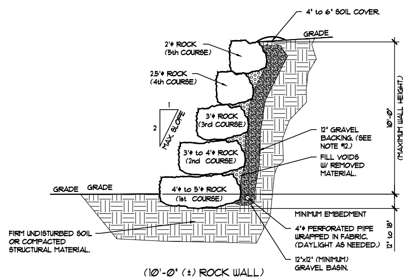
FRONT ELEVATION

SCALE: 1/4" = 1'-0"

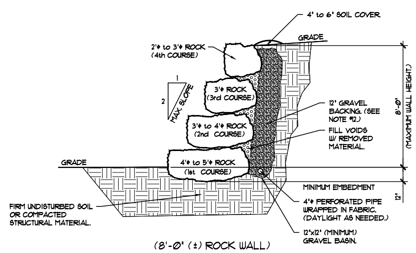
RETAINING WALL NOTES:

THESE ROCK/ BOULDER RETAINING WALL DETAILS ARE APPLICABLE FOR FRONT SIDE AND SIDE YARD LANDSCAPING RETAINING WALLS ONLY!

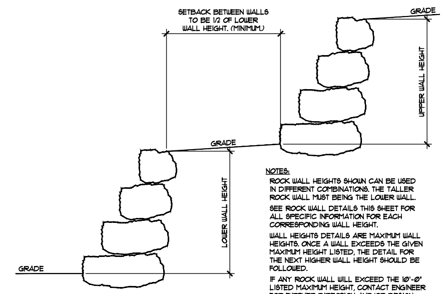
ALL REAR ROCK/ BOULDER RETAINING WALLS ARE TO BE CONSTRUCTED IN ACCORDANCE WITH THE DESIGN AND DETAILS PROVIDED BY GEOSTRATA GEOTECHNICAL DOCUMENTS, JOB NO. 910-001.



D / GP2 SECTION THRU ROCK WALL
SCALE: NONE



C / GP2 SECTION THRU ROCK WALL
SCALE: NONE



NOTES:

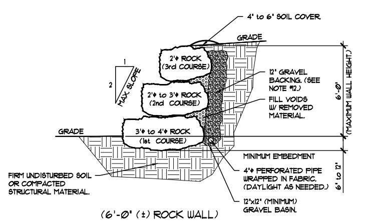
ROCK WALL HEIGHTS SHOWN CAN BE USED IN DIFFERENT COMBINATIONS. THE TALLER ROCK WALL MUST BEING THE LOWER WALL.

SEE ROCK WALL DETAILS THIS SHEET FOR ALL SPECIFIC INFORMATION FOR EACH CORRESPONDING WALL HEIGHT.

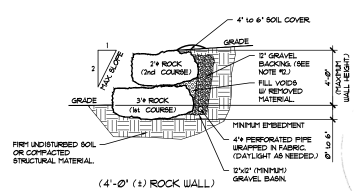
WALL HEIGHTS DETAILS ARE MAXIMUM WALL HEIGHTS. ONCE A WALL EXCEEDS THE GIVEN MAXIMUM HEIGHT LISTED, THE DETAIL FOR THE NEXT HIGHER WALL HEIGHT SHOULD BE FOLLOWED.

IF ANY ROCK WALL WILL EXCEED THE 10'-0" LISTED MAXIMUM HEIGHT, CONTACT ENGINEER FOR FURTHER DIRECTION AND/OR DESIGN.

E / GP2 SECTION THRU TWO TIER ROCK WALL
SCALE: NONE



B / GP2 SECTION THRU ROCK WALL
SCALE: NONE



A / GP2 SECTION THRU ROCK WALL
SCALE: NONE

ROCK WALL NOTES:

1. SOIL SLOPES SHALL BE FREE DRAINING (SANDY GRAVELS) WITH MINIMAL AMOUNTS OF CLAY. FABRIC REQUIRED FOR ALL WALLS OVER 4'-0" EXCEPT FOR WELL GRADED GRAVEL WITH FINES.
2. ROCKS SHALL BE ANGULAR GRANITE OR DOLOMITE STONES OR SIMILAR HARDNESS, EACH ARE TO BE NON-SOLUBLE, HARD AND DURABLE.
3. ROCKS SHALL BE KEYED TOGETHER AND INTERLOCKED WITH LOWER ROCKS.
4. BASE ROCKS SHALL BE BURIED TO THE DEPTHS SHOWN.
5. EARTH SHALL BE THROUGHLY COMPACTED BEFORE PLACEMENT OF ROCKS.
6. THE BUILDING OFFICIAL SHALL REQUIRE A SOILS REPORT PREPARED BY A LICENCED GEOTECHNICAL ENGINEER WHERE WATER IS ENCOUNTERED OR WHERE FINE GRAINED (CLAY) SOILS EXIST. NO CLAY SOILS MAY BE PLACED WITHIN 24" BEHIND ROCK WALLS.
7. BASE ROCK DIAMETERS SHALL NOT BE LESS THAN 3'-6", EXCEPT FOR WALLS LESS THAN 4'-0" IN HEIGHT. UPPER ROCKS SHALL NOT BE LESS THAN 2'-0" DIAMETER.
8. STEPPED ROCK WALLS SHALL BE ENGINEERED AND ARE REQUIRED TO HAVE A SPECIAL INSPECTION BY CES.
9. ESTABLISHED VEGETATION IS REQUIRED ALONG THE TOP OF ALL WALLS TO PREVENT WASHING AND EROSION.
10. A MINIMUM SET BACK OF 1 1/2 TIMES THE WALL HEIGHT IS REQUIRED FROM ALL STRUCTURES. REQUIRED FROM ALL STRUCTURES.
11. ALL WORK SHALL COMPLY WITH CURRENT APPLICABLE CODES.
12. 12" OF GRAVEL BACKING NOT REQUIRED AS SHOWN IF NO WATER CONCERNS ARE PRESENT AND FREE DRAINING SOIL IS INSTALLED INSTEAD.

REGISTERED STRUCTURAL ENGINEER No. 167797 R. LYNN CARLSON STATE OF UTAH 2/4/17

Carlson Engineering Services, I
Structural Engineering Servi
380 North 200 West Suite
Bountiful, Utah 84010
phone: (801) 296-2784
phone: (801) 296-6253

GRADING PLAN DETAILS

RASMUSSEN RESIDENCE
LOT #1R @ DAUPHINE'-SAVOY-PIEDMONT SUBDIVISION
6498 SOUTH BYBEE DRIVE
WEBER COUNTY, UTAH

RELEASE DATE:	03/03/17
REVISIONS: date:	item:
04/06/17	PERMIT SET
DRAWN BY:	JOE HUNTER
NO. OF SHEETS:	2 OF 2
SHEET NO.:	GP2

Exhibit A

April 14, 2017

Matt Rasmussen

Reference: Lot 1R Dauphine-Savory Piedmont Subdivision
Weber County, Utah.

The structural soil design was based on GeoStrata's Report, Job No. 910-001, prepared for Melanie Rasmussen. The structural design meets all design requirements of this report.

Please feel free to contact me with any questions or comments.

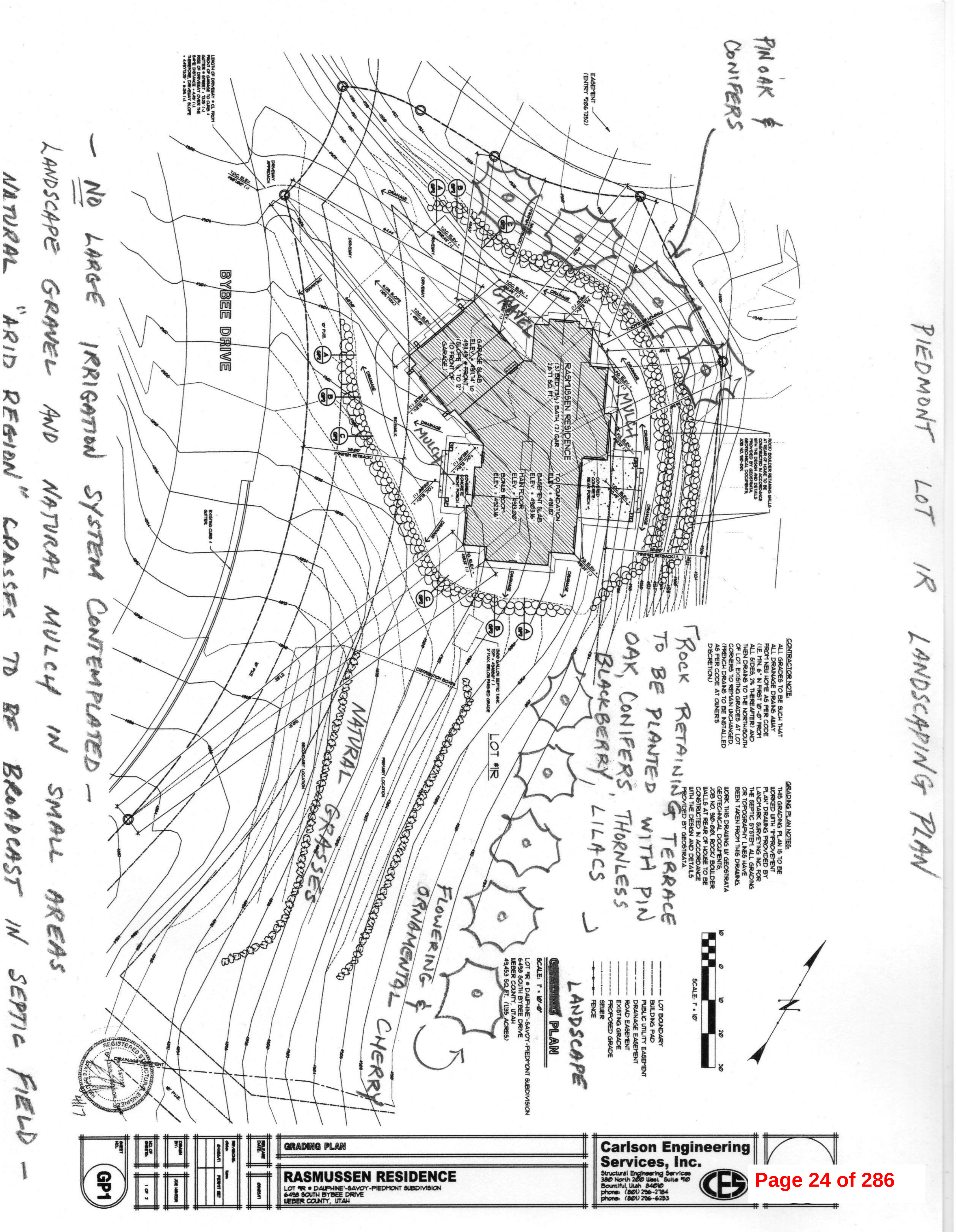
Respectfully,

R. Lynn Carlson, S.E.

REGISTERED STRUCTURAL ENGINEER
No. 167797
R. LYNN CARLSON
4/17
STATE OF UTAH

Carlson Engineering Services, Inc.
380 North 200 West, Suite 110 · Bountiful, UT 84010 · (801) 296-2784 · Fax (801) 296-6253

Exhibit A


PIEDMONT LOT 1R LANDSCAPING PLAN
PIN OAK & CONIFERS
– NO LARGE IRRIGATION SYSTEM CONTEMPLATED –
LANDSCAPE GRAVEL AND NATURAL MULCH IN SMALL AREAS
NATURAL "ARID REGION" GRASSES TO BE BROADCAST IN SEPTIC FIELD –
ROCK RETAINING TERRACE TO BE PLANTED WITH PIN OAK, CONIFERS, THORNLESS BLACKBERRY, LILACS
FLOWERING & ORNAMENTAL CHERRY
NATURAL GRASSES
GRAVEL
MULCH
LANDSCAPE PLAN
BYBEE DRIVE
RASMUSSEN RESIDENCE
LOT 1R
GRADING PLAN
Carlson Engineering Services, Inc.
RASMUSSEN RESIDENCE
LOT 1R • DAUPHINE'-SAVOY-PIEDMONT SUBDIVISION
6498 SOUTH BYBEE DRIVE
WEBER COUNTY, UTAH
GP1

GeoStrata

Engineering & Geosciences
14425 South Center Point Way Bluffdale, Utah 84065
Phone (801) 501-0583 | Fax (801) 501-0584

Geotechnical Investigation for Dauphine-Savory Piedmont Subdivision Lots 1R and 2R and adjacent 2-acre property Weber County, Utah

GeoStrata Job No. 910-001

December 10, 2013

Prepared for:

Matt Rasmussen
2927 Melanie Lane
Ogden, UT 84403

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

Prepared for:

Matt Rasmussen
2927 Melanie Lane
Ogden, UT 84403

Geotechnical Investigation for
Dauphine-Savory Piedmont Subdivision Lots 1R and 2R and adjacent 2-acre property
Weber County, Utah
GeoStrata Job No. 910-001

Prepared by:

J. Scott Seal, E.I.T.
Staff Engineer

Reviewed by:

12/9/13

Mark I. Christensen, P.E.
Senior Engineer

GeoStrata
14425 South Center Point Way
Bluffdale, UT 84065
(801) 501-0583

December 10, 2013

TABLE OF CONTENTS

APPENDICES

1.0 EXECUTIVE SUMMARY

This report presents the results of a geotechnical investigation conducted for residential building lots 1R and 2R of the proposed Dauphine-Savory Piedmont subdivision as well as an adjacent 2-acre parcel located at approximately 6500 South Bybee Drive in Weber County, Utah. The purposes of this investigation were to assess the nature and engineering properties of the subsurface soils at the site and to provide recommendations for general site grading and the design and construction of foundations, slabs-on-grade, and exterior concrete flatwork.

The site is mantled by a layer of topsoil composed of silt, sand, cobble and boulders that is approximately 1½ to 2 feet thick. Underlying the topsoil we encountered a layer of Holocene-aged alluvial fan deposits generally consisting dense Silty SAND (SM) with gravel, cobble and boulders to Silty GRAVEL (GM) with sand, cobble and boulders. The silts observed during our explorations were non-plastic, and appeared to be susceptible to hydro-collapse. The gravel, cobble and boulders were subangular to subrounded and had a 2- to 3- inch average diameter and a 10-inch maximum diameter. These alluvial fan deposits persisted to the full depth of the exploratory trenches and test pits. Undocumented fill material was not observed during our exploration.

Based on the subsurface conditions encountered at the site, it is our opinion that the subject site is suitable for the proposed development provided that the recommendations contained in this report are incorporated into the design and construction of the project. Due to the presence of relatively collapsible soils, the proposed structures should be founded upon a minimum of 24 inches of properly placed and compacted structural fill. Conventional spread and strip footings may be used to support the proposed structures, and may be proportioned for a maximum net allowable bearing capacity of **2,200 psf.**

Strategic site grading is also recommended to aid in reducing the potential for the site to be impacted by debris flow/alluvial fan flooding. Additional information concerning this hazard can be found in the Geological Hazards report prepared for the site by GeoStrata.

NOTE: The scope of services provided within this report is limited to the assessment of the subsurface conditions at the subject site. The executive summary is provided solely for purposes of overview and is not intended to replace the report of which it is part and should not be used separately from the report.

2.0 INTRODUCTION

2.1 PURPOSE AND SCOPE OF WORK

This report presents the results of a geotechnical investigation conducted for Lots 1R and 2R of the proposed Dauphine-Savory Piedmont subdivision and a two acre parcel located south of the two lots. The properties are located at approximately 6500 South Bybee Drive in Weber County, Utah. The purposes of this investigation were to assess the nature and engineering properties of the subsurface soils at the site and to provide recommendations for general site grading and the design and construction of foundations, slabs-on-grade, and exterior concrete flatwork.

The scope of work completed for this study included a site reconnaissance, subsurface exploration, soil sampling, laboratory testing, engineering analyses, and preparation of this report. Our services were performed in accordance with our proposal, dated September 27, 2013 and your signed authorization.

The recommendations contained in this report are subject to the limitations presented in the "Limitations" section of this report (Section 7.1).

2.2 PROJECT DESCRIPTION

The project site is an irregularly-shaped property located in the foothills of the Wasatch Mountains at approximately 6500 South Bybee Drive in unincorporated Weber County, Utah (see Plate A-1, *Site Vicinity Map*). The subject property currently exists as undisturbed, native hillside. We understand that the development as planned will include three residential building lots with associated driveways and landscaped areas. The buildings for the proposed lots are anticipated to be a single or two story structures, on the order of 3,500 square feet in size, and will likely include basements founded on conventional spread footings.

3.0 METHODS OF STUDY

3.1 LITERATURE REVIEW

In preparation of this report, we have reviewed the Geologic Hazard Maps prepared by the Utah Geologic Survey for Weber County. These maps were assembled by the Utah Geological Survey and indicate areas in Weber County that may be subject to geological hazards. The hazards investigated by these maps include debris flow, surficial faulting, landslide susceptibility, and liquefaction (Christenson and Shaw, 2008). Review of these maps indicates that the site is located within a debris flow special study area due to the presence of channels and alluvial fans where debris flows and alluvial-fan flooding has been known to occur. The site is also located within an area mapped as having a low liquefaction potential, and is mapped as being in an area that is considered susceptible to shallow and/or deep-seated landslides. The map suggests that the site is located near a portion of the Weber Segment of the Wasatch Fault. As such, two fault investigation trenches were excavated as part of our field investigation in order to identify the presence and locations of any fault scarps located on the property. The results of our fault trenching are summarized in a separate report. A geologic map of the Ogden 7.5 Minute Quadrangle was also reviewed for additional information concerning the surficial geologic units present at the site (Yonkee and Lowe, 2004). Due to the geologic hazards identified during the literature review, a geologic hazards investigation was performed and is presented in a separate report.

3.2 FIELD INVESTIGATION

As a part of this investigation, subsurface soil conditions were explored by excavating two exploratory trenches to depths ranging from 6½ to 12½ feet in depth below the existing site grade. In addition, two exploratory test pits were advanced at the subject site to a depth of 11 feet below the existing site grade. The approximate locations of the exploratory trenches and test pits are shown on the *Exploration Location Map*, Plate A-2, in Appendix A. These exploration points were selected to provide a representative cross section of the subsurface soil conditions in the anticipated vicinity of the proposed structures. Subsurface soil conditions as encountered in the explorations were logged at the time of our investigation by a geotechnical engineer and are presented on the enclosed Test Pit and Trench Logs, Plates B-1 to B-4 in Appendix B. A *Key to Soil Symbols and Terminology* is presented on Plate B-5.

Both the trenches and the test pits were excavated using a trackhoe. Bulk samples of the subsurface soils were obtained from both the trench and test pit locations and transported to our laboratory for testing to evaluate the engineering properties of the various earth materials observed. Due to the relatively coarse-grained nature of the subsurface soils, collecting relatively "undisturbed" soil samples was not feasible. The soils were classified according to the Unified Soil Classification System (USCS) by the geotechnical engineer. Classifications for the individual soil units are shown on the attached Test Pit Logs.

3.3 LABORATORY INVESTIGATION

Geotechnical laboratory tests were conducted on selected bulk soil samples obtained during our field investigation. The laboratory testing program was designed to evaluate the engineering characteristics of onsite earth materials. Laboratory tests conducted during this investigation include:

- Grain Size Distribution Analysis (ASTM D422)
- Atterberg Limits (ASTM D4318)
- Water-soluble sulfate concentration for cement type recommendations
- Resistivity and pH to evaluate corrosion potential of ferrous metals in contact with site soils

The results of the laboratory testing are presented on the Test Pit Logs in Appendix B (Plates B-1 to B-4), and the laboratory testing result plates in Appendix C (Plates C-1 through C-3).

3.4 ENGINEERING ANALYSIS

Engineering analyses were performed using soil data obtained from the laboratory test results and empirical correlations from material density, depositional characteristics and classification. Appropriate factors of safety were applied to the results consistent with industry standards and the accepted standard of care.

Excavation stability was evaluated based on the field conditions encountered, laboratory test results, and soil type. Occupational Safety and Health (OSHA) minimum requirements are typically prescribed unless conditions warrant further flattening of excavation walls.

4.0 GENERALIZED SITE CONDITIONS

4.1 SURFACE CONDITIONS

At the time of our field investigation the site was in a relatively natural state and vegetated with a relatively dense growth of scrub oak as well as native shrubs and grasses. The eastern portion of the property drains towards the southwest at a moderate slope. The western portion of the property becomes increasingly flat, and drains towards the west-southwest. Maximum topographic relief across the site is estimated to be approximately 110 feet. Improvements at the site were limited to unpaved roadways. A small shed was located near the mouth of the Broad Hollow drainage on lot 2R.

4.2 SUBSURFACE CONDITIONS

As previously discussed, subsurface soil conditions were explored at the site by excavating two exploratory trenches across the westernmost lots, as well as two test pits on the eastern portions of the property. The trenches extended to depths ranging from 6½ to 12½ feet in depth below the existing site grade, whereas the test pits extended to a depth of 11 feet below the existing site grade. The soils encountered in the exploratory trenches and test pits were visually classified and logged during our field investigations and are included on the test pit and trench logs in Appendix B (Plates B-1 to B-4). The subsurface conditions encountered during our investigation are discussed below.

4.2.1 Earth Materials

Based on our observations and geologic literature review, the site is underlain by Holocene- to Upper Pleistocene-aged alluvial fan deposits likely sourced from Broad Hollow to the east of the site (Yonkee and Lowe, 2004). Descriptions of the soil units encountered are described below:

Topsoil: Generally consists of a dense, moist, brown Clayey SAND (SC) with gravel, cobble and boulders. Typically displays a trace 'pinhole' structure. This unit also has an organic appearance and texture, with both thin and larger roots throughout. Topsoil was observed throughout the entire project site, and is anticipated to overlie the majority of the site.

Holocene-aged Alluvial Fan Deposits: Where observed, these sediments generally consist of dense, moist, light brown to brown Silty GRAVEL (GM) with sand, Poorly Graded GRAVEL

(GP-GM) with silt and sand, Silty SAND (SM), and Sandy SILT (ML), each with varying amounts of gravel, cobble and occasional boulders. The gravel, cobble and boulders observed within this deposit were typically subangular to angular, composed of grey to brown schist and quartz, and had diameters ranging from ½ inch to 24 inches. All fine-grained soils observed within this deposit were non-plastic. According to Yonkee and Lowe, 2004, these alluvial fan deposits are deposited thoughout active drainage channels and are largely composed of debris flow sediments. This deposit persisted to the full depth of our investigations.

The stratification lines shown on the enclosed test pit and trench logs represent the approximate boundary between soil types (Plates B-1 to B-4). The actual in-situ transition may be gradual. Due to the nature and depositional characteristics of the native soils, care should be taken in interpolating subsurface conditions between and beyond the exploration locations.

4.2.2 Groundwater

Groundwater was not encountered in any of the explorations completed for this investigation. Seasonal fluctuations in precipitation, surface runoff from adjacent properties, or other on or offsite sources may increase moisture conditions at the site; groundwater conditions can be expected to rise depending on the time of the year. We anticipate that groundwater is relatively deep in this area and should not impact the proposed construction.

5.0 GEOLOGIC CONDITIONS

5.1 GEOLOGIC SETTING

The site is located in Unincorporated Weber County (Uintah Heights), Utah at an elevation ranging from 4900 to 4970 feet above mean sea level within the northern portion of the Salt Lake Basin. The Salt Lake basin is a deep, sediment-filled structural basin of Cenozoic age flanked by the Wasatch Range and Wellsville Mountains to the east and the Promontory Mountains, the Spring Hills, and the West Hills to the west (Hintze, 1980). The southern portion of the Salt Lake Basin is bordered on the west by the east shore of the Great Salt Lake. The Wasatch Range is the easternmost expression of pronounced Basin and Range extension in north-central Utah.

The near-surface geology of the Salt Lake Valley is dominated by sediments, which were deposited within the last 30,000 years by Lake Bonneville (Scott and others, 1983; Hintze, 1993). As the lake receded, streams began to incise large deltas that had formed at the mouths of major canyons along the Wasatch Range, and the eroded material was deposited in shallow lakes and marshes in the basin and in a series of recessional deltas and alluvial fans. Sediments toward the center of the valley are predominately deep-water deposits of clay, silt and fine sand. However, these deep-water deposits are in places covered by a thin post-Bonneville alluvial cover. Surface sediments within the vicinity of Trench 1 are mapped as Pleistocene-aged lacustrine gravel-bearing deposits associated with the regressive (Provo) phase of the Bonneville lake cycle (Yonkee and Lowe, 2004). This unit is described as clast-supported, moderately to well-sorted, pebble to cobble gravel and gravelly sand, interlayered with some silt and sand; deposited and reworked in higher energy environments along the Provo and regressive shorelines near the mountain front. The thickness of this unit is generally less than 20 feet. Based on our observations, the sediment exposed in Trench 1 is more likely associated with alluvial fan processes that have reworked Bonneville-aged sediment. The surface sediments within the vicinity of Trench 2 are mapped as Holocene-aged alluvial fan deposits (Yonkee and Lowe, 2004). This unit is described as a mixture of gravel and sand deposited by streams, and diamicton deposited by debris flows; forms fans having distinct levees and channels at mouths of mountain-fronts canyons. The thickness of this unit is generally less than 20 feet. GeoStrata's observations of the subsurface sediment concur with the preceding description. The surface sediments within the vicinity of the two test pits, TP-1 and TP-2, excavated on the eastern portion of the property are mapped as Bonneville lacustrine gravel-bearing deposits as described above. Based on our observations, the sediment exposed in both of the test pits are more likely associated with alluvial fan processes that have reworked Bonneville-aged sediment.

5.2 SEISMICITY AND FAULTING

The site is located west of the mouth of Broad Hollow within the foothills of the Wasatch Mountain Range. The Weber segment of the Wasatch fault zone is mapped approximately 400 feet west of the subject lots along the toe of the steeply west dipping range front. The Weber segment of the Wasatch fault is thought to have most recently experienced a seismic event during the Quaternary Period, and there is evidence that as many as 10 to 15 events have occurred along this segment in the last 15,000 years (Hecker, 1993). A location near Kaysville, Utah indicated that the Weber Segment has a measureable offset of 1.4 to 3.4 meters per event (McCalpin and others, 1994). The Weber Segment may be capable of producing earthquakes as large as magnitude 7.5 (Ms) and has a recurrence interval of approximately 1,200 years. The southern terminus of the Weber Segment occurs at the Salt Lake Salient, a ridge of Paleozoic and Tertiary bedrock that extends west of the Wasatch Front at the northern end of the Salt Lake rupture segment. The geometry of linkage between the main rupture zones in the Weber segment and faults in the interior of the Salt Lake salient is not clear. Surface scarps at the southern margin of the salient are discontinuous but apparently extend into the large normal fault along the eastern boundary of the segment. There is no reported evidence for Quaternary movement on this fault in the interior of the salient, so presumably the Quaternary ruptures have not reactivated most of this fault. The Pleasant View Salient marks the boundary between the Weber Segment and the Brigham City Segment to the north (Personius, 1986, Zoback, 1983).

The site is also located approximately 23 miles east of the East Great Salt Lake fault zone (Hecker, 1993). Evidence suggests that this fault zone has been active during Holocene times (0 to 10,000 years) and has segment lengths comparable to that of the Wasatch fault zone, indicating that it is capable of producing earthquakes of a comparable magnitude (7.5 Ms).

Analysis of the ground shaking hazard along the Wasatch Front suggests that the Wasatch Fault Zone is the single greatest contributor to the seismic hazard in the Salt Lake City region. Each of the faults listed above show evidence of Holocene-aged movement, and is therefore considered active.

Seismic hazard maps depicting probabilistic ground motions and spectral response have been developed for the United States by the U.S. Geological Survey as part of NEHRP/NSHMP (Frankel et al, 1996). These maps have been incorporated into both *NEHRP Recommended Provisions for Seismic Regulations for New Buildings and Other Structures* (FEMA, 1997) and the *International Building Code* (IBC) (International Code Council, 2009). Spectral responses for the Maximum Considered Earthquake (MCE) are shown in the table below. These values generally correspond to a two percent probability of exceedance in 50 years (2PE50) for a "firm rock" site. To account for site effects, site coefficients which vary with the magnitude of spectral acceleration are used. Based on our field exploration, it is our opinion that this location is best described as a Site Class D. The spectral accelerations are shown in the table below. The spectral accelerations are calculated based on the site's approximate latitude and longitude of 41.1447 and -111.9061° respectively and the United States Geological Survey 2009 ground motion calculator version 5.1.0 (USGS, 2011). Based on IBC, the site coefficients are F_a=1.00 and F_v= 1.50. From this procedure the peak ground acceleration (PGA) is estimated to be 0.57g.

MCE Seismic Response Spectrum Spectral Acceleration Values for IBC Site Class D[a]

Site Location: **Latitude = 41.1447 N** **Longitude = -111.9061W**	**Site Class D Site Coefficients:** **Fa = 1.00** **Fv = 1.50**
Spectral Period (sec)	**Response Spectrum Spectral Acceleration (g)**
0.2	$S_{MS}=(F_a*S_s=1.00*1.42) = 1.42$
1.0	$S_{M1}=(F_v*S_1=1.50*0.58) = 0.87$

[a] IBC 1615.1.3 recommends scaling the MCE values by 2/3 to obtain the design spectral response acceleration values; values reported in the table above have not been reduced.

Additional geological hazards observed at the subject site during our field investigation area discussed in a separate geologic conditions report completed by GeoStrata for the subject site.

6.0 ENGINEERING CONCLUSIONS AND RECOMMENDATIONS

6.1 GENERAL CONCLUSIONS

Supporting data upon which the following recommendations are based have been presented in the previous sections of this report. The recommendations presented herein are governed by the physical properties of the earth materials encountered and tested as part of our subsurface exploration and the anticipated design data discussed in the **PROJECT DESCRIPTION** section. If subsurface conditions other than those described herein are encountered in conjunction with construction, and/or if design and layout changes are initiated, GeoStrata should be informed so that our recommendations can be reviewed and revised as changes or conditions may require.

Based on the subsurface conditions encountered at the site, it is our opinion that the subject site is suitable for the proposed development provided that the recommendations contained in this report are incorporated into the design and construction of the project.

6.2 EARTHWORK

Prior to the placement of foundations, general site grading is recommended to provide proper support for foundations, exterior concrete flatwork, and concrete slabs-on-grade. Site grading is also recommended to provide proper drainage and moisture control on the subject property and to aid in preventing differential settlement of foundations as a result of variations in subgrade moisture conditions. Strategic site grading is also recommended to aid in reducing the potential for the site to be impacted by debris flow/alluvial fan flooding. Additional information concerning this hazard can be found in the Geological Hazards report prepared for the site by GeoStrata.

6.2.1 General Site Preparation and Grading

Within areas to be graded (below proposed structures, fill sections, concrete flatwork, or pavement sections), any existing vegetation, debris, undocumented fill, or otherwise unsuitable soils should be removed. Any soft, loose, or disturbed soils (if encountered) should also be removed. Following the removal of vegetation, unsuitable soils, and loose or disturbed soils, as described above, site grading may be conducted to bring the site to design elevations. If over-excavation is required, the excavation should extend a minimum of one foot laterally for every foot of depth of over-excavation. Excavations should extend laterally at least two feet beyond flatwork, pavements, and slabs-on-grade. If materials are encountered that are not represented in the test pit logs or may present a concern, GeoStrata should be notified so observations and further recommendations as required can be made.

6.2.2 Soft Soil Stabilization

Although not anticipated, soft or pumping soils may be exposed in excavations at the site. Once exposed, all subgrade surfaces beneath proposed structure, pavements, and flat work concrete should be proof rolled with a piece of heavy wheeled-construction equipment. If soft or pumping soils are encountered, these soils should be stabilized prior to construction of footings. Stabilization of the subgrade soils can be accomplished using a clean, coarse angular material worked into the soft subgrade. We recommend the material be greater than 2 inch diameter, but less than 6 inches. A locally available pit-run gravel may be suitable but should contain a high percentage of particles larger than 2 inches and have less than 7 percent fines (material passing the No. 200 sieve). A pit-run gravel may not be as effective as a coarse, angular material in stabilizing the soft soils and may require more material and greater effort. The stabilization material should be worked (pushed) into the soft subgrade soils until a firm relatively unyielding surface is established. Once a firm, relatively unyielding surface is achieved, the area may be brought to final design grade using structural fill.

In large areas of soft subgrade soils, stabilization of the subgrade may not be practical using the method outlined above. In these areas it may be more economical to place a woven geotextile fabric against the soft soils covered by 18 inches of coarse, sub-rounded to rounded material over the woven geotextile. An inexpensive non-woven geotextile "filter" fabric should also be placed over the top of the coarse, sub-rounded to rounded fill prior to placing structural fill or pavement section soils to reduce infiltration of fines from above. The woven geotextile should be Amoco 2004 or prior approved equivalent. The filter fabric should consist of an Amoco 4506, Amoco 4508, or equivalent as approved by the Geotechnical Engineer.

6.2.3 Excavation Stability

Based on Occupational Safety and Health Administration (OSHA) guidelines for excavation safety, trenches with vertical walls up to 5 feet in depth may be occupied, however, the presence of fill soils, loose soils, or wet soils may require that the walls be flattened to maintain safe working conditions. When the trench is deeper than 5 feet, we recommend a trench-shield or shoring be used as a protective system to workers in the trench. Based on our soil observations, laboratory testing, and OSHA guidelines, native soils at the site classify as Type C soils. Deeper excavations, if required, should be constructed with side slopes no steeper than one and one-half horizontal to one vertical (1.5H:1V). If wet conditions are encountered, side slopes should be further flattened to maintain slope stability. Alternatively shoring or trench boxes may be used to improve safe work conditions in trenches. The contractor is ultimately responsible for trench and site safety. Pertinent OSHA requirements should be met to provide a safe work environment. If site specific conditions arise that require engineering analysis in accordance with OSHA regulations, GeoStrata can respond and provide recommendations as needed.

We recommend that a GeoStrata representative be on-site during all excavations to assess the exposed foundation soils. We also recommend that the Geotechnical Engineer be allowed to review the grading plans when they are prepared in order to evaluate their compatibility with these recommendations.

6.2.4 Structural Fill and Compaction

All fill placed for the support of structures, concrete flatwork or pavements should consist of structural fill. Structural fill may consist of a reworked, native gravelly soil provided that it is first screened in order to meet the requirements as follows; all structural fill should be free of vegetation, debris or frozen material, and should contain no inert materials larger than 4 inches nominal size. Native fine-grained soils may also be used as structural fill, but the contractor should be aware that these soils may be difficult to moisture condition and properly compact. Alternatively, an imported structural fill meeting the specifications below may be used. If soil is imported for use as structural fill, we recommend that it be a relatively well graded granular soil with a maximum of 50 percent passing the No. 4 mesh sieve and a maximum fines content (minus No.200 mesh sieve) of 25 percent. All structural fill soils should be approved by the Geotechnical Engineer prior to placement. Clay and silt particles in imported structural fill should have a liquid limit less than 35 and a plasticity index less than 15 based on the Atterberg Limit's test (ASTM D-4318). The contractor should anticipate testing all soils used as structural fill frequently to assess the maximum dry density, fines content, and moisture content, etc.

All structural fill should be placed in maximum 6-inch loose lifts if compacted by small hand-operated compaction equipment, maximum 8-inch loose lifts if compacted by light-duty rollers, and maximum 10-inch loose lifts if compacted by heavy duty compaction equipment that is capable of efficiently compacting the entire thickness of the lift. We recommend that all structural fill be compacted on a horizontal plane, unless otherwise approved by the geotechnical engineer. Structural fill should be compacted to at least 95% of the MDD, as determined by ASTM D-1557. The moisture content should be at or slightly above the OMC at the time of placement and compaction. Also, prior to placing any fill, the excavations should be observed by the geotechnical engineer to observe that any unsuitable materials or loose soils have been removed. In addition, proper grading should precede placement of fill, as described in the **General Site Preparation and Grading** subsection of this report (Section 6.2.1).

Fill soils placed for subgrade below exterior flat work and pavements, should be within 3% of the OMC when placed and compacted to at least 95% of the MDD as determined by ASTM D-1557. All utility trenches backfilled below the proposed structure, pavements, and flatwork concrete, should be backfilled with structural fill that is within 3% of the OMC when placed and compacted to at least 95% of the MDD as determined by ASTM D-1557. All other trenches, in landscape areas, should be backfilled and compacted to at least 90% of the MDD (ASTM D-1557).

The gradation, placement, moisture, and compaction recommendations contained in this section meet our minimum requirements, but may not meet the requirements of other governing agencies such as city, county, or state entities. If their requirements exceed our recommendations, their specifications should override those presented in this report.

6.3 FOUNDATIONS

All topsoil underlying any proposed foundation elements should be over-excavated. Due to the presence of potentially collapsible soils, we recommend that foundations be established on a minimum of 24 inches of properly placed and compacted structural fill. Strip and spread footings should be a minimum of 18 and 36 inches wide, respectively, and exterior shallow footings should be embedded at least 30-inches below final grade for frost protection and confinement. Interior footings not subject to frost should be embedded at least 18 inches below final grade to provide confinement.

Conventional strip footings founded entirely on properly compacted structural fill may be proportioned for a maximum net allowable bearing capacity of **2,500 psf**. The net allowable bearing capacity may be increased (typically by one-third) for temporary loading conditions such as transient wind and seismic loads. All footing excavations should be observed by the Geotechnical Engineer prior to footing placement.

Settlements of properly designed and constructed conventional footings, founded as described above, are anticipated to be less than 1 inch. Differential settlements should be on the order of half the total settlement over 30 feet.

6.5 EARTH PRESSURES AND LATERAL RESISTANCE

Lateral forces imposed upon conventional foundations due to wind or seismic forces may be resisted by the development of passive earth pressures and friction between the base of the footing and the supporting soils. In determining the frictional resistance against concrete, a coefficient of friction of 0.43 should be used for structural fill, drain gravel, or native sandy soils against concrete. A coefficient of friction of 0.34 should be used for fine-grained soils.

Ultimate lateral earth pressures from natural soils and *granular* backfill acting against retaining walls and buried structures may be computed from the lateral pressure coefficients or equivalent fluid densities presented in the following table:

Condition	Lateral Pressure Coefficient	Equivalent Fluid Density (pounds per cubic foot)
Active*	0.39	47
At-rest**	0.56	68
Passive*	2.56	308
Seismic Active***	0.85	102
Seismic Passive***	-1.29	-155

These coefficients and densities assume level, granular backfill with no buildup of hydrostatic pressures. The force of the water should be added to the presented values if hydrostatic pressures are anticipated. If sloping backfill is present, we recommend the geotechnical engineer be consulted to provide more accurate lateral pressure parameters once the design geometry is established.

Walls and structures allowed to rotate slightly should use the active condition. If the element is constrained against rotation, the at-rest condition should be used. These values should be used with an appropriate factor of safety against overturning and sliding. A value of 1.5 is typically used. Additionally, if passive resistance is calculated in conjunction with frictional resistance, the passive resistance should be reduced by ½.

For seismic analyses, the *active* and *passive* earth pressure coefficient provided in the table is based on the Mononobe-Okabe pseudo-static approach and only accounts for the dynamic horizontal thrust produced by ground motion. Hence, the resulting dynamic thrust pressure *should be added* to the static pressure to determine the total pressure on the wall. The pressure distribution of the dynamic horizontal thrust may be closely approximated as an inverted triangle with stress decreasing with depth and the resultant acting at a distance approximately 0.6 times the loaded height of the structure, measured upward from the bottom of the structure.

The coefficients shown assume a vertical wall face. Hydrostatic and surcharge loadings, if any, should be added. Over-compaction behind walls should be avoided. Resisting passive earth pressure from soils subject to frost or heave, or otherwise above prescribed minimum depths of embedment, should usually be neglected in design.

6.6 CONCRETE SLABS-ON-GRADE CONSTRUCTION

Concrete slabs-on-grade should be constructed over at least 4 inches of compacted gravel overlying native soils or a zone of structural fill that is at least 12 inches thick. Disturbed native soils should be compacted to at least 95% of the MDD as determined by ASTM D-1557 (modified proctor) prior to placement of gravel. The gravel should consist of road base or clean drain rock with a ¾-inch maximum particle size and no more than 12 percent fines passing the No. 200 mesh sieve. The gravel layer should be compacted to at least 95 percent of the MDD of modified proctor or until tight and relatively unyielding if the material is non-proctorable. All concrete slabs should be designed to minimize cracking as a result of shrinkage. Consideration should be given to reinforcing the slab with welded wire, re-bar, or fiber mesh.

6.7 MOISTURE PROTECTION AND SURFACE DRAINAGE

Precautions should be taken during and after construction to minimize over-wetting of soils beneath foundations, flatwork concrete, and pavements. Moisture should not be allowed to infiltrate soils in the vicinity of the proposed structure. Grading should be planned and executed to provide positive surface drainage away from fills, slopes, and the structure. We recommend using a minimum surface slope of 2 percent for graded earth surfaces. Additionally, we recommend that drains be provided to convey water a minimum of 10 feet away from all exterior walls.

Over-wetting of soils prior to or during construction may result in softening and pumping of the subgrade. This may result in equipment mobility problems and/or difficulty in achieving compaction, and consequently, necessitate soil stabilization measures.

6.8 SOIL CORROSION POTENTIAL

A representative soil sample was tested in the laboratory to evaluate the soluble sulfate content. The laboratory test results indicate that the sample tested had soluble sulfate content of 72.9 ppm. Based on this result, the soils are classified as having a low potential for sulfate attack to concrete. We anticipate that conventional Type I/II cement can be used for all of the concrete.

To evaluate the corrosion potential of ferrous metal in contact with onsite native soil, a representative soil sample was tested in our soils laboratory for soil resistivity (AASHTO T288) and pH. The tests indicated that the onsite soil tested has a minimum soil resistivity of 4,000 OHM-cm, and a pH of 7.2. Based on this result, the onsite native soil is considered **corrosive** to ferrous metal. Consideration should be given to retaining the services of a qualified corrosion engineer to provide an assessment of any metal in contact with existing site soils, particularly ancillary water lines and reinforcing steel, and valves. Otherwise, metals should be coated with an appropriate material to prevent soils-metal contact.

7.0 CLOSURE

7.1 LIMITATIONS

The recommendations contained in this report are based on our limited field exploration, laboratory testing, and understanding of the proposed construction. The subsurface data used in the preparation of this report were obtained from the explorations made for this investigation. It is possible that variations in the soil and groundwater conditions could exist between and beyond the points explored. The nature and extent of variations may not be evident until construction occurs. If any conditions are encountered at this site that are different from those described in this report, GeoStrata should be immediately notified so that we may make any necessary revisions to recommendations contained in this report. In addition, if the scope of the proposed construction changes from that described in this report, GeoStrata should be notified.

This report 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.

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 report in its entirety. The use of information contained in this report for bidding purposes should be done at the Contractor's option and risk.

7.2 ADDITIONAL SERVICES

The recommendations made in this report are based on the assumption that an adequate program of tests and observations will be made during construction. GeoStrata staff should be on site to verify compliance with these recommendations. These tests and observations should include, but not necessarily be limited to, the following:

- Observations and testing during site preparation, earthwork and structural fill placement.
- Observation of foundation soils to assess their suitability for footing placement.
- Observation of soft/loose soils over-excavation.
- Observation of temporary excavations and shoring.
- Consultation as may be required during construction.
- Quality control and observation of concrete placement.

We also recommend that project plans and specifications be reviewed by GeoStrata to verify compatibility with our conclusions and recommendations. Additional information concerning the scope and cost of these services can be obtained from our office.

We appreciate the opportunity to be of service on this project. Should you have any questions regarding the report or wish to discuss additional services, please do not hesitate to contact us at your convenience at (801) 501-0583.

8.0 REFERENCES CITED

Christenson, G.E., Shaw, L.M., 2008, Geographic Information System database showing geologic-hazard special study areas, Wasatch Front, Utah: Utah Geological Survey Circular 106, 7 p.

Federal Emergency Management Agency [FEMA], 1997, *NEHRP Recommended Provisions for Seismic Regulations for New Buildings and Other Structures,* FEMA 302, Washington, D.C.

Frankel, A., Mueller, C., Barnard, T., Perkins, D., Leyendecker, E.V., Dickman, N., Hanson, S., and Hopper, M., 1996, *National Seismic-hazard Maps: Documentation*, U.S. Geological Survey Open-File Report 96-532, June.

Hintze, L.F., 1980, Geologic map of Utah: Utah Geological and Mineral Survey Map A-1, Scale 1:500,000.

Hintze, L.F., 1993, Geologic History of Utah, Brigham Young University Studies, Special Publication 7, 202p.

McCalpin, J.P., Foreman, S.L., Lowe, M. 1994, Reevaluation of Holocene faulting at the Kaysville site, Weber segment of the Wasatch fault zone, Utah, Tectonics, American Geophysical Union Publication, Vol. 13, No. 1, Pages 1-16.

Personius, S.F., 1986, The Brigham City Segment – A new segment of the Wasatch fault zone, northern Utah, Geological Society of America Abstracts with Programs, v. 18, no. 5, p. 402.

Scott, W.E., McCoy, W.D., Shorba, R.R., and Meyer, R., 1983, Reinterpretation of the exposed record of the last two cycles of Lake Bonneville, western United States: Quaternary Research, V.20, p. 261-285.

Yonkee, A., Lowe, M., 2004, Geologic Map of the Ogden 7.5' Quadrangle, Weber and Davis Counties, Utah, Utah Geological Survey, Map 200, Plate 1.

Zoback, M.L., 1983, Structure and Cenozoic tectonics along the Wasatch Fault Zone, Utah, in Miller, D.M., Todd, V.R., and Howard, K.A., eds., Tectonics and stratigraphy of the eastern Great Basin, Geological Society of America Special Paper 157, p. 3-27.

Appendix A

1:24,000

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

All Locations are Approximate

GeoStrata
Engineering & Geosciences

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

Exploration Location Map

Plate A-1

1:3,000

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

All Locations are Approximate

N

egend

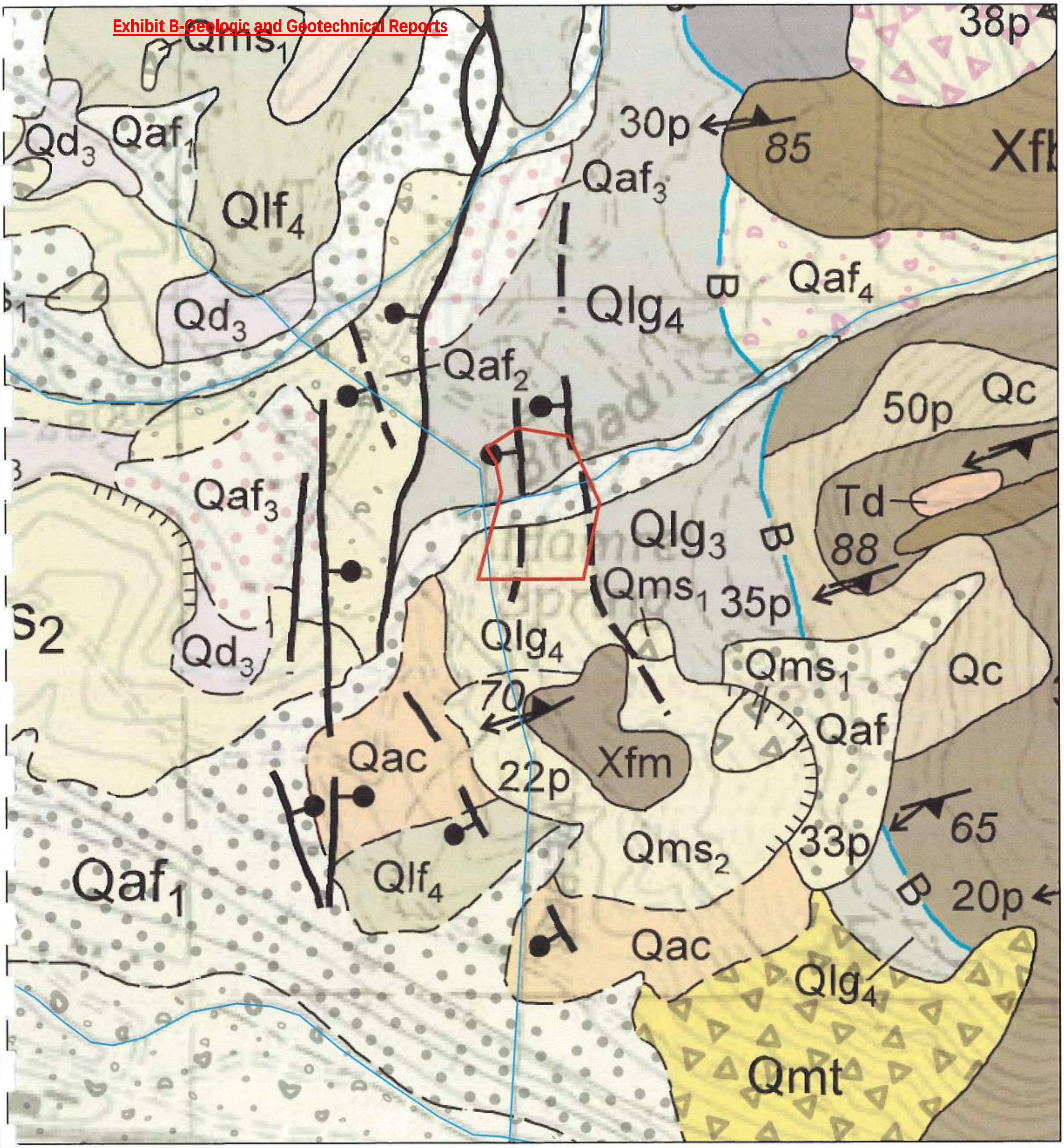
- Site Boundary
- Fault
- Trench
- Test Pit

GeoStrata
Engineering & Geosciences

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

Exploration Location Map

Plate A-2



?ac – Colluvium and Alluvium undivided
?af – Alluvial fan deposits
?lg – Lacustrine gravel-bearing deposits
?f – lacustrine fine-grained deposits
?ms – Landslide deposits
?m – Migmatic gneiss

0 150 300 600 900 1,200 Feet

1:6,000

Base Map: USGS 7.5 Minute Topographic Map obtained from the State of Utah AGRC.

All Locations are Approximate

N

GeoStrata
Engineering & Geosciences

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

Geologic Map

Plate A-3

Appendix B

DATE	
STARTED:	10/22/13
COMPLETED:	10/22/13
BACKFILLED:	10/22/13

Matt Rassmusen
Dauphine-Savory Piedmont Subdivision
Weber County, UT
Project Number 910-001

GeoStrata Rep: S. Seal
Rig Type: Trackhoe

TEST PIT NO:
Trench 1
Sheet 1 of 1

LOCATION: NORTHING | EASTING | ELEVATION

Depth (meters)	Depth (feet)	Unified Soil Classification	Material Description
0	0		TOPSOIL; Sandy SILT - dark brown, moist, frequent thick roots
		ML	Sandy SILT - stiff, brown, moist - carbonate stringers
1	5		
2		SM	Silty SAND - dense, brown, moist
3	10		Bottom of Test Pit @ 10 Feet
4			

Other columns: Samples, Water Level, Graphical Log, Dry Density (pcf), Moisture Content %, Percent minus 200, Liquid Limit, Plasticity Index (no entries).

Moisture Content and Atterberg Limits: Plastic Limit — Moisture Content — Liquid Limit; scale 10 20 30 40 50 60 70 80 90 (no data plotted).

LOG OF TEST PITS (B) TEST PIT LOGS - GEOTECH.GPJ GEOSTRATA.GDT 12/10/13

GeoStrata

SAMPLE TYPE
- GRAB SAMPLE
- 2.5" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
- ▼ MEASURED
- ▽ ESTIMATED

NOTES:

Plate B-1

DATE			
STARTED: 10/22/13	Matt Rassmusen Dauphine-Savory Piedmont Subdivision Weber County, UT	GeoStrata Rep: S. Seal	TEST PIT NO:
COMPLETED: 10/22/13		Rig Type: Trackhoe	Trench 2
BACKFILLED: 10/22/13	Project Number 910-001		Sheet 1 of 1

LOCATION

NORTHING | EASTING | ELEVATION

DEPTH METERS	DEPTH FEET	SAMPLES	WATER LEVEL	GRAPHICAL LOG	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density (pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index	Moisture Content and Atterberg Limits (Plastic Limit — Moisture Content — Liquid Limit; 10 20 30 40 50 60 70 80 90)
0	0					TOPSOIL; Silty GRAVEL with sand - dark brown, moist, roots throughout						
					GM	Silty GRAVEL with sand - dense, brown, moist, gravel is rounded to subrounded						
1	5											
2					SM	Silty SAND with gravel - dense, light brown, moist, gravel is subangular						
3	10											
						Bottom of Test Pit @ 11 Feet						
4												

LOG OF TEST PITS (B) TEST PIT LOGS - GEOTECH.GPJ GEOSTRATA.GDT 12/10/13

GeoStrata

SAMPLE TYPE
- GRAB SAMPLE
- 2.5" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
- ▼ MEASURED
- ▽ ESTIMATED

NOTES:

Plate B-2

DATE		Project	GeoStrata Rep / Rig Type	TEST PIT NO.
STARTED:	10/22/13	Matt Rassmusen	GeoStrata Rep: S. Seal	TP-1
COMPLETED:	10/22/13	Dauphine-Savory Piedmont Subdivision	Rig Type: Trackhoe	Sheet 1 of 1
BACKFILLED:	10/22/13	Weber County, UT Project Number 910-001		

LOCATION: NORTHING / EASTING / ELEVATION

Depth (feet)	Samples	Unified Soil Classification	Material Description	Dry Density (pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
0			TOPSOIL; Clayey SAND with gravel, cobbles, and boulders - with roots and pinholes throughout					
		SM	Silty SAND with gravel and cobbles - dense, brown, moist to slightly moist, gravel is subrounded, cobbles observed up to 10" in diameter					
	Grab				3.2	12.3	NP	NP
	Grab	GP-GM	Poorly Graded GRAVEL with silt and sand - dense, brown, moist to slightly moist, gravels are subrounded, gravel observed up to 3" in diameter		0.8	7.9	NP	NP
			@ 9.5 ft - material is angular, gravel observed up to 6" in diameter					
11			Bottom of Test Pit @ 11 Feet					

Moisture Content and Atterberg Limits: Plastic Limit — Moisture Content — Liquid Limit; 10 20 30 40 50 60 70 80 90

DEPTH: METERS 0, 1, 2, 3, 4; FEET 0, 5, 10

SAMPLE TYPE
- GRAB SAMPLE
- 2.5" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
- ▼ MEASURED
- ▽ ESTIMATED

NOTES:

GeoStrata

Plate B-3

DATE		Client / Project	GeoStrata	TEST PIT NO:
STARTED:	10/22/13	Matt Rassmusen	GeoStrata Rep: S. Seal	TP-2
COMPLETED:	10/22/13	Dauphine-Savory Piedmont Subdivision	Rig Type: Trackhoe	Sheet 1 of 1
BACKFILLED:	10/22/13	Weber County, UT Project Number 910-001		

LOCATION: NORTHING / EASTING / ELEVATION

Moisture Content and Atterberg Limits: Plastic Limit — Moisture Content — Liquid Limit (scale 10 20 30 40 50 60 70 80 90)

DEPTH (Feet)	SAMPLES	UNIFIED SOIL CLASSIFICATION	MATERIAL DESCRIPTION	Dry Density (pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
0			TOPSOIL; Silty SAND with gravel, cobble, and boulders - with roots and pinholes throughout					
		SP-SM	Poorly Graded SAND with silt, gravel, and cobbles - dense, brown, moist to slightly moist, gravel is subrounded to subangular, cobbles observed up to 6" in diameter					
~6	Grab				2.0	10.9	NP	NP
		GP	Poorly Graded GRAVEL with sand and cobbles - dense, brown, moist to slightly moist, gravel is subangular, gravel observed up to 6" in diameter					
~8.5	Grab				0.8	3.8	NP	NP
11			Bottom of Test Pit @ 11 Feet					

SAMPLE TYPE
- GRAB SAMPLE
- 2.5" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
- ▼ - MEASURED
- ▽ - ESTIMATED

NOTES:

GeoStrata

Plate B-4

UNIFIED SOIL CLASSIFICATION SYSTEM

MAJOR DIVISIONS			USCS SYMBOL	TYPICAL DESCRIPTIONS
COARSE GRAINED SOILS (More than half of material is larger than the #200 sieve)	GRAVELS (More than half of coarse fraction is larger than the #4 sieve)	CLEAN GRAVELS WITH LITTLE OR NO FINES	GW	WELL-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES
			GP	POORLY-GRADED GRAVELS, GRAVEL-SAND MIXTURES WITH LITTLE OR NO FINES
		GRAVELS WITH OVER 12% FINES	GM	SILTY GRAVELS, GRAVEL-SILT-SAND MIXTURES
			GC	CLAYEY GRAVELS, GRAVEL-SAND-CLAY MIXTURES
	SANDS (More than half of coarse fraction is smaller than the #4 sieve)	CLEAN SANDS WITH LITTLE OR NO FINES	SW	WELL-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE OR NO FINES
			SP	POORLY-GRADED SANDS, SAND-GRAVEL MIXTURES WITH LITTLE OR NO FINES
		SANDS WITH OVER 12% FINES	SM	SILTY SANDS, SAND-GRAVEL-SILT MIXTURES
			SC	CLAYEY SANDS SAND-GRAVEL-CLAY MIXTURES
FINE GRAINED SOILS (More than half of material is smaller than the #200 sieve)	SILTS AND CLAYS (Liquid limit less than 50)		ML	INORGANIC SILTS & VERY FINE SANDS, SILTY OR CLAYEY FINE SANDS, CLAYEY SILTS WITH SLIGHT PLASTICITY
			CL	INORGANIC CLAYS OF LOW TO MEDIUM PLASTICITY, GRAVELLY CLAYS, SANDY CLAYS, SILTY CLAYS, LEAN CLAYS
			OL	ORGANIC SILTS & ORGANIC SILTY CLAYS OF LOW PLASTICITY
	SILTS AND CLAYS (Liquid limit greater than 50)		MH	INORGANIC SILTS, MICACEOUS OR DIATOMACEOUS FINE SAND OR SILT
			CH	INORGANIC CLAYS OF HIGH PLASTICITY, FAT CLAYS
			OH	ORGANIC CLAYS & ORGANIC SILTS OF MEDIUM-TO-HIGH PLASTICITY
HIGHLY ORGANIC SOILS			PT	PEAT, HUMUS, SWAMP SOILS WITH HIGH ORGANIC CONTENTS

LOG KEY SYMBOLS

BORING SAMPLE LOCATION

TEST-PIT SAMPLE LOCATION

WATER LEVEL (level after completion)

WATER LEVEL (level where first encountered)

CEMENTATION

DESCRIPTION	DESCRIPTION
WEAKELY	CRUMBLES OR BREAKS WITH HANDLING OR SLIGHT FINGER PRESSURE
MODERATELY	CRUMBLES OR BREAKS WITH CONSIDERABLE FINGER PRESSURE
STRONGLY	WILL NOT CRUMBLE OR BREAK WITH FINGER PRESSURE

OTHER TESTS KEY

C	CONSOLIDATION	SA	SIEVE ANALYSIS
AL	ATTERBERG LIMITS	DS	DIRECT SHEAR
UC	UNCONFINED COMPRESSION	T	TRIAXIAL
S	SOLUBILITY	R	RESISTIVITY
O	ORGANIC CONTENT	RV	R-VALUE
CBR	CALIFORNIA BEARING RATIO	SU	SOLUBLE SULFATES
COMP	MOISTURE/DENSITY RELATIONSHIP	PM	PERMEABILITY
CI	CALIFORNIA IMPACT	-200	% FINER THAN #200
COL	COLLAPSE POTENTIAL	Gs	SPECIFIC GRAVITY
SS	SHRINK SWELL	SL	SWELL LOAD

MODIFIERS

DESCRIPTION	%
TRACE	<5
SOME	5 - 12
WITH	>12

MOISTURE CONTENT

DESCRIPTION	FIELD TEST
DRY	ABSENCE OF MOISTURE, DUSTY, DRY TO THE TOUCH
MOIST	DAMP BUT NO VISIBLE WATER
WET	VISIBLE FREE WATER, USUALLY SOIL BELOW WATER TABLE

STRATIFICATION

DESCRIPTION	THICKNESS	DESCRIPTION	THICKNESS
SEAM	1/16 - 1/2"	OCCASIONAL	ONE OR LESS PER FOOT OF THICKNESS
LAYER	1/2 - 12"	FREQUENT	MORE THAN ONE PER FOOT OF THICKNESS

GENERAL NOTES

1. Lines separating strata on the logs represent approximate boundaries only. Actual transitions may be gradual.
2. No warranty is provided as to the continuity of soil conditions between individual sample locations.
3. Logs represent general soil conditions observed at the point of exploration on the date indicated.
4. In general, Unified Soil Classification designations presented on the logs were evaluated by visual methods only. Therefore, actual designations (based on laboratory tests) may vary.

APPARENT / RELATIVE DENSITY - COARSE-GRAINED SOIL

APPARENT DENSITY	SPT (blows/ft)	MODIFIED CA. SAMPLER (blows/ft)	CALIFORNIA SAMPLER (blows/ft)	RELATIVE DENSITY (%)	FIELD TEST
VERY LOOSE	<4	<4	<5	0 - 15	EASILY PENETRATED WITH 1/2-INCH REINFORCING ROD PUSHED BY HAND
LOOSE	4 - 10	5 - 12	5 - 15	15 - 35	DIFFICULT TO PENETRATE WITH 1/2-INCH REINFORCING ROD PUSHED BY HAND
MEDIUM DENSE	10 - 30	12 - 35	15 - 40	35 - 65	EASILY PENETRATED A FOOT WITH 1/2-INCH REINFORCING ROD DRIVEN WITH 5-LB HAMMER
DENSE	30 - 50	35 - 60	40 - 70	65 - 85	DIFFICULT TO PENETRATED A FOOT WITH 1/2-INCH REINFORCING ROD DRIVEN WITH 5-LB HAMMER
VERY DENSE	>50	>60	>70	85 - 100	PENETRATED ONLY A FEW INCHES WITH 1/2-INCH REINFORCING ROD DRIVEN WITH 5-LB HAMMER

CONSISTENCY - FINE-GRAINED SOIL

CONSISTENCY	SPT (blows/ft)	TORVANE UNTRAINED SHEAR STRENGTH (tsf)	POCKET PENETROMETER UNCONFINED COMPRESSIVE STRENGTH (tsf)	FIELD TEST
VERY SOFT	<2	<0.125	<0.25	EASILY PENETRATED SEVERAL INCHES BY THUMB. EXUDES BETWEEN THUMB AND FINGERS WHEN SQUEEZED BY HAND.
SOFT	2 - 4	0.125 - 0.25	0.25 - 0.5	EASILY PENETRATED ONE INCH BY THUMB. MOLDED BY LIGHT FINGER PRESSURE.
MEDIUM STIFF	4 - 8	0.25 - 0.5	0.5 - 1.0	PENETRATED OVER 1/2 INCH BY THUMB WITH MODERATE EFFORT. MOLDED BY STRONG FINGER PRESSURE.
STIFF	8 - 15	0.5 - 1.0	1.0 - 2.0	INDENTED ABOUT 1/2 INCH BY THUMB BUT PENETRATED ONLY WITH GREAT EFFORT.
VERY STIFF	15 - 30	1.0 - 2.0	2.0 - 4.0	READILY INDENTED BY THUMBNAIL.
HARD	>30	>2.0	>4.0	INDENTED WITH DIFFICULTY BY THUMBNAIL.

GeoStrata

Soil Symbols Description Key

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

Plate B-5

Appendix C

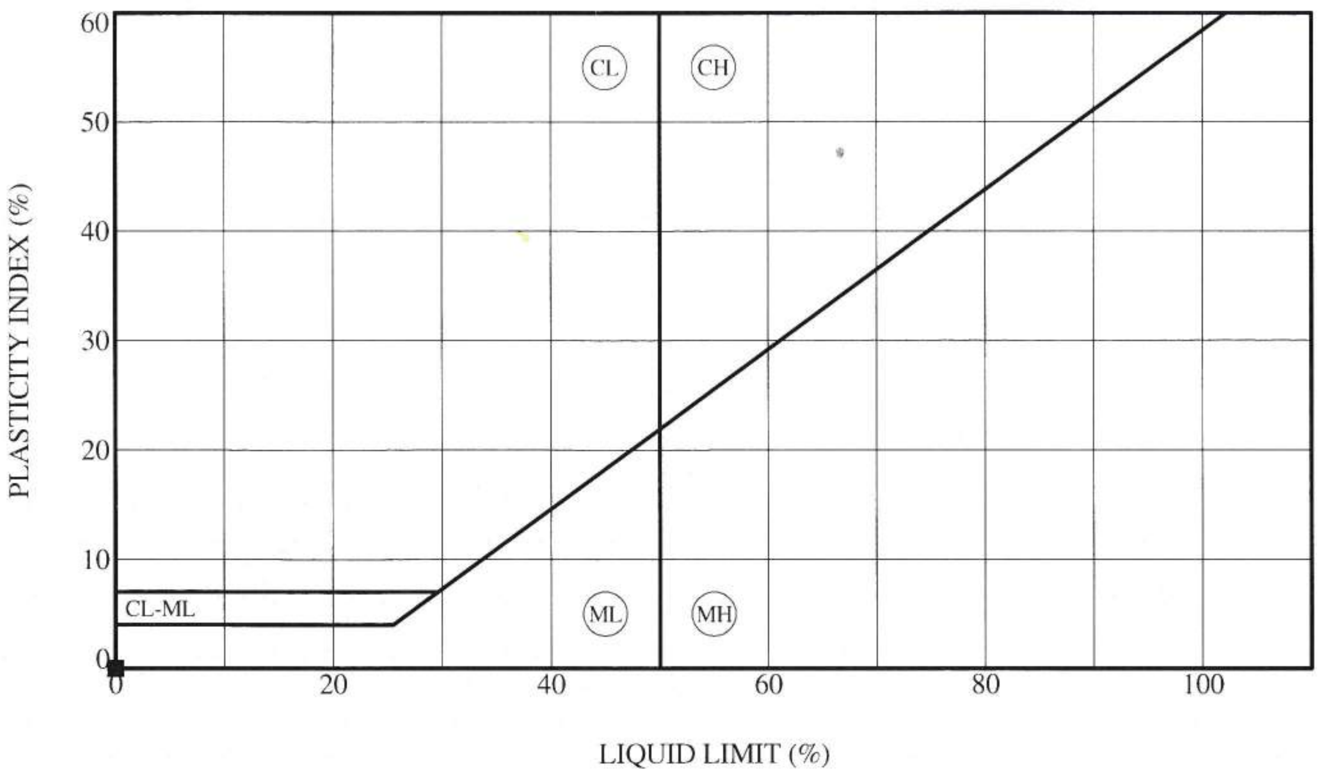
Test Pit No.	USCS Classification	Sample Depth (feet)	Natural Moisture Content (%)	Gradation			Atterberg		Sulfate Content (ppm)	Resistivity (Ω-cm)	pH
				Gravel (%)	Sand (%)	Fines (%)	LL	PI			
TP-1	SM	6.0	3.2	34.7	53.0	12.3	NP	NP			
TP-1	GP-GM	8.0	0.8	63.3	28.8	7.9	NP	NP	72.3	4000	7.2
TP-2	SP-SM	5.5	2.0	30.4	58.7	10.9	NP	NP			
TP-2	GP	8.0	0.8	71.2	25.0	3.8	NP	NP			

GeoStrata

Lab Summary Report

Matt Rassmusen
Dauphine-Savory Piedmont Subdivision
Weber County, UT
Project Number: 910-001

Plate C - 1



	Sample Location	Depth (ft)	LL (%)	PL (%)	PI (%)	Fines (%)	Classification
●	**TP-1**	**6.0**	**NP**	**NP**	**NP**		**Silty SAND with gravel**
⌧	**TP-1**	**8.0**	**NP**	**NP**	**NP**		**Poorly Graded GRAVEL with silt and sand**
▲	**TP-2**	**5.5**	**NP**	**NP**	**NP**		**Poorly Graded SAND with silt and gravel**
★	**TP-2**	**8.0**	**NP**	**NP**	**NP**		**Poorly Graded GRAVEL with sand**

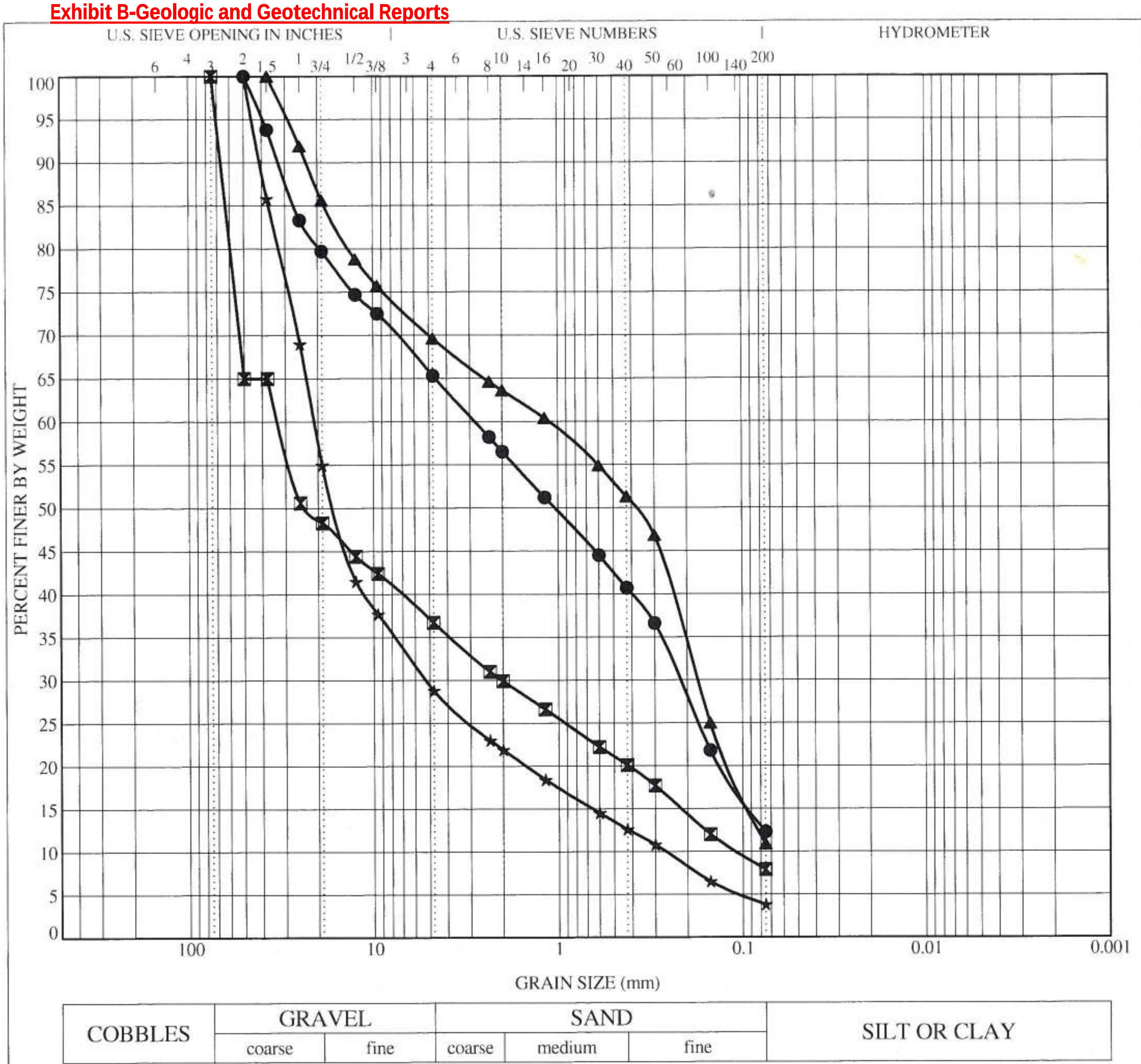
C_ATTERBERG TEST PIT LOGS - GEOTECH.GPJ GEOSTRATA.GDT 12/5/13

GeoStrata

ATTERBERG LIMITS' RESULTS - ASTM D 4318

Matt Rassmusen
Dauphine-Savory Piedmont Subdivision
Weber County, UT
Project Number: 910-001

Plate C - 2



Sample Location		Depth	Classification	LL	PL	PI	Cc	Cu
●	**TP-1**	**6.0**	**Silty SAND with gravel**	**NP**	**NP**	**NP**	**0.27**	**44.44**
⊠	**TP-1**	**8.0**	**Poorly Graded GRAVEL with silt and sand**	**NP**	**NP**	**NP**	**1.18**	**304.54**
▲	**TP-2**	**5.5**	**Poorly Graded SAND with silt and gravel**	**NP**	**NP**	**NP**	**0.38**	**15.66**
★	**TP-2**	**8.0**	**Poorly Graded GRAVEL with sand**	**NP**	**NP**	**NP**	**4.92**	**79.47**

Sample Loctaion		Depth	D100	D60	D30	D10	%Gravel	%Sand	%Silt	%Clay
●	**TP-1**	**6.0**	**50**	**2.818**	**0.22**		**34.7**	**53.0**	**12.3**	
⊠	**TP-1**	**8.0**	**75**	**32.575**	**2.03**	**0.107**	**63.3**	**28.8**	**7.9**	
▲	**TP-2**	**5.5**	**37.5**	**1.123**	**0.176**		**30.4**	**58.7**	**10.9**	
★	**TP-2**	**8.0**	**50**	**20.957**	**5.215**	**0.264**	**71.2**	**25.0**	**3.8**	

GeoStrata

GRAIN SIZE DISTRIBUTION - ASTM D422

Matt Rassmusen
Dauphine-Savory Piedmont Subdivision
Weber County, UT
Project Number: 910-001

Plate

C - 3

C_GSD TEST PIT LOGS - GEOTECH.GPJ GEOSTRATA.GDT 12/5/13

Appendix D

Seismic Ground Motion Values: USGS, 2009; Dobry and others, 2000

Project: Dauphine-Savory Piedmont Subdivision Geotechnical Investigation
Project No.: 910-001
Project Location: Weber County, Utah
Date: Wednesday, December 04, 2013
Engineer: JSS

Site Coordinates:
Latitude: **40.3218** degrees
Longitude: **-111.8233** degrees

Exceedance Probability: **2** %
Exposure Time: **50** years
S_s = **1.416** From USGS 2002 Probabilistic Seismic Hazard Maps for 2475-year Return Period
S_1 = **0.583**

Site Soil Class: **D** (Stiff soil)
F_a = 1.00
F_v = 1.50

Site Class	Values of Site Factor, F_a, for Short-Period Range of Spectral Acceleration				
	$S_S \le 0.25$	$S_S = 0.5$	$S_S = 0.75$	$S_S = 1.0$	$S_S \ge 1.25$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.2	1.2	1.1	1.0	1.0
D	1.6	1.4	1.2	1.1	1.0
E	2.5	1.7	1.2	0.9	0.9
F	*	*	*	*	*

(*)Site-specific geotechnical investigation and dynamic site response analyses shall be performed

Site Class	Values of Site Factor, F_v, for Long-Period Range of Spectral Acceleration				
	$S_1 \le 0.1$	$S_1 = 0.2$	$S_1 = 0.3$	$S_1 = 0.4$	$S_1 \ge 0.5$
A	0.8	0.8	0.8	0.8	0.8
B	1.0	1.0	1.0	1.0	1.0
C	1.7	1.6	1.5	1.4	1.3
D	2.4	2.0	1.8	1.6	1.5
E	3.5	3.2	2.8	2.4	2.4
F	*	*	*	*	*

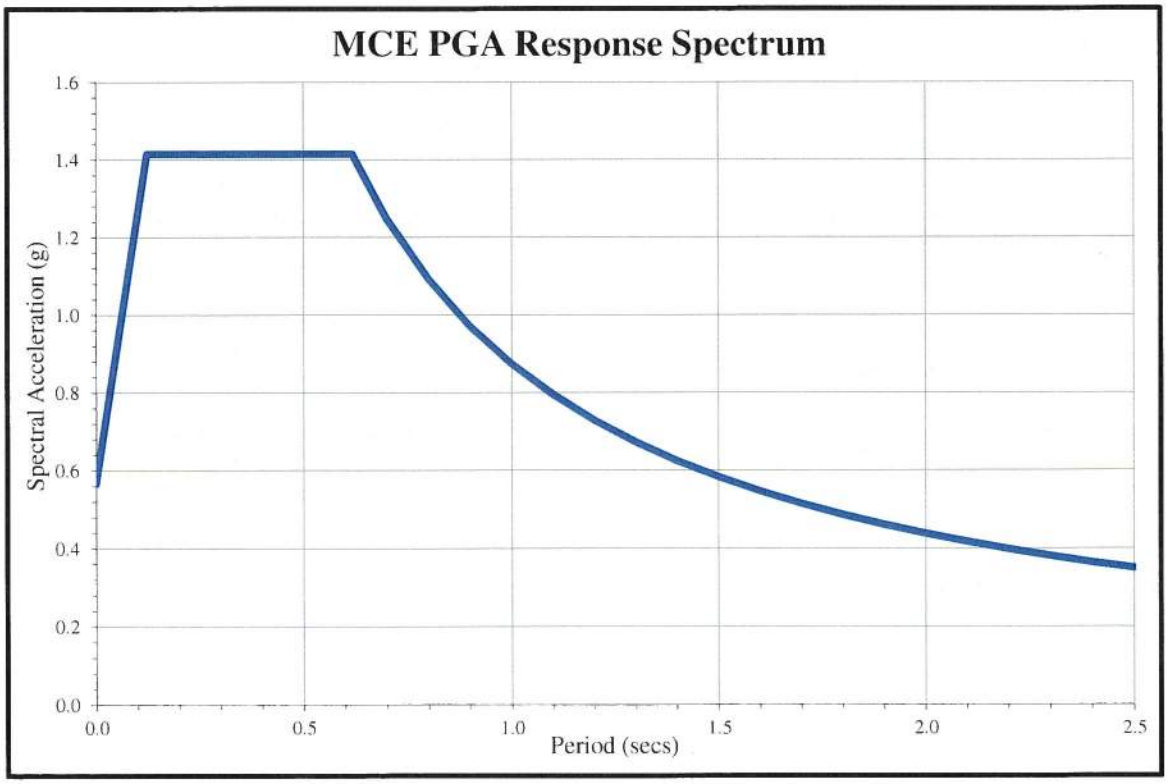
(*)Site-specific geotechnical investigation and dynamic site response analyses shall be performed

Adjusted for Site Conditions:
$S_{MS} = F_a \times S_S =$ (1.00 x 1.42) = 1.41 g
$S_{M1} = F_v \times S_1 =$ (1.50 x 0.58) = 0.87 g

MCE PGA = 0.4 x S_{MS} = (0.4 x 1.41) = **0.57 g**
MCE $T_0 = 0.2 \times (S_{M1}/S_{MS})$ = (0.2 x [0.87/1.41]) = 0.12 secs
MCE $T_S = (S_{M1}/S_{MS})$ = (0.87/1.41) = 0.62 secs

Response Time Step, ΔT = **0.1**

Period (sec)	MCE Spectral Acceleration (g)
0.00	0.57
0.12	1.41
0.62	1.41
0.70	1.25
0.80	1.09
0.90	0.97
1.00	0.87
1.10	0.80
1.20	0.73
1.30	0.67
1.40	0.62
1.50	0.58
1.60	0.55
1.70	0.51
1.80	0.49
1.90	0.46
2.00	0.44
2.10	0.42
2.20	0.40
2.30	0.38
2.40	0.36
2.50	0.35



D-1

Engineering & Geosciences
14425 South Center Point Way Bluffdale, Utah 84065
Phone (801) 501-0583 | Fax (801) 501-0584

Geologic Hazards Assessment
Dauphine-Savory Piedmont Subdivision Lots 1R and 2R and adjacent 2-acre property
Weber County, Utah

GeoStrata Job No. 910-001

December 10, 2013

Prepared for:

Matt Rasmussen
2927 Melanie Lane
Ogden, UT 84403

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

Prepared for:

Matt Rasmussen
2927 Melanie Lane
Ogden, UT 84403

Geologic Hazards Assessment
Dauphine-Savory Piedmont Subdivision Lots 1R and 2R and adjacent 2-acre property
Weber County, Utah
GeoStrata Job No. 910-001

Prepared by:

J. Scott Seal, E.I.T.
Staff Engineer

Reviewed by:

LICENSED PROFESSIONAL GEOLOGIST
#5242839
TIMOTHY J. THOMPSON
12/10/13
STATE OF UTAH

Timothy J. Thompson, P.G.
Senior Geologist

GeoStrata
14425 South Center Point Way
Bluffdale, UT 84065
(801) 501-0583

December 10, 2013

TABLE OF CONTENTS

APPENDICES

Plates

Plate A-1 – Site Vicinity Map
Plate A-2 – Exploration Location Map
Plate A-3 – Surficial Geology Map

Plate B-1 – Trench 1 Log
Plate B-2 – Trench 2 Log
Plates B-3 and B-4 – Test Pit Logs

1.0 EXECUTIVE SUMMARY

The purpose of this investigation and report is to assess potential surface fault rupture hazards as well as any other geologic hazards present at the proposed Dauphine-Savory Piedmont residential development as well as a second adjacent property located at approximately 6500 South Bybee Drive in Weber County, Utah. An engineering geologist investigated the geologic conditions within the general site area.

An active fault is reported as passing within 300 feet of the subject property, and as such the subject property is included within a surficial faulting special study zone. This fault is reported to be west dipping and to be one of the main splays of the Weber segment of the Wasatch fault zone. Two exploratory trenches were excavated across residential building lot 1R and adjacent property, and extended to depths ranging from 6½ to 12½ feet below the existing site grade. The soils exposed in the trenches consisted of Holocene-aged alluvial fan and debris flow deposits. The soils consisted of silt, sand, gravel, with occasional cobble and boulders. No evidence of faulting was observed within either of the trenches completed at the subject property. Therefore, no setback recommendations are required nor provided. In addition, two exploratory test pits were excavated on building lot 2R, and extended to a depth of 11 feet. The soils exposed in the test pits consisted of Holocene-aged alluvial fan and debris flow deposits

The site was identified as being at an elevated risk of being impacted by alluvial fan flooding/debris flows. Based on our observations, the site has experienced numerous debris flows as well as alluvial fan floods during the Holocene. It is recommended that site grading and catchment basins/earthen barriers be utilized to minimize the risk of the proposed development being impacted by alluvial fan flooding/debris flows. A debris flow analysis was beyond the scope of this project, but should be considered prior to development.

Due to the potential for alluvial fan flooding and debris flows at the site, strategic grading to create deflection berms and a break in slope away from each residence with slopes great enough and slope heights sufficient to allow alluvial fan flooding/debris flow events from the north and northeast directions to flow around each residence are likely the most feasible forms of mitigation available to the property owner at this time.

NOTICE: The scope of services provided within this report are limited to the assessment of the subsurface conditions for the proposed development. This executive summary is not intended to replace the report of which it is part and should not be used separately from the report. The executive summary is provided solely for purposes of overview. The executive summary omits a number of details, any one of which could be crucial to the proper application of this report.

2.0 INTRODUCTION

2.1 PURPOSE AND SCOPE OF WORK

The purpose of this investigation and report is to assess the proposed Dauphine Savory Piedmont residential development located at approximately 6500 South Bybee Drive in Weber County, Utah for the presence of geologic hazards that may impact development of the site. This report also covers an adjoining 2-acre property not associated with the proposed Dauphine Savory Piedmont development. Both sites are located within a fault hazard special study area as delineated by the *Surface Fault Rupture Special Study Areas, Wasatch Front and Nearby Areas, Utah* map prepared by the Utah Geological Survey (Christenson and Shaw, 2008). In addition, both sites are located within a debris flow special study area as delineated by the Debris-Flow/Alluvial Fan Special Study Areas, Wasatch Front and Nearby Areas, Utah prepared by the Utah Geological Survey (Christenson and Shaw, 2008). The work performed for this report was performed in accordance with our proposal, dated September 11, 2013. Our scope of services included the following:

- Review of available references and maps of the area;
- Review and evaluation of aerial photographs covering the site area;
- Geologic reconnaissance of the site by an engineering geologist to observe and document pertinent surface features indicative of possible surface rupture fault hazards, debris flow hazards or other geologic hazards.
- Subsurface investigation consisting of trenching across the site from east to west exposing the soil stratigraphy and observing the exposed soil for evidence of surface fault rupture or other geologic hazards.
- Preparation of hand drawn logs to document any fault structures, debris flow deposits or evidence of geologic hazards encountered during our subsurface investigation; and
- Evaluation of our observations combined with existing information and preparation of this written report with conclusions and recommendations regarding possible surface rupture hazards or any other geologic hazards observed to affect the site.

The recommendations contained in this report are subject to the limitations presented in the Limitations section of this report.

2.2 PROJECT DESCRIPTION

The project site is located in the foothills of the Wasatch Mountains at approximately 6500 South Bybee Drive in Weber County (Uintah Heights), Utah. Proposed development, as currently planned, will consist of two to three residential building lots as well as associated roadways and landscape areas. The subject property also includes a 2-acre portion that adjoins the two to three lots to the south. The subject property currently exists as undeveloped hillside property accessed through unpaved trails and roadways. The subject site slopes moderately to the west, and has an estimated topographic change of approximately 70 feet. The project site is shown on the Site Vicinity Map included in the Appendix of this report (Plate 1). The Appendix also includes a Surficial Geology Map (Plate 2) and a Site Exploration Location Map (Plate 3).

3.0 METHODS OF STUDY

3.1 OFFICE INVESTIGATION

To prepare for the investigation, GeoStrata personnel reviewed pertinent literature and maps listed in the references section of this report, which provided background information on the local geologic history of the area and the locations of suspected or known geologic hazards. A detailed knowledge of the stratigraphic units expected in the area provided a useful time-stratigraphic framework for interpreting the units exposed in the trench excavated for the study. In addition, the presence of specific stratigraphic units is also very useful in determining the presence and severity of other geologic hazards that may be present on the subject property.

3.2 GEOLOGIC INVESTIGATION

An engineering geologist investigated the geologic conditions within the general site area. A field geologic reconnaissance was conducted to observe existing geologic conditions and to assess existing surficial evidence of surface fault ruptures, debris flow deposits or evidence other geologic hazards. Based on the geologic reconnaissance, a location was selected for subsurface investigation by means of trenching. While conducting our fieldwork for the surface fault rupture hazard and debris flow hazard assessment we conducted site observations to assess what other geologic hazards might impact the site.

3.3 SUBSURFACE INVESTIGATION

An exploratory trench was excavated across residential building lot 1R and a second trench was excavated across the adjoining property to the south of lot 1R in order to expose and observe the subsurface soils and to assess the subject site for surface fault rupture hazards, debris flow hazards and other geologic hazards. In addition, two exploratory test pits were excavated on residential lot 2R in order to expose and observe the subsurface soils present on that portion of the subject property. The locations of these two trenches and the exploratory test pits are shown on the Site/Exploration Location Map (Plate 3). The geology exposed in these trenches will be described and interpreted in subsequent sections of this report.

4.0 GEOLOGIC CONDITIONS

4.1 GEOLOGIC SETTING

The site is located in Unincorporated Weber County (Uintah Heights), Utah at an elevation ranging from 4900 to 4970 feet above mean sea level within the northern portion of the Salt Lake Basin. The Salt Lake basin is a deep, sediment-filled structural basin of Cenozoic age flanked by the Wasatch Range and Wellsville Mountains to the east and the Promontory Mountains, the Spring Hills, and the West Hills to the west (Hintze, 1980). The southern portion of the Salt Lake Basin is bordered on the west by the east shore of the Great Salt Lake. The Wasatch Range is the easternmost expression of pronounced Basin and Range extension in north-central Utah.

The near-surface geology of the Salt Lake Valley is dominated by sediments, which were deposited within the last 30,000 years by Lake Bonneville (Scott and others, 1983; Hintze, 1993). As the lake receded, streams began to incise large deltas that had formed at the mouths of major canyons along the Wasatch Range, and the eroded material was deposited in shallow lakes and marshes in the basin and in a series of recessional deltas and alluvial fans. Sediments toward the center of the valley are predominately deep-water deposits of clay, silt and fine sand. However, these deep-water deposits are in places covered by a thin post-Bonneville alluvial cover. Surface sediments within the vicinity of Trench 1 are mapped as Pleistocene-aged lacustrine gravel-bearing deposits associated with the regressive (Provo) phase of the Bonneville lake cycle (Yonkee and Lowe, 2004). This unit is described as clast-supported, moderately to well-sorted, pebble to cobble gravel and gravelly sand, interlayered with some silt and sand; deposited and reworked in higher energy environments along the regressive shorelines near the mountain front. The thickness of this unit is generally less than 20 feet. Based on our observations, the sediment exposed in Trench 1 is more likely associated with alluvial fan processes that have reworked Bonneville-aged sediment. The surface sediments within the vicinity of Trench 2 are mapped as Holocene-aged alluvial fan deposits (Yonkee and Lowe, 2004). This unit is described as a mixture of gravel and sand deposited by streams, and diamicton deposited by debris flows; forms fans having distinct levees and channels at mouths of mountain-fronts canyons. The thickness of this unit is generally less than 20 feet. GeoStrata's observations of the subsurface sediment concur with the preceding description. The surface sediments within the vicinity of the two test pits, TP-1 and TP-2, excavated on the eastern portion of the property are mapped as Bonneville lacustrine gravel-bearing deposits as described above. Based on our observations, the sediment exposed in both of the test pits are more likely associated with alluvial fan processes that comprise reworked Bonneville-aged sediment.

4.2 TECTONIC SETTING

The site is located west of the mouth of Broad Hollow within the foothills of the Wasatch Mountain Range. The Weber segment of the Wasatch fault zone is mapped approximately 400 feet west of the subject lots along the toe of the steeply west dipping range front. The Weber segment of the Wasatch fault is thought to have most recently experienced a seismic event during the Quaternary Period, and there is evidence that as many as 10 to 15 events have occurred along this segment in the last 15,000 years (Hecker, 1993). A location near Kaysville, Utah indicated that the Weber Segment has a measureable offset of 1.4 to 3.4 meters per event (McCalpin and others, 1994). The Weber Segment may be capable of producing earthquakes as large as magnitude 7.5 (Ms) and has a recurrence interval of approximately 1,200 years. The southern terminus of the Weber Segment occurs at the Salt Lake Salient, a ridge of Paleozoic and Tertiary bedrock that extends west of the Wasatch Front at the northern end of the Salt Lake rupture segment. The geometry of linkage between the main rupture zones in the Weber segment and faults in the interior of the Salt Lake salient is not clear. Surface scarps at the southern margin of the salient are discontinuous but apparently extend into the large normal fault along the eastern boundary of the segment. There is no reported evidence for Quaternary movement on this fault in the interior of the salient, so presumably the Quaternary ruptures have not reactivated most of this fault. The Pleasant View Salient marks the boundary between the Weber Segment and the Brigham City Segment to the north (Personius, 1986, Zoback, 1983).

The site is also located approximately 23 miles east of the East Great Salt Lake fault zone (Hecker, 1993). Evidence suggests that this fault zone has been active during Holocene times (0 to 10,000 years) and has segment lengths comparable to that of the Wasatch fault zone, indicating that it is capable of producing earthquakes of a comparable magnitude (7.5 Ms).

Analysis of the ground shaking hazard along the Wasatch Front suggests that the Wasatch Fault Zone is the single greatest contributor to the seismic hazard in the Salt Lake City region. Each of the faults listed above show evidence of Holocene-aged movement, and is therefore considered active.

5.0 GENERALIZED SITE CONDITIONS

5.1 SURFACE CONDITIONS

As stated previously, the project site is located in the foothills of the Wasatch Mountains at approximately 6500 South Bybee Drive in Weber County (Uintah Heights), Utah, and is underlain by alluvial fan and debris flow deposits originating from drainages to the east of the subject site. The site is in a relatively natural state, and is heavily vegetated with scrub oak, sage brush and native weeds and grasses. A small shed and associated unpaved roadway was observed on building lot 2R. No structures were observed on the other portions of the subject property. The properties to the north, east, and south of the subject site are undeveloped hillside properties, while the properties to the west are occupied by established residential developments.

5.2 SUBSURFACE CONDITIONS

The subsurface soil conditions were explored for the purpose of evaluating the presence or absence of active faults as well as any other geologic hazards at the subject property by excavating two trenches across the subject site oriented generally east to west approximately perpendicular to the mapped splays of the Weber segment of the Wasatch fault. Subsurface soil conditions and soil stratigraphy were logged at the time of trenching (Plates 4 through 11). The following is a description of the trench excavation as observed during our field investigation.

5.2.1 Trench 1 Description

The trench was approximately 90 feet long, oriented approximately S80°W, and extended along the southern portion of lot 1R. The trench was excavated with a trackhoe to depths ranging from 6½ to 10 feet below the existing site grade. Trench 1 was located to intersect any faults that trend through the proposed buildable portion of the subject lot. A hand log of the trench can be found on Plates 4 through 11.

Sediments exposed in the trench were observed to be comprised of massively to weakly bedded silt and sand deposits with occasional units of gravel and cobble in a matrix of silt and sand, and were observed to comprise alluvial fan deposits with occasional debris flow deposits. The soils exposed in Trench 1 have been separated into five stratigraphic units and labeled Unit 1 through Unit 5. The oldest sediment observed at the bottom of Trench 1 was designated as Unit 1, and was only observed within the eastern-most 7½ feet of the trench. Unit 1 was observed to consist of a silt and sand and contained crude laminations approximately every 3 to 4 inches. Iron staining was prevalent throughout, while the sand content increased with depth. Unit 1 is believed to represent lacustrine silt and sand deposits of Pleistocene-age (mapped unit Qlf_4). Considering the presence of thin laminations as well as the lack of gravel, it is likely that these soils were deposited in deeper water environments and as delta bottom set beds during transgression or regression of Lake Bonneville.

Unit 2 was observed to span the full length of the trench with the exception of the easternmost 7-feet, which were occupied by Unit 1. Unit 2 was observed to consist of sand and silt. The sediment comprising Unit 2 was observed to be massively bedded, moderately sorted, and was weakly cemented. Unit 2 is believed to represent Holocene alluvial fan deposits. Considering the general lack of gravel-cobble- sediment, it is believed that these deposits represent alluvial sediments located in the more distal portion of the fan. These alluvial sediments were dominated by fluvial processes and likely alluvial fan flooding as well.

Unit 3 was contained within Unit 2, and was not present in all portions of the trench. Unit 3 was observed to consist of massively bedded sand, silt, gravel, and cobbles. The gravel and cobbles were observed to be subangluar to subrounded, and had a maximum observed diameter of 12 inches. No visible imbrication was observed in the gravel and cobble material, which were supported in a matrix of sand and silt. This unit was first observed approximately 34 feet west of the eastern end of the trench, and persisted for the remaining length of the trench. This unit obtained a maximum thickness of approximately 3 feet. Based on the massive bedding and the presence of oversized material, Unit 3 is believed to represent debris flow deposits of Holocene age comprised of sediment that was deposited during periodic debris flow events with enough energy to reach the distal portions of the fan.

Unit 4 was observed to immediately overlie Unit 2. Unit 4 was observed to consist of massively bedded silt and sand. This unit was observed to contain significant root traces, carbonate stringers, and had a dark brown color. Occasional seams of sand and gravel in a matrix of silt were present, and ranged from 3 to 10 feet in length and 6 to 12 inches in thickness. No imbrication of the gravel and cobbles was apparent, and their maximum observed diameter was approximately 3 inches. The presence of occasional gravel layers is believed to represent small scale debris flow or hyper-concentrated flow events. Based on the overall lack of oversized material, it is likely that the sediment located outside of the gravel layers was deposited by alluvial fan processes located near distal portions of the fan.

Unit 5 was observed to be contained within Unit 2. Unit 5 was observed to consist of massively bedded silt and sand with gravel. The gravel was observed to be subangular, and had a maximum observed diameter of 1½ inches. No imbrication of the gravel was apparent. Unit 5 is believed to represent a small scale debris flow or hyper-concentrated flow event with enough energy to reach the distal portion of the fan.

Unit 6 was observed to immediately overlie Unit 2. Unit 5 was observed to consist of silt, sand, and gravel with occasional cobble. The gravel and cobble were angular, had a maximum diameter of approximately 12 inches, and did not appear to be imbricated. It is our opinion that Unit 6 represents the active soil profile. The presence of well-developed O, B, and C topsoil horizons suggests that the current site geomorphology has been established for a relatively long time.

It is our opinion that the oldest continuous material, Unit 2 was deposited at some point in the Holocene, and considering the depth of the trench it is believed that the sediments are of an age to preserve evidence of Holocene-aged movement along the Weber segment of the Wasatch Fault. No fault-related deformation was observed within any of the deposits observed in Trench 1. It is our opinion that no active surface rupture faults are located within the limits of the area exposed in Trench 1.

5.2.2 Trench 2 Description

The trench was excavated approximately 95 feet long, oriented approximately N80°W, and extended through the 2-acre property located adjacent to building lots 1R and 2R. The trench was excavated with a trackhoe to a depth of approximately 7½ to 12½ feet. Trench 1 was located to intersect any faults that trend through the proposed buildable portion of the subject lot. A hand log of the trench can be found on Plate B-2.

Sediments exposed in the trench were observed to be comprised of massively bedded gravel and cobble in a matrix of silt and sand, and are thought to represent a series of alluvial deposits as well as possible debris flow deposits. The soils exposed in Trench 2 have been separated into seven stratigraphic units, and labeled Unit 1 through Unit 7. The oldest sediment observed at the bottom of Trench 2 was designated as Unit 1, and consisted of sand, silt and gravel. Unit 1 was first observed approximately 55 feet from the eastern end of Trench 2, and persisted to the western end. The gravel was subangular to subrounded and had an average diameter of 1 to 1½ inches. This soil unit was moderately-sorted, moderately- to weakly-cemented, and largely matrix supported. Based on the lack of bedding and imbrication, Unit 1 is believed to represent an older Holocene debris flow deposit.

Unit 2 was observed to overlie Unit 1, and was first observed approximately 43 feet from the eastern end of Trench 2, and persisted to the western end. Unit 2 consisted of massively bedded sand, gravel, and cobble in a silty matrix. The gravel and cobble are subrounded, and have an average diameter of 2-inches, although cobbles up to 8-inches in diameter were observed. No imbrication of the gravel and cobbles was apparent. This soil unit was lightly cemented, and contained significant iron staining throughout. Based on the lack of bedding and imbrication, it is our opinion that Unit 2 represents predominately debris flow sediments of Holocene-age deposited on the medial portion of the alluvial fan.

Unit 3 was observed to immediately overlie Unit 2, and was first observed approximately 28 feet from the eastern end of Trench 2 and persisted for a length of approximately 30 feet. Unit 3 was observed to consist of massively bedded gravel and cobbles in a matrix of sand and silt. The gravel and cobbles were angular to subangular, and had an average diameter of 1 inch, although material up to 5 inches in diameter was observed. Smaller (2 to 3 feet in length) channels of moderately sorted gravel and sand with minor silt were observed throughout. The gravel in these channels appeared to be weakly imbricated towards the west. Based on the overall lack of bedding as well as the lack of imbrication, it is our opinion that Unit 3 represents Holocene-aged debris flow events. In small places it appears that the debris flow deposits were reworked by smaller fluvial processes.

Unit 4 was observed to immediately overlie Unit 3, and was first observed at the eastern end of the trench and persisted approximately 50 feet to the west. Unit 4 was observed to consist of massively bedded sand and gravel in a silty matrix. The gravels were subangular, and had an average diameter of 1½ inch. Much like Unit 3, smaller (2 to 3 feet in length) channels of moderately sorted gravel and sand with minor silt were observed throughout. The gravel in these channels appeared to be weakly imbricated towards the west. Based on the overall lack of bedding as well as the lack of imbrication, it is our opinion that Unit 3 represents Holocene-aged debris flow events. In small places it appears that the debris flow deposits were reworked by smaller fluvial processes.

Unit 5 was observed to immediately overlie Unit 4, and was first observed at the eastern end of the trench and persisted approximately 42 feet to the west. Unit 5 was observed to consist of massively bedded sand and gravel in a silty matrix. The gravels were subangluar to subrounded, and had an average diameter of 1½ to 2 inches. Much like Units 3 and 4, Unit 5 contained smaller (2 to 3 foot in length) channels of moderately sorted gravel and sand with minor silt were observed throughout. The gravel in these channels appeared to be weakly imbricated towards the west. This unit also contained possible paleosol layers. Based on the overall lack of bedding as well as the lack of imbrication, it is our opinion that Unit 3 represents Holocene-aged debris flow events. In small places it appears that the debris flow deposits were reworked by smaller fluvial processes.

Unit 6 was observed to immediately overlie all the previous discussed units, and was observed to consist of gravel and cobbles in a matrix of silt and sand. The gravel and cobble were angular to subangular, had a maximum diameter of approximately 8 inches, and did not appear to be imbricated. It is our opinion that Unit 3 represents the active soil profile. The presence of well-developed O, B, and C topsoil horizons suggests that the current site geomorphology has been established for a relatively long time.

It is our opinion that the oldest material, Unit 1, was deposited at some point in the Holocene, and considering the depth of the trench it is believed that the sediments are of an age to preserve evidence of Holocene-aged movement along the Weber segment of the Wasatch Fault. No fault-related deformation was observed within any of the deposits observed in Trench 2. It is our opinion that no active surface rupture faults are located within the limits of the area exposed in Trench 2.

5.2.3 Test Pit 1 Description

Test pit TP-1 was excavated on the western portion of the easternmost residential lot, and was approximately 11 feet in depth. Test pit TP-1 was located to investigate the subsurface soils for the presence of debris flow deposits. A test pit log of TP-1 can be found on Plate 12.

Sediments exposed in the test pit were observed to be comprised of massively bedded gravel, cobble and locally boulders in a matrix of silt and sand, and were observed to represent a series of alluvial deposits and debris flow deposits. The soils exposed in TP-1 have been separated into six stratigraphic units, and labeled Unit 1 through Unit 6. The oldest sediment observed at the bottom of TP-1 was designated as Unit 1, and was observed to consist of sand, silt and gravel with occasional cobble. The sediment comprising Unit 1 was observed to be moderately sorted. The gravel and cobble within Unit 1 were observed to be subangular to subrounded with an average diameter of ½ to 1 inches. Some material up to 4-inches in diameter was observed. The gravels and cobble showed weak imbrication oriented towards the northwest. Unit 1 is believed to represent an older (lower Holocene) alluvial fan deposit. Considering that the clast size within this Unit 1 was observed to be generally below 3 inches and that the majority of these clasts were observed to be horizontally bedded and show weak imbrication to the northwest, it is believed that these deposits represent alluvial sediments located in the more distal portion of the alluvial fan. These alluvial sediments where dominated by fluvial processes and likely alluvial fan flooding as well.

Unit 2 was observed to immediately overlie Unit 1. Unit 2 was observed to consist of massively bedded sand, silt, gravel, and cobbles. The gravel and cobbles were observed to be subrounded, and had a maximum observable diameter of 6 inches. No imbrication was apparent in the gravel and cobbles. It was observed that Unit 2 became increasingly dominated by coarse-grained material with depth. Based on the fact that no imbrication was observed in this unit, it is our opinion that Unit 2 represents inter-layered alluvial and debris flow sediments of Holocene age comprised of sediment that was deposited on the medial portion of the alluvial fan.

Unit 3 was observed to immediately overlie Unit 2. Unit 3 was observed to consist of weakly bedded gravel in a sand and silt matrix. The sediment comprising Unit 3 was observed to be moderately sorted. The gravel and cobble within Unit 1 were observed to be subrounded with an average diameter of ½ to 1 inches. Some material up to 10-inches in diameter was observed. The gravels and cobble showed weak imbrication oriented towards the northwest. Unit 1 is believed to represent a Holocene alluvial fan deposit. Considering that the clast size within this Unit 1 was observed to be generally below 3 inches and that the majority of these clasts were observed to be horizontally bedded and show weak imbrication to the northwest, it is believed that these deposits represent alluvial sediments located in the more distal portion of the alluvial fan. These alluvial sediments where dominated by fluvial processes and likely alluvial fan flooding as well.

Unit 4 was observed to immediately overlie Unit 3. Unit 4 was observed to consist of massively bedded sand, silt, gravel, cobbles and boulders. The gravel and cobbles were observed to be subrounded to subangular, and had a maximum observable diameter of 14 inches. No imbrication was apparent in the gravel and cobbles. Based on the fact that no imbrication was observed in this unit, it is our opinion that Unit 4 represents inter-layered alluvial and debris flow sediments of Holocene age comprised of sediment that was deposited on the medial portion of the alluvial fan.

Unit 5 was observed to immediately overlie Unit 4. Unit 5 was observed to consist of massively bedded sand, silt, gravel, cobbles and boulders. The gravel and cobbles were observed to be subrounded to subangular, and had a maximum observable diameter of 24 inches. No imbrication was apparent in the gravel and cobbles. Based on the fact that no imbrication was observed in this unit, it is our opinion that Unit 5 represents inter-layered alluvial and debris flow sediments of Holocene age comprised of sediment that was deposited on the medial portion of the alluvial fan.

Unit 6 was observed to consist of silt, sand, gravel, cobble and boulders. The gravel, cobble and boulders were angular, had a maximum diameter of approximately 18 inches, and did not appear to be imbricated. Unit 6 was poorly-sorted, and contained within a matrix of silt and sand. It is our opinion that Unit 6 represents the active soil profile. The presence of well-developed O, B, and C topsoil horizons suggests that the current site geomorphology has been established for a relatively long time.

5.2.4 Test Pit 2 Description

Test pit TP-2 was excavated on the eastern portion of the easternmost residential lot, and was approximately 11 feet in depth. Test pit TP-2 was located to investigate the subsurface soils for the presence of debris flow deposits. A test pit log of TP-2 can be found on Plate 13.

Sediments exposed in the test pit were observed to be comprised of massively bedded gravel, cobble and locally boulders in a matrix of silt and sand, and were observed to represent a series of alluvial deposits and debris flow deposits. The soils exposed in TP-2 have been separated into six stratigraphic units, and labeled Unit 1 through Unit 6. The oldest sediment observed at the bottom of TP-1 was designated as Unit 1, and was observed to consist of sand, silt and gravel with occasional cobble. The sediment comprising Unit 1 was observed to be massively bedded. The gravel and cobble within Unit 1 were observed to be subangular to subrounded with an average diameter of 2 inches. Some material up to 12-inches in diameter was observed. No imbrication was apparent in the gravel and cobbles. It was observed that Unit 1 became increasingly dominated by coarse-grained material with depth. Based on the fact that no imbrication was observed in this unit, it is our opinion that Unit 1 represents inter-layered alluvial and debris flow sediments of Holocene age comprised of sediment that was deposited on the medial portion of the alluvial fan.

Unit 2 was observed to immediately overlie Unit 1. Unit 2 was observed to consist of weakly bedded gravel and cobbles in a matrix of silt and sand. The gravel and cobbles were observed to be subrounded to subangular, and had an average diameter of 1 inch, although material up to 8 inches was observed. The gravels and cobbles showed weak imbrication oriented to the west-northwest. Unit 2 is believed to represent a Holocene alluvial fan deposit. Considering that the clast size within this Unit 1 was observed to be generally below 3 inches and that the majority of these clasts were observed to be horizontally bedded and show weak imbrication to the west-northwest, it is believed that these deposits represent alluvial sediments located in the more distal portion of the alluvial fan. These alluvial sediments where dominated by fluvial processes and likely alluvial fan flooding as well.

Unit 3 was observed to immediately overlie Unit 2. Unit 3 was observed to consist of massively bedded sand, silt and gravel. The gravel was observed to be subrounded and had a maximum observable diameter of 2 inches. Smaller (2 to 3 inches in length) channels of moderately sorted gravel and sand with minor silt were observed throughout this deposit. The gravel in these channels appeared to be weakly imbricated towards the west. Based on the overall lack of bedding as well as the lack of imbrication, it is our opinion that Unit 3 represents Holocene-aged debris flow events. In small places it appears that the debris flow deposits were reworked by smaller fluvial processes.

Unit 4 was observed to immediately overlie Unit 3. Unit 4 was observed to consist of weakly bedded gravel and cobbles in a matrix of silt and sand. The gravel and cobbles were observed to be subrounded to subangular, and had an average diameter of ¾ inch, although material up to 3 inches was observed. Unit 4 is believed to represent a Holocene alluvial fan deposit. Considering that the clast size within this Unit 4 was observed to be generally below 3 inches and that the majority of these clasts were observed to be horizontally bedded and show weak imbrication to the west-northwest, it is believed that these deposits represent alluvial sediments located in the more distal portion of the alluvial fan. These alluvial sediments where dominated by fluvial processes and likely alluvial fan flooding as well.

Unit 5 was observed to immediately overlie Unit 4. Unit 5 was observed to consist of massively bedded sand, silt, gravel and cobble. The gravel and cobbles were observed to be subrounded to subangular, and had a maximum observable diameter of 6 inches. No imbrication was apparent in the gravel and cobbles. Based on the fact that no imbrication was observed in this unit, it is our opinion that Unit 5 represents inter-layered alluvial and debris flow sediments of Holocene age comprised of sediment that was deposited on the medial portion of the alluvial fan.

Unit 6 was observed to consist of silt, sand, gravel, cobble and boulders. The gravel, cobble and boulders were angular, had a maximum diameter of approximately 18 inches, and did not appear to be imbricated. Unit 3 was poorly-sorted, and contained within a matrix of silt and sand. It is our opinion that Unit 3 represents the active soil profile. The presence of well-developed O, B, and C topsoil horizons suggests that the current site geomorphology has been established for a relatively long time.

6.0 CONCLUSIONS AND RECOMMENDATIONS

6.1 SURFACE RUPTURE HAZARD

GeoStrata conducted a surface fault rupture hazard assessment across building lot 1R as well as on the adjacent 2-acre parcel to assess these residential lots for surface fault rupture hazards. Trenching was not completed on building lot 2R as it is located outside of the surficial faulting special study zone. The western lots were selected for surface fault rupture hazard assessment because these two lots are located closest to the mapped location of the Weber segment of the Wasatch fault zone. Plate A-2 show the mapped locations of the Weber segment of the Wasatch fault zone as reported by Yonkee and Lowe (2004) and by Nelson and Personius (1993). Plate A-2 also shows the surface fault rupture hazard special study area as determined by GeoStrata utilizing a distance of 500 feet from the reported location of the Weber segment. This distance of 250 feet is recommended by Christiansen and others (2003) for the upthrown side of the fault. Since the location of the fault was reported by Nelson and Personius (1993) on a larger and less accurate scale, GeoStrata used the location as reported by Yonkee and Lowe (2004) to assess the special study area in an attempt to be more conservative.

The fault mapped by Yonkee and Lowe (2004) was not observed in the trenches excavated by GeoStrata. It is the opinion of GeoStrata that the fault mapped by Yonkee and Lowe (2004) is located to the west of our exploration trenches. Based on the lack of any observed faulting in the Holocene-aged alluvial fan deposits observed at the bottom of both our exploratory trenches, it is our opinion that no active surface fault rupture-related deformation underlies the areas of the western two residential lots where the two trenches were excavated and observed.

It should be noted that while it is our opinion that the sediments observed within the trenches are of proper age to preserve evidence of recent seismic event, no age testing was completed as part of this investigation. As such, there remains the possibility that the sediments are upper Holocene-aged, and not of proper age to preserve fault movement. The trenches excavated as part of this investigation were advanced to the maximum practical depth.

6.2 ALLUVIAL FAN FLOODING/DEBRIS FLOW

Alluvial fan flooding is a potential hazard that may exist in areas containing Holocene alluvial fan deposits. This type of flooding typically occurs as a debris flood consisting of a mixture of soil, organic material, and rock debris transported by fast-moving flood water. Debris floods and debris flows can be a hazard on or below alluvial fans or in stream channels above alluvial fans. Precipitation (rainfall and snowmelt) is generally viewed as a debris-flow “trigger”, but this represents only one of the many factors that contribute to debris-flow hazard. Vegetation, root depth, soil gradation, antecedent moisture conditions and long term climatic cycles all contribute to the generation of debris and initiation of debris-flows. Events of relatively short duration, such as a fire, can significantly alter a basin’s natural resistance to debris-flow mobilization for an extended period of time. These factors are difficult to quantify or predict and vary not only between different watersheds, but also within each sub-area of a drainage basin. In general, there are two methods by which a debris-flow can be mobilized: 1) when shallow landslides from channel side-slopes are conveyed in existing channels when mixed with water and 2) channel scour where debris is initially mobilized by moving water in a channel and then the mobilized debris continues to assemble and transport downstream sediments.

Based on our field observations, residential building lot 1R is underlain by Holocene-aged alluvial fan deposits and is likely located near the distal or lateral portions of the fan. The finer-grained nature of the sediments observed in Trench 1 suggests that the area surrounding Trench 1 does not experience as many high energy events, with only one to two packets of debris flow sediment being observed. Our observations suggest that the adjacent 2-acre property containing Trench 2 experiences higher energy events, with 5 to 6 stacked debris flow packets being observed within our excavation. The debris flows likely originated from Broad Hollow drainage located to the east of the subject lots. Based on these observations, it is likely that Trench 2 is located in a more active channel, whereas Trench 1 is located in a distal edge of the fan, and experiences fewer debris flow events. Both of the test pits located on building lot 2R contained 5 stacked debris flow/fluvial flooding events, indicating that they are located in a relatively high-energy portion of the channel.

Based on the presence of mapped and observed past alluvial fan deposits on the subject site, the site does have the potential to be impacted by future alluvial fan flooding and debris flows. It is our recommendation that mitigation of alluvial fan flooding and debris flow hazards be designed prior to development of the site and implemented as part of construction. Given the location of Broad Hollow, alluvial fan flooding and debris flows affecting the site would come from the east to northeast.

Study of the Broad Hollow drainage basin and the entire alluvial fan deposit were outside the scope of this investigation. Proper site grading and drainage planning will greatly reduce the potential for future alluvial fan flooding/debris flow events from impacting the proposed development, however, it is likely that further remediation for this property and adjoining properties, such as a catchment basin at the canyon mouth or redirecting berm will be required to properly minimize the potential for future impacts from alluvial fan flooding/debris flow events. Based on observations made at the time of our investigation, the property owner has constructed a catchment upgradient from the proposed development. While this basin will aid in reducing the potential for debris flow events from impacting the property, it remains a possibility that large events will surpass the volume of the basin, and as such it is recommended that strategic grading be implemented to create deflection berms and a break in slope away from each residence with slopes great enough and slope heights sufficient to allow alluvial fan flooding/debris flow events from the east and northeast directions to flow around each residence. These are likely the most feasible forms of mitigation available to the property owner at this time. Based on our observations the average debris flow event appears to deposit 5 to 6 feet of sediment. This value should be verified through the completion of a formal debris flow analysis.

7.0 CLOSURE

7.1 LIMITATIONS

The conclusions and recommendations contained in this report 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. The subsurface data used in the preparation of this report were obtained from the explorations made for this investigation. It is possible that variations in the soil and subsurface conditions could exist between the points explored. The nature and extent of variations may not be evident until construction occurs. If any conditions are encountered at this site that are different from those described in this report, our firm should be immediately notified so that we may make any necessary revisions to recommendations contained in this report. In addition, if the scope of the proposed development changes from that described in this report, our firm should also be notified.

This report 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 or other geologic hazards involves a certain level of inherent risk. It is impossible to predict where ground rupture will occur during a seismic event. New faults may develop, existing faults may propagate beyond their current lengths, and displacement and ground shaking may be greater or less than that currently anticipated.

This report 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 report in its entirety. We are not responsible for the technical interpretations by others of the information described or documented in this report. The use of information contained in this report for bidding purposes should be done at the Contractor's option and risk.

8.0 REFERENCES CITED

Black, B.D., Hecker, S., Hylland, M.D., Christenson, G.E., and McDonald G.N., 2003, Quaternary Fault and Fold Database and Map of Utah: Utah geological Survey Map 193DM.

Christenson, G. E., Batatian, L. D. and Nelson C. V. 2003, Guidelines for Evaluating Surface-Fault-Rupture Hazards in Utah: Utah Geological Survey Miscellaneous Publication 03-6, 11 p.

Christenson, G.E., and Shaw, L.M., 2008, Geographic Information System database showing geologic-hazard special study areas, Wasatch Front, Utah; Utah Geological Survey Circular 106, j7 P., GIS data, scale 1:24,000.

Hintze, L.F. 1993, Geologic History of Utah, Brigham Young University Studies, Special Publication 7, 202 p.

Hintze, L.F., 1980, Geologic Map of Utah: Utah Geological and Mineral Survey Map-A-1, scale 1:500,000.

McCalpin, J.P., Foreman, S.L., Lowe, M. 1994, Reevaluation of Holocene faulting at the Kaysville site, Weber segment of the Wasatch fault zone, Utah, Tectonics, American Geophysical Union Publication, Vol. 13, No. 1, Pages 1-16

Nelson, A.R., Personius, S.F., 1993, Surficial Geologic Map of the Weber Segment, Wasatch Fault Zone, Weber and Davis Counties, Utah, U.S. Geological Survey, Miscellaneous Investigations Series, Map I-2199.

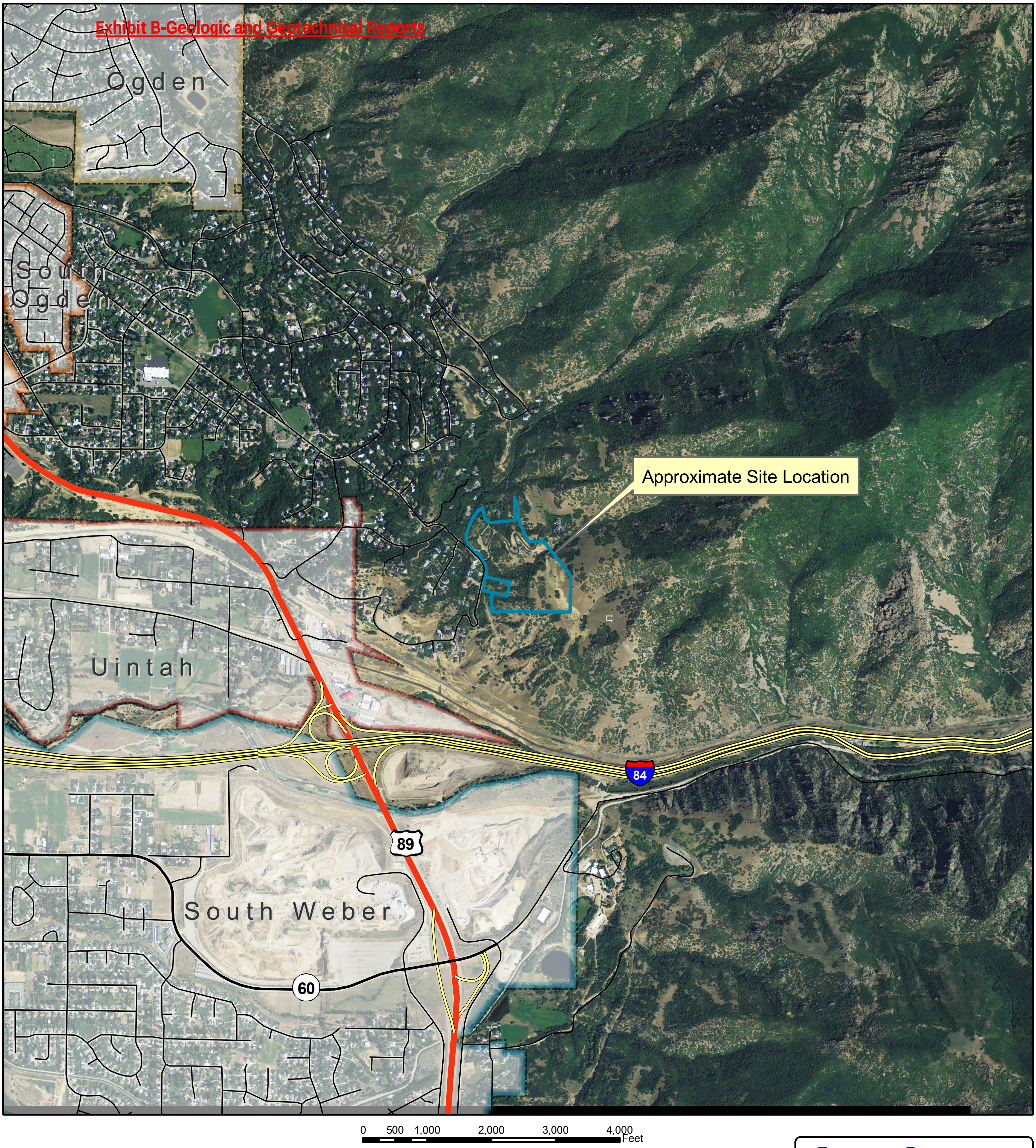
Personius, S.F., 1986, The Brigham City Segment – A new segment of the Wasatch Fault zone, Northern Utah; Geological Society of America Abstracts with Programs, V. 18, No 5, P.402.

Scott, W.E., McCoy, W.D., Shorba, R.R., and Rubin, Meyer, 1983, Reinterpretation of the exposed record of the last two cycles of Lake Bonneville, western United States: Quaternary Research, v.20, p. 261-285.

Stokes, W.L., 1986, Geology of Utah: Utah Museum of Natural History and Utah Geological and Mineral Survey Occasional Paper Number 6, 280 p.

Yonkee, A., Lowe, M., 2003, Geologic Map of the Ogden 7.5' Quadrangle, Weber and Davis Counties, Utah, Utah Geological Survey Map 200.

Zoback, M.L., 1983, Structure and Cenozoic tectonism along the Wasatch fault zone, Utah, Geological Society of America Memoir 157, p. 3-27.



1:24,000

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

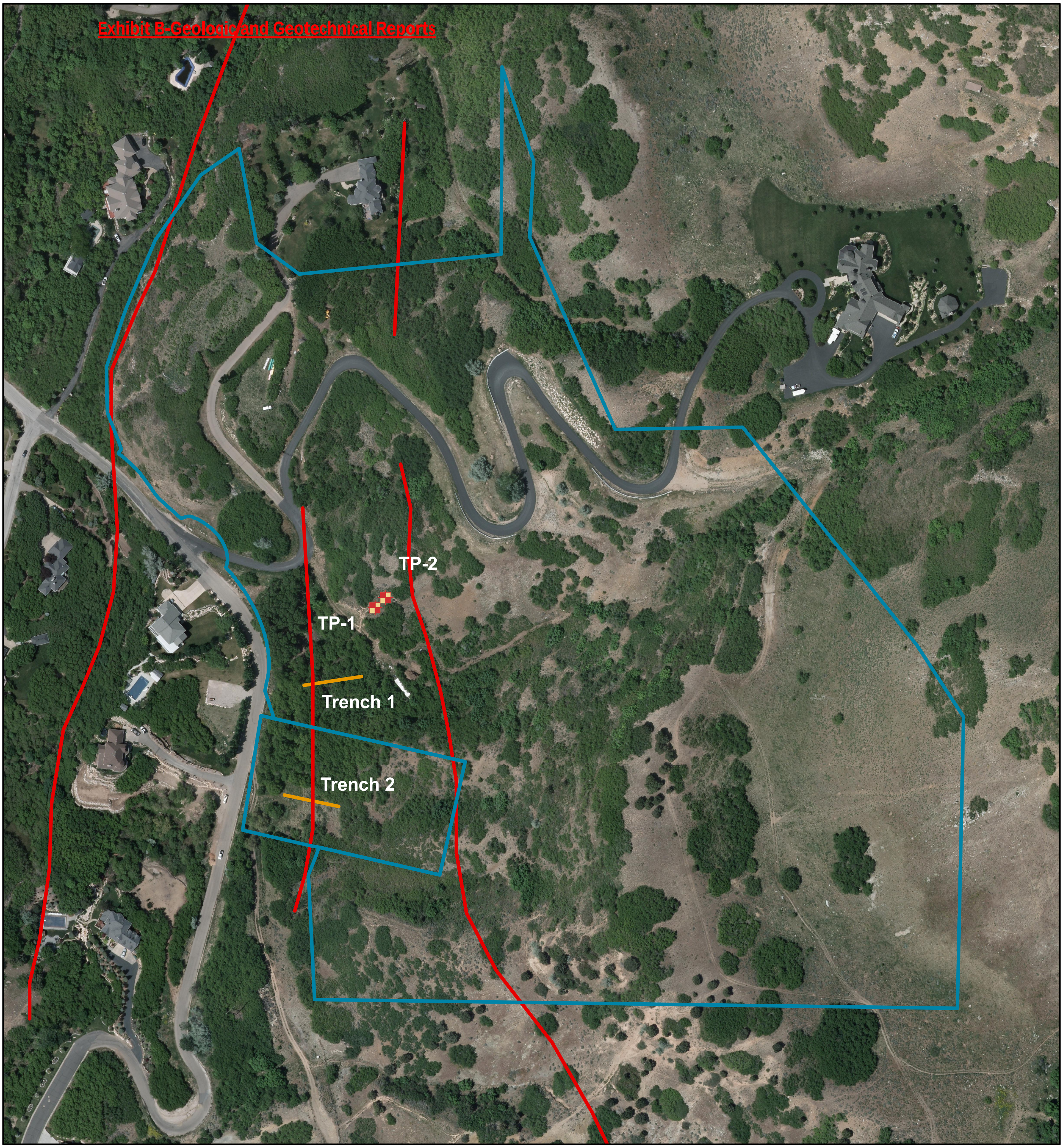
All Locations are Approximate

GeoStrata
Engineering & Geosciences

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

Exploration Location Map

Plate A-1



1:3,000

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

All Locations are Approximate

Legend

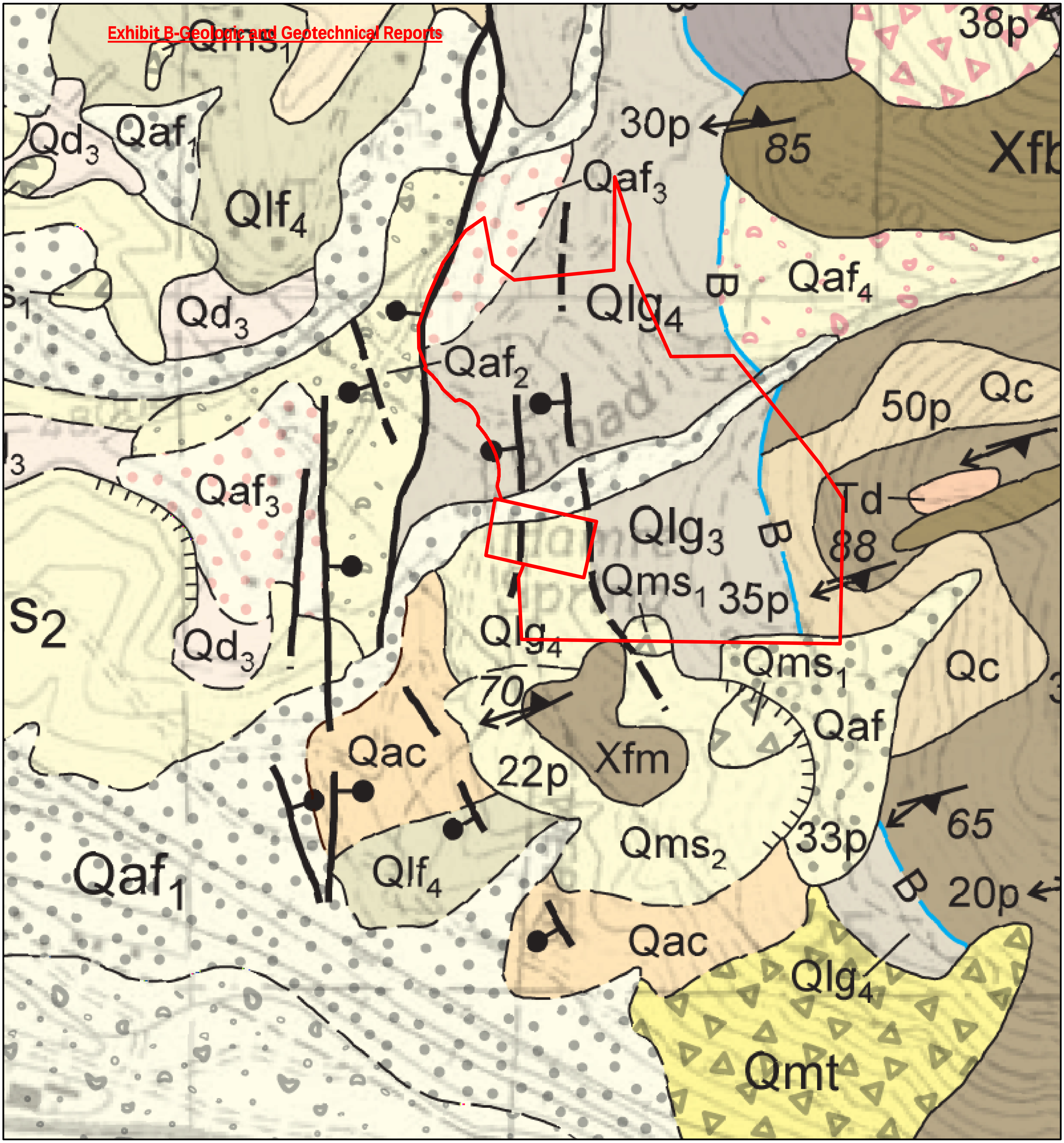
- Site Boundary
- Fault
- Trench
- Test Pit

GeoStrata
Engineering & Geosciences

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

Exploration Location Map

Plate A-2



Legend

Site Boundary

Qac – Colluvium and Alluvium undivided

Qaf – Alluvial fan deposits

Qlg – Lacustrine gravel-bearing deposits

Qlf – lacustrine fi□-grained deposits

Qms – Landslide deposits

Xfm – Migmatic □□gneiss

0 100 200 400 600 800 Feet

1:6,000

Base Map: USGS 7.5 Minute Topographic Map obtained from the State of Utah AGRC.

All Locations are Approximate

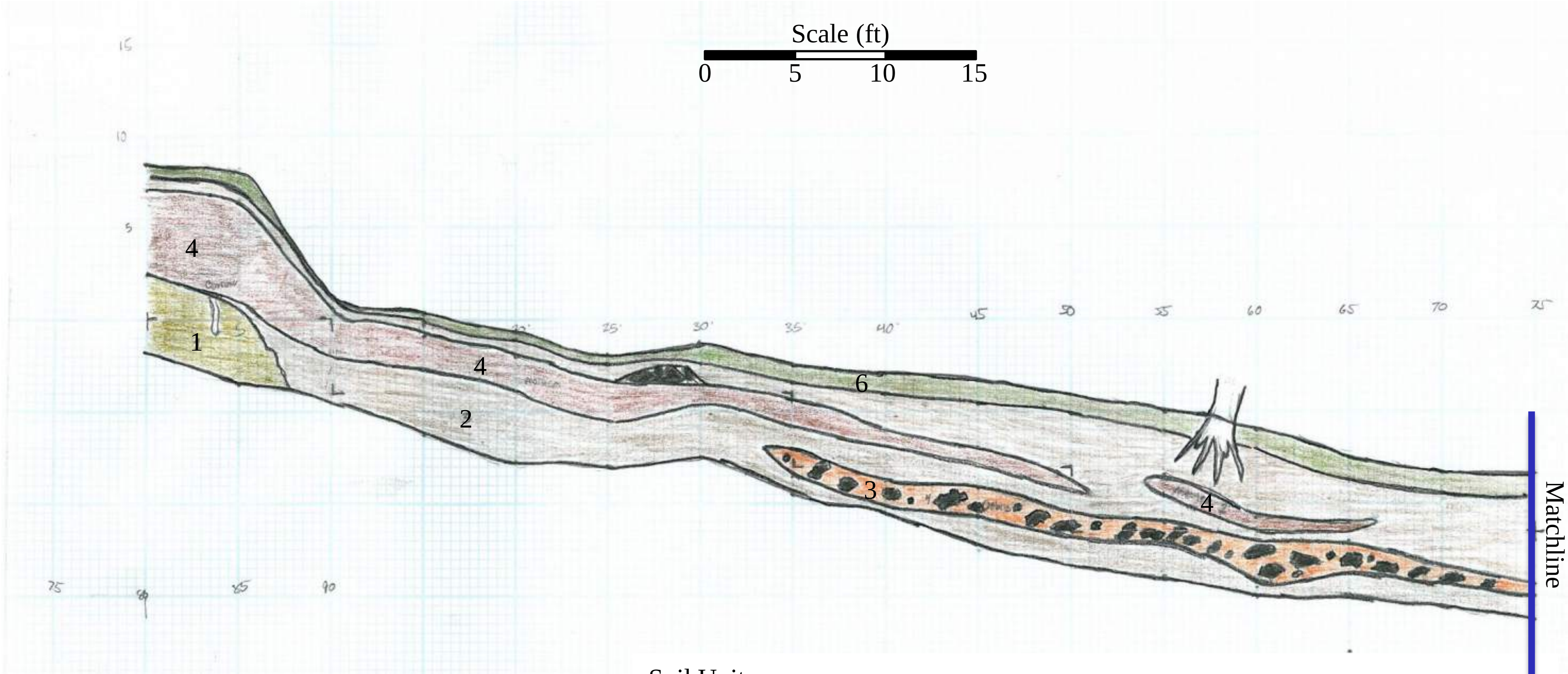
N

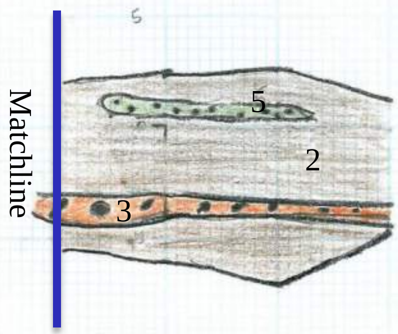
GeoStrata Engineering & Geosciences

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

Geologic Map

Plate A-3





Soil Units

1 – Lacustrine SILT and SAND, crudely laminated, 3-4 inches of Fe staining, sand more prevalent with depth

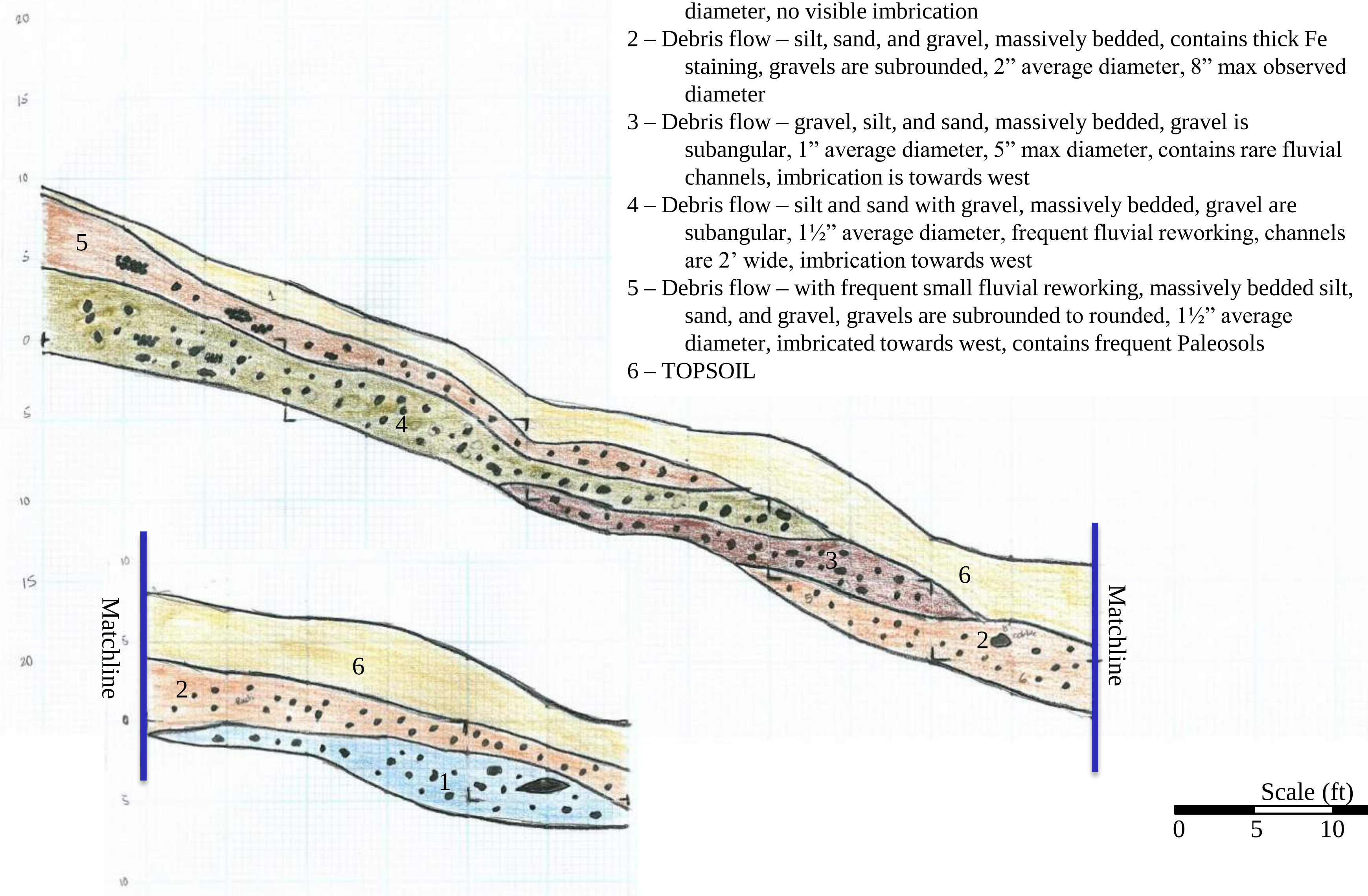
2 – Massive Sandy SILT, alluvial fan, no stringers, weakly cemented

3 – Debris flow, alluvial fan deposit, cobbles up to 12" in diameter, subangular to subrounded, silt and sand matrix supported, massively bedded

4 – Massive Sandy SILT, prevalent carbonate stringers

5 – Debris flow deposit, gravels up to 1½" in diameter

6 – Active topsoil horizon



Soil Units

1 – Debris flow – silt, sand, and gravel, massively bedded, gravel are subrounded to subangular, 1” average diameter, 3” max observed diameter, no visible imbrication

2 – Debris flow – silt, sand, and gravel, massively bedded, contains thick Fe staining, gravels are subrounded, 2” average diameter, 8” max observed diameter

3 – Debris flow – gravel, silt, and sand, massively bedded, gravel is subangular, 1” average diameter, 5” max diameter, contains rare fluvial channels, imbrication is towards west

4 – Debris flow – silt and sand with gravel, massively bedded, gravel are subangular, 1½” average diameter, frequent fluvial reworking, channels are 2’ wide, imbrication towards west

5 – Debris flow – with frequent small fluvial reworking, massively bedded silt, sand, and gravel, gravels are subrounded to rounded, 1½” average diameter, imbricated towards west, contains frequent Paleosols

6 – TOPSOIL

Scale (ft)

0 5 10 15

GeoStrata

Lab Summary Report

Matt Rassmusen
Dauphine-Savory Piedmont Subdivision
Weber County, UT
Project Number: 910-001

Plate B - 2

DATE		
STARTED:	10/22/13	
COMPLETED:	10/22/13	
BACKFILLED:	10/22/13	

Matt Rassmusen
Dauphine-Savory Piedmont Subdivision
Weber County, UT
Project Number 910-001

GeoStrata Rep: S. Seal
Rig Type: Trackhoe

TEST PIT NO:
TP-1
Sheet 1 of 1

LOCATION
NORTHING EASTING ELEVATION

DEPTH (FEET)	SAMPLES	MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
0		TOPSOIL; Clayey SAND with gravel, cobbles, and boulders - with roots and pinholes throughout					
		Debris Flow - massively bedded, sand, gravel, cobbles and boulders in silty matrix, clasts are subangular to subrounded, boulders observed up to 24" in diameter, novisible imbrication					
5		Debris Flow - massively bedded, sand, gravel, cobbles and boulders in silty/clayey matrix, clasts are subrounded to subangular, dark brown color, possible paleosol, cobbles observed up to 10" in diameter					
	▯	Hyper-Concentrated Flow - gravel in a silt and sand matrix, weakly bedded, gravel is subrounded, cobbles observed up to 10" in diameter, weak imbrication to the NW		3.2	12.3	NP	NP
	▯	Debris Flow - massively bedded, sand and gravel in silt matrix, gravels are subrounded, gravel observed up to 3" in diameter @ 9.5 ft - material is angular, gravel observed up to 6" in diameter		0.8	7.9	NP	NP
10		Hyper-Concentrated Flow - gravel in a silt and sand matrix, weakly bedded, gravel is subrounded to subangular, gravel observed up to 4" in diameter, weak imbrication to the NW					
		Bottom of Test Pit @ 11 Feet					

METERS: 0, 1, 2, 3, 4

Moisture Content and Atterberg Limits
Plastic Limit — Moisture Content ● — Liquid Limit
10 20 30 40 50 60 70 80 90

UNIFIED SOIL CLASSIFICATION | WATER LEVEL | GRAPHICAL LOG

GeoStrata

SAMPLE TYPE
▯ - GRAB SAMPLE
▨ - 2.5" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
▼ - MEASURED
▽ - ESTIMATED

NOTES:

Plate
B-3

DATE		
STARTED:	10/22/13	
COMPLETED:	10/22/13	
BACKFILLED:	10/22/13	

Matt Rassmusen
Dauphine-Savory Piedmont Subdivision
Weber County, UT
Project Number 910-001

GeoStrata Rep: S. Seal
Rig Type: Trackhoe

TEST PIT NO:
TP-2
Sheet 1 of 1

LOCATION
NORTHING EASTING ELEVATION

Depth scale: METERS 0–4; FEET 0–10

MATERIAL DESCRIPTION	Dry Density(pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
TOPSOIL; Silty SAND with gravel, cobble, and boulders - with roots and pinholes throughout					
Debris Flow - massively bedded, sand, gravel, and cobbles in silt matrix, gravel is subrounded to subangular, cobbles observed up to 6" in diameter					
Fluvial Deposit - gravel in a sand and silt matrix, weakly bedded, gravel is subrounded to subangular, gravel observed up to 3" in diameter					
Huper-Concentrated Flow - sand with gravel and silt, massively bedded, contains frequent 2-3" long channel deposits, weakly cemented, gravel is subrounded, gravel observed up to 2" in diameter		2.0	10.9	NP	NP
Fluvial Deposit - gravel in a matrix of silt and sand, weakly bedded, gravel is subangular, gravel observed up to 6" in diameter, no imbrication		0.8	3.8	NP	NP
Debris Flow - massively bedded, sand, gravel and cobbles in a silt matrix, gravel is subrounded, cobbles observed up to 12" in diameter					
Bottom of Test Pit @ 11 Feet					

Moisture Content and Atterberg Limits
Plastic Limit — Moisture Content — Liquid Limit
10 20 30 40 50 60 70 80 90

LOG OF TEST PITS (B) TEST PIT LOGS.GPJ GEOSTRATA.GDT 12/5/13

GeoStrata

SAMPLE TYPE
- GRAB SAMPLE
- 2.5" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
- MEASURED
- ESTIMATED

NOTES:

Plate B-4

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 Christensen, P.E.
Timothy Thompson, P.G.

5/8/14

LICENSED PROFESSIONAL ENGINEER MARK I. CHRISTENSEN No. 188039 LICENSED STATE OF UTAH

Date: **May 8, 2014**

Subject: **Review of Proposed Residential Development – Dauphine-Savory Piedmont Subdivision, GeoStrata Project # 910-001**

The memorandum has been completed as a response to a request by Matt Rasmussen to assess construction plans submitted to GeoStrata for a proposed single family residence on Lot 2R within the proposed Dauphine-Savory Piedmont Subdivision in unincorporated Weber County, Utah. GeoStrata previously completed a geotechnical and geological assessment of the subject property, the results of which may be found in two separate reports dated December 10, 2013. The purpose of this memorandum is to assess if the proposed site plan meets the recommendations made within our 2013 report. Construction plans for the proposed residential structure were provided by the Client, and were prepared by David E. Wiggins Architect. These plans are entitled S'Fondare Estate and are dated August 12, 2012.

As part of our assessment, the geological report completed by GeoStrata was reviewed. A summary of the pertinent conclusions and recommendations within the report are as follows:

1) The subject building lot is not located within a surficial faulting special study zone. As such, no fault trenches were excavated. Rather subsurface soil conditions were investigated through the excavation of two exploratory test pits.

2) The subject building lot was identified as being at an elevated risk of being impacted by alluvial fan flooding/debris flows.

3) It is recommended that strategic site grading and catchment basins/earthen barriers be utilized to minimize the risk of the proposed development being impacted by alluvial fan flooding/debris flow events.

In addition, the geotechnical report completed by GeoStrata was reviewed. A summary of pertinent conclusions and recommendations within the report are as follows:

1) Due to the presence of highly collapsible soils, the proposed structure should be founded upon a minimum of 24 inches of properly placed and compacted structural fill.

2) Strip and spread footings should be a minimum of 18 and 36 inches wide, respectively, and exterior shallow footings should be embedded at least 30-inches below final grade for frost protection and confinement.

These summaries are not all-inclusive. A full review of the subject reports should be made prior to the initiation of construction activities.

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.

The plans do include recommendations concerning the embedment and size of the foundation elements. Based on our review, the proposed footings meet or exceed the recommendations made in our geotechnical report. The plans do not indicate that the footing elements will need to be placed upon a minimum of 24 inches of properly placed and compacted structural fill. This requirement should be incorporated into the construction of the residence.

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.

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.

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

MEMORANDUM

PROFESSIONAL GEOLOGIST LICENSED 4/24/15 # 5242839 TIMOTHY J. THOMPSON STATE OF UTAH

To: **Matt Rasmussen**

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

Date: **April 24, 2015**

Subject: **Review Response for Geological Review – 6472 and 6498 South Bybee Drive, Weber County Parcel Numbers: 07-753-0001 and 07-753-0002 Uintah, Utah, SBI Project Number 2-14-522**

GeoStrata has received review questions of our report titled **Geologic Hazards Assessment, 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. This report was prepared for Mr. Matt Rasmussen and submitted to Weber County for review. Mr. David B. Simon, P.G. of Simon Bymaster Inc. (SBI) prepared a review of our report. This memorandum was prepared in response to a series of review questions presented in a letter prepared by Mr. Simon and dated November 29, 2014.

Review Questions – S.B.I.

1. "The Table of contents indicate the report contains the following plates:

   Plate A-1, Site Vicinity Map
   Plate A-2, Site Exploration Map
   Plate A-3, Surficial Geology Map
   Plate A-4, Trench 1 Log
   Plate A-5, Trench 2 Log
   Plates B-3 and B-4, Test Pit Logs

   The title on Plates A-1 and A-2 is "Exploration Location Map." The title on Plates B-1 and B-2 is Lab Summary Report. SBI suggests Weber County request GeoStrata submit all plates with correct titles."

GeoStrata Response: GeoStrata has reviewed the referenced plates and has updated the incorrect title blocks. Updated versions of the plates have been produced and attached to the end of this letter. As part of this review, additional plates have been completed. The plates attached to the end of this letter are as follows;

Plate A-1, Site Vicinity Map
Plate A-2, Exploration Location Map
Plate A-3, Site Vicinity Geologic Map
Plate A-4, Site Vicinity Geologic Map Key (Key for Plate A-3)
Plate A-5, Site Specific Geologic Map
Plate A-6, Site Geologic Setback Map
Plate A-7, Hillshade 180° Sun-angle Map, with site boundaries and exploration locations.
Plate A-8, Hillshade 180° Sun-angle Map, without site boundaries and exploration locations.
Plate A-9, Hillshade 90° Sun-angle Map, with site boundaries and exploration locations.
Plate A-10, Hillshade 90° Sun-angle Map, without site boundaries and exploration locations.

Plate B-1 and B-2, Trench 1 Hand Log
Plate B-3 and B-4, Trench 3 Hand Log

2. "Plates B-1 and B-2, "Lab Summary Report," are presumably the logs of the trenches excavated at the site. It is standard of practice for trench logs to: a) contain both a vertical and horizontal scale, b) indicate the trench corresponding to the log, c) indicate the trench wall documented and, c) [sic] indicate the orientation of the trench (Salt Lake County, 20021, 2002b; Christenson and others, 2003; Draper City, 2007; McCalpin, 2009; Morgan County, 2010).

   Christenson and others (2003), state (page 8), "Some form of vertical and horizontal logging control must be used and shown on the log. The log should document all pertinent information from the trench, including geologic-unit contacts and descriptions, faults and other deformation features, and sample locations."

   SBI suggests Weber County request GeoStrata submit properly annotated trench logs.

GeoStrata Response: GeoStrata has reviewed the referenced trench logs and have added the requested information. Updated versions of the trench logs have been attached to the end of this letter as Plates B-1 to B-4. It should be noted that, at the request of the Client, the study area has been altered, and it is now requested that this report be prepared in order to assess residential building lots 1R and 2R only. As a result, Trench 2 as discussed in our 2013 report will not be included as it was excavated as part of an on-going study for the 2-acre portion of the property outside of residential building lots 1R and 2R. In addition, it should be noted that in order to assess the surficial fault rupture hazard on lot 2R, an additional trench (Trench 3) was completed. This trench has been included as Trench 3.

3. "Section 2.2, Project Description (p.2), states "…Proposed development, as currently planned, will consist of two to three residential building lots as well as associated roadways and landscaped areas. The subject property also includes a 2-acre portion that adjoins the two to three lots to the south… The project site is shown on the Site Vicinity Map included in the Appendix of this report (Plate 1). The Appendix also includes a Surficial Geology Map (Plate 2 and a Site Exploration Location Map (Plate 3)."

Building envelopes 1R and 2R are not delineated on any of the figures in the report. Also, the report did not contain Plates 1, 2, and 3.

SBI recommends Weber County request GeoStrata:

a. Submit a site plan, clearly delineating proposed building envelopes, particularly 1R and 2R.
b. Confirm that Plates 1, 2, and 3 are Plates A-1, A-2, and A-3.

GeoStrata Response: GeoStrata has reviewed the referenced plates and has added the requested data onto Plate A-2, Exploration Location Map. Plates 1, 2, and 3 were indeed intended to be Plates A-1, A-2, and A-3. This error has been corrected, and updated Appendix A Plates have been attached to the end of this letter.

4. "Section 2.1, Purpose and Scope of Work (p. 2), indicates GeoStrata reviewed and evaluated aerial photographs covering the site area. SBI suggests Weber County request GeoStrata provide the source, date, flight-line numbers, and scale of aerial photos used (Christenson, 2003).

GeoStrata Response: The following aerial photographs were reviewed as part of this investigation;

Source	Date	Flight-line Number	Scale
UGS	9/26/1937	10-AAJ3-49	Unknown
UGS	9/26/1937	10-AAJ3-50	Unknown
UGS	1970	WF2-5 141	1:12,000
UGS	1970	WF2-5 142	1:12,000
UGS	1970	WF2-15 210	1:6,000
UGS	1970	WF2-15 211	1:6,000
UGS	1970	WF2-15 212	1:6,000
UGS	1970	WF2-15 213	1:6,000
UGS	1970	WF2-15 214	1:6,000

In addition to the aerial photographs listed above, GeoStrata has also investigated hillshade maps produced using <1m Lidar data obtained from the AGRC. The UGS informed GeoStrata that reassessment of fault scarp location is underway using this data along the Wasatch Front. Based on our review of this Lidar data and our stereo aerial photography review, no visible lineations or other surface fault rupture related geomorphology was observed that would indicate the presence of surface fault ruptures on or adjacent to the subject site. As part of our review of the Lidar data , the following plates were produced and attached to the end of this report;

Plate A-7, Hillshade 180° Sun-angle Map, with site boundaries and exploration locations.
Plate A-8, Hillshade 180° Sun-angle Map, without site boundaries and exploration locations.

Plate A-9, Hillshade 90° Sun-angle Map, with site boundaries and exploration locations.
Plate A-10, Hillshade 90° Sun-angle Map, without site boundaries and exploration locations.

5. "Plate A-3, Geologic Map, is improperly referenced. For clarity, the correct reference is Yonkee, W.A. and Lowe, M., 2004, Geologic map of the Ogden 7.5 minute quadrangle, Utah Geological Survey Open-File Report M-200, 42 p., 2 pl., scale 1:24,000, which is in the consultant's references.

   The referenced geologic map in the south part of the property has two errors, regarding either the color and/or geologic unit designations. SBI contacted the Utah Geological Survey (UGS) about the apparent errors, which they confirmed are present on the map. The correct map, provided by the UGS, is attached.

GeoStrata Response: No map could be found as an attachment to the review document. As such, GeoStrata also contacted the UGS for a copy of the corrected version of the referenced map. The map provided to GeoStrata was identical to the map obtained from the UGS website, which was utilized in our 2013 investigation.

6. "Apparently Plate A-3, in the referenced report, was enlarged from Yonkee and Lowe (2004), which can be problematic, particularly when the limitations of enlarging a geologic map are not indicated. Yonkee and Lowe (2004) performed the mapping at a scale of 1:24,000 and the map is intended to be used at the scale of the publication. Plate A-3 is presented in the GeoStrata report at 1:6,000.

   Once enlarged, without reference, a level of detail is inherently implied, which is not factual. At the enlarged scale, significantly greater detail would be inherently expected, especially in regard to delineation of surficial deposits. Enlarging geologic maps in such a manner is fundamentally not sound geologic practice. Also, GeoStrata notes in the report areas where GeoStrata disagree with the geology shown on Plate A-3. It is standard of practice to include a site-specific geologic map (particularly for a site of several acres in size) (Salt Lake County, 2002a, 2002b; Christenson and others, 2003; Draper City, 2007; Morgan County, 2010). SBI recommends Weber County request the consultant submit a site-specific geologic map.

GeoStrata Response: The correct reference for Plate A-3 has been provided on the updated plate attached to this letter. Plate A-3 is also presented at the appropriate scale. GeoStrata has completed a site-specific geologic map based on our field observations and aerial photography review. The map has been attached to the end of this letter as Plate A-5.

7. "According to the geology depicted on Plate A-3, there is a landslide deposit at the south-center part of the south property boundary (unit Qms_1 on Plate A-3). SBI suggests Weber County request GeoStrata discuss the impacts of the landslide deposit on proposed development.

GeoStrata Response: The referenced landslide deposits (unit Qms_1) is located on the southern-most portion of the property, approximately 135 feet south of the buildable pad on lot 1R, and approximately 195 feet south of the buildable pad on lot 2R. The landslide deposit is mapped with an axis of movement oriented to the south, and is additionally separated from the proposed building pads by a small drainage. As such, it is it is our opinion that the mapped landslide will have no impact on the areas of proposed development on Lots R1 and R2.

8. "Throughout the report GeoStrata references alluvial fan deposits and debris flow deposits. SBI recommends Weber County request GeoStrata describe the general characteristics of the two deposits.

GeoStrata Response: GeoStrata has revisited the site since our original 2013 report was prepared, and determined that additional trenching and closer examination of the existing trenches was required. An additional trench (Trench 3) was excavated across the proposed building area of lot 2R and Trenches 1 and 2 were deepened, re-cleaned, and re-investigated. As a result of these additional investigations, we have updated our geologic interpretations of the sediment observed within the exploratory trenches. The updated interpretations are as follows;

<u>Trench 1 Description:</u>
Trench 1 was approximately 90 feet long, oriented approximately S80°W, and was excavated in order to assess the proposed building area of lot 1R for the presence of surface fault rupture hazards and debris flow potential within the buildable portion of the lot. The trench was excavated with a trackhoe to depths ranging from 8½ to 12 feet below the existing site grade. A hand log of the trench can be found on Plates B-1 and B-2. It should be noted that based on conversations with the Client, the area near the eastern portion of the trench contains a cut section completed several years prior to this investigation to aid in the construction of the roadway to the east. This cut is reflected in the eastern portion of our logs as the disappearance of Units 3 and 4 (see below for unit descriptions).

Sediments exposed in Trench 1 have been separated into four stratigraphic units and labeled Unit 1 through Unit 4. The oldest sediment observed at the bottom of the trench was designated as Unit 1, and was observed to persist for the full length of the trench. Unit 1 was observed to consist of silt and sand, and contained crude laminations 3 to 4 inches apart. The unit was weakly bedded, and contained significant iron staining. Unit 1 was interpreted as representing a lacustrine silt and sand deposit of Pleistocene-age. When referring to the geologic mapping completed by Yonkee and Lowe (2004), this deposit most closely matches the description given for Bonneville transgressive fine-grained deposits (Qlf_4), which are described as "Intervals of calcareous clay to silt, and intervals of rhythmically interbedded fine- to medium-sand and silt near mouth of Weber Canyon; deposited in deeper water environments, and as delta bottom set beds during transgression of Lake Bonneville".

Unit 2 was observed to span a length of approximately 57 feet, being first observed at approximately 33 feet from the eastern end of the trench and persisting to the western end of the trench. Unit 2 was observed to consist of massively bedded silt and sand with minor gravel and infrequent cobble. The gravel and cobbles were observed to be largely rounded to subrounded, were generally up to 3 inches in diameter with a maximum observed diameter of approximately 12-inches, and were contained within a matrix of silt and sand, although in several places the deposit was clast supported. The cobbles were weakly imbricated and indicated a flow to the west. Unit 2 was interpreted as representing Pleistocene-Holocene stream alluvium sourced by intermittent streams from the foothills of the Wasatch Mountains to the east. When referring to the geologic mapping completed by Yonkee and Lowe (2004), this deposit most closely matches the description given for stream alluvium (Qal), which are described as "mostly clast-supported, moderate- to well-sorted, pebble and cobble gravel, gravelly sand, and silty sand; deposited along modern channels and inactive beaches".

Unit 3 was observed to span the entire length of Trench 1 with the exception of an approximate 5 foot long segment where the sediment had been removed by human activities. Unit 3 was observed to consist of massively bedded sand and silt. This unit contained significant organics, and several areas contained relatively large root-balls which appeared to have destroyed the original depositional characteristics of the soil. Based on the silt/sand nature of the sediment, Unit 3 is interpreted as being Holocene-aged colluvium and alluvium deposits composed of re-worked Bonneville fine-grained deposits sourced from upslope of the site. When referring to the geologic mapping completed by Yonkee and Lowe (2004), this deposit most closely matches the description given for colluvium and alluvium, undivided (Qac), which is described as "Pebble to boulder gravel and clay – to boulder-rich diamiction; includes hillslope colluvium, small fans, stream alluvium, and small landslide deposits; mapped along some vegetated canyon areas in Wasatch Range".

Unit 4 was observed to span the entire length of Trench 1 with the exception of an approximate 20 foot long segment where the sediment had been removed by human activities. Unit 4 was observed to consist of massively bedded silt, sand, gravel, and trace cobble. This unit was dark brown to black in color, contained significant organics, and contained numerous relatively large root-balls. Based on our observations, Unit 4 is interpreted as being a Holocene-aged active soil profile with well-developed O, B, and C soil horizons.

Based on our observations, the oldest continuous material, Unit 1, was deposited by Bonneville Lake processes during the Pleistocene. As such, it is of proper age to preserve evidence of Holocene-aged movement along the Weber segment of the Wasatch Fault. No fault-related deformation was observed within any of the deposits observed in Trench 1. As such, it is our opinion that no active surface rupture faults are located underlying the proposed buildable area of Lot 1R

Trench 2 Description:

The trench was approximately 95 feet long, oriented approximately N80°W, and extended through the 2-acre property located adjacent to building lots 1R and 2R. The trench was excavated with a trackhoe to a depth of approximately 7½ to 12½ feet. Trench 2 was located to intersect any faults that trend through the proposed buildable portion of this area of investigation.

As per the Client's request, this report will focus only on the buildable portions of Lots 1R and 2R. The additional 2-acre portion investigated through the excavation of Trench 2 will be discussed in a future report.

Trench 3 Description:
The additional trench excavated as part of our updated 2014 investigation has been designated as Trench 3, and was located to assess the proposed buildable portion of residential building lot 2R. The mapped portion of Trench 3 was approximately 110 feet long, and was excavated to a depth of 5½ to 17½ feet. A hand log of the trench may be found attached to the end of this letter as Plates B-3 and B-4. The location of Trench 3 may be found on Plate A-2, Exploration Location Map. It should be noted that a relatively small area of human disturbance was encountered within the pathway of Trench 3.

Sediments exposed in Trench 3 have been separated into six stratigraphic units and labeled Unit 1 through Unit 5. The oldest sediment observed at the bottom of the trench was designated as Unit 1, and was observed in relatively limited portions near the eastern end of the trench. Unit 1 was observed to consist of moderately weathered, strong, closely fractured schist bedrock. When referring to the geologic mapping completed by Yonkee and Lowe (2004), this deposit most closely matches the description given for Early Proterozoic Metamorphic and Igneous Rocks, Muscovite-bearing schist (Xfs), which is described as "grey-brown, strongly foliated, schist to gneiss containing variable amounts of muscovite, biotite, quartz, and feldspar".

Unit 2 was observed to span an approximate 50 foot long section of the eastern portion of the trench. Unit 2 was observed to consist of thinly bedded course-grained sand and gravel. Occasional seams of this unit were moderately cemented. The gravels were subrounded to round, and largely clast supported. Measurements of the strike and dip of this unit ranged from S25°W to S51°E with Dips of 43° to 51°, respectively. Unit 3 was interpreted as representing Pleistocene-aged lacustrine gravel deposits. When referring to the geologic mapping completed by Yonkee and Lowe (2004), this deposit most closely matches the description given for Lacustrine gravel-bearing deposits associated with the transgressive phase of the Bonneville lake cycle (Qlg_4), which are described as "clast-supported, moderately to well-sorted, pebble to cobble gravel with some silt to sand in interfluve areas and away from mountain front; gravels contain rounded to subrounded clasts, and some subangular clasts derived from reworking of mass-wasting and alluvial fan deposits; Deposited in higher energy environments along shorelines and small fan deltas as Lake Bonneville was transgressing; grades westward away from shorelines into fine-grained lacustrine deposits (Qlf_4)".

Unit 3 was observed to persist for nearly the full length of the trench, with the exception of the western-most 20 feet. Unit 3 was observed to consist of silt and sand, and contained crude laminations 3 to 4 inches apart. The unit was weakly bedded, and contained significant iron staining. Unit 3 was interpreted as representing a lacustrine silt and sand deposit of Pleistocene-age, and correlates to Unit 1 observed in Trench 1. When referring to the geologic mapping completed by Yonkee and Lowe (2004), this deposit most closely matches the description given for Bonneville transgressive fine-grained deposits (Qlf_4), which are described as "Intervals of calcareous clay to silt, and intervals of rhythmically interbedded fine- to medium-sand and silt near mouth of Weber Canyon; deposited in deeper water environments, and as delta bottom set beds during transgression of Lake Bonneville".

Unit 4 was observed to persist for the full length of the trench, and was observed to consist of massively bedded sand and silt. This unit contained significant organics, and several areas contained relatively large root-balls which appeared to have destroyed the original depositional characteristics of the soil. Based on the silt/sand nature of the sediment, Unit 3 is interpreted as being Holocene-aged colluvium and alluvium deposits composed of re-worked Bonneville fine-grained deposits sourced from upslope of the site. When referring to the geologic mapping completed by Yonkee and Lowe (2004), this deposit most closely matches the description given for colluvium and alluvium, undivided (Qac), which is described as "Pebble to boulder gravel and clay – to boulder-rich diamiction; includes hillslope colluvium, small fans, stream alluvium, and small landslide deposits; mapped along some vegetated canyon areas in Wasatch Range".

Unit 5 was observed to persist for the full length of the trench, with the exception of an approximate 5-foot wide section where it had been removed by human activities. Unit 5 was observed to consist of massively bedded silt, sand, gravel, and trace cobble. This unit was dark brown to black in color, contained significant organics, and contained numerous relatively large root-balls. Based on our observations, Unit 4 is interpreted as being a Holocene-aged active soil profile with well-developed O, B, and C soil horizons.

Unit 6 was observed to persist for approximately 5 feet approximately 70 to 75 feet from the western end of the trench. Unit 6 was observed to consist of massively bedded silt, sand, gravel, and cobble. Based on conversations with the Client as well as on our field observations, Unit 6 is being interpreted as being historical fill soils associated with the construction of the unpaved roadway leading to the central portions of residential building lot 2R. This unit had a maximum thickness of approximately 18-inches.

Based on our observations, Units 1, 2 and 3 are of proper age to preserve evidence of Holocene-aged movement along the Weber segment of the Wasatch Fault. No fault-related deformation was observed within any of the deposits observed in Trench 3. As such, it is our opinion that no active surface rupture faults are located underlying the proposed buildable area of Lot 2R. Hand logs of the trenches showing our updated interpretations and additional explorations have been attached to the end of this letter as Plates B-1 to B-4.

9. "GeoStrata concluded "...Based on our field observations, residential building lot 1R is underlain by Holocene-aged alluvial fan deposits and is likely located near the distal or lateral portions of the fan….It is likely that Trench 2 is located in a more active channel, whereas Trench 1 is located in a distal edge of the fan, and experiences fewer debris flow events…Both of the test pits located on building lot 2R contained 5 stacked debris flow/fluvial flooding events, indicating that they are located in a relatively high energy portion of the channel…Based on the presence of mapped and observed past alluvial fan

deposits on the subject site, the site does have the potential to be impacted by future alluvial fan flooding and debris flows."

Alluvial fans are the primary sites of debris-flow deposition. The debris-flow hazard depends on the site location on an alluvial fan (Giraud, 2005). SBI suggests Weber County request GeoStrata delineate the alluvial fan and active channel(s) on the site-specific geologic map.

GeoStrata Response: GeoStrata has completed the requested map and has attached it to the end of this letter as Plate A-5. It should be noted that after additional observations of the pre-existing and new exploratory trenches, it is interpreted that the alluvial fan sediment is largely confined to the channel located to the south of Trenches 1 and 3. The test pits completed previously by GeoStrata as part of our 2013 investigation were excavated within the channel and encountered stacked debris and hyper-concentrated flows. These deposits were not observed in trenches 1 or 3. Mapping completed by Yonkee and Lowe (2004) suggests that the active alluvial fan associated with the observed channel is located down-slope from the subject site. GeoStrata understand that a separate hydrological study has been completed by another firm for the subject site. As part of that study, we understand that a setback has been delineated from either side of the channel. GeoStrata has included this setback on our site-specific geologic map (Plate A-5) and on our Site Geologic Setback Map (Plate A-6).

10. "In Section 5.2.1, Trench 1 Description, (p. 7), GeoStrata states: "…A hand log of the trench can be found on Plates 4 through 11."

    SBI recommends Weber County request GeoStrata provide Plates 4 through 11, which were not included in the December 10, 2003 [sic, 2013] GeoStrata report.

GeoStrata Response: GeoStrata has updated the requested plates with the proper plate numbering system. However, based on our updated investigation, our trench logs have been altered from their 2013 form. In addition, the property containing Trench 2 is no longer being considered for development at this time. As a result the logs of Trench 2 will not be necessary for this investigation. A hand log of Trench 1 and Trench 3 may be found attached to this letter as Plates B-1 to B-4.

11. "On page 9, (5.2.1 Trench 1 Description), page 11 (5.2.2 Trench 2 Description), page 13 (5.2.3 Test Pit 1 Description), and page 15 (5.2.4 Test Pit 2 Description), the Consultant states "…The presence of well-developed O, B, and C topsoil horizons suggests that the current site geomorphology has been established for a relatively long time."

    Consistent with long-established, geologic standards-of-practice (Birkeland, 1999), it is appropriate to document soil-stratigraphic development by providing at least one, representative, standard soil-profile measurement and description. It would assist the review process if GeoStrata would provide their soil-profile measurement and description. SBI suggests Weber County request GeoStrata submit their soil-profile measurement, indicate the location of the profile on the site-specific geologic map, and clarify what is meant by "…a relatively long time."

GeoStrata Response: GeoStrata is not using the topsoil profile to indicate the age of the sediment, and has removed any verbiage that may have suggested such. As a result, it is not considered necessary that GeoStrata conduct a soil profile measurement and description. To inquire as the nature of "standard of care" in the region, GeoStrata contacted Mr. Bill Black of Western Geologic, who reported that he does not consider such a requirement to be within the "standard of care". He further stated that a soil specialist should be retained should a soil-profile measurement be necessary. Permission was received by Mr. Black to summarize the conversation.

12. In Section 6.1 Surface Rupture Hazard (P. 16), GeoStrata states: "GeoStrata conducted a surface fault rupture hazard assessment across building lot 1R as well as on adjacent 2-acre parcel to assess these residential lots for surface fault rupture hazards. Trenching was not completed on building lot 2R as it is located outside of the surficial faulting special study zone. …Plate A-2 also shows the surface fault rupture hazard special study area as determined by GeoStrata utilizing a distance of 500 feet from the reported location of the Weber segment. This distance of 250 feet is recommended by Christensen [sic Christenson] and others (2003) for the upthrown side of the fault. Since the location of the fault was reported by Nelson and Personius (1993) on a larger and less accurate scale, GeoStrata used the location as reported by Yonkee and Lowe (2004) to assess the special study area in an attempt to be more conservative."

    In the executive summary and in Section 3.3 (Subsurface Investigation), page 4, GeoStrata states "…two exploratory test pits were excavated on building lot 2R."

    Christenson and others (2003), recommend, for well-defined faults, a special study area 500 feet wide on the downthrown side and 250 feet wide on the upthrown side. The two test pits, as shown on Figure A-2 of the December 10, 2013, GeoStrata report, are located between two north-south trending, normal faults (downthrown to the west). According to Plates A-2 and A-3 of the December 10, 2013, GeoStrata report, the test pits are about 90 feet from the east fault and 125 feet from the west fault, well within this special study area recommended in Christenson and others (2003).

    Also, Plate A-2 in the December 10, 2013 GeoStrata report does not depict the surface-fault-rupture hazard special study area as determined by GeoStrata, utilizing a distance of 500 feet from the reported location of the "Weber segment"

    SBI recommends Weber County request:

a. GeoStrata submit Plate A-2 depicting the surface fault rupture hazard special study area as determined by GeoStrata utilizing a distance of 500 feet from the reported location of the Weber segment.

b. Clarify why building lot 2R was not included in their surface-fault-rupture hazard study.

GeoStrata Response: Upon review, it does indeed appear that residential building lot 2R should be included within the surface-fault-rupture hazard study zone as per Christenson and others (2003). As a result, GeoStrata has excavated an additional trench (Trench 3) in order to assess the proposed building pad of building Lot 2R. Our observations of Trench 3 are discussed as a response to review comment 8. A map showing the areas assessed by our investigatory trenches is included as Plate A-6, Site Geologic Setback Map.

13. On page 9 (Section 5.2.1 Trench 1 Description), GeoStrata states: "It is our opinion that the oldest continuous material, Unit 2 was deposited at some point in the Holocene, and considering the depth of the trench it is believed that the sediments are of an age to preserve evidence of Holocene-aged movement along the Weber segment of the Wasatch Fault. No fault-related deformation was observed within any of the deposits observed in Trench 1. It is our opinion that no active surface rupture faults are located within the limits of the area exposed in Trench 1."

    On page 11 (Section 5.2.2 Trench 2 Description), GeoStrata states: "It is our opinion that the oldest material, Unit 1, was deposited at some point in the Holocene, and considering the depth of the trench it is believed that the sediments are of an age to preserve evidence of Holocene-aged movement along the Weber segment of the Wasatch Fault. No fault related deformation was observed within any of the deposits observed in Trench 2. It is our opinion that no active surface rupture faults are located within the limits of the area exposed in Trench 2."

    On page 16 (6.1 Surface Rupture Hazard), GeoStrata states: "It should be noted that while it is our opinion that the sediments observed within the trenches are of proper age to preserve evidence of recent seismic event, no age testing was completed as part of this investigation. As such, there remains the possibility that the sediments are upper Holocene-aged, and not of proper age to preserve fault movement. The trenches excavated as part of this investigation were advanced to the maximum practical depth," (italics added).

    GeoStrata states that it is their "opinion" that the oldest continuous material in the trenches were deposited at some time in the Holocene, and, considering the depth of the trenches, it is their belief that the age of the sediments is sufficient to preserve evidence of Holocene-aged movement along the Weber segment of the Wasatch Fault.

    GeoStrata subsequently expresses uncertainly in whether or not the trenches were excavated to a sufficient depth to observe Holocene-aged faulting and that the trenches excavated to the maximum practical depth. The two trenches excavated by GeoStrata ranged from 5 to 10 feet in depth and from 6 to 9 feet in depth, respectively; less than the practical depth limit of trenching, generally considered 15 to 20 feet (in most cases). Trenches must extend at least through sediments inferred to be older than several fault recurrence intervals.

    SBI recommends Weber County request GeoStrata provide:

a. The location of the trenches and test pits on a site plan.

b. Data to support their opinion that the oldest continuous sediments in the trenches were deposited at some time in the Holocene and the sediments are of an age to preserve evidence of at least the last two surface fault rupture earthquakes (Nelson and others, 2006).
c. An explanation for their interpretation that the depth of the two trenches was within the practical limit of excavation.
d. Additional quantitative data regarding the age of sediments exposed in the trenches.
e. Recommendations that reflect their inherent uncertainties regarding the age of sediments exposed in the trenches.

Christenson and others (2003), state:

a. Depth of Excavation (page 7): "For suspected Holocene faults, trenches should extend through all unfaulted Holocene deposits and artificial fill to determine whether a fault has been active during Holocene time. However, an early Holocene fault may be concealed by unfaulted younger Holocene deposits and not be encountered within the practical depth limit of trenching, generally 15 to 20 feet (5-6 meters) in most cases. For such trenches exposing unfaulted Holocene deposits where pre-Holocene deposits are below the practical depth of trenching, the practical limitations of the trenching should be acknowledged in the report and uncertainties should be reflected in the conclusions and recommendations. In cases where an otherwise well-defined Holocene fault is buried too deeply at a particular site to be exposed in trenches, the uncertainty in its location can be addressed by increasing setback distances along a project trace. Borehole or geoprobe samples and cone penetrometer soundings with precise vertical control may help extend the depth of investigation.

b. Trench Logging and Interpretation (page 8): "…The engineering geologist interprets the ages of sediments exposed in the trench and, when necessary, obtains samples for radiocarbon or other age determinations to constrain the age of most recent surface fault rupture. In the Lake Bonneville basin of northwestern Utah, the relation of deposits to latest Pleistocene Bonneville lake-cycle sediments is commonly used to infer ages of sediments, and thus estimate ages of surface-faulting events. Unfaulted Bonneville lake cycle sediments in a trench therefore provide evidence that Holocene faulting has not occurred at that site. Outside the Lake Bonneville basin and in the Lake Bonneville basin but above the highest shoreline, determining the age of surficial deposits is generally less straightforward and commonly requires advanced knowledge of location Quaternary stratigraphy and geomorphology, and familiarity with appropriate geochronologic techniques. At sites lacking deposits of known and sufficiently old ages, particularly to assess Holocene activity, radiocarbon or other age determinations of deposits that contrain the age of the most recent surface faulting event may be required (McCalpin, 1996).

GeoStrata Response: GeoStrata has created an updated site plan showing the proposed buildable portions of residential lots 1R and 2R as well as the locations of our explorations (both trenches and test pits). This site plan has been attached to the end of this letter as Plate A-2.

Upon further review of the exploratory trenches, both pre-existing and new, it is the opinion of GeoStrata that the oldest sediment exposed in both trenches 1 and 3 consist of Pleistocene-aged lacustrine deposits. Reasoning behind our interpretations is given in our descriptions of the updated trenches which are given as a response to comment 8. Pleistocene-aged sediments will by nature be old enough to preserve evidence of Holocene-aged fault movement along the Weber Segment of the Wasatch fault zone.

The term "practical limit of excavation" was applied to the equipment and space available with which to excavate the trenches. In additional conversations with the Client, it was determined that, although not preferred, additional vegetation could be disrupted in order to excavate to greater depths. As a result, the existing trenches (Trenches 1 and 2) were advanced an additional 2 to 3 feet, which is the maximum practical depth of the equipment available. This additional depth revealed Pleistocene-aged lacustrine sediment within the bottoms of both these trenches. Due to the portions of Trench 3 being located on the crest of a slope, depths up to 17 feet could be obtained in this area.

GeoStrata understands the desire to obtain more quantitative age of sediments when it was thought that only Holocene-aged sediments were observed within the trench. With the exposure of Pleistocene-aged lacustrine sediments within the bottom of each of the trenches, it is no longer considered necessary to obtain soil ages, as these Pleistocene-aged deposits are by nature of sufficient age to preserve Holocene-aged surficial movement.

With the exposure of Pleistocene-aged sediment, it is no longer considered necessary to apply additional recommendations due to the uncertainties regarding the age of sediments exposed in trenches.

14. The December 10, 2013, GeoStrata report States:

a. In Section 6.2 Alluvial Fan Flooding/Debris Flow (page 17): "Study of the Broad Hollow drainage basin and the entire alluvial fan deposit were outside the scope of this investigation."
b. In Section 6.2 Alluvial Fan Flooding/Debris Flow (page 18P): "Based on our observations the average debris flow event appears to deposit 5 to 6 feet of sediment. This value should be verified through the completion of a formal debris flow analysis."

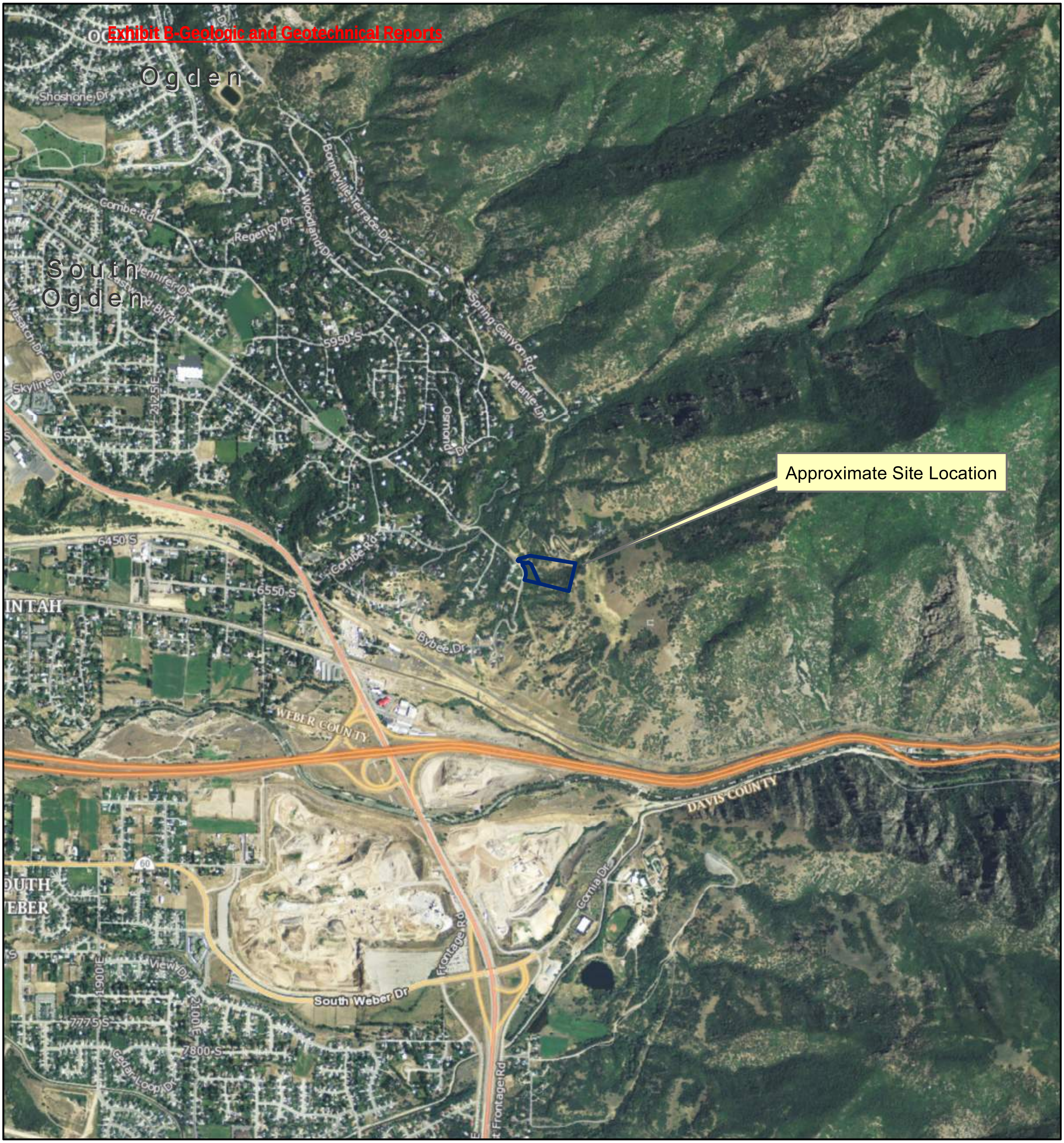
SBI recommends Weber County request the applicant submit a debris flow analysis for the subject property as recommended by GeoStrata.

GeoStrata Response: GeoStrata has been informed that a hydrological study has been completed for the site, and that recommendations concerning site grading to reduce the potential for the site to be impacted by alluvial fan flooding/debris flow have been given in reports completed by others. All recommendations presented in these reports should be incorporated into the design of the project.

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 other 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

N

1:24,000

Base Map: Utah AGRC Hybrid Basemap

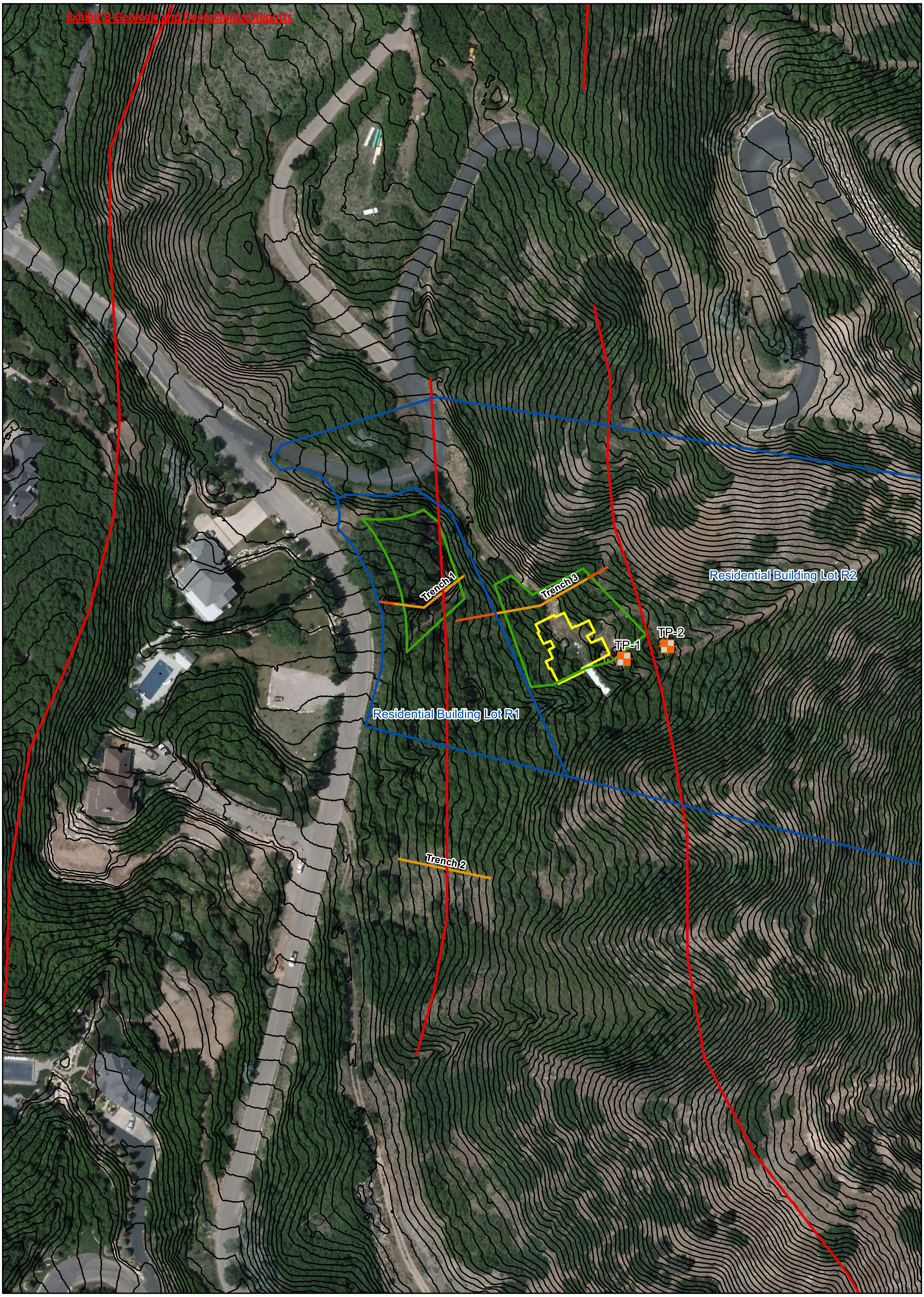
All Locations are Approximate

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

Legend

Site Boundary

Geologic Unit descriptions provided on plate A-4

1:24,000

Base Map: Yonkee, W.A. and Lowe, M., 2004,
Geologic map of the Ogden 7.5 minute quadrangle, Utah
Geological Survey Open-File Report M-200, 42p., 2pl., scale 1:24,000

All Locations are Approximate

N

GeoStrata

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

Geologic Map

Plate A-3

Exhibit B-Geologic and Geotechnical Reports

Quaternary Surficial Deposits

Units are subdivided based on dominant process (l- lacustrine, d- deltaic, a- alluvial, m- mass wasting, g- glacial), and on relative age (1- Holocene (younger), 2- Holocene (older), 3- Lake Bonneville regressive, 4- Lake Bonneville transgressive, and 5- pre-Lake Bonneville).
Units with form X/Y indicates thin (generally less than 3 meters [10 ft] thick) deposits of X overlying deposits of Y.

Qlg_3 Lacustrine gravel-bearing deposits, Bonneville regressive– *Clast-supported, moderately to well-sorted, pebble to cobble gravel and gravelly sand, interlayered with some silt and sand; deposited and reworked in higher energy environments along the Provo and regressive shorelines near the mountain front; mapped at elevations below Provo shoreline; thickness less than 6 meters (20 ft).*

Qlf_3 Lacustrine fine-grained deposits, Bonneville regressive– *Medium sand to silt deposited and reworked in moderate-energy environments near and below Provo shoreline away from mountain front in southern part of quadrangle; also includes calcareous clay, silt, and fine sand deposited in deeper water environments in the subsurface within western part of quadrangle; thickness of deposits near shoreline generally less than 6 meters (20 ft).*

Qlg_4 Lacustrine gravel-bearing deposits, Bonneville transgressive– *Clast-supported, moderately to well-sorted, pebble to cobble gravel, with some silt to sand in interfluve areas and away from mountain front; gravels contain rounded to subrounded clasts, and some subangular clasts derived from reworking of mass-wasting and alluvial-fan deposits; deposited in higher energy environments along shorelines and small fan deltas as Lake Bonneville was transgressing; grades westward away from shorelines into fine-grained lacustrine deposits (Qlf_4); total thickness locally as much as 60 meters (200 ft).*

Qlf_4 Lacustrine fine-grained deposits, Bonneville transgressive– *Intervals of calcareous clay to silt, and intervals of rhythmically interbedded fine to medium sand and silt near mouth of Weber Canyon; deposited in deeper water environments, and as delta bottomset beds during transgression of Lake Bonneville; total thickness, including subsurface deposits, locally as much as 150 meters (500 ft).*

Qd_3 Deltaic deposits, Bonneville regressive– *Main part of unit includes foreset beds of rhythmically interlayered, gently inclined, fine to medium sand and silt, and topset beds of clast-supported, moderately to well-sorted, pebble and cobble gravel and gravelly sand; gravels contain rounded to subrounded clasts; deposited when Lake Bonneville was at and regressing from Provo shoreline; forms large, gently westward-inclined surface that was locally reworked along regressive shorelines; total thickness locally as much as 30 meters (100 ft). Unit also includes moderately to well-sorted, pebble and cobble gravel in smaller terraces more than 30 meters (100 ft) above modern stream level that are graded to delta deposits and shorelines above the Gilbert level; exposed thickness of terrace gravels up to 6 meters (20 ft).*

Qd_4 Deltaic deposits, Bonneville transgressive– *Topset beds of clast-supported, moderately to well-sorted, pebble gravel and gravelly sand; contains abundant subrounded to rounded basement clasts; deposited as Lake Bonneville was near a transgressive shoreline at an elevation of about 1,520 meters (5,000 ft); thickness of topset beds 2 to 4 meters (7 - 13 ft).*

Qal Stream alluvium, undivided– *Mostly clast-supported, moderate- to well-sorted, pebble and cobble gravel, gravelly sand, and silty sand; deposited along modern channels and inactive benches; mapped where active channels and benches are too narrow to map separately; exposed thickness less than 12 meters (40 ft).*

Qal_1 Younger stream alluvium, Holocene– *Clast-supported, moderate- to well-sorted, pebble and cobble gravel, gravelly sand, and silty sand; deposited along modern channels and flood plains; mapped where fluvial processes are currently or episodically active; exposed thickness less than 6 meters (20 ft).*

Qal_2 Older stream alluvium, Holocene– *Clast-supported, moderately to well-sorted, pebble and cobble gravel, gravelly sand, and silty sand; deposited along inactive flood plains and terraces 3 to 9 meters (10-30 ft) above modern stream level; mapped where fluvial processes are generally no longer active; exposed thickness less than 6 meters (20 ft).*

Qat_2 Older alluvial terrace deposits, Holocene– *Clast-supported, moderately to well-sorted, pebble and cobble gravel and gravelly sand; contains subangular to rounded clasts; forms terraces 9 to 15 meters (30-50 ft) above modern stream level that appear graded to base levels below the Gilbert shoreline; exposed thickness less than 6 meters (20 ft).*

Qag_4 Alluvial gravel of Ogden Canyon–*Clast-supported, moderately sorted, pebble to boulder alluvial gravel, with some lacustrine sand layers at top of unit; gravel contains angular to subrounded clasts and is weakly to strongly cemented by calcite; present in small erosional remnants along Ogden Canyon; original thickness as much as 60 meters (200 ft).*

Qaf Alluvial-fan deposits, undivided– *Mixture of clast-supported, moderately sorted, pebble to cobble gravel and sand deposited by streams, and matrix-supported, poorly sorted, pebble to boulder gravel to diamicton deposited by debris flows; mapped where deposits lack cross-cutting relations and relative age is uncertain; exposed thickness less than 9 meters (30 ft).*

Qaf_1 Younger alluvial-fan deposits, Holocene– *Mixture of gravel and sand deposited by streams, and diamicton deposited by debris flows; forms fans having distinct levees and channels at mouths of mountain-front canyons; exposed thickness less than 6 meters (20 ft).*

Qaf_2 Older alluvial-fan deposits, Holocene– *Mixture of gravel and sand deposited by streams, and diamicton deposited by debris flows; forms fans with poorly preserved levees that are slightly incised by modern stream channels; exposed thickness less than 6 meters (20 ft).*

Qaf_3 Alluvial-fan deposits, Bonneville regressive– *Mixture of gravel and sand deposited by streams, and diamicton deposited by debris flows; contains mostly angular to subrounded clasts plus some recycled, well-rounded lacustrine clasts; forms fans having subdued morphology that are graded to the Provo or other regressive shorelines and are incised by modern stream channels; exposed thickness less than 9 meters (30 ft).*

Qaf_4 Alluvial-fan deposits, Bonneville transgressive– *Mixture of gravel deposited by streams and diamicton deposited by debris flows; gravel contains mostly angular to subrounded clasts; locally weakly cemented with calcite; fans have subdued morphology, display top surfaces graded to the Bonneville shoreline, and are deeply incised by modern stream channels; total thickness of some composite fans as much as 60 meters (200 ft).*

Qms Landslide deposits, undivided– *Unsorted, unstratified deposits of angular boulders, sand, silt, clay, and bedrock blocks; deposits generally found on steeper slopes that are covered by thick vegetation and display hummocky topography; deposits formed by single to multiple slides, slumps, and flows; mapped where lack of cross-cutting relations prevents relative age determination; querried where hummocky topography is more subdued; thickness uncertain.*

Qms_1 Younger landslide deposits, Holocene– *Unsorted, unstratified mixtures of gravel, sand, silt, and clay redeposited by slides, slumps, and flows; deposits display distinctly hummocky topography and fresh scarps, and are currently or have been recently active; many of these deposits are within older slide complexes.*

Qms_2 Older landslide deposits, Holocene– *Unsorted, unstratified mixtures of mostly sand, silt, and clay redeposited by single to multiple slides, slumps, and flows; deposits display hummocky topography but lack fresh scarps and are mostly inactive; deposits found mostly along moderate slopes where rivers and streams have incised into finer grained lacustrine and deltaic deposits; unit also includes slides of boulder-rich diamicton that reactivated parts of older slide complexes in the Wasatch Range.*

Qms_3 Landslide deposits, Bonneville regressive– *Mixture of silt, fine sand, and minor gravel redeposited in a flow slide and lateral spread as a result of liquefaction, probably during large earthquake(s); deposits display disrupted bedding, landslide-related lineaments and scarps, and hummocky topography; one large deposit is present in the quadrangle and formed after regression from the Provo level but before major downcutting by streams.*

Qms_5 Landslide deposits, pre-Bonneville to Bonneville transgressive– *Unsorted, unstratified deposits of angular boulders, sand, silt, clay, and bedrock blocks; deposited by multiple slides, slumps, and flows; parts of these slides are covered by Lake Bonneville deposits and reworked along the Bonneville shoreline, and parts of some slides are interlayered with Bonneville-transgressive lacustrine deposits.*

Qmf Debris-flow deposits, undivided– *Matrix- to clast-supported cobble and boulder gravel, with variable amounts of sand, silt, and clay matrix; surfaces variably rubbly and commonly have levees and channels; includes multiple events graded to various levels above modern channels; unit grades into alluvial fans at mouths of canyons, and into colluvium, talus, and slide deposits at higher elevations in source areas; thickness probably less than 9 meters (30 ft).*

Qmt Talus– *Deposits of angular pebble to boulder fragments with little or no matrix and little to no vegetation cover, which have accumulated at bases of some steep bedrock slopes and cliffs; thickness uncertain in most areas, but probably less than 15 meters (50 ft).*

Qma Avalanche deposits– *Diamicton and vegetative debris that have accumulated from repeated avalanches along moderately steep, northerly facing chutes at higher elevations; only one relatively large deposit mapped.*

Qc Colluvium– *Weakly to non-layered, variably sorted, matrix- to clast-supported, pebble to boulder gravel and diamicton of local origin; contains angular to subangular clasts in variable amounts of clay, silt, and sand matrix; deposits formed mostly by creep and slope wash, also includes small landslides, talus, debris cones, minor alluvium, and small bedrock exposures; found mostly along vegetated slopes in Wasatch Range, and locally covering scarps along the Wasatch fault zone; thickness probably less than 15 meters (50 ft) in most areas.*

Qac Colluvium and alluvium, undivided– *Pebble to boulder gravel and clay- to boulder-rich diamicton; includes hillslope colluvium, small fans, stream alluvium, and small landslide deposits; mapped along some vegetated canyon areas in Wasatch Range; thickness probably less than 15 meters (50 ft) in most areas.*

Qgr Rock-glacier deposits– *Bouldery debris with little or no matrix; displays hummocky forms with cross-slope ridges and little or no vegetation; present near bases of some cirque headwalls at higher elevations near Mount Ogden.*

Qgt_y Glacial till, younger– *Boulders to pebbles in sparse sandy to silty matrix; displays distinct moraine crests and limited soil development; present in upper part of cirque basin northeast of Mount Ogden.*

Qgt_o Glacial till, older– *Boulders to pebbles in variable amounts of sandy to silty matrix; displays more subdued moraine crests and greater soil development compared to younger till; present within cirque basins near Mount Ogden; probably late Pinedale age (about 25 to 10 ka).*

Qf Artificial fill– *Excavated and reworked debris; only larger areas mapped along rail and roadways in Weber Canyon, and near an abandoned landfill.*

Basin Fill

Qb Quaternary basin fill– *Weakly to non-consolidated mixture of alluvial and lacustrine clay, silt, sand, gravel, marl, and thin tuffaceous layers; includes two thicker, gravel-bearing zones corresponding to the Sunset and Delta aquifers; shown only on cross sections; up to 400 meters (1,300 ft) thick.*

Tb Late Tertiary basin fill– *Weakly to strongly consolidated mixture of conglomerate, sandstone, mudstone, tuffaceous sandstone, tuff, and lacustrine limestone; only shown on cross sections; up to 2,400 meters (8,000 ft) thick.*

Tertiary Igneous Rocks

Td Tertiary igneous dikes– *Dark colored, non-foliated dikes composed of altered hornblende, biotite, and feldspar phenocrysts in a fine-grained, highly altered matrix; interpreted to be Tertiary age.*

Cretaceous Altered and Deformed Rocks

Kc Chloritic gneiss, cataclasite, and mylonite– *Dark- to gray-green, variably fractured and altered gneiss, intensely fractured cataclasite, and mylonite to phyllonite with micaceous cleavage; derived by greenschist-facies alteration and varying degrees of cataclastic and plastic deformation that overprinted protoliths from the Farmington Canyon Complex; contains variable amounts of fine-grained, recrystallized chlorite, muscovite, and epidote; found within shear zones and along the Ogden floor thrust.*

Kfx Imbricated fault rocks– *Intensely deformed, complexly imbricated fault-zone rocks derived from a mixture of Farmington Canyon Complex and Cambrian sedimentary rock protoliths; contains fault-bounded slices of limestone and shale with intense cleavage and tight folds, and mixed cataclasite to mylonite; mapped along parts of the Ogden floor thrust.*

K(?)q Quartz veins and pods– *Veins and pods of quartz with minor chlorite, epidote, muscovite, and hematite; veins and pods cross cut gneissic foliation and are locally associated with chlorite alteration within rocks of the Farmington Canyon Complex; only larger bodies mapped; interpreted to be mostly related to Cretaceous alteration.*

Paleozoic Sedimentary Rocks

Mg Gardison Limestone– *Ledge- to cliff-forming, medium- to dark-gray, thin- to thick-bedded, fossiliferous limestone to dolomitic limestone; contains local chert lenses and widespread fragments of fossil corals, crinoids, and brachiopods; top not exposed in quadrangle but about 200 meters (660 ft) thick in nearby areas.*

Db Beirdneau Formation– *Overall slope-forming, yellow- to red- to light-gray, interlayered, sandy to silty dolomite and limestone, fine- to medium-grained sandstone, shale, flat-pebble conglomerate, and sedimentary breccia; uppermost part consists of argillaceous limestone and shale; about 50 to 100 meters (170-330 ft) thick, but thickness varies due to widespread minor faulting and folding.*

Dhw Hyrum Dolomite and Water Canyon Formation, undivided– *Hyrum consists of ledge-forming, medium- to dark-gray, medium- to thick-bedded, dolomite and minor silty limestone; Water Canyon consists of slope-forming, light- to yellow-gray, sandy to silty dolomite; unit is about 50 to 100 meters (170-330 ft) thick.*

Of Fish Haven Dolomite– *Cliff-forming, medium- to dark-gray, medium- to thick-bedded, slightly fossiliferous dolomite; about 40 to 80 meters (130-260 ft) thick.*

Og Garden City Formation– *Ledge- and slope-forming, tan to light-gray, thin- to thick-bedded, silty dolomite, dolomite, silty limestone, and siltstone; has well-layered appearance; some layers are slightly fossiliferous and some layers contain siltstone-filled cracks; about 60 to 120 meters (200-400 ft) thick, but thickness varies due to widespread minor faulting.*

Csn St. Charles and Nounan Formations, undivided– *St. Charles consists mostly of cliff-forming, light- to dark-gray, massive-weathering dolomite, with a thin interval of sandy dolomite and sandstone corresponding to the Worm Creek Quartzite Member at its base; Nounan consists of cliff-forming, light- to dark-gray, massive-weathering, dolomite and minor silty dolomite with local twiggy structures; unit is about 300 to 450 meters (1,000-1,500 ft) thick.*

Cb Bloomington Formation– *Slope-forming, orange-gray to brown, thin-bedded, interlayered, shaley limestone, shale, fine-grained limestone with abundant orange-weathering silty ribbons, flat-pebble conglomerate, oncolitic limestone, and oolitic limestone; about 30 to 60 meters (100-200 ft) thick, but thickness varies due to widespread minor faulting.*

Cm Maxfield Formation, undivided– *Total thickness about 180 to 300 meters (600-1000 ft), but total thickness and thicknesses of individual members vary due to widespread deformation.*

Cmu Upper limestone and dolomite member– *Upper part consists mostly of cliff-forming, light- to dark-gray, medium- to thick-bedded, dolomite, oolitic dolomite, and minor limestone, with widespread twiggy structures; lower part consists mostly of ledge-forming, light- to medium-gray, thin- to thick-bedded, oolitic limestone, fine-grained limestone with yellow-weathering silty ribbons, and minor dolomite; distinctive interval of interlayered dark-gray cherty dolomite and light-gray boundstone found near top of the member; about 100 to 150 meters (330-500 ft) thick.*

Cma Middle argillaceous limestone member– *Overall slope-forming, overall brown to orange-gray, thin- to medium-bedded, interlayered, argillaceous limestone with black, clay-filled cracks, shale with limestone nodules, fine-grained limestone with orange-weathering silty ribbons, oolitic limestone, oncolitic limestone, and flat-pebble conglomerate; about 40 to 80 meters (130-260 ft) thick.*

Cml Lower limestone member– *Ledge-forming, light- to medium-gray, thin- to medium-bedded limestone with abundant orange-weathering silty ribbons and minor oolitic limestone; thin interval of shaley limestone near middle of member separates upper and lower ledges; about 40 to 80 meters (130-260 ft) thick.*

Co Ophir Shale, undivided– *Total thickness of about 90 to 200 meters (300-700 ft), but total thickness and thicknesses of individual members vary widely due to intense deformation.*

Cou Upper shale member– *Slope-forming, gray-brown to olive-drab, variably calcareous, silty to micaceous shale (or argillite), with some thin, silty limestone beds; generally poorly exposed and strongly deformed; probably about 40 to 80 meters (130-260 ft) thick.*

Com Middle limestone member– *Ledge-forming, light- to medium-gray, thin- to medium-bedded limestone with abundant orange-weathering silty ribbons and minor oolitic limestone; probably about 6 to 20 meters (20-70 ft) thick.*

Col Lower shale member– *Slope-forming, brown- to olive-drab, silty to micaceous shale (or argillite), with some fine-grained sandstone layers at base; generally poorly exposed and strongly deformed; probably about 40 to 100 meters (130-330 ft) thick.*

Ct Tintic Quartzite– *Main part of formation consists of cliff-forming, white to tan, thin- to thick-bedded, quartz-rich, well-cemented sandstone (orthoquartzite) with some lenses of quartz-pebble conglomerate and thin layers of argillite; argillite intervals increase in abundance and quartz pebbles decrease in abundance toward the top of the formation; basal part of the formation consists of heterogeneous mixture of green to purple to tan, arkosic sandstone, quartz-pebble conglomerate, and micaceous siltstone; about 400 to 450 meters (1,300-1,500 ft) thick.*

Early Proterozoic Metamorphic and Igneous Rocks

Xf Farmington Canyon Complex, undivided– *Shown only on cross sections.*

Units exposed in footwall of Ogden floor thrust

Xfgf Granitic gneiss of Ogden footwall– *Light- to pink-gray, moderately to strongly foliated, hornblende-bearing granitic gneiss; unit also contains widespread, variably deformed pegmatitic dikes and some pods of amphibolite.*

Xfh Hornblende-plagioclase gneiss– *Dark-gray to black, moderately to strongly foliated, hornblende-plagioclase gneiss, with minor garnet, quartz, and biotite in some layers; garnet grains up to 2.5 centimeters (1 inch) in size.*

Xfs Muscovite-bearing schist– *Gray-brown, strongly foliated, schist to gneiss containing variable amounts of muscovite, biotite, quartz, and feldspar, with minor garnet in some layers; muscovite grains are up to 2.5 centimeters (1 inch) in size; unit also contains some thin layers of hornblende-plagioclase gneiss.*

Units exposed in hanging wall of Ogden floor thrust

Xfa Meta-gabbro and amphibolite– *Black to green-black, non- to strongly foliated, pyroxene-bearing meta-gabbro to amphibolite with varying amounts of plagioclase; forms pods in granitic gneiss but only larger bodies mapped.*

Xfgh Granitic gneiss of Ogden hanging wall– *Light- to pink-gray, moderately to strongly foliated, fine- to medium-grained, hornblende-bearing granitic gneiss with rare orthopyroxene; gneiss is locally fractured and displays red hematite alteration; gneiss cut by variably deformed, light-colored pegmatitic dikes; unit also contains small pods of meta-gabbro and amphibolite; gradational contacts with migmatitic gneiss.*

Xfm Migmatitic gneiss– *Medium- to light-pink-gray, strongly foliated and layered, migmatitic, quartzo-feldspathic gneiss with widespread garnet and biotite; gneiss cut by widespread, variably deformed, pegmatitic dikes; unit also contains widespread amphibolite layers, granitic gneiss bands, and some thin layers of biotite-rich schist; gradational contacts with granitic gneiss.*

Xfb Biotite-rich schist– *Medium-gray to dark-brown, strongly foliated, biotite-rich schist with widespread garnet and sillimanite; displays alternating biotite-rich and quartz-feldspar-rich bands that are rotated into complex fold patterns; schist cut by variably deformed, garnet-bearing pegmatite dikes; unit also contains some thin layers of amphibolite, quartz-rich gneiss, and granitic gneiss; gradational contacts with migmatitic gneiss.*

Xfq Quartz-rich gneiss– *Milky- to green-white, quartz gneiss with lesser amounts of plagioclase and chrome-green mica; locally contains thin layers of biotite-rich schist and amphibolite.*

Xfu Meta-ultramafic and mafic rocks– *Dark-green to black, variably foliated, pyroxene-, amphibole-, and olivine-bearing ultramafic rock, hornblendite, and amphibolite.*

MAP AND CROSS-SECTION SYMBOLS

Contact--*Dashed where location approximate; dotted where concealed.*

Scratch Contact--*Used between subunits and combined unit.*

Normal Fault--*Dashed where location approximate; dotted where concealed; solid bar and ball on downthrown side; arrows show relative movement on cross section.*

Normal Fault--*Concealed; inferred and delineated from geophysical data; open ball and bar on downthrown side; arrows show relative movement on cross section.*

U / D Steeply Dipping Fault--*High-angle fault with normal apparent stratigraphic throw; actual offset may be more complex; dashed where location approximate; dotted where concealed; U and D show up and down on throw.*

Thrust Fault--*Dotted where concealed; teeth on upper plate; arrows show relative movement on cross section.*

Lineament--*Related to liquefaction and possible ground cracks in Qms_3*

Quartz veins related to K(?)q.

Moraine Crests

Landslide Scarp

Erosional Scarp--*Related to river terraces incised into Lake Bonneville delta along Weber River.*

Fold Axial Traces--*Location approximate; dotted where concealed.*

anticline

syncline

Strike and Dip of bedding

35 inclined

85 overturned

45t Trend and Plunge of minor fold

75c Strike and Dip of cleavage

45 Strike and Dip of high-grade metamorphic foliation

55p Trend and Plunge of mineral lineation

X Prospect Pit

Gravel Pit

Shorelines

X Regressive shoreline of Lake Bonneville

P Provo shoreline of Lake Bonneville

B Bonneville shoreline of Lake Bonneville

Y Transgressive shoreline of Lake Bonneville

Yonkee, W.A. and Lowe, M., 2004, Geologic map of the Ogden 7.5 minute quadrangle, Utah Geological Survey Open-File Report M-200, 42p., 2pl., scale 1:24,000

GeoStrata

Description of Geologic Map Units

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

Plate
A - 4

Legend

- Site Boundary
- Not Mapped
- Qaf1 - Younger alluvial fan deposits
- Qlf4 - lacustrine fine-grained deposits, Bonneville transgressive
- Proposed 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

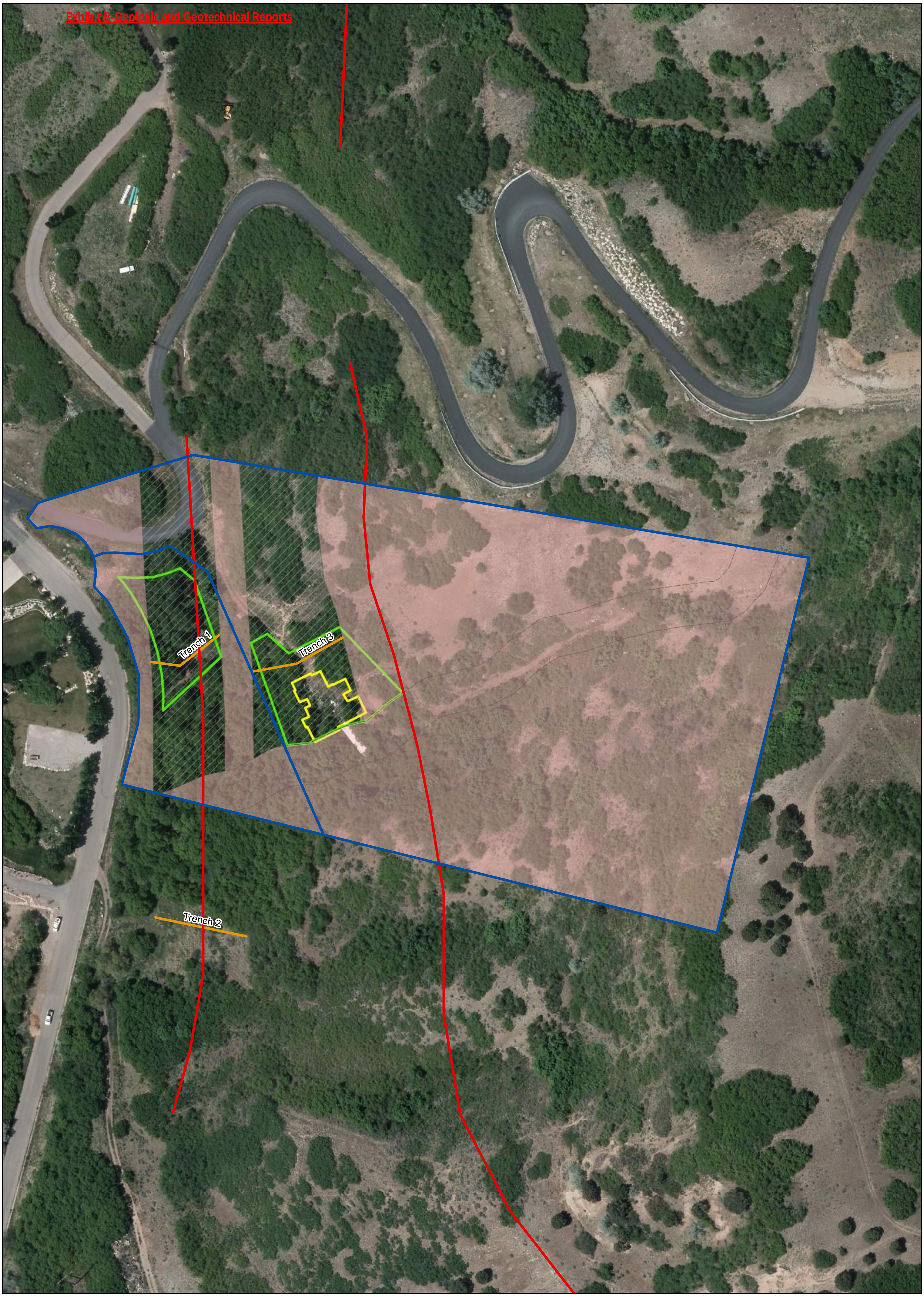
N

GeoStrata

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

Site Geologic Setback Map

Plate A-6



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

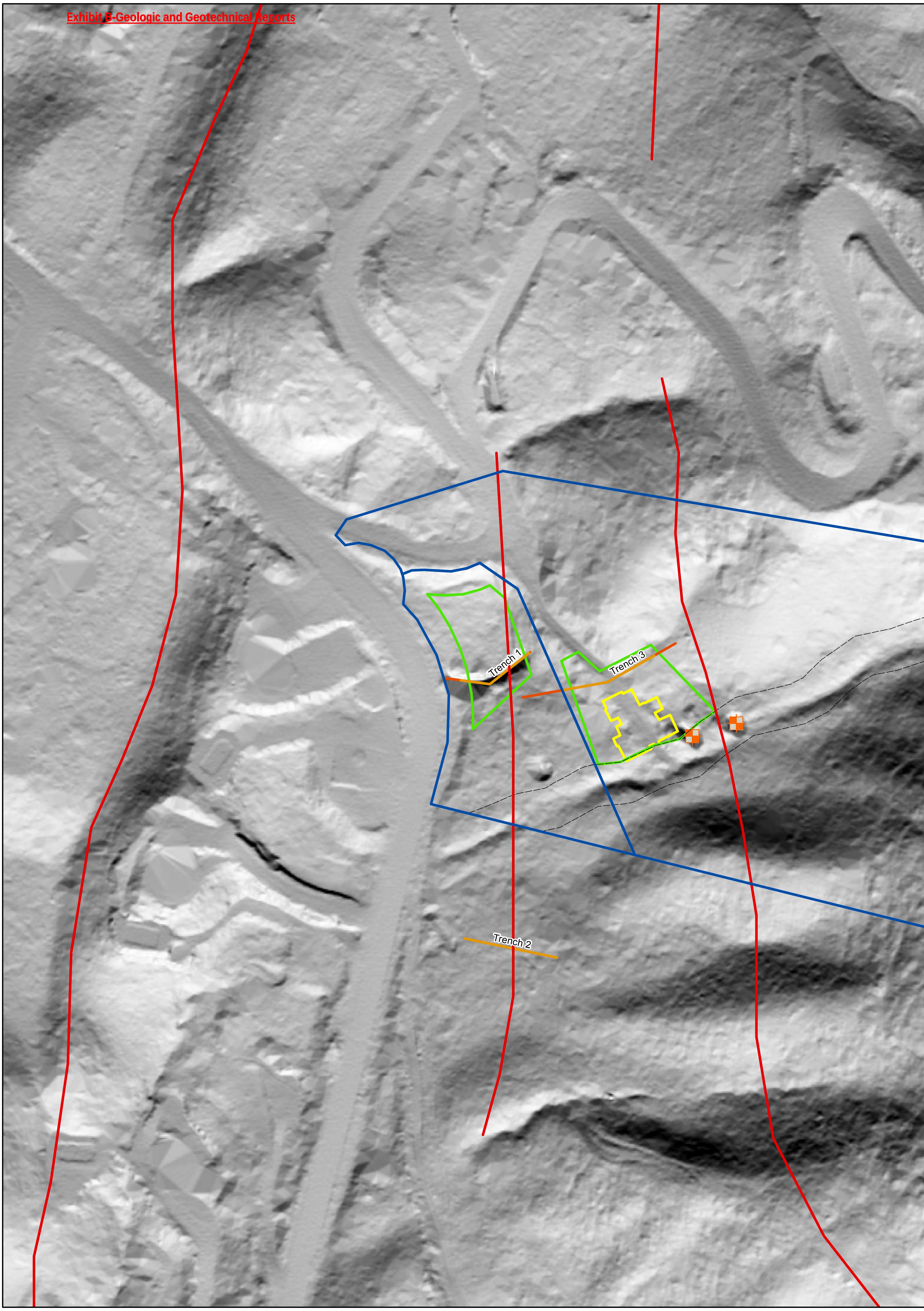
N

GeoStrata

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

Site Geologic Setback Map

Plate A-6



Site Boundary
Fault
Logged Portion of Trench
Drainage Setback
Excavated Trench
Test Pit
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

Hillshade 180

Plate A-7

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

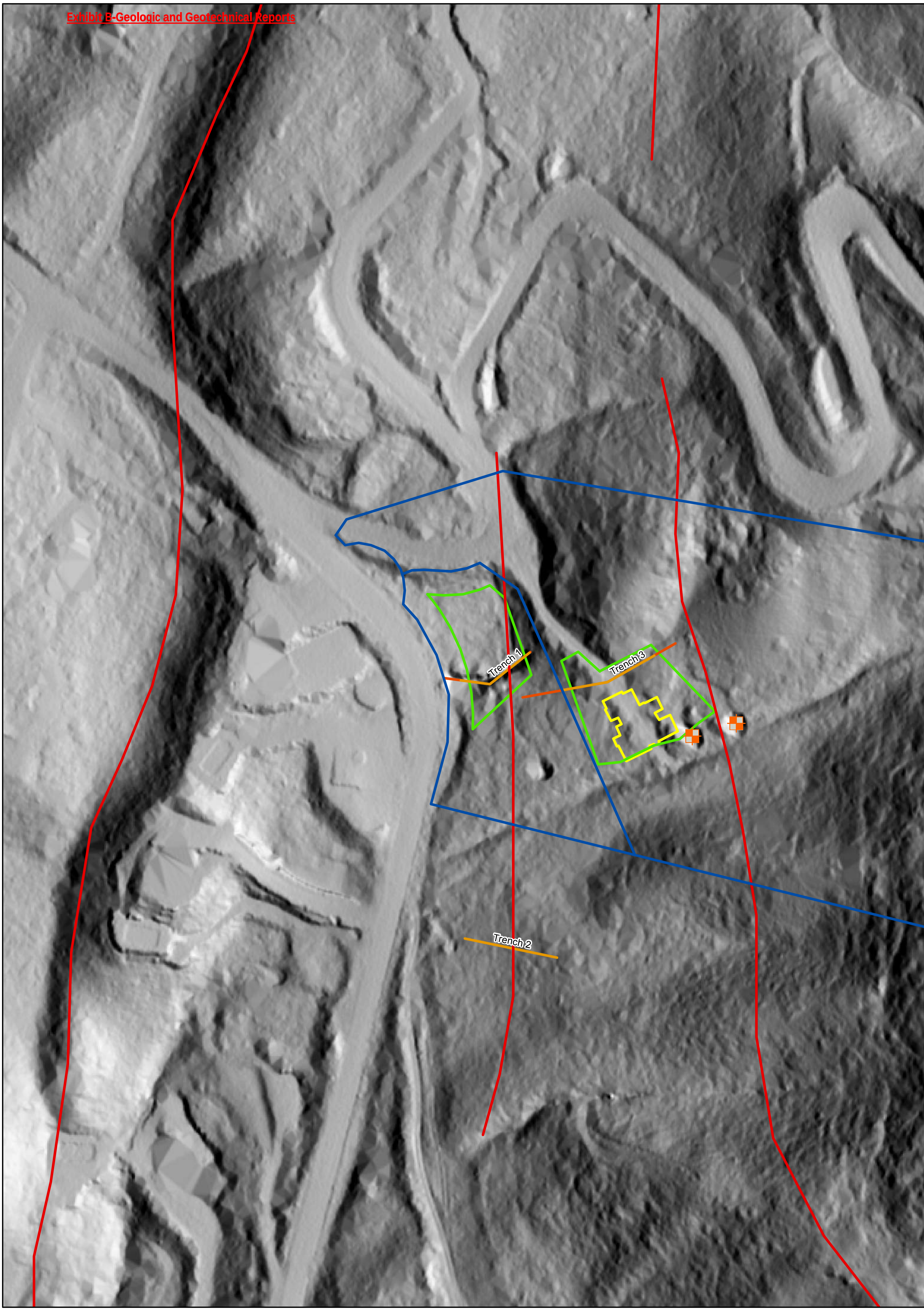
N

GeoStrata

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

Hillshade 180

Plate A-8



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

GeoStrata

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

Hillshade 90

Plate
A-9

1:1,200

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

All Locations are Approximate

N

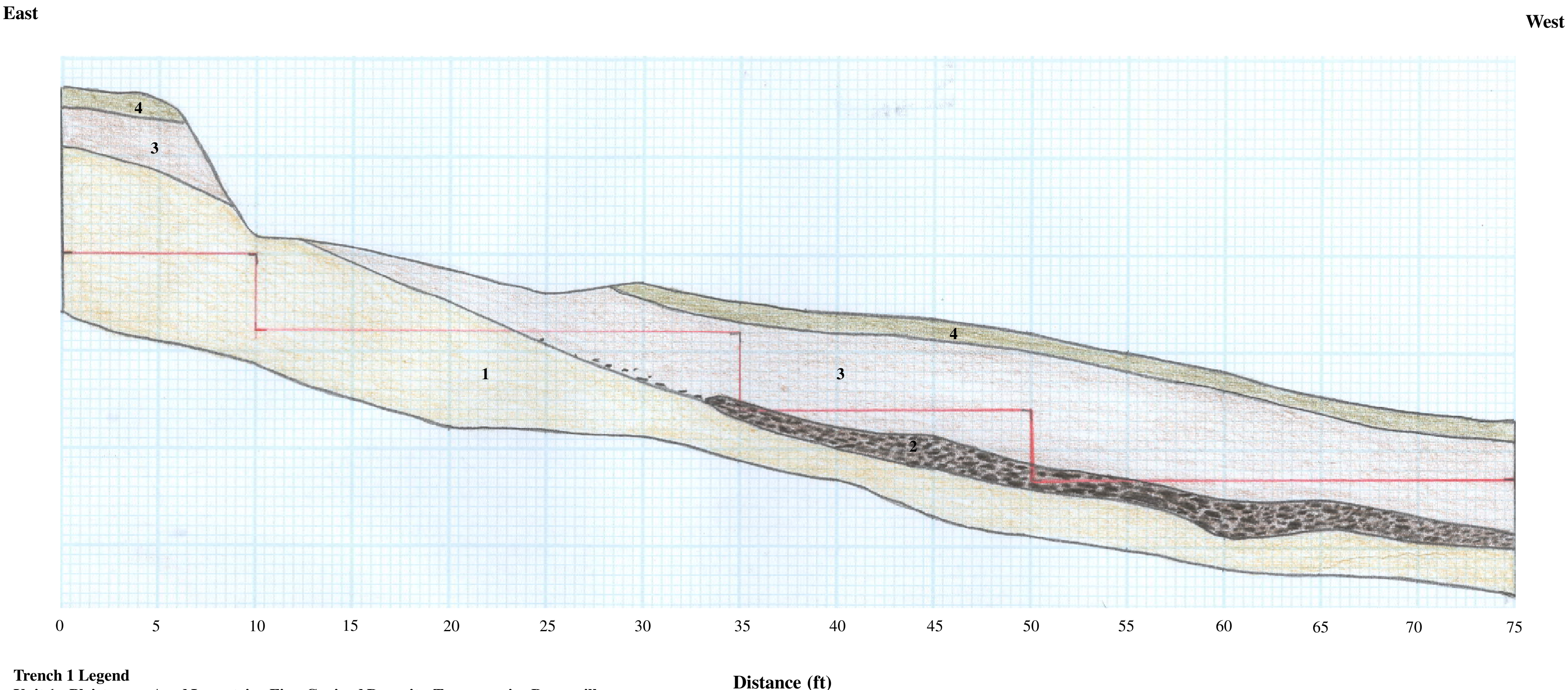
GeoStrata

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

Hillshade 90

Plate
A-9

TRENCH 1 SOUTH WALL



Trench 1 Legend
Unit 1 - Pleistocene-Aged Lacustrine Fine-Grained Deposits, Transgressive Bonneville
Unit 2 – Pleistocene/Holocene-Aged Stream Alluvium Deposits
Unit 3 - Holocene-Aged Colluvium and Alluvium
Unit 4 – Holocene-Aged Topsoil

1 inch = 5 feet
Horizontal Scale = Vertical Scale

logged by T. Thompson

Fault Study
Dauphine-Savory Piedmont Subdivision
Ogden, Utah
Project Number: 910-001

Trench 1 South Wall Trench Log
0 to 75 Feet

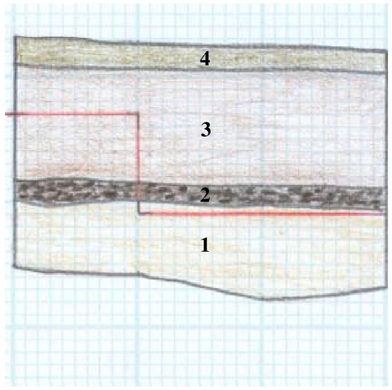
GeoStrata

Plate
B-1

TRENCH 1 SOUTH WALL

East

West



Distance (ft)

1 inch = 5 feet
Horizontal Scale = Vertical Scale

Trench 1 Legend
Unit 1 - Pleistocene-Aged Lacustrine Fine-Grained Deposits, Transgressive Bonneville
Unit 2 – Pleistocene/Holocene-Aged Stream Alluvium Deposits
Unit 3 - Holocene-Aged Colluvium and Alluvium
Unit 4 – Holocene-Aged Topsoil

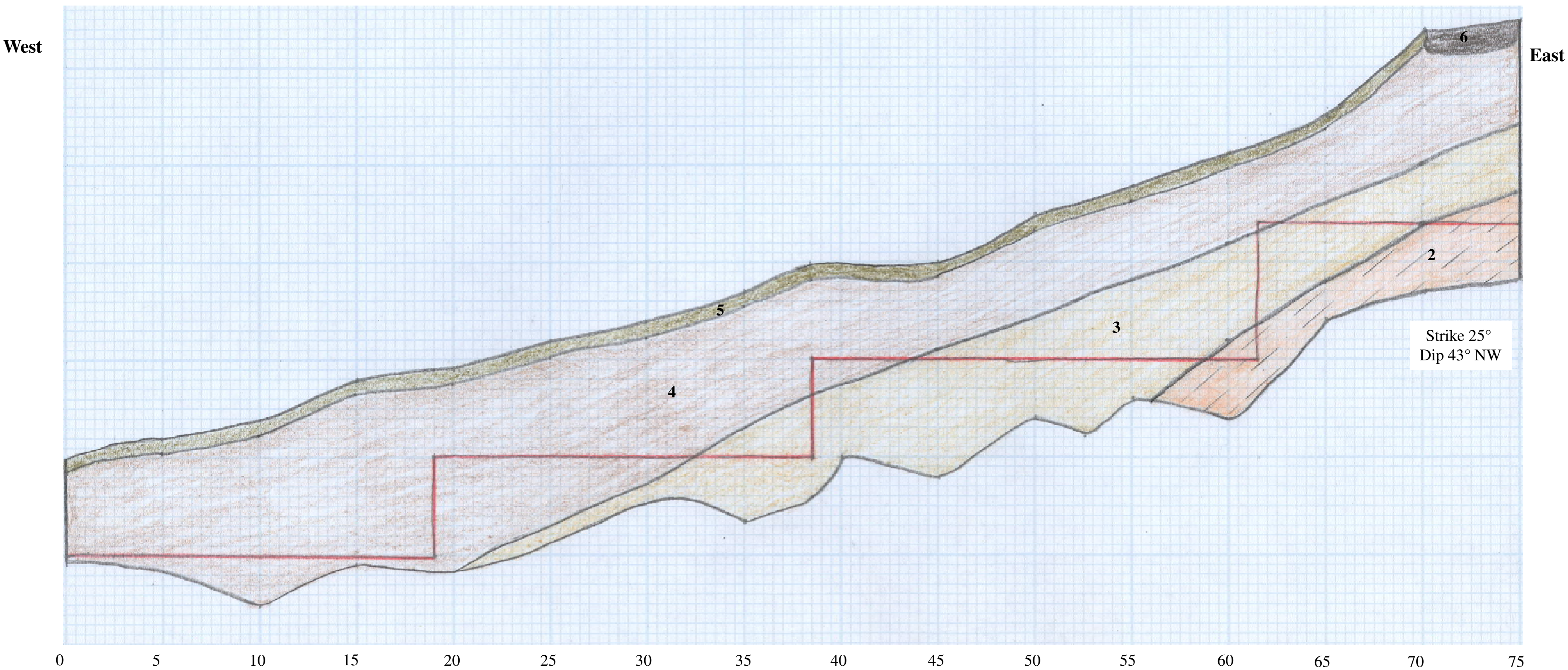
logged by T. Thompson

Fault Study
Dauphine-Savory Piedmont Subdivision
Ogden, Utah
Project Number: 910-001

Trench 1 South Wall Trench Log
75 to 90 Feet

Plate
B-2

TRENCH 3 NORTH WALL



Distance (ft)

1 inch = 5 feet
Horizontal Scale = Vertical Scale

Trench 3 Legend
Unit 1 – BEDROCK - Early Proterozoic Metamorphic and Igneous Rocks
Unit 2 – Pleistocene-Aged Lacustrine Gravel Deposits, Transgressive Bonneville
Unit 3 – Pleistocene-Aged Lacustrine Fine-Grained Deposits, Transgressive Bonneville
Unit 4 – Holocene-Aged Colluvium and Alluvium
Unit 5 – Holocene-Aged Topsoil
Unit 6 – Holocene-Aged Historical Fill Soils

logged by T. Thompson

Fault Study
Dauphine-Savory Piedmont Subdivision
Ogden, Utah
Project Number: 910-001

Trench 3 North Wall Trench Log
0 to 75 Feet

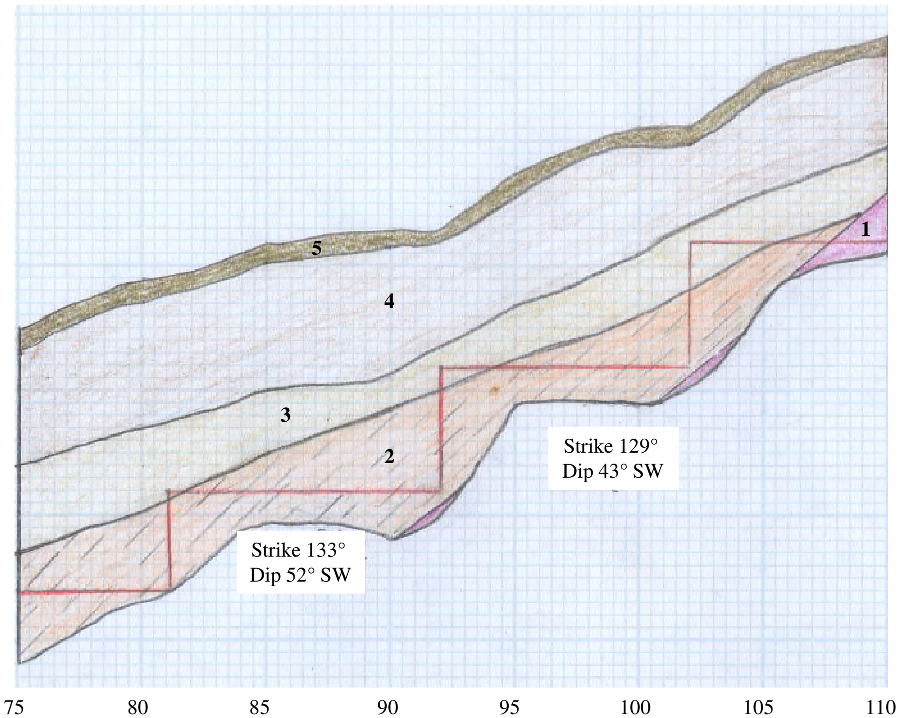
GeoStrata

Plate B-3

TRENCH 3 NORTH WALL

West

East



Trench 3 Legend
Unit 1 – BEDROCK - Early Proterozoic Metamorphic and Igneous Rocks
Unit 2 – Pleistocene-Aged Lacustrine Gravel Deposits, Transgressive Bonneville
Unit 3 – Pleistocene-Aged Lacustrine Fine-Grained Deposits, Transgressive Bonneville
Unit 4 – Holocene-Aged Colluvium and Alluvium
Unit 5 – Holocene-Aged Topsoil
Unit 6 – Holocene-Aged Historical Fill Soils

Distance (ft)

1 inch = 5 feet
Horizontal Scale = Vertical Scale

logged by T. Thompson

Fault Study
Dauphine-Savory Piedmont Subdivision
Ogden, Utah
Project Number: 910-001

Trench 3 North Wall Trench Log
75 to 110 Feet

GeoStrata

Plate B-4

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.

5/3/15
LICENSED PROFESSIONAL ENGINEER MARK I. CHRISTENSEN No. 188039 STATE OF UTAH

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

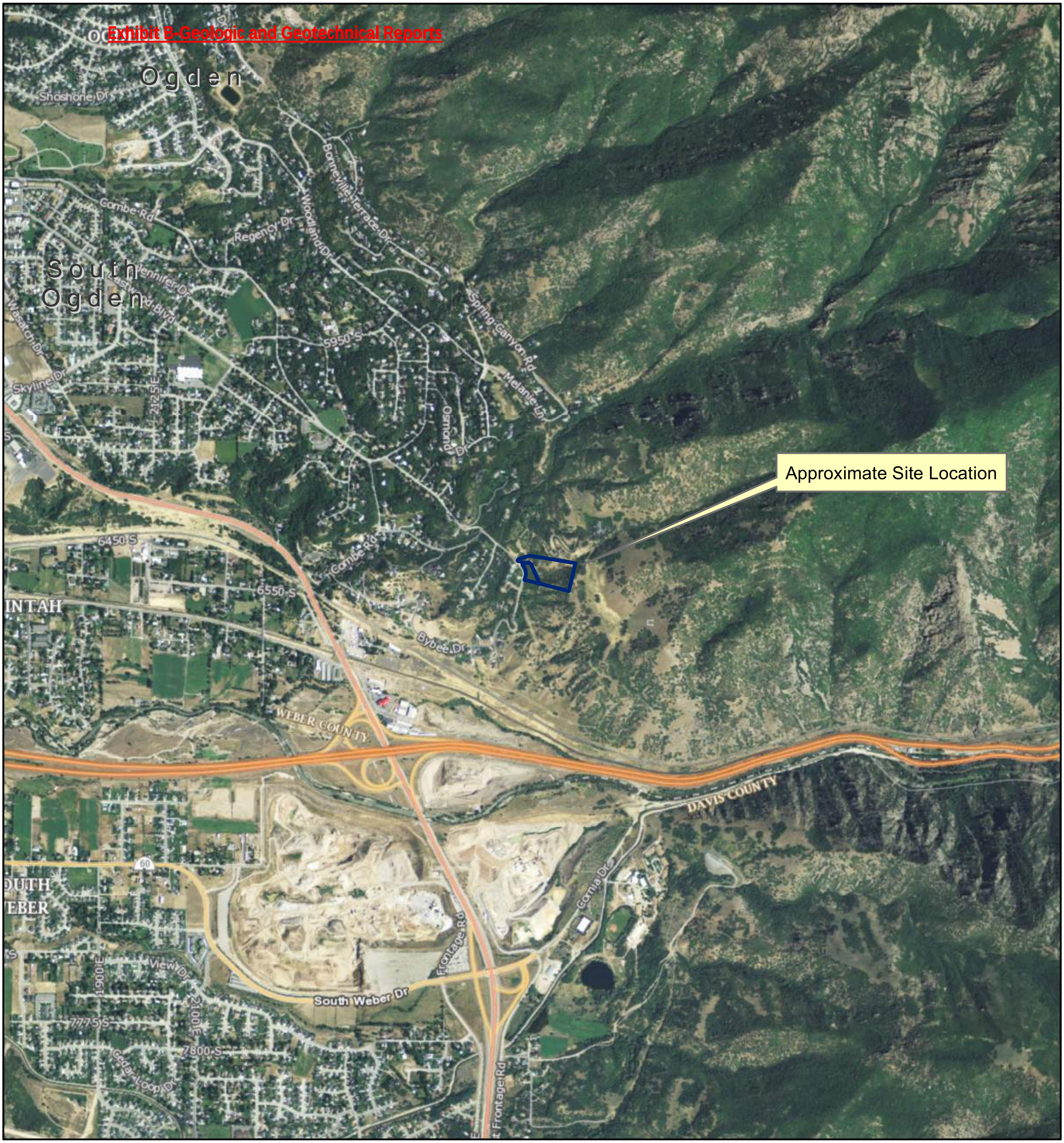
report."

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

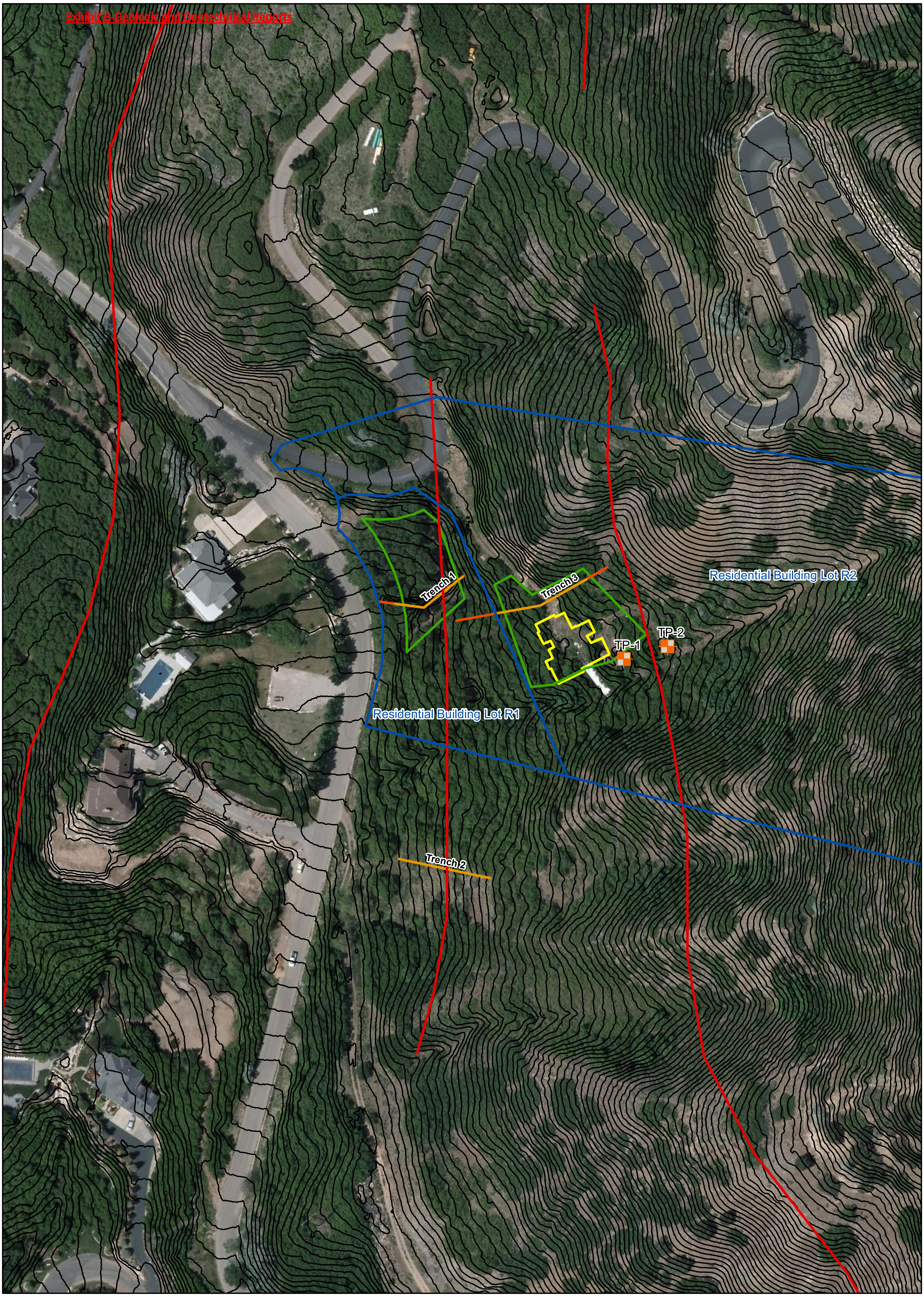
N

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!!

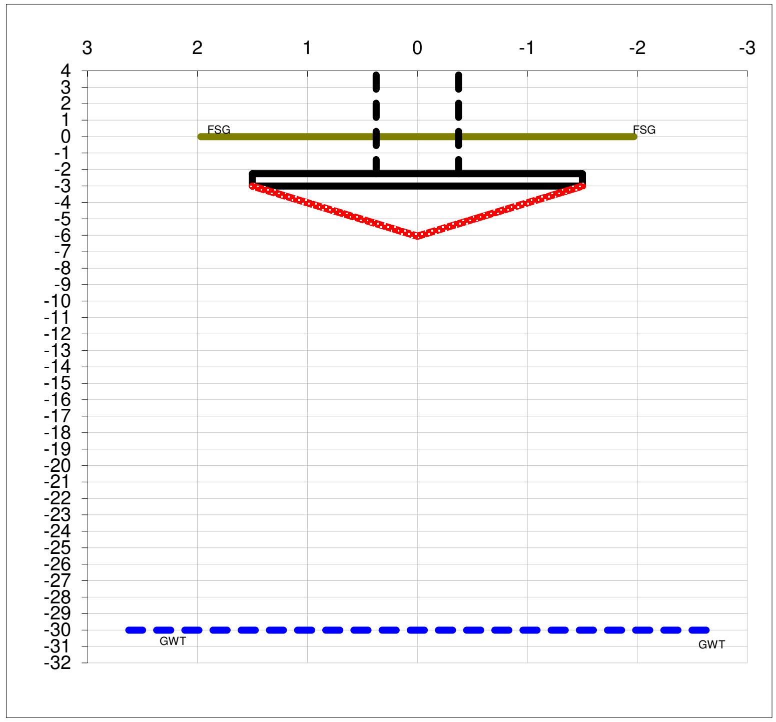
Wednesday, December 04, 2013

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	

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



q = γ'D = 360.00 psf

use γ' = 120.00 pcf

Φ_{ps}* = 31 °

*use Φ_{ps} only if L'/B' ≥ 2.0

use Φ = 31 °

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'·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:

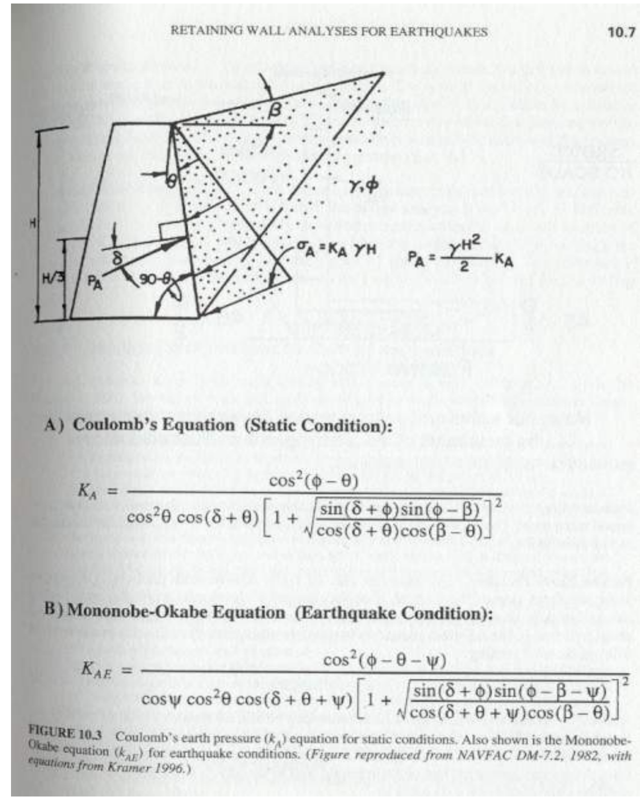
K_a =	0.3201		
K_{ah} =	0.3201		
K_p =	3.1240		44.52
K_{ph} =	3.1240		-87.18

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):

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

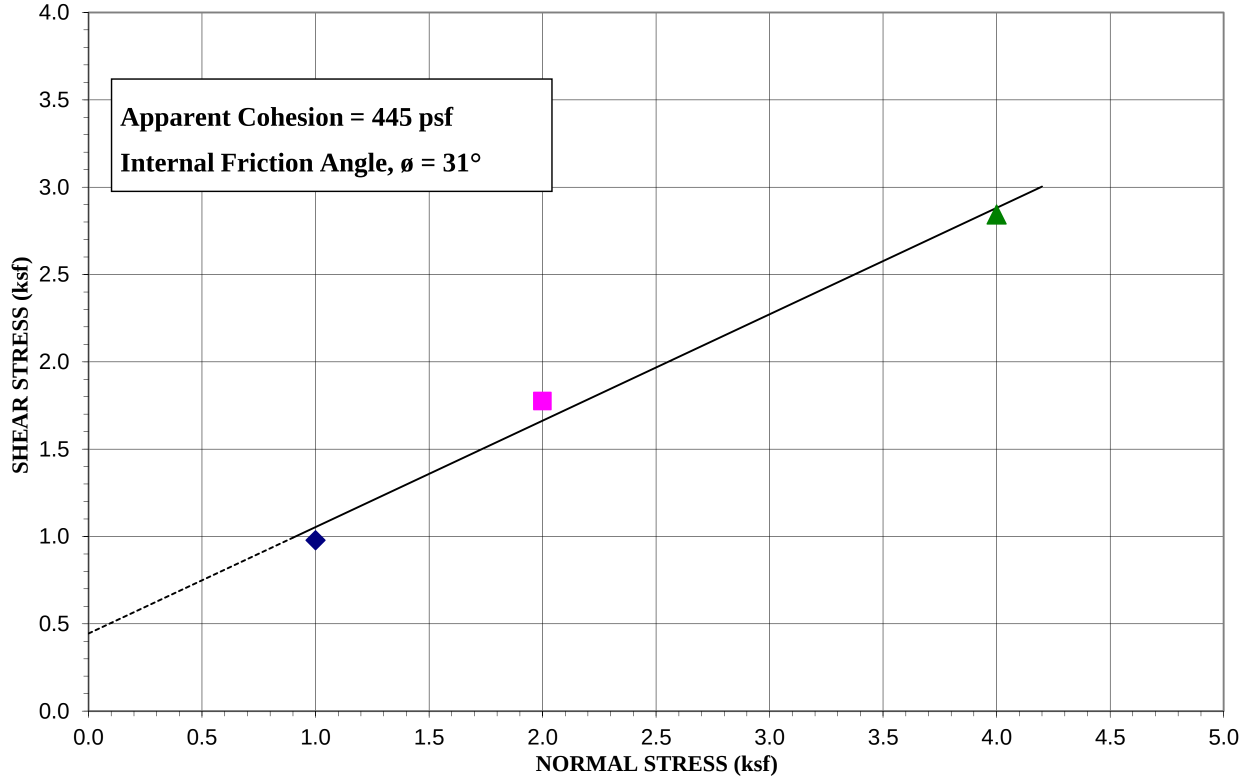
B) Mononobe-Okabe Equation (Earthquake Condition):

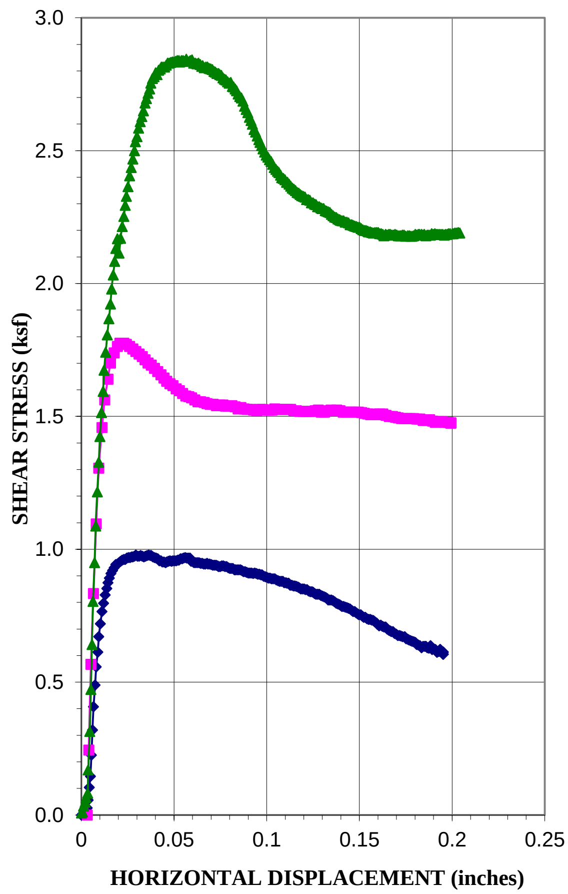
$$K_{AE} = \frac{\cos^2(\phi-\theta-\psi)}{\cos\psi\cos^2\theta\cos(\delta+\theta+\psi)\left[1+\sqrt{\frac{\sin(\delta+\phi)\sin(\phi-\beta-\psi)}{\cos(\delta+\theta+\psi)\cos(\beta-\theta)}}\right]^2}$$

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

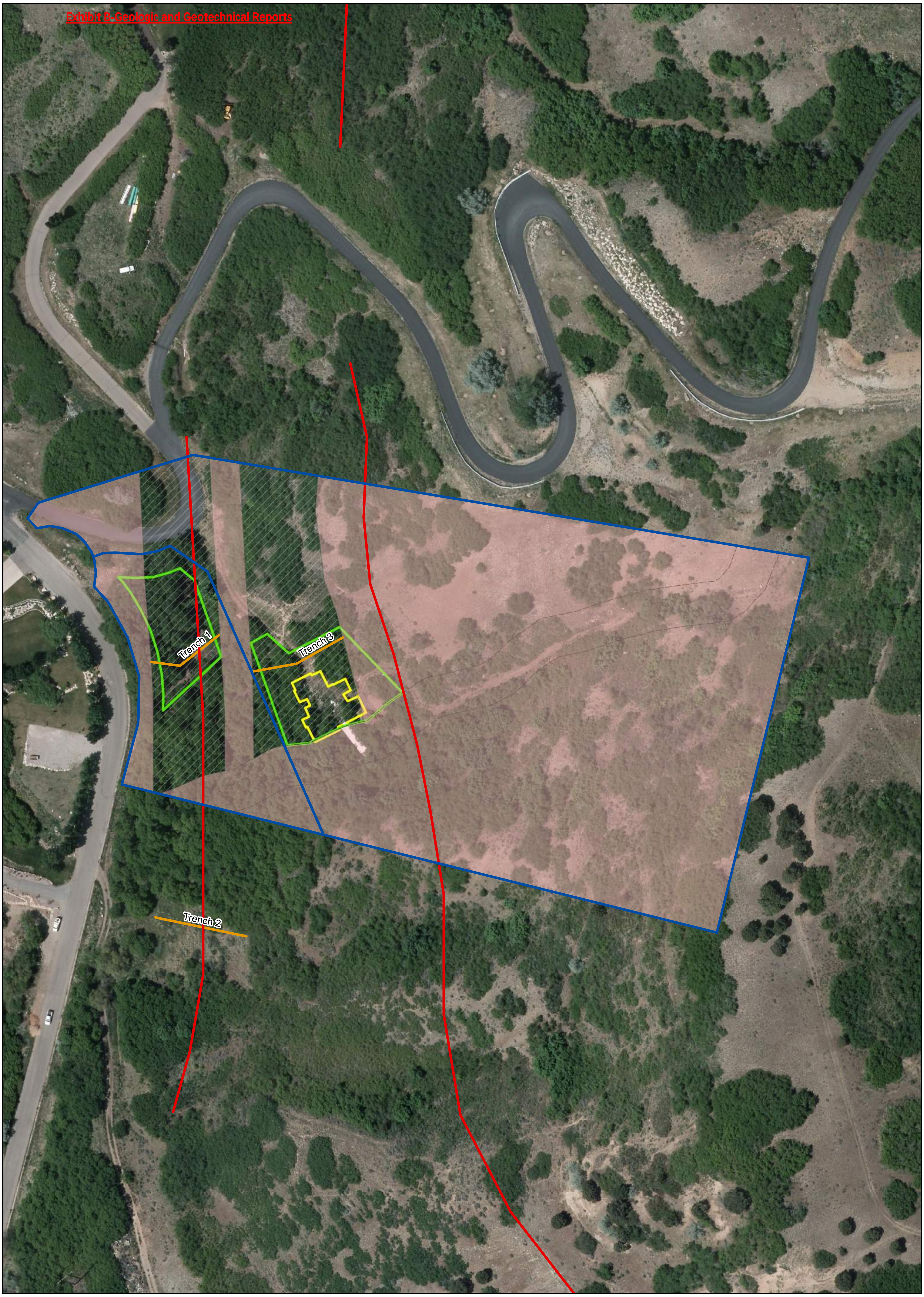
PROJECT: Dauphine-Savory Piedmont Subdivision

PROJECT NO.: **910-001**

GeoStrata

Plate
A-5

Exhibit B-Geologic and Geotechnical Reports



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

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.

5/3/15

LICENSED PROFESSIONAL ENGINEER MARK I. CHRISTENSEN No. 188039 LICENSED STATE OF UTAH

Date: May 4, 2015

Subject: **Review Response for Retaining Wall 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 concerning proposed rockery retaining walls associated with the proposed Dauphine-Savory Piedmont Subdivision Lots 1R and 2R. We understand that the review comments were made concerning a rockery design prepared by Silverpeak Engineering in a report dated October 29, 2014. GeoStrata has been retained to complete a rockery design and respond to the review comments. 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. "The design procedure used by Silverpeak does not cover all aspects of rock retaining wall design. The design should be revised and completed in general accordance with 2006 FHWA-CLF/TD-06-006 "Rockery Design and Construction Guidelines." The document is free online and provides a detailed procedure for the internal and external analysis for rock walls."

GeoStrata Response: GeoStrata has completed an updated rockery design using the site plan provided by Silverpeak Engineering titled "Rasmussen Residence Weber Canyon, Uintah, Utah" and dated October 29, 2014. This site plan contained proposed final wall elevations and heights. The rockery design will be submitted as a separate report attached to this review response document, and will be completed in accordance with the recommendations made in the 2006 FHWA CLF/TD-06-006 document.

2. "The retaining wall design was based on assumed soil parameters. The soil parameters used in the retaining wall design should be substantiated with laboratory testing."

GeoStrata Response: GeoStrata has completed a direct shear test on a sample obtained from the subject property (Trench 3). Based on the results of our testing, the soil parameters consist of a friction angle (ϕ) of 31° and a cohesion of 445 psf. Results of our laboratory testing have been attached to the end of our rockery analysis and design document as Plate D-1.

3. "The retaining wall design did not address seismic conditions. The seismic analysis should follow the analysis procedure as provided in the FHWA document referenced in Item (1)."

GeoStrata Response: GeoStrata has completed a rockery design as per the FHWA document. It may be found attached to the end of this letter.

4. "The wall design should include global stability analysis under static and seismic conditions. The seismic load should be based on the characteristic earthquake with spectral accelerations factored for site conditions in accordance with the IBC. The input and output files should be included with the results of the analysis."

GeoStrata Response: GeoStrata has completed the analyses recommended in the above comment. The results of which may be found in the attached rockery analysis and design document.

5. "The design should address saturation of the retained soils as a result of spring thaw and the presence of a septic system at the tow of the wall."

GeoStrata Response: GeoStrata recommends that a filter fabric be placed behind the wall in order to provide drainage should saturation of the retained soils occur. Recommendations concerning the construction of the wall may be found in our attached rockery design document.

6. "The construction detail should address a drainage layer behind the wall in accordance with the FHWA document referenced in Item (1) above."

GeoStrata Response: GeoStrata has completed the recommended construction detail discussed above.

7. "The design should address an inspection schedule by the engineer of record."

GeoStrata Response: GeoStrata has established a recommended inspection schedule in the attached rockery analysis and design."

8. "The design engineer should provide a final inspection letter when the wall is complete that verifies inspection during construction and that the wall was constructed in accordance with the approved design."

GeoStrata Response: GeoStrata concurs with the above statement.

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.

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

May 4, 2015

Matt Rasmussen
2927 Melanie Lane
Ogden, Utah 84403

Subject: Rockery Analysis and Design
Dauphine-Savory Piedmont Subdivision Lots 1R and 2R
Weber County, Utah
GeoStrata Project No. 910-001

Mr. Rasmussen,

As requested, GeoStrata has evaluated two proposed rockeries to be constructed on residential building lot 2R within the Dauphine-Savory Piedmont subdivision in Weber County, Utah. Information concerning the rockeries, including location and proposed height, were obtained from a proposed site grading and drainage plan prepared by Silverpeak Engineering and dated October 29, 2014. The first rockery investigated will be located to the east-northeast of the proposed residence and will consist of a single tier with a maximum exposed vertical height of 9 feet (8 feet exposed). The slope above this rockery will consist of a 3.5(H):1(V) ascending slope, whereas the slope below the rockery will be relatively horizontal in order to accommodate the proposed residence and yard area. This rockery has been designated as Rockery 1.

The second rockery investigated will be located the western edge of the proposed residence, and will consist of a single tier with a maximum exposed vertical height of 5 feet (4 feet exposed). The slope above the rockery will be approximately horizontal in order to accommodate the residence, whereas the slope below the rockery will consist of a 2(H):1(V) descending slope. This rockery has been designated as Rockery 2.

The rockeries are shown on the Site Plan which is included as Plate A-1 in Appendix A.

The rockery analysis included in this report was completed in accordance with the accepted industry standards of care including global stability, internal stability and external stability. The rockery design was based on discussions with the Client, our understanding of the project site geometry as observed during site visits and laboratory testing of a sample of on-site soils. The following paragraphs further describe the analysis and design procedures.

Soil Parameters

The native site soils were observed through the advancement of three exploratory trenches as well as two test pits. A sample of the near-surface soils was obtained from Trench 3. The soil consisted of a light brown Silty SAND (SM) with occasional gravel, and appeared to be consistent and homogenous across the cut. A direct shear (ASTM D3080) test was completed on a sample obtained from Trench 3. Laboratory test results included in Appendix D of this report indicate a friction angle of 31 degrees with a cohesion value of 445 psf.

Horizontal Ground Acceleration

GeoStrata has previously calculated the anticipated peak ground acceleration for the subject property as part of our 2013 investigation. Results of our calculations indicated that the peak ground acceleration (PGA) is estimated to be 0.57g.

Internal and External Stability Analysis

Engineering analysis of the rockeries included determination of minimum rock sizes. Minimum rock size was evaluated by analyzing overturning and sliding for individual rocks within the rockeries along a 1-foot unit length. Lateral earth pressures were calculated using the Coulomb approach, incorporating back slope and surcharge. Seismic considerations were incorporated using the Mononobe-Okabe equation as well as through using the procedure outlined in publications No. FHWA-CFL/TD-06-006 and FHWA-NHI-10-024. The boulders were considered to be an anisotropic material with a boulder-to-boulder lateral shear resistance characterized by a friction angle of 45° and a cohesion value of 0 psf. A cohesion value of 2,000 psf was assumed to characterize the internal rock strength. It was also assumed that chinking material is not allowed to remain on the boulder surface and the boulders have a contact area equal to 70% of the assumed bottom surface. Typical minimum factor of safety requirements for these conditions are 1.5 for overturning and 1.1 for sliding. Results of our internal stability analysis are included in Appendix B.

It should be noted that due to the presence of the backslope behind Rockery 1, as well as the moderately strong anticipated seismic forces, it was not feasible to utilize the Mononobe-Okabe equation. An alternative methodology is presented in the FHWA-CFL/TD-06-006 document. This methodology utilizes using a global stability program (in this case, SLIDE) in order to determine the seismic forces the wall experiences during a seismic event. Results of our global stability analysis indicate that the slope as proposed will remain stable during a seismic event, and as such the seismic forces put upon the wall have been reduced to 0.

Global Stability Analysis

The global stability analysis included both static and pseudo-static (seismic) analysis of the maximum section of both of the proposed rockeries. The stability analyses were completed using the geometric conditions, soil strengths and assumed rockery construction as observed on site and described in previous paragraphs. The investigated section of Rockery 1 was designated as section A-A'. The investigated section of Rockery 2 was designated as section B-B'. Minimum factors of safety of 1.5 and 1.1 for static and seismic conditions, respectively, were considered acceptable. The results of the global stability analyses are presented in Appendix C.

Rockery Construction Specifications

Based on the analysis and the constraints presented in this report and in accordance with the Associated Rockery Contractors (ARC) *Rock Wall Construction Guidelines*, the attached drawings and specifications presented in Appendix A (Plates A-2 and A-3) were developed. The following paragraphs further describe design elements that should be incorporated into the rockery construction.

Section drawings of the proposed rockeries are included in Appendix A as Plates A-2 and A-3. Based on our design analyses, the rock facing should not be placed steeper than 0.5 to 1 (horizontal to vertical) and the bottom rocks of the rockeries should be keyed into the ground a minimum of 12 inches. Rock facing should be placed in general accordance with the ARC *Rockery Construction Guidelines* as summarized in the attached Construction Specifications, Plate A-4. The guidelines state:

- Rocks should be placed so that there are no continuous joint planes in either the vertical or lateral direction.
- Rocks should be staggered such that each rock bears on the two rocks below it.
- The upper plane of each rock between courses (the top surface of rock), should slope back towards the slope face and away from the face of the rock wall.

A channel lined with a minimum of 6 inches of low permeability soil should be constructed above the top course of rock and should slope to the southern end of the rockery. The purpose of the channel is to prevent surface water such as precipitation or irrigation from flowing over the top of the rockery or infiltrating the soil above and behind the rockery.

Conclusions and Limitations

The results of the analyses indicate that the proposed rockeries met adequate factors of safety. Section drawings of the rockery and General Construction Guidelines are provided in Appendix A. The rockeries should be constructed as shown in the drawings. Boulders should be set with the largest dimension perpendicular to the rockery facing. To increase facing stability, voids between boulders should be chinked with smaller rocks.

The design drawings and specifications have been completed to reduce the potential for erosion and scour at the toe of the rockeries and saturation of the slope behind the rockeries. Efforts should be made to quickly vegetate/landscape the area above the rockeries to reduce erosion and infiltration.

A perforated drainage pipe and a 1.0-foot partition of gravel wrapped in geotextile fabric or alternatively a continuously placed prefabricated drainage composite has been included in the section drawings to provide some drainage behind the wall.

Conditions such as leaky or broken irrigation lines and ponding of precipitation or runoff can lead to saturation of the soil behind the rockery, which can lead to slope failure. Erosion and scouring of soils at the toe of the rockery can undermine the rockery which may also eventually lead to slope failure. The Owner/Client should be aware of the risks if these or other conditions occur that could jeopardize the stability of the rockery.

Inspection Scheduling

In order to facilitate inspection of the rockery during construction and observe compliance with our design documents, we propose the following schedule:

1. Inspect the first course of rocks for size, embedment, and back drain construction.
2. Inspect the second or third course of rocks for size, position and placement, and drainage.
3. Inspect finished rockeries for conformance to design requirements such as maximum heights, batter, front and back slope geometries, and rock sizing, positioning and placement.

The contractor, owner or developer is responsible for informing GeoStrata of the construction schedule to facilitate the inspections. The reviewing engineer also reserves the right to increase the frequency of inspections if conditions warrant.

We appreciate the opportunity to provide you with our services. If you have any questions please don't hesitate to contact us at your convenience.

Respectfully,
GeoStrata

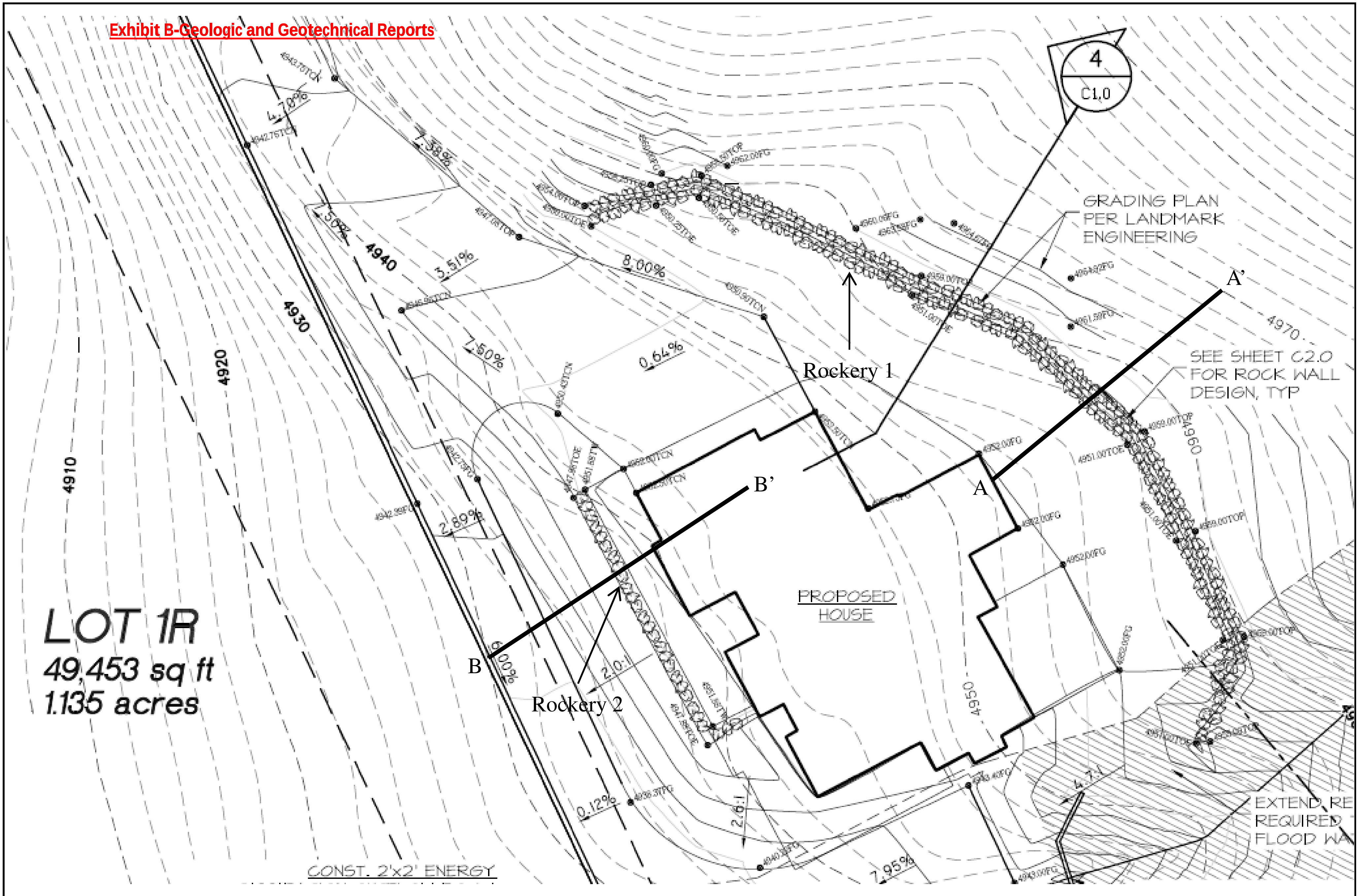
Reviewed by

5/13/15

Licensed Professional Engineer
Mark I. Christensen
No. 188039
Licensed
State of Utah

J. Scott Seal, P.E.
Staff Engineer

Mark I. Christensen, P.E.
Senior Engineer



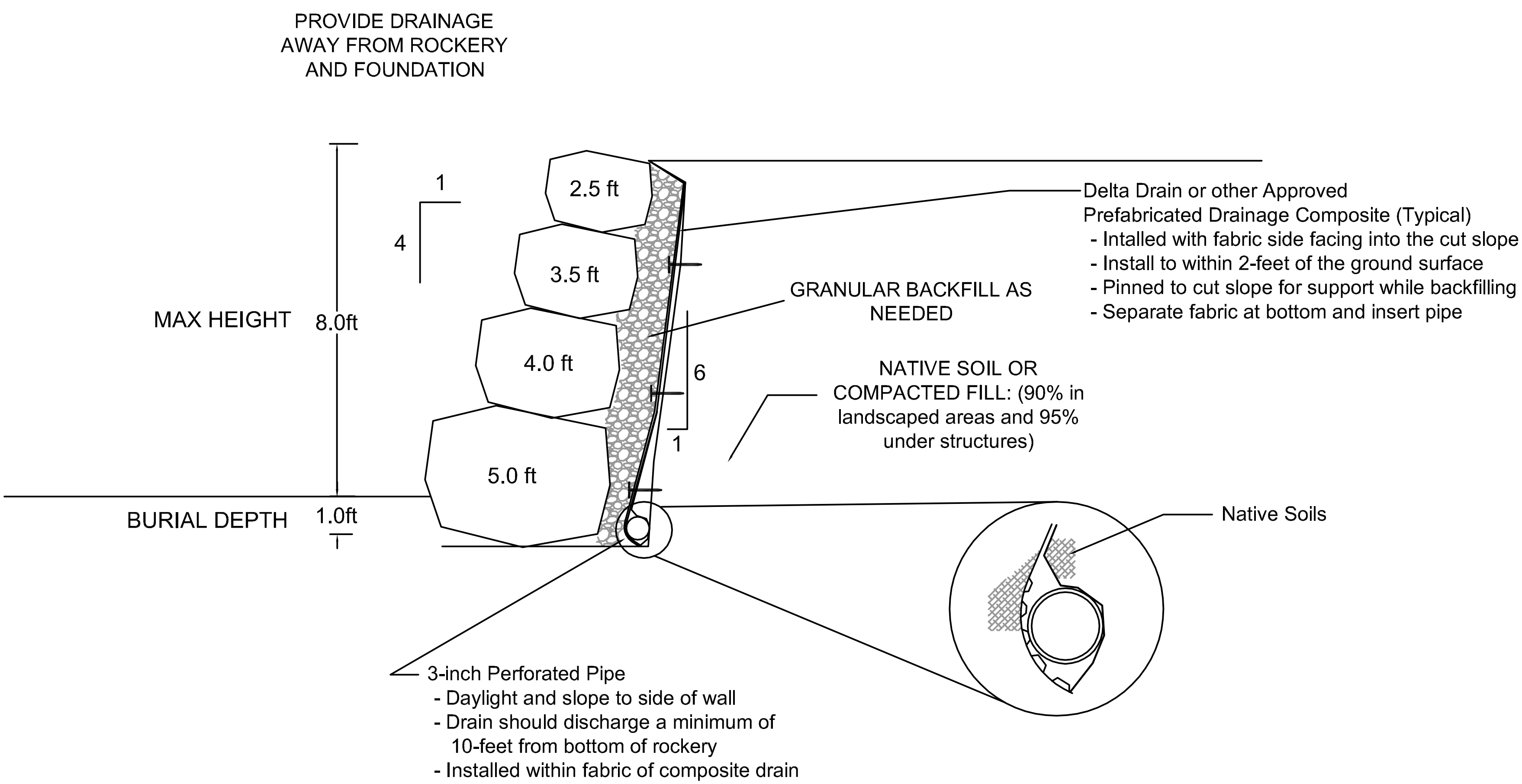
GeoStrata

Dauphine-Savory Piedmont – Lot 2R Site Map

Rockery Analysis and Design
Matt Rasmussen
Lot 2R
Weber County, Utah

Plate A - 1

Rockery 1 Cross Section



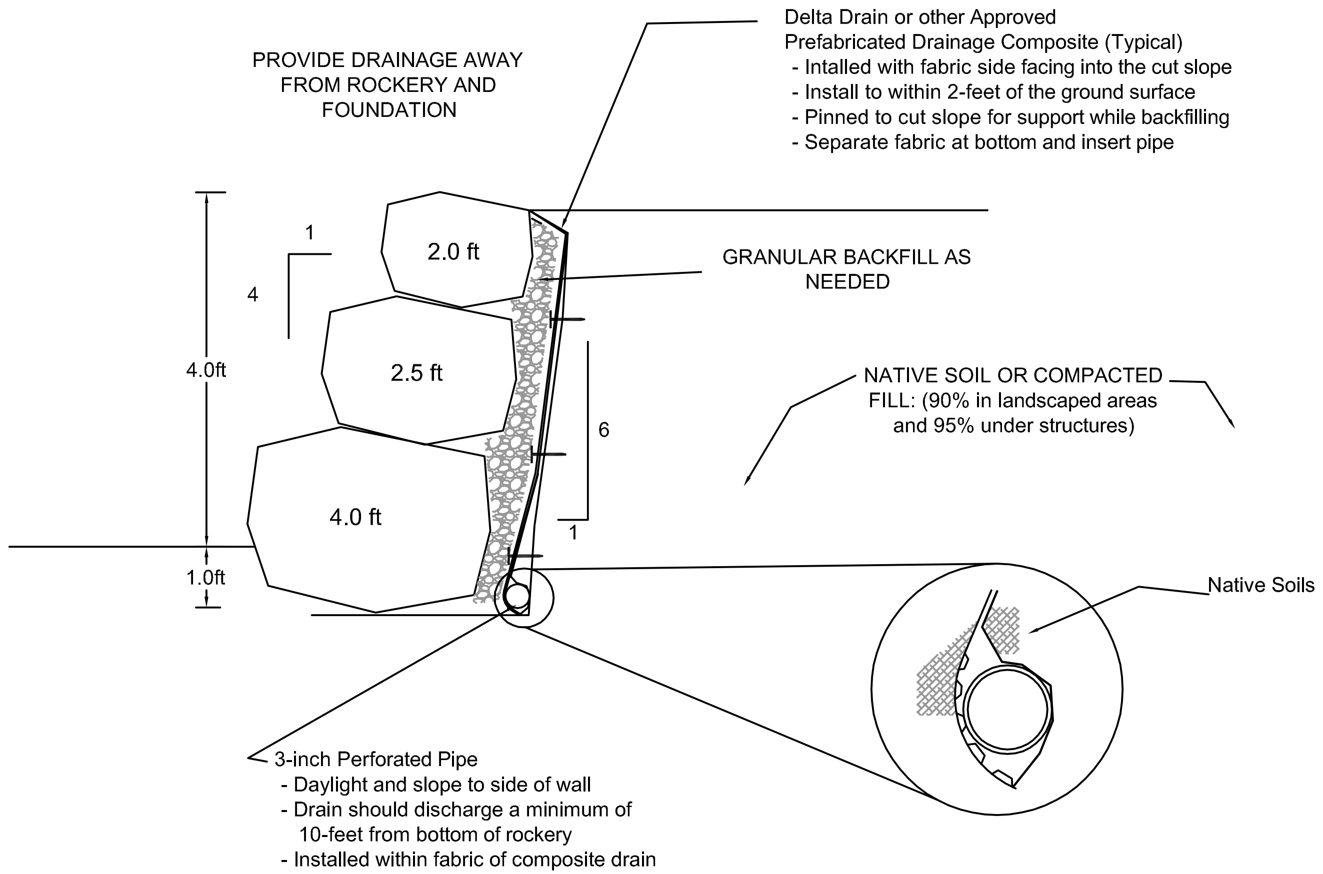
not to scale

GeoStrata

Matt Rasmussen
Dauphine-Savory Pidemont Subdivision Lot 2R
Weber County, UT
Project Number: 910-001

Plate
A-2

Rockery 2 Cross Section



Not to scale

GeoStrata

Matt Rasumussen
Dauphine-Savory Piedmont Subdivision Lot 2R
Weber County, UT
Project Number: 910-001

Plate
A-3

Rock Stacking Construction Specifications:

The rock stacking guidelines provided include installation of the rock facing, drain and backfill material. Design and construction information is based on empirical correlations, site geometry and the engineering analysis performed as part of the scope of work for this project.

MATERIALS

- Retained soils are to consist of native cut soils. If granular fill is required the material should consist of 4-inch minus granular soils compacted to a minimum of 90 percent ASTM D-1557 in landscape areas and 95 percent underneath structures. Any backfill material should be approved by the Geotechnical Engineer prior to importing.
- Rock Boulders to be used as facing should be durable angular particles with a minimum nominal diameter of 1½-feet. Rock sizes should be in accordance with design drawings.

INSTALLATION

- Rocks should be stacked in general accordance with the Associated Rockery Contractors (ARC) Rockery Construction Guidelines, summarized as follows:
    - Rocks should be placed so that there are no continuous joint planes in either the vertical or lateral direction.
    - Wherever possible, each rock should bear on at least two rocks below it.
    - The upper plane of each rock between courses (the top surface of rock), should slope back towards the slope face and away from the face of the rock wall.

- Rock facing should be stacked at a maximum steepness of ½ horizontal to 1 vertical for all rock slopes greater than 6-feet in height. Rock faced slopes less than 6-feet may be stacked steeper upon approval from the Geotechnical Engineer and if ARC guidelines are followed. Bottom row of rocks should be buried (keyed in) a minimum depth of 1 foot.

- Rock wall should be inspected at regular intervals by Geotechnical Engineer to accommodate final inspection and acceptance letter.

Interactive Rockery Minimum Rock Size Stability Calculations
SEISMIC INTERNAL STABILITY

Project: Dauphine-Savory Piedmont Subdivision
Proposed Rockery Analysis
Location: Weber County, Utah
Project No: 910-001
Engineer: JSS
Date: May 2, 2015

Minimum Factors of Safety

	Allowable	Actual
Overturning:	1.50	1.70
Sliding:	1.10	1.13
Bearing Capacity:	2.25	4.11
Bulging:	1.50	8.12

Rockery Section Investigated: 8-ft

Geometry of Proposed Rockery — **PGA:** 0.57 — **Minimum Rock Diameter =** 2.5

Backslope (for flat backslope V=0):	**Toeslope** (for flat toeslope V=0):	**Rockery Batter** (for vertical stacking H=0):	**Backcut Slope** (for vertical stacking H=0):
3.5 H. 1 V.	1 H. 0 V.	1 H. 4 V.	1 H. 6 V.
β = 15.95 degrees	β_T = 0.00 degrees	Ψ_{front} = 14.04 degrees	Ψ_{back} = 9.4623 degrees
surcharge, q_B = 0 psf	surcharge, q_T = 0 psf	Number of Rocks (8 max): 4	Appr. Rockery Length = 235

Soil/Rock Properties

Retained Soil Properties	**Foundation Soil Properties:**	**Boulder Properties:**
$\gamma_{backfill}$ = 120 pcf	$\gamma_{foundation}$ = 120 pcf	$\gamma_{Rock\ Boulder}$ = 145 pcf
$\phi_{backfill}$ = 31 degrees	$\phi_{foundation}$ = 31 degrees	$\phi_{Boulder\ Interface}$ = 45.0 degrees
$c_{backfill}$ = 445 psf	$c_{foundation}$ = 445 psf	$\tau_{Boulder\ Interface}$ = 0 lb/ft (Ult. Shear Cap.)
Friction Factor, α_B = 0.601	Friction Factor, α_F = 0.601	Rockery Embedment, D = 1.0 ft
$\delta_{backfill} = \alpha_B * \phi_{backfill}$ = 18.63 degrees	$\delta_{found.} = \alpha_F * \phi_{foundation}$ = 18.63 degrees	Rock Interface Red. Factor* = 0.7 *Adjust Depending on
K_a = 0.27707 K_{ah} = 0.26256	Depth to Groundwater, z = 100.0 ft	Rock Stacking Red. Factor* = 0.6 Boulder Geometry

Fae = 0 **Acting at** 0 **ft**

3. Enter Rock Diamters in Table Below
Actual Back of Rock Batter, θ: -5.28 degrees from vertical (CW)

4. Calculate Hinge Height do not use
Avg. rock diameter: 3.75 ft Hinge Ht., H_h = 40.59 ft

5. Calculate the Factor of Safety against Overturning (Min. FS = 1.5)

Wall Weight, W_1 =	5,075	lb/ft		
Effective Weight, W^*_1 =	5,075	lb/ft		
Acting At: x = 3.23	y = 4.25			
Resisting Moment, M_{res} =	16,543.2	lb	Static Resist	16543
Driving Moment, M_{drv} =	9,713.8	lb	Driving Resist	3962.7
$FS_{ovt} = M_{res}/M_{drv}$ =	1.70		FS	4.1747

Mononobe-Okabe Equation Fails,
Check Global Stability to determine Fae

6. Calculate the Factor of Safety against Base Sliding (Min. FS = 1.1)

Static Resist	3206.6	Resisting Force, P_{res} =	3,049.4	lb/ft
Static Drive	1320.9	Driving Force, P_{ah1} =	2,690.4	lb/ft
FS Static	2.4276	$FS_{sld} = P_{res}/P_{ah1}$ =	1.13	

7. Calculate the Factor of Safety for Bearing Capacity (Min. FS = 2.3)

		Soil Wedge Weight, W_s =	447	lb/ft
Static Sress	1250	Bearing Zone Width, B =	5.83	ft
Static Pressure	9954.8	Composite Force Acts at x =	3.38	ft
FS Static	7.9639	Eccentricity, e =	0.143	ft
		Effective Bearing Stress, σ_{vb} =	2,421	psf
		Max. Allowable Bearing Pressure, q_{ULT} =	9,955	psf
		$FS_{bearing} = q_{ULT}/\sigma_{vb}$ =	4.11	

8. Calculate the Factors of Safety for Internal Buldging (Min. FS = 1.5)
Values tabulated below. See sheet C-1 for equations

Approximate Maximum Exposed Rockery Height: **8.0** ft

Rock Course (starting from bottom), *i*	Min. Rock Dia. (ft)	Approx. Rock Area (ft^2)	$H_{1,i}$ (top down) (ft)	P_{ahi} (lb/ft)	Rock Weight (lb/ft)	Accum. Wt (lb/ft)	Rock to Rock Slide Resis. (lb/ft)	F.S. Bulging
1	5.0	19.2	9.0000	1,276.0	2,787	6,146	4,302	See Base Sliding
2	4.0	11.0	6.0	567.1	1,588	3,359	2,351	8.12
3	3.5	8.2	3.6	204.2	1,189	1,771	1,239	13.17
4	2.5	4.0	1.5	35.4	581	581	407	53.58

Interactive Rockery Minimum Rock Size Stability Calculations

SEISMIC INTERNAL STABILITY

Project: Dauphine-Savory Piedmont Subdivision
Proposed Rockery Analysis
Location: Weber County, Utah
Project No: 910-001
Engineer: JSS
Date: May 2, 2015

Minimum Factors of Safety

	Allowable	Actual
Overturning:	1.50	1.93
Sliding:	1.10	1.15
Bearing Capacity:	2.25	6.52
Bulging:	1.50	27.25

Rockery Section Investigated: 4-ft

Geometry of Proposed Rockery — **PGA:** 0.57 — **Minimum Rock Diameter =** 2.0

Backslope (for flat backslope V=0):	**Toeslope** (for flat toeslope V=0):	**Rockery Batter** (for vertical stacking H=0):	**Backcut Slope** (for vertical stacking H=0):
3.5 H. 0 V.	2 H. 1 V.	1 H. 4 V.	1 H. 6 V.
β = 0.00 degrees	β_T = -26.57 degrees	Ψ_{front} = 14.04 degrees	Ψ_{back} = 9.4623 degrees
surcharge, q_B = 0 psf	surcharge, q_T = 0 psf	Number of Rocks (8 max): 3	Appr. Rockery Length = 80

Soil/Rock Properties

Retained Soil Properties	**Foundation Soil Properties:**	**Boulder Properties:**
$\gamma_{backfill}$ = 120 pcf	$\gamma_{foundation}$ = 120 pcf	$\gamma_{Rock\ Boulder}$ = 145 pcf
$\phi_{backfill}$ = 31 degrees	$\phi_{foundation}$ = 31 degrees	$\phi_{Boulder\ Interface}$ = 45.0 degrees
$c_{backfill}$ = 445 psf	$c_{foundation}$ = 445 psf	$\tau_{Boulder\ Interface}$ = 0 lb/ft (Ult. Shear Cap.)
Friction Factor, α_B = 0.601	Friction Factor, α_F = 0.601	Rockery Embedment, D = 1.0 ft
$\delta_{backfill} = \alpha_B{}^*\phi_{backfill}$ = 18.63 degrees	$\delta_{found.} = \alpha_F{}^*\phi_{foundation}$ = 18.63 degrees	Rock Interface Red. Factor* = 0.7 — *Adjust Depending on Boulder Geometry
K_a = 0.22381 — K_{ah} = 0.21209	Depth to Groundwater, z = 100.0 ft	Rock Stacking Red. Factor* = 0.6

Fae = 705.5 **Acting at** 2.387 **ft**

3. Enter Rock Diamters in Table Below
Actual Back of Rock Batter, θ: -1.34 degrees from vertical (CW)

4. Calculate Hinge Height — do not use
Avg. rock diameter: 2.83 ft — Hinge Ht., H_h = 120.89 ft

5. Calculate the Factor of Safety against Overturning (Min. FS = 1.5)

Wall Weight, W_1 =	2,364	lb/ft		
Effective Weight, W^*_1 =	2,364	lb/ft		
Acting At: x =	2.33	y = 2.41		
Resisting Moment, M_{res} =	6,122.5	lb	Static Resist	5810.4
Driving Moment, M_{drv} =	3,168.9	lb	Driving Resist	582.46
$FS_{ovt} = M_{res}/M_{drv}$ =	1.93		FS	9.9755

6. Calculate the Factor of Safety against Base Sliding (Min. FS = 1.1)

Static Resist	1460.9	Resisting Force, P_{res} =	1,536.7	lb/ft
Static Drive	342.63	Driving Force, P_{ah1} =	1,333.9	lb/ft
FS Static	4.2639	$FS_{sld} = P_{res}/P_{ah1}$ =	1.15	

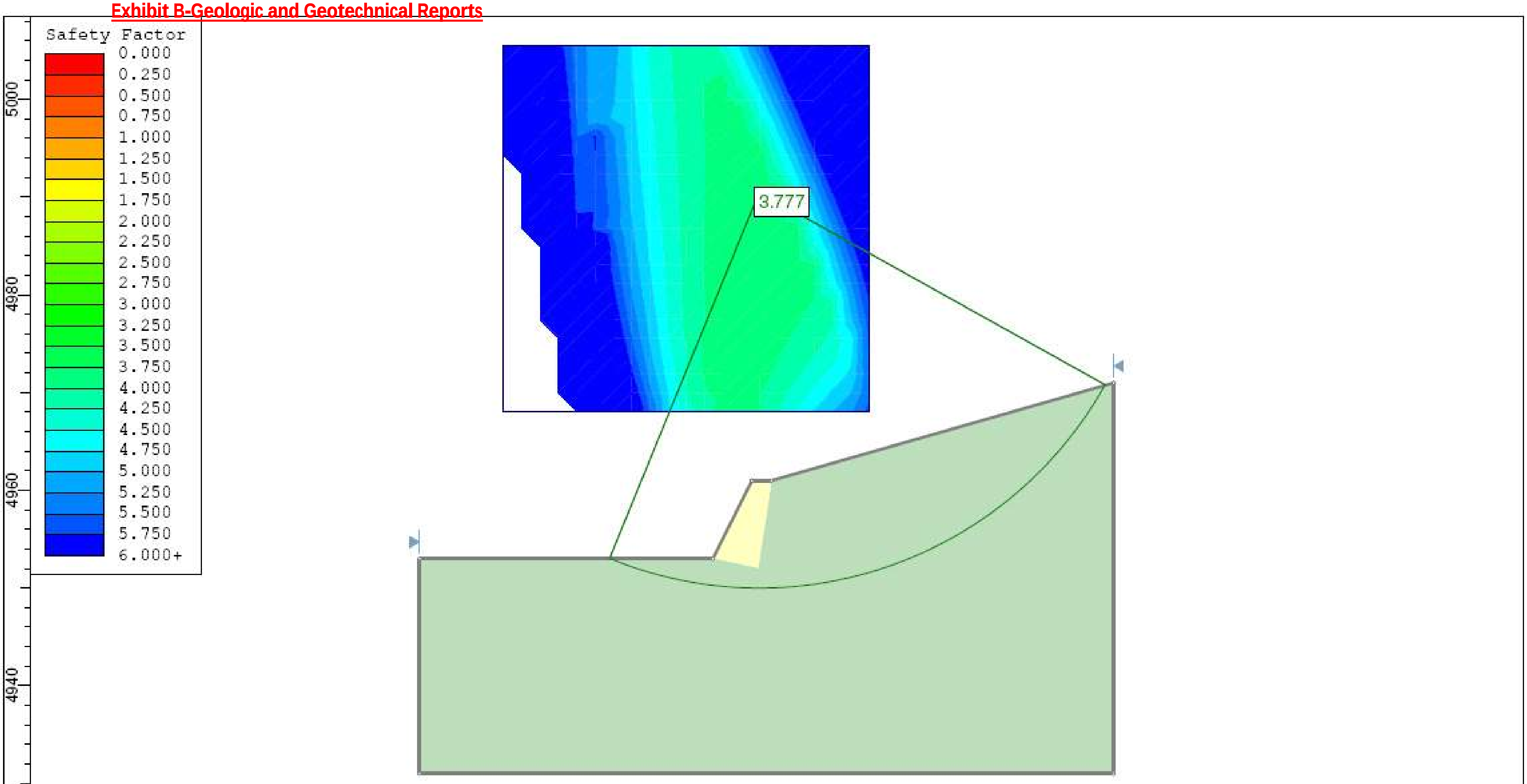
7. Calculate the Factor of Safety for Bearing Capacity (Min. FS = 2.3)

		Soil Wedge Weight, W_s =	37	lb/ft
Static Sress	470.9	Bearing Zone Width, B =	4.12	ft
Static Pressure	9079.8	Composite Force Acts at x =	2.35	ft
FS Static	19.282	Eccentricity, e =	-0.150	ft
		Effective Bearing Stress, σ_{vb} =	1,393	psf
		Max. Allowable Bearing Pressure, q_{ULT} =	9,080	psf
		$FS_{bearing} = q_{ULT}/\sigma_{vb}$ =	6.52	

8. Calculate the Factors of Safety for Internal Buldging (Min. FS = 1.5)
Values tabulated below. See sheet C-1 for equations

Approximate Maximum Exposed Rockery Height: **4.1** ft

Rock Course (starting from bottom), *i*	Min. Rock Dia. (ft)	Approx. Rock Area (ft^2)	$H_{1,i}$ (top down) (ft)	P_{ahi} (lb/ft)	Rock Weight (lb/ft)	Accum. Wt (lb/ft)	Rock to Rock Slide Resis. (lb/ft)	F.S. Bulging
1	4.0	12.3	5.1000	331.0	1,784	2,747	1,923	See Base Sliding
2	2.5	4.0	2.7	92.8	587	964	675	27.25
3	2.0	2.6	1.2	18.3	377	377	264	45.44



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Cohesion 2 (psf)	Phi 2 (deg)	Angle (ccw to 1) (deg)	Water Surface	Ru
Rockery		135	Anisotropic strength	2000	0	0	45	15	None	0
Native Silty SAND (SM)		120	Mohr-Coulomb	445	31				None	0

GeoStrata

Dauphine-Savory Piedmont – Lot 2R Section A-A' Static

Rockery Analysis and Design
Matt Rasmussen
Lot 2R
Weber County, Utah

Plate C - 1

Slide Analysis Information

SLIDE - An Interactive Slope Stability Program

Project Summary

File Name: Section A-A' Static
Slide Modeler Version: 6.033
Project Title: SLIDE - An Interactive Slope Stability Program
Date Created: 5/2/2015, 2:19:31 PM

General Settings

Units of Measurement: Imperial Units
Time Units: days
Permeability Units: feet/second
Failure Direction: Right to Left
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

Bishop simplified
Janbu simplified

Number of slices: 25
Tolerance: 0.005

Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 62.4 lbs/ft3
Advanced Groundwater Method: None

Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Grid Search
Radius Increment: 10
Composite Surfaces: Disabled
Reverse Curvature: Create Tension Crack
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Material Properties

Property	Rockery	Native Silty SAND (SM)

Color		
Strength Type	Anisotropic strength	Mohr-Coulomb
Unit Weight [lbs/ft3]	135	120
Cohesion [psf]		445
Friction Angle [deg]		31
Cohesion 1 [psf]	2000	
Cohesion 2 [psf]	0	
Friction Angle 1 [deg]	0	
Friction Angle 2 [deg]	45	
Angle from 1 [deg]	15	
Water Surface	None	None
Ru Value	0	0

Global Minimums

Method: bishop simplified

FS: 3.776920
Center: 34.767, 4990.523
Radius: 40.536
Left Slip Surface Endpoint: 19.430, 4953.000
Right Slip Surface Endpoint: 70.159, 4970.760
Resisting Moment=2.22421e+006 lb-ft
Driving Moment=588894 lb-ft
Total Slice Area=396.11 ft2

Method: janbu simplified

FS: 3.466280
Center: 36.635, 4984.920
Radius: 36.365
Left Slip Surface Endpoint: 19.213, 4953.000

Right Slip Surface Endpoint: 70.125, 4970.750
Resisting Horizontal Force=53460.3 lb
Driving Horizontal Force=15422.9 lb
Total Slice Area=464.878 ft2

Valid / Invalid Surfaces

Method: bishop simplified

Number of Valid Surfaces: 4399
Number of Invalid Surfaces: 452

Error Codes:

Error Code -106 reported for 5 surfaces
Error Code -108 reported for 447 surfaces

Method: janbu simplified

Number of Valid Surfaces: 4276
Number of Invalid Surfaces: 575

Error Codes:

Error Code -106 reported for 5 surfaces
Error Code -108 reported for 570 surfaces

Error Codes

The following errors were encountered during the computation:

-106 = Average slice width is less than 0.0001 * (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

Slice Data

Global Minimum Query (bishop simplified) - Safety Factor: 3.77692

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	2.02915	93.3405	Native Silty SAND (SM)	445	31	133.135	502.841	96.2638	0	96.2638
2	2.02915	265.331	Native Silty SAND (SM)	445	31	146.013	551.479	177.21	0	177.21
3	2.02915	408.663	Native Silty SAND (SM)	445	31	156.369	590.592	242.306	0	242.306
4	2.02915	524.616	Native Silty SAND (SM)	445	31	164.374	620.829	292.628	0	292.628
5	2.02915	614.17	Native Silty SAND (SM)	445	31	170.164	642.696	329.022	0	329.022
6	2.02915	1030.18	Native Silty SAND (SM)	445	31	201.913	762.611	528.595	0	528.595
7	2.02915	2169.48	Native Silty SAND (SM)	445	31	290.36	1096.67	1084.55	0	1084.55
8	2.02915	2878.4	Native Silty SAND (SM)	445	31	343.649	1297.93	1419.52	0	1419.52
9	2.02915	2722.2	Native Silty SAND (SM)	445	31	328.776	1241.76	1326.03	0	1326.03
10	2.02915	2820.18	Native Silty SAND (SM)	445	31	333.742	1260.52	1357.25	0	1357.25
11	2.02915	2900.41	Native Silty SAND (SM)	445	31	337.232	1273.7	1379.18	0	1379.18
12	2.02915	2955.05	Native Silty SAND (SM)	445	31	338.66	1279.09	1388.16	0	1388.16
13	2.02915	2983.38	Native Silty SAND (SM)	445	31	337.998	1276.59	1384	0	1384
14	2.02915	2984.46	Native Silty SAND (SM)	445	31	335.199	1266.02	1366.4	0	1366.4
15	2.02915	2957.05	Native Silty SAND (SM)	445	31	330.196	1247.12	1334.96	0	1334.96
16	2.02915	2899.54	Native Silty SAND (SM)	445	31	322.899	1219.56	1289.09	0	1289.09
17	2.02915	2809.91	Native Silty SAND (SM)	445	31	313.187	1182.88	1228.05	0	1228.05
18	2.02915	2685.53	Native Silty SAND (SM)	445	31	300.908	1136.51	1150.86	0	1150.86
19	2.02915	2523.05	Native Silty SAND (SM)	445	31	285.861	1079.68	1056.28	0	1056.28
20	2.02915	2318.02	Native Silty SAND (SM)	445	31	267.789	1011.42	942.673	0	942.673
21	2.02915	2064.54	Native Silty SAND (SM)	445	31	246.348	930.436	807.901	0	807.901
22	2.02915	1754.4	Native Silty SAND (SM)	445	31	221.08	835.002	649.071	0	649.071
23	2.02915	1375.71	Native Silty SAND (SM)	445	31	191.346	722.697	462.167	0	462.167

SLIDEINTERPRET 6.033	*Project* SLIDE - An Interactive Slope Stability Program		
	Analysis Description		
	Drawn By	*Scale*	*Company*
	Date 5/2/2015, 2:19:31 PM		*File Name* Section A-A' Static.slim

24	2.02915	910.125	Native Silty SAND (SM)	445	31	156.214	590.006	241.33	0	241.33
25	2.02915	326.396	Native Silty SAND (SM)	445	31	114.231	431.44	-22.5674	0	-22.5674

Global Minimum Query (janbu simplified) - Safety Factor: 3.46628

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	2.03648	125.847	Native Silty SAND (SM)	445	31	152.478	528.532	139.02	0	139.02
2	2.03648	358.77	Native Silty SAND (SM)	445	31	171.747	595.323	250.18	0	250.18
3	2.03648	555.58	Native Silty SAND (SM)	445	31	187.401	649.586	340.489	0	340.489
4	2.03648	718.793	Native Silty SAND (SM)	445	31	199.805	692.58	412.042	0	412.042
5	2.03648	850.318	Native Silty SAND (SM)	445	31	209.231	725.253	466.418	0	466.418
6	2.03648	1231.79	Native Silty SAND (SM)	445	31	240.48	833.571	646.692	0	646.692
7	2.03648	2387.22	Native Silty SAND (SM)	445	31	338.386	1172.94	1211.5	0	1211.5
8	2.03648	3217.46	Native Silty SAND (SM)	445	31	406.425	1408.78	1604	0	1604
9	2.03648	3090.29	Native Silty SAND (SM)	445	31	391.632	1357.51	1518.67	0	1518.67
10	2.03648	3204.04	Native Silty SAND (SM)	445	31	397.447	1377.66	1552.21	0	1552.21
11	2.03648	3305.75	Native Silty SAND (SM)	445	31	402.111	1393.83	1579.12	0	1579.12
12	2.03648	3379.04	Native Silty SAND (SM)	445	31	404.261	1401.28	1591.52	0	1591.52
13	2.03648	3423.2	Native Silty SAND (SM)	445	31	403.872	1399.93	1589.28	0	1589.28
14	2.03648	3437.25	Native Silty SAND (SM)	445	31	400.891	1389.6	1572.07	0	1572.07
15	2.03648	3419.79	Native Silty SAND (SM)	445	31	395.234	1369.99	1539.44	0	1539.44
16	2.03648	3368.96	Native Silty SAND (SM)	445	31	386.782	1340.7	1490.69	0	1490.69
17	2.03648	3282.34	Native Silty SAND (SM)	445	31	375.376	1301.16	1424.89	0	1424.89
18	2.03648	3156.69	Native Silty SAND (SM)	445	31	360.799	1250.63	1340.8	0	1340.8
19	2.03648	2987.75	Native Silty SAND (SM)	445	31	342.763	1188.11	1236.75	0	1236.75
20	2.03648	2769.71	Native Silty SAND (SM)	445	31	320.881	1112.26	1110.51	0	1110.51
21	2.03648	2494.43	Native Silty SAND (SM)	445	31	294.618	1021.23	959.005	0	959.005
22	2.03648	2150.03	Native Silty SAND (SM)	445	31	263.215	912.377	777.845	0	777.845
23	2.03648	1717.93	Native Silty SAND (SM)	445	31	225.53	781.751	560.449	0	560.449
24	2.03648	1165.94	Native Silty SAND (SM)	445	31	179.704	622.906	296.085	0	296.085

25	2.03648	427.395	Native Silty SAND (SM)	445	31	122.248	423.744	-35.3757	0	-35.3757

Interslice Data

Global Minimum Query (bishop simplified) - Safety Factor: 3.77692

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	19.4305	4953	0	0	0
2	21.4596	4952.23	343.753	0	0
3	23.4888	4951.59	754.292	0	0
4	25.5179	4951.06	1200.08	0	0
5	27.5471	4950.63	1656.61	0	0
6	29.5762	4950.32	2105.09	0	0
7	31.6054	4950.11	2625.63	0	0
8	33.6345	4950	3331.14	0	0
9	35.6637	4950	4036.32	0	0
10	37.6928	4950.09	4575.92	0	0
11	39.722	4950.29	4983.56	0	0
12	41.7511	4950.59	5250.54	0	0
13	43.7803	4951	5370.07	0	0
14	45.8094	4951.52	5338.15	0	0
15	47.8386	4952.15	5153.71	0	0
16	49.8677	4952.9	4818.96	0	0
17	51.8969	4953.78	4339.88	0	0
18	53.926	4954.8	3726.98	0	0
19	55.9552	4955.97	2996.48	0	0
20	57.9843	4957.29	2172.05	0	0
21	60.0135	4958.81	1287.59	0	0
22	62.0426	4960.54	391.646	0	0

23	64.0718	4962.52	-445.019	0	0
24	66.101	4964.81	-1115.52	0	0
25	68.1301	4967.5	-1448.77	0	0
26	70.1593	4970.76	0	0	0

Global Minimum Query (janbu simplified) - Safety Factor: 3.46628

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	19.2131	4953	0	0	0
2	21.2496	4951.97	454.141	0	0
3	23.2861	4951.09	1023.63	0	0
4	25.3226	4950.36	1655.87	0	0
5	27.3591	4949.76	2311.13	0	0
6	29.3956	4949.28	2959.4	0	0
7	31.432	4948.93	3678.6	0	0
8	33.4685	4948.69	4654.61	0	0
9	35.505	4948.57	5676.84	0	0
10	37.5415	4948.57	6485.02	0	0
11	39.578	4948.67	7127.94	0	0
12	41.6145	4948.9	7595.44	0	0
13	43.651	4949.24	7877.66	0	0
14	45.6874	4949.7	7967.8	0	0
15	47.7239	4950.29	7862.22	0	0
16	49.7604	4951.01	7560.76	0	0
17	51.7969	4951.87	7067.2	0	0
18	53.8334	4952.88	6390.15	0	0
19	55.8699	4954.06	5544.41	0	0
20	57.9064	4955.43	4553.1	0	0
21	59.9428	4957.01	3451.29	0	0
22	61.9793	4958.84	2292.22	0	0

23	64.0158	4960.99	1158.87	0	0
24	66.0523	4963.54	188.015	0	0
25	68.0888	4966.67	-371.737	0	0
26	70.1253	4970.75	0	0	0

List Of Coordinates

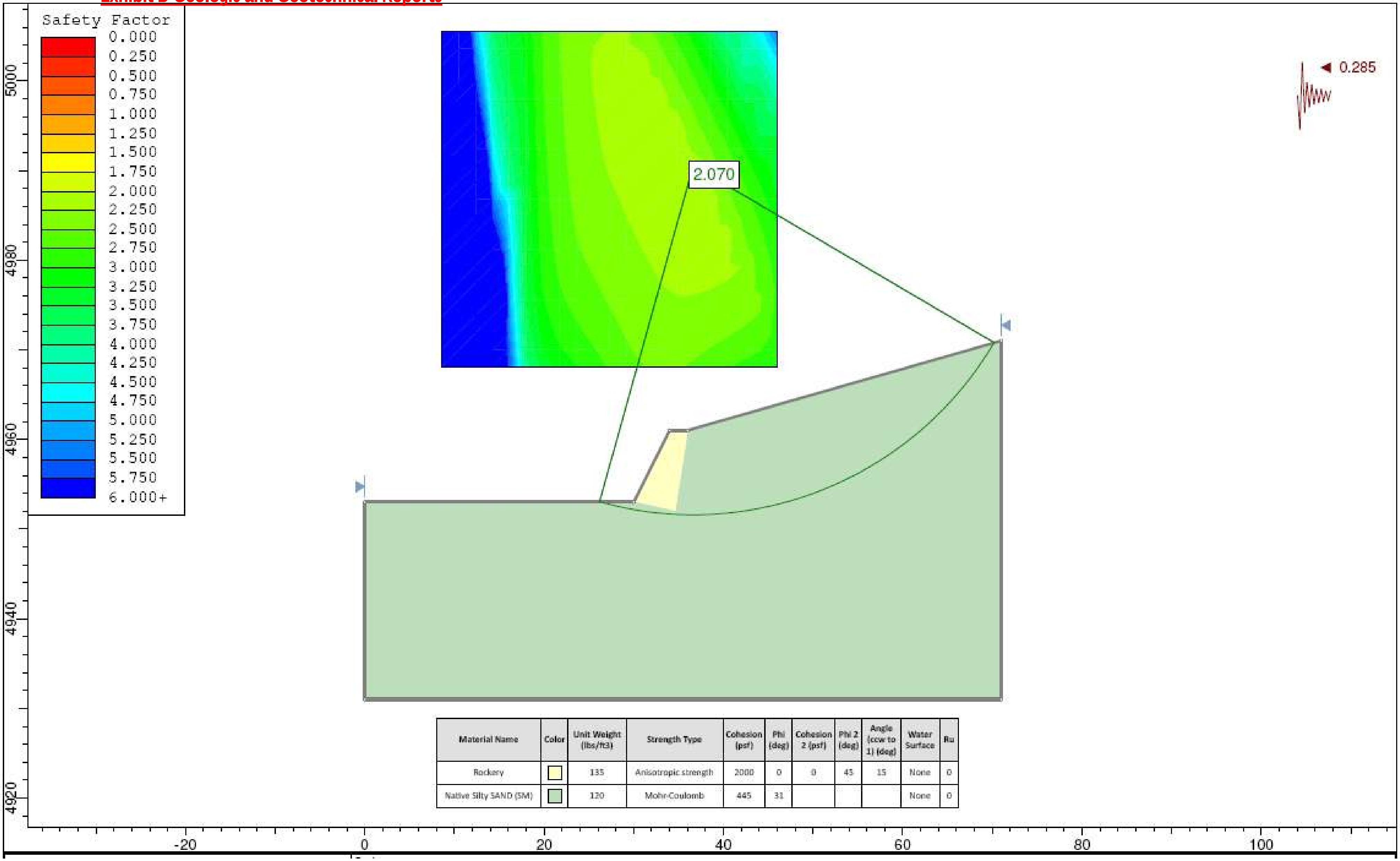
External Boundary

X	Y
0	4931
71	4931
71	4971
36	4961
34	4961
30	4953
0	4953

Material Boundary

X	Y
30	4953
34.6	4952
36	4961

SLIDEINTERPRET 6.033	*Project* SLIDE - An Interactive Slope Stability Program		
	Analysis Description		
	Drawn By	*Scale*	*Company*
	Date 5/2/2015, 2:19:31 PM		*File Name* Section A-A' Static.slim



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Cohesion 2 (psf)	Phi 2 (deg)	Angle (ccw to 1) (deg)	Water Surface	Ru
Rockery		135	Anisotropic strength	2000	0	0	45	15	None	0
Native Silty SAND (SM)		120	Mohr-Coulomb	445	31				None	0

GeoStrata

Dauphine-Savory Piedmont – Lot 2R Section A-A' PStatic

Rockery Analysis and Design
Matt Rasmussen
Lot 2R
Weber County, Utah

Plate C - 2

Slide Analysis Information

SLIDE - An Interactive Slope Stability Program

Project Summary

File Name: Section A-A' PStatic
Slide Modeler Version: 6.033
Project Title: SLIDE - An Interactive Slope Stability Program
Date Created: 5/2/2015, 2:19:31 PM

General Settings

Units of Measurement: Imperial Units
Time Units: days
Permeability Units: feet/second
Failure Direction: Right to Left
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

Bishop simplified
Janbu simplified

Number of slices: 25
Tolerance: 0.005

Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 62.4 lbs/ft3
Advanced Groundwater Method: None

Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Grid Search
Radius Increment: 10
Composite Surfaces: Disabled
Reverse Curvature: Create Tension Crack
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 0.285

Material Properties

Property	Rockery	Native Silty SAND (SM)
Color		
Strength Type	Anisotropic strength	Mohr-Coulomb
Unit Weight [lbs/ft3]	135	120
Cohesion [psf]		445
Friction Angle [deg]		31
Cohesion 1 [psf]	2000	
Cohesion 2 [psf]	0	
Friction Angle 1 [deg]	0	
Friction Angle 2 [deg]	45	
Angle from 1 [deg]	15	
Water Surface	None	None
Ru Value	0	0

Global Minimums

Method: bishop simplified

FS: 2.069640
Center: 36.635, 4990.523
Radius: 38.958
Left Slip Surface Endpoint: 26.159, 4953.000
Right Slip Surface Endpoint: 70.218, 4970.776
Resisting Moment=1.76284e+006 lb-ft
Driving Moment=851758 lb-ft
Total Slice Area=342.642 ft2

Method: janbu simplified

FS: 1.845660
Center: 38.503, 4981.184
Radius: 33.289
Left Slip Surface Endpoint: 20.788, 4953.000
Right Slip Surface Endpoint: 70.113, 4970.747
Resisting Horizontal Force=53329.7 lb
Driving Horizontal Force=28894.7 lb
Total Slice Area=498.946 ft2

Valid / Invalid Surfaces

Method: bishop simplified

Number of Valid Surfaces: 4846
Number of Invalid Surfaces: 5

Error Codes:

Error Code -106 reported for 5 surfaces

Method: janbu simplified

Number of Valid Surfaces: 4744
Number of Invalid Surfaces: 107

Error Codes:

Error Code -106 reported for 5 surfaces
Error Code -108 reported for 102 surfaces

Error Codes

The following errors were encountered during the computation:

-106 = Average slice width is less than 0.0001 * (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

Slice Data

Global Minimum Query (bishop simplified) - Safety Factor: 2.06964

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	1.76234	47.3664	Native Silty SAND (SM)	445	31	240.557	497.867	87.9851	0	87.9851
2	1.76234	132.989	Native Silty SAND (SM)	445	31	251.927	521.399	127.149	0	127.149
3	1.76234	486.395	Native Silty SAND (SM)	445	31	309.299	640.138	324.765	0	324.765
4	1.76234	1371.58	Native Silty SAND (SM)	445	31	455.675	943.083	828.952	0	828.952
5	1.76234	2119.12	Native Silty SAND (SM)	445	31	575.037	1190.12	1240.09	0	1240.09
6	1.76234	2051.8	Native Silty SAND (SM)	445	31	556.265	1151.27	1175.43	0	1175.43
7	1.76234	2088.12	Native Silty SAND (SM)	445	31	554.953	1148.55	1170.91	0	1170.91
8	1.76234	2176.77	Native Silty SAND (SM)	445	31	562.097	1163.34	1195.51	0	1195.51
9	1.76234	2248.41	Native Silty SAND (SM)	445	31	566.279	1171.99	1209.92	0	1209.92
10	1.76234	2302.82	Native Silty SAND (SM)	445	31	567.528	1174.58	1214.22	0	1214.22
11	1.76234	2339.67	Native Silty SAND (SM)	445	31	565.854	1171.12	1208.46	0	1208.46
12	1.76234	2358.49	Native Silty SAND (SM)	445	31	561.247	1161.58	1192.59	0	1192.59
13	1.76234	2358.69	Native Silty SAND (SM)	445	31	553.675	1145.91	1166.5	0	1166.5
14	1.76234	2339.5	Native Silty SAND (SM)	445	31	543.084	1123.99	1130.03	0	1130.03
15	1.76234	2299.94	Native Silty SAND (SM)	445	31	529.399	1095.67	1082.89	0	1082.89
16	1.76234	2238.81	Native Silty SAND (SM)	445	31	512.514	1060.72	1024.73	0	1024.73
17	1.76234	2154.61	Native Silty SAND (SM)	445	31	492.294	1018.87	955.083	0	955.083
18	1.76234	2045.45	Native Silty SAND (SM)	445	31	468.566	969.763	873.353	0	873.353
19	1.76234	1908.94	Native Silty SAND (SM)	445	31	441.111	912.941	778.783	0	778.783

20	1.76234	1741.99	Native Silty SAND (SM)	445	31	409.65	847.828	670.419	0	670.419
21	1.76234	1540.55	Native Silty SAND (SM)	445	31	373.827	773.688	547.029	0	547.029
22	1.76234	1299.12	Native Silty SAND (SM)	445	31	333.184	689.57	407.033	0	407.033
23	1.76234	1009.96	Native Silty SAND (SM)	445	31	287.113	594.221	248.346	0	248.346
24	1.76234	661.565	Native Silty SAND (SM)	445	31	234.799	485.95	68.1514	0	68.1514
25	1.76234	235.41	Native Silty SAND (SM)	445	31	175.099	362.391	-137.484	0	-137.484

Global Minimum Query (janbu simplified) - Safety Factor: 1.84566

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	1.973	135.862	Native Silty SAND (SM)	445	31	325.084	599.994	257.953	0	257.953
2	1.973	387.294	Native Silty SAND (SM)	445	31	363.577	671.04	376.194	0	376.194
3	1.973	600.052	Native Silty SAND (SM)	445	31	393.409	726.099	467.828	0	467.828
4	1.973	777.469	Native Silty SAND (SM)	445	31	415.899	767.609	536.912	0	536.912
5	1.973	980.301	Native Silty SAND (SM)	445	31	442.544	816.786	618.755	0	618.755
6	1.973	1919.55	Native Silty SAND (SM)	445	31	598.942	1105.44	1099.16	0	1099.16
7	1.973	3018.77	Native Silty SAND (SM)	445	31	776.79	1433.69	1645.46	0	1645.46
8	1.973	3169.12	Native Silty SAND (SM)	445	31	786.559	1451.72	1675.47	0	1675.47
9	1.973	3201.49	Native Silty SAND (SM)	445	31	776.543	1433.24	1644.7	0	1644.7
10	1.973	3334.36	Native Silty SAND (SM)	445	31	783.4	1445.89	1665.77	0	1665.77
11	1.973	3439.45	Native Silty SAND (SM)	445	31	785.47	1449.71	1672.11	0	1672.11
12	1.973	3516.44	Native Silty SAND (SM)	445	31	782.801	1444.78	1663.92	0	1663.92
13	1.973	3564.72	Native Silty SAND (SM)	445	31	775.404	1431.13	1641.2	0	1641.2
14	1.973	3583.31	Native Silty SAND (SM)	445	31	763.223	1408.65	1603.78	0	1603.78
15	1.973	3570.85	Native Silty SAND (SM)	445	31	746.144	1377.13	1551.32	0	1551.32
16	1.973	3525.44	Native Silty SAND (SM)	445	31	723.984	1336.23	1483.25	0	1483.25
17	1.973	3444.56	Native Silty SAND (SM)	445	31	696.481	1285.47	1398.77	0	1398.77
18	1.973	3324.85	Native Silty SAND (SM)	445	31	663.268	1224.17	1296.75	0	1296.75
19	1.973	3161.72	Native Silty SAND (SM)	445	31	623.846	1151.41	1175.66	0	1175.66
20	1.973	2948.84	Native Silty SAND (SM)	445	31	577.527	1065.92	1033.38	0	1033.38

21	1.973	2677.12	Native Silty SAND (SM)	445	31	523.345	965.917	866.951	0	866.951
22	1.973	2332.75	Native Silty SAND (SM)	445	31	459.889	848.798	672.032	0	672.032
23	1.973	1893.01	Native Silty SAND (SM)	445	31	384.966	710.516	441.894	0	441.894
24	1.973	1315.01	Native Silty SAND (SM)	445	31	294.789	544.081	164.898	0	164.898
25	1.973	492.152	Native Silty SAND (SM)	445	31	181.179	334.395	-184.078	0	-184.078

Interslice Data

Global Minimum Query (bishop simplified) - Safety Factor: 2.06964

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	26.1592	4953	0	0	0
2	27.9215	4952.55	449.603	0	0
3	29.6838	4952.19	901.418	0	0
4	31.4462	4951.91	1397.86	0	0
5	33.2085	4951.72	1972.1	0	0
6	34.9708	4951.6	2524.08	0	0
7	36.7332	4951.57	2960.7	0	0
8	38.4955	4951.61	3291.11	0	0
9	40.2579	4951.73	3512.05	0	0
10	42.0202	4951.94	3620.38	0	0
11	43.7825	4952.23	3614.82	0	0
12	45.5449	4952.6	3495.98	0	0
13	47.3072	4953.06	3266.43	0	0
14	49.0695	4953.6	2930.8	0	0
15	50.8319	4954.24	2496.02	0	0
16	52.5942	4954.98	1971.62	0	0
17	54.3566	4955.83	1370.2	0	0
18	56.1189	4956.79	708.055	0	0

19	57.8812	4957.87	6.12141	0	0
20	59.6436	4959.09	-708.686	0	0
21	61.4059	4960.45	-1401.46	0	0
22	63.1682	4962	-2026.21	0	0
23	64.9306	4963.74	-2520.79	0	0
24	66.6929	4965.74	-2798.26	0	0
25	68.4553	4968.05	-2730.51	0	0
26	70.2176	4970.78	0	0	0

Global Minimum Query (janbu simplified) - Safety Factor: 1.84566

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	20.788	4953	0	0	0
2	22.761	4951.85	898.693	0	0
3	24.734	4950.88	1872.89	0	0
4	26.707	4950.06	2862.12	0	0
5	28.68	4949.38	3824.96	0	0
6	30.653	4948.83	4754.97	0	0
7	32.626	4948.42	5846.71	0	0
8	34.599	4948.12	7001.28	0	0
9	36.572	4947.95	7940.85	0	0
10	38.545	4947.9	8652.61	0	0
11	40.518	4947.96	9146.25	0	0
12	42.491	4948.13	9416.84	0	0
13	44.464	4948.43	9462.66	0	0
14	46.437	4948.85	9285.16	0	0
15	48.41	4949.4	8889.09	0	0
16	50.383	4950.09	8282.91	0	0
17	52.356	4950.91	7479.34	0	0
18	54.329	4951.9	6496.41	0	0

19	56.302	4953.05	5359.06	0	0
20	58.275	4954.4	4101.67	0	0
21	60.248	4955.98	2772.36	0	0
22	62.221	4957.83	1440.58	0	0
23	64.194	4960.02	211.748	0	0
24	66.167	4962.67	-740.453	0	0
25	68.14	4966.03	-1087.25	0	0
26	70.113	4970.75	0	0	0

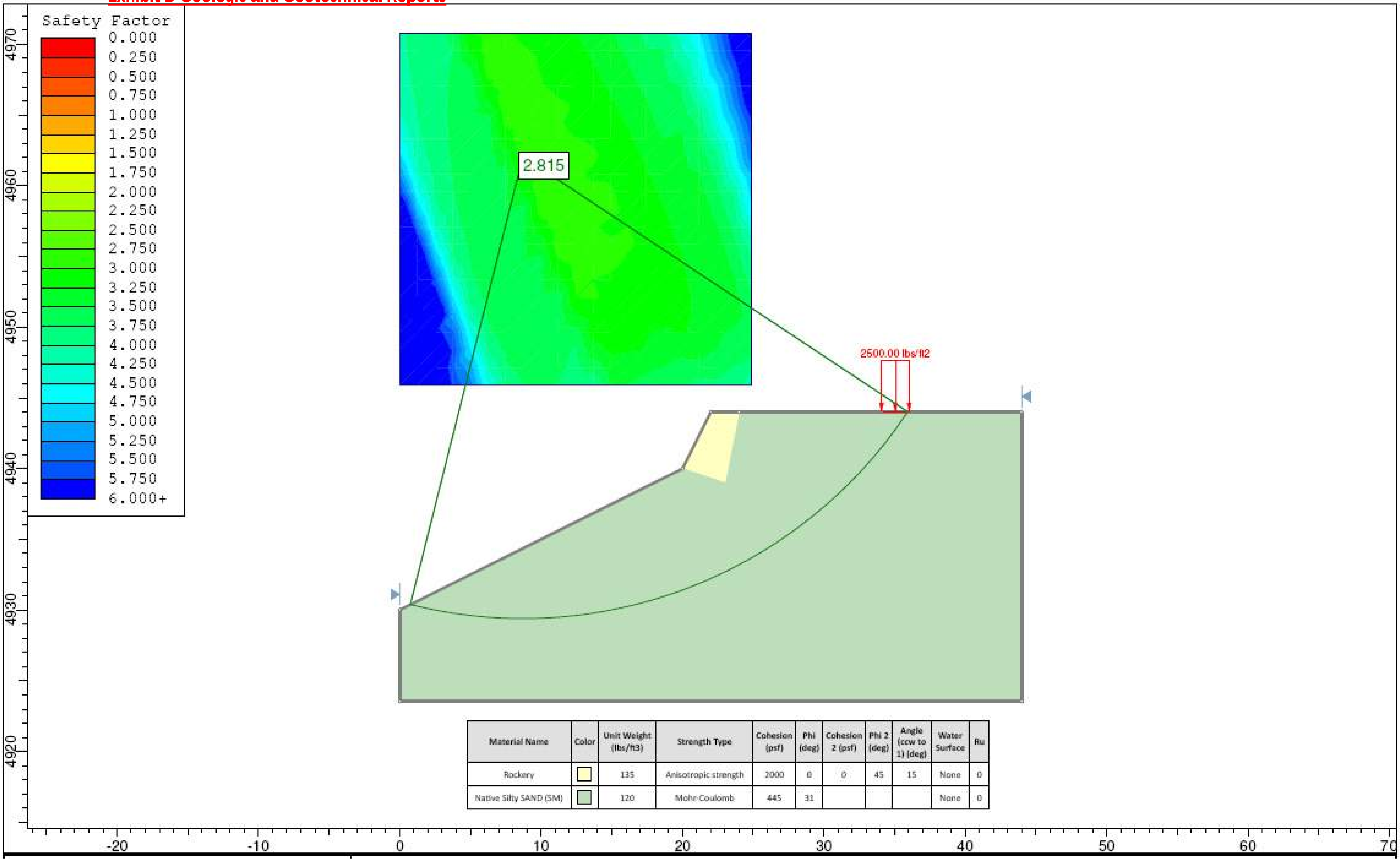
List Of Coordinates

External Boundary

X	Y
0	4931
71	4931
71	4971
36	4961
34	4961
30	4953
0	4953

Material Boundary

X	Y
30	4953
34.6	4952
36	4961



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Cohesion 2 (psf)	Phi 2 (deg)	Angle (ccw to 1) [deg]	Water Surface	Ru
Rockery		135	Anisotropic strength	2000	0	0	45	15	None	0
Native Silty SAND (SM)		120	Mohr-Coulomb	445	31				None	0

GeoStrata

Dauphine-Savory Piedmont – Lot 2R Section B-B' Static

Rockery Analysis and Design
Matt Rasmussen
Lot 2R
Weber County, Utah

Plate C - 3

Slide Analysis Information

SLIDE - An Interactive Slope Stability Program

Project Summary

File Name: Section B-B' Static
Slide Modeler Version: 6.033
Project Title: SLIDE - An Interactive Slope Stability Program
Date Created: 5/2/2015, 2:33:07 PM

General Settings

Units of Measurement: Imperial Units
Time Units: days
Permeability Units: feet/second
Failure Direction: Right to Left
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

Bishop simplified
Janbu simplified

Number of slices: 25
Tolerance: 0.005

Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 62.4 lbs/ft3
Advanced Groundwater Method: None

Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Grid Search
Radius Increment: 10
Composite Surfaces: Disabled
Reverse Curvature: Create Tension Crack
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

1 Distributed Load present

Distributed Load 1

Distribution: Constant
Magnitude [psf]: 2500
Orientation: Normal to boundary

Material Properties

Property	Rockery	Native Silty SAND (SM)
Color		
Strength Type	Anisotropic strength	Mohr-Coulomb
Unit Weight [lbs/ft3]	135	120
Cohesion [psf]		445
Friction Angle [deg]		31
Cohesion 1 [psf]	2000	
Cohesion 2 [psf]	0	
Friction Angle 1 [deg]	0	
Friction Angle 2 [deg]	45	
Angle from 1 [deg]	15	
Water Surface	None	None
Ru Value	0	0

Global Minimums

Method: bishop simplified

FS: 2.814930
Center: 8.709, 4962.066
Radius: 32.687

Left Slip Surface Endpoint: 0.733, 4930.366
Right Slip Surface Endpoint: 35.951, 4944.000
Resisting Moment=1.19491e+006 lb-ft
Driving Moment=424488 lb-ft
Total Slice Area=220.122 ft2

Method: janbu simplified

FS: 2.370280
Center: 11.198, 4955.844
Radius: 27.559
Left Slip Surface Endpoint: 0.714, 4930.357
Right Slip Surface Endpoint: 36.082, 4944.000
Resisting Horizontal Force=34078.7 lb
Driving Horizontal Force=14377.5 lb
Total Slice Area=263.521 ft2

Valid / Invalid Surfaces

Method: bishop simplified

Number of Valid Surfaces: 4820
Number of Invalid Surfaces: 31

Error Codes:

Error Code -103 reported for 4 surfaces
Error Code -107 reported for 8 surfaces
Error Code -108 reported for 19 surfaces

Method: janbu simplified

Number of Valid Surfaces: 4705
Number of Invalid Surfaces: 146

Error Codes:

Error Code -103 reported for 4 surfaces
Error Code -107 reported for 8 surfaces
Error Code -108 reported for 134 surfaces

Error Codes

The following errors were encountered during the computation:

-103 = Two surface / slope intersections, but one or more surface / nonslope external polygon intersections lie between them. This usually occurs when the slip surface extends past the bottom of the soil region, but may also occur on a benched slope model with two sets of Slope Limits.
-107 = Total driving moment or total driving force is negative. This will occur if the wrong failure direction is specified, or if high external or anchor loads are applied against the failure direction.
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

Slice Data

Global Minimum Query (bishop simplified) - Safety Factor: 2.81493

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	1.40872	86.7121	Native Silty SAND (SM)	445	31	179.979	506.627	102.565	0	102.565
2	1.40872	254.674	Native Silty SAND (SM)	445	31	204.628	576.013	218.041	0	218.041
3	1.40872	411.843	Native Silty SAND (SM)	445	31	227.15	639.412	323.555	0	323.555
4	1.40872	558.441	Native Silty SAND (SM)	445	31	247.643	697.098	419.562	0	419.562
5	1.40872	694.629	Native Silty SAND (SM)	445	31	266.184	749.29	506.423	0	506.423
6	1.40872	820.504	Native Silty SAND (SM)	445	31	282.833	796.156	584.422	0	584.422
7	1.40872	936.102	Native Silty SAND (SM)	445	31	297.636	837.824	653.769	0	653.769
8	1.40872	1041.41	Native Silty SAND (SM)	445	31	310.623	874.383	714.612	0	714.612
9	1.40872	1136.34	Native Silty SAND (SM)	445	31	321.816	905.889	767.048	0	767.048
10	1.40872	1220.76	Native Silty SAND (SM)	445	31	331.22	932.361	811.103	0	811.103

11	1.40872	1294.46	Native Silty SAND (SM)	445	31	338.832	953.789	846.766	0	846.766
12	1.40872	1357.18	Native Silty SAND (SM)	445	31	344.636	970.125	873.952	0	873.952
13	1.40872	1408.56	Native Silty SAND (SM)	445	31	348.602	981.291	892.536	0	892.536
14	1.40872	1470.4	Native Silty SAND (SM)	445	31	353.821	995.981	916.988	0	916.988
15	1.40872	1826.52	Native Silty SAND (SM)	445	31	399.747	1125.26	1132.14	0	1132.14
16	1.40872	2045.93	Native Silty SAND (SM)	445	31	425.621	1198.09	1253.36	0	1253.36
17	1.40872	1849.98	Native Silty SAND (SM)	445	31	394.032	1109.17	1105.37	0	1105.37
18	1.40872	1696.54	Native Silty SAND (SM)	445	31	368.548	1037.44	985.982	0	985.982
19	1.40872	1546.76	Native Silty SAND (SM)	445	31	343.778	967.712	869.936	0	869.936
20	1.40872	1379.13	Native Silty SAND (SM)	445	31	316.865	891.953	743.855	0	743.855
21	1.40872	1191.52	Native Silty SAND (SM)	445	31	287.619	809.628	606.843	0	606.843
22	1.40872	981.13	Native Silty SAND (SM)	445	31	255.8	720.06	457.776	0	457.776
23	1.40872	744.131	Native Silty SAND (SM)	445	31	221.099	622.378	295.206	0	295.206
24	1.40872	475.105	Native Silty SAND (SM)	445	31	324.483	913.398	779.545	0	779.545
25	1.40872	165.892	Native Silty SAND (SM)	445	31	552.753	1555.96	1848.94	0	1848.94

Global Minimum Query (janbu simplified) - Safety Factor: 2.37028

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	1.41471	105.625	Native Silty SAND (SM)	445	31	228.64	541.941	161.337	0	161.337
2	1.41471	309.547	Native Silty SAND (SM)	445	31	264.543	627.04	302.965	0	302.965
3	1.41471	499.178	Native Silty SAND (SM)	445	31	296.766	703.418	430.08	0	430.08
4	1.41471	675.172	Native Silty SAND (SM)	445	31	325.622	771.815	543.912	0	543.912
5	1.41471	838.025	Native Silty SAND (SM)	445	31	351.35	832.798	645.404	0	645.404
6	1.41471	988.101	Native Silty SAND (SM)	445	31	374.134	886.802	735.285	0	735.285
7	1.41471	1125.65	Native Silty SAND (SM)	445	31	394.113	934.158	814.094	0	814.094
8	1.41471	1250.8	Native Silty SAND (SM)	445	31	411.39	975.11	882.248	0	882.248
9	1.41471	1363.6	Native Silty SAND (SM)	445	31	426.038	1009.83	940.031	0	940.031
10	1.41471	1464	Native Silty SAND (SM)	445	31	438.102	1038.43	987.626	0	987.626
11	1.41471	1551.83	Native Silty SAND (SM)	445	31	447.602	1060.94	1025.1	0	1025.1

12	1.41471	1626.83	Native Silty SAND (SM)	445	31	454.532	1077.37	1052.43	0	1052.43
13	1.41471	1688.61	Native Silty SAND (SM)	445	31	458.864	1087.64	1069.52	0	1069.52
14	1.41471	1765.72	Native Silty SAND (SM)	445	31	465.351	1103.01	1095.11	0	1095.11
15	1.41471	2143.6	Native Silty SAND (SM)	445	31	520.353	1233.38	1312.09	0	1312.09
16	1.41471	2341.45	Native Silty SAND (SM)	445	31	544.359	1290.28	1406.79	0	1406.79
17	1.41471	2140.98	Native Silty SAND (SM)	445	31	504.025	1194.68	1247.68	0	1247.68
18	1.41471	1988.97	Native Silty SAND (SM)	445	31	471.779	1118.25	1120.48	0	1120.48
19	1.41471	1833.01	Native Silty SAND (SM)	445	31	439.157	1040.93	991.788	0	991.788
20	1.41471	1654.68	Native Silty SAND (SM)	445	31	403.35	956.052	850.534	0	850.534
21	1.41471	1450.49	Native Silty SAND (SM)	445	31	363.961	862.689	695.153	0	695.153
22	1.41471	1215.46	Native Silty SAND (SM)	445	31	320.446	759.547	523.494	0	523.494
23	1.41471	942.128	Native Silty SAND (SM)	445	31	272.035	644.799	332.521	0	332.521
24	1.41471	618.238	Native Silty SAND (SM)	445	31	411.535	975.454	882.823	0	882.823
25	1.41471	220.864	Native Silty SAND (SM)	445	31	574.787	1362.41	1526.82	0	1526.82

Interslice Data

Global Minimum Query (bishop simplified) - Safety Factor: 2.81493

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	0.73283	4930.37	0	0	0
2	2.14155	4930.04	286.091	0	0
3	3.55026	4929.79	629.887	0	0
4	4.95898	4929.59	1012.06	0	0
5	6.3677	4929.46	1415.66	0	0
6	7.77642	4929.39	1825.79	0	0
7	9.18513	4929.38	2229.31	0	0
8	10.5939	4929.43	2614.6	0	0
9	12.0026	4929.54	2971.44	0	0

10	13.4113	4929.72	3290.84	0	0
11	14.82	4929.95	3564.98	0	0
12	16.2287	4930.25	3787.14	0	0
13	17.6374	4930.62	3951.7	0	0
14	19.0462	4931.06	4054.11	0	0
15	20.4549	4931.56	4087.98	0	0
16	21.8636	4932.14	3992.98	0	0
17	23.2723	4932.8	3764.72	0	0
18	24.681	4933.55	3496.01	0	0
19	26.0897	4934.38	3190.08	0	0
20	27.4985	4935.32	2859.21	0	0
21	28.9072	4936.37	2525.89	0	0
22	30.3159	4937.54	2218.88	0	0
23	31.7246	4938.85	1975.86	0	0
24	33.1333	4940.34	1847.76	0	0
25	34.542	4942.04	982.263	0	0
26	35.9508	4944	0	0	0

Global Minimum Query (janbu simplified) - Safety Factor: 2.37028

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	0.714139	4930.36	0	0	0
2	2.12885	4929.82	409.672	0	0
3	3.54356	4929.37	919.963	0	0
4	4.95828	4929	1497.8	0	0
5	6.37299	4928.71	2115.59	0	0
6	7.7877	4928.5	2750.01	0	0
7	9.20242	4928.36	3381.15	0	0
8	10.6171	4928.29	3991.88	0	0
9	12.0318	4928.3	4567.38	0	0

10	13.4466	4928.38	5094.79	0	0
11	14.8613	4928.53	5562.98	0	0
12	16.276	4928.76	5962.34	0	0
13	17.6907	4929.06	6284.73	0	0
14	19.1054	4929.44	6523.34	0	0
15	20.5201	4929.91	6670.75	0	0
16	21.9348	4930.46	6680.34	0	0
17	23.3495	4931.11	6540.5	0	0
18	24.7643	4931.86	6320.93	0	0
19	26.179	4932.71	6027.13	0	0
20	27.5937	4933.69	5675.37	0	0
21	29.0084	4934.81	5292.08	0	0
22	30.4231	4936.1	4913.07	0	0
23	31.8378	4937.58	4589.02	0	0
24	33.2525	4939.32	4396.01	0	0
25	34.6672	4941.4	3141.66	0	0
26	36.082	4944	0	0	0

List Of Coordinates

Distributed Load

X	Y
36.0403	4944
34.0731	4944

External Boundary

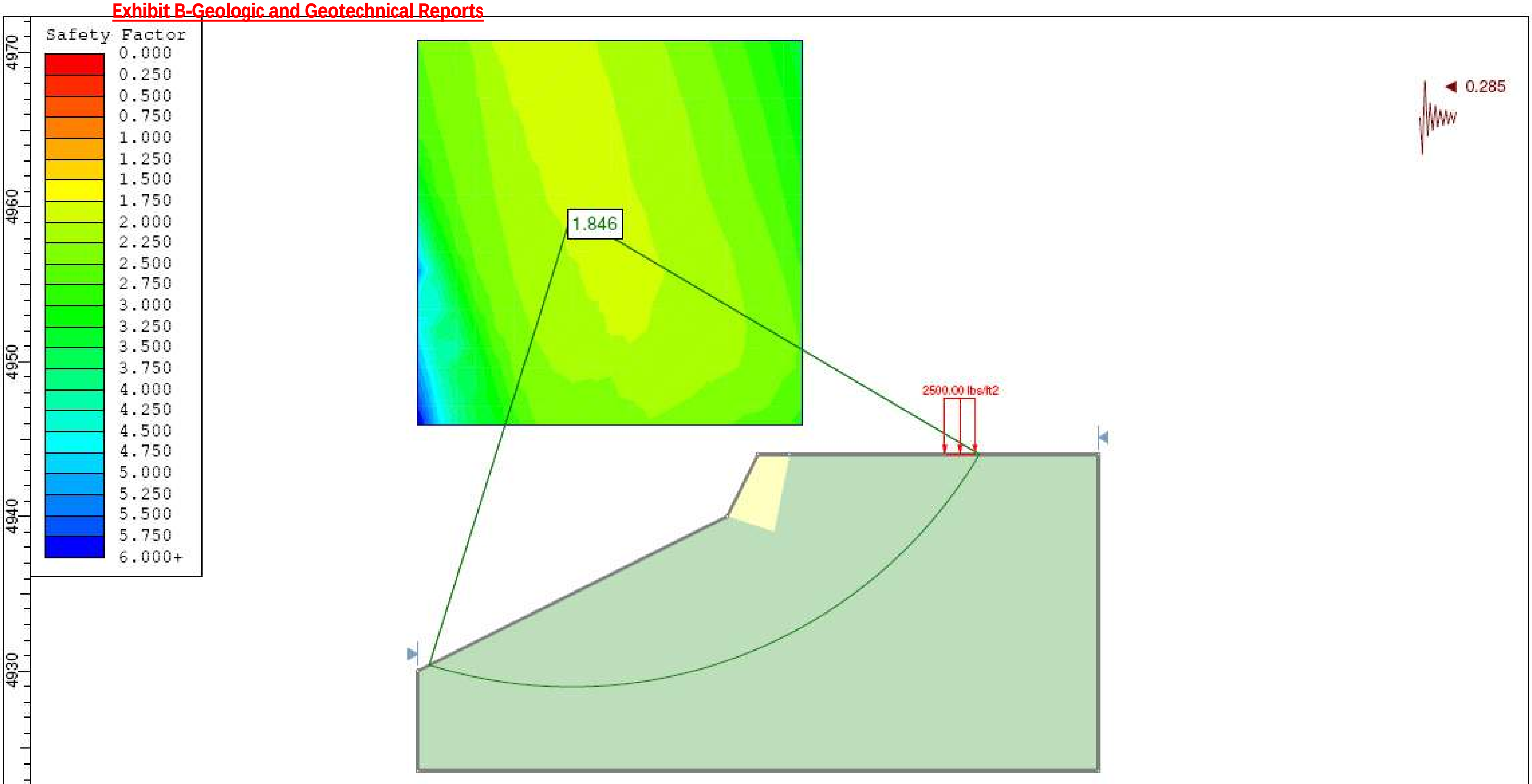
X	Y
0	4923.55

44	4923.55
44	4944
24	4944
22	4944
20	4940
0	4930

Material Boundary

X	Y
20	4940
23	4939
24	4944

SLIDEINTERPRET 6.033	*Project*	SLIDE - An Interactive Slope Stability Program	
	Analysis Description		
	Drawn By	*Scale*	*Company*
	Date 5/2/2015, 2:33:07 PM		*File Name* Section B-B' Static.slim



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Cohesion 2 (psf)	Phi 2 (deg)	Angle (ccw to 1) (deg)	Water Surface	Ru
Rockery		135	Anisotropic strength	2000	0	0	45	15	None	0
Native Silty SAND (SM)		120	Mohr-Coulomb	445	31				None	0

GeoStrata

Dauphine-Savory Piedmont – Lot 2R Section B-B' PStatic

Rockery Analysis and Design
Matt Rasmussen
Lot 2R
Weber County, Utah

Plate C - 4

Slide Analysis Information

SLIDE - An Interactive Slope Stability Program

Project Summary

File Name: Section B-B' PStatic
Slide Modeler Version: 6.033
Project Title: SLIDE - An Interactive Slope Stability Program
Date Created: 5/2/2015, 2:33:07 PM

General Settings

Units of Measurement: Imperial Units
Time Units: days
Permeability Units: feet/second
Failure Direction: Right to Left
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

Bishop simplified
Janbu simplified

Number of slices: 25
Tolerance: 0.005

Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 62.4 lbs/ft3
Advanced Groundwater Method: None

Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Grid Search
Radius Increment: 10
Composite Surfaces: Disabled
Reverse Curvature: Create Tension Crack
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 0.285
1 Distributed Load present

Distributed Load 1

Distribution: Constant
Magnitude [psf]: 2500
Orientation: Normal to boundary

Material Properties

Property	Rockery	Native Silty SAND (SM)
Color		
Strength Type	Anisotropic strength	Mohr-Coulomb
Unit Weight [lbs/ft3]	135	120
Cohesion [psf]		445
Friction Angle [deg]		31
Cohesion 1 [psf]	2000	
Cohesion 2 [psf]	0	
Friction Angle 1 [deg]	0	
Friction Angle 2 [deg]	45	
Angle from 1 [deg]	15	
Water Surface	None	None
Ru Value	0	0

Global Minimums

Method: bishop simplified

FS: 1.845700
Center: 9.954, 4959.577
Radius: 30.631

Left Slip Surface Endpoint: 0.733, 4930.367
Right Slip Surface Endpoint: 36.328, 4944.000
Resisting Moment=1.13772e+006 lb-ft
Driving Moment=616417 lb-ft
Total Slice Area=241.493 ft2

Method: janbu simplified

FS: 1.566710
Center: 11.198, 4955.844
Radius: 27.559
Left Slip Surface Endpoint: 0.714, 4930.357
Right Slip Surface Endpoint: 36.082, 4944.000
Resisting Horizontal Force=32734.2 lb
Driving Horizontal Force=20893.6 lb
Total Slice Area=263.521 ft2

Valid / Invalid Surfaces

Method: bishop simplified

Number of Valid Surfaces: 4845
Number of Invalid Surfaces: 6

Error Codes:

Error Code -103 reported for 4 surfaces
Error Code -108 reported for 2 surfaces

Method: janbu simplified

Number of Valid Surfaces: 4749
Number of Invalid Surfaces: 102

Error Codes:

Error Code -103 reported for 4 surfaces
Error Code -108 reported for 98 surfaces

Error Codes

The following errors were encountered during the computation:

-103 = Two surface / slope intersections, but one or more surface / nonslope external polygon intersections lie between them. This usually occurs when the slip surface extends past the bottom of the soil region, but may also occur on a benched slope model with two sets of Slope Limits.
-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

Slice Data

Global Minimum Query (bishop simplified) - Safety Factor: 1.8457

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	1.42381	95.9996	Native Silty SAND (SM)	445	31	290.371	535.937	151.344	0	151.344
2	1.42381	281.742	Native Silty SAND (SM)	445	31	331.135	611.175	276.562	0	276.562
3	1.42381	455.183	Native Silty SAND (SM)	445	31	367.672	678.613	388.798	0	388.798
4	1.42381	616.691	Native Silty SAND (SM)	445	31	400.295	738.825	489.007	0	489.007
5	1.42381	766.541	Native Silty SAND (SM)	445	31	429.249	792.264	577.944	0	577.944
6	1.42381	904.923	Native Silty SAND (SM)	445	31	454.725	839.286	656.202	0	656.202
7	1.42381	1031.95	Native Silty SAND (SM)	445	31	476.876	880.17	724.246	0	724.246
8	1.42381	1147.65	Native Silty SAND (SM)	445	31	495.816	915.128	782.425	0	782.425
9	1.42381	1251.98	Native Silty SAND (SM)	445	31	511.629	944.313	830.999	0	830.999
10	1.42381	1344.85	Native Silty SAND (SM)	445	31	524.37	967.829	870.136	0	870.136
11	1.42381	1426.04	Native Silty SAND (SM)	445	31	534.069	985.732	899.927	0	899.927
12	1.42381	1495.29	Native Silty SAND (SM)	445	31	540.734	998.032	920.398	0	920.398
13	1.42381	1552.21	Native Silty SAND (SM)	445	31	544.343	1004.69	931.486	0	931.486

14	1.42381	1644.07	Native Silty SAND (SM)	445	31	554.665	1023.75	963.194	0	963.194
15	1.42381	2047.85	Native Silty SAND (SM)	445	31	627.28	1157.77	1186.25	0	1186.25
16	1.42381	2182.36	Native Silty SAND (SM)	445	31	643.35	1187.43	1235.61	0	1235.61
17	1.42381	1976.11	Native Silty SAND (SM)	445	31	591.554	1091.83	1076.51	0	1076.51
18	1.42381	1830.55	Native Silty SAND (SM)	445	31	552.376	1019.52	956.163	0	956.163
19	1.42381	1675.9	Native Silty SAND (SM)	445	31	511.977	944.956	832.07	0	832.07
20	1.42381	1501.3	Native Silty SAND (SM)	445	31	468.4	864.526	698.209	0	698.209
21	1.42381	1304.08	Native Silty SAND (SM)	445	31	421.357	777.698	553.702	0	553.702
22	1.42381	1080.63	Native Silty SAND (SM)	445	31	370.48	683.795	397.422	0	397.422
23	1.42381	825.869	Native Silty SAND (SM)	445	31	315.292	581.934	227.896	0	227.896
24	1.42381	532.173	Native Silty SAND (SM)	445	31	589.412	1087.88	1069.93	0	1069.93
25	1.42381	187.22	Native Silty SAND (SM)	445	31	621.821	1147.7	1169.48	0	1169.48

Global Minimum Query (janbu simplified) - Safety Factor: 1.56671

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	1.41471	105.625	Native Silty SAND (SM)	445	31	366.116	573.597	214.022	0	214.022
2	1.41471	309.547	Native Silty SAND (SM)	445	31	419.321	656.955	352.752	0	352.752
3	1.41471	499.178	Native Silty SAND (SM)	445	31	466.066	730.191	474.637	0	474.637
4	1.41471	675.172	Native Silty SAND (SM)	445	31	507.042	794.387	581.478	0	581.478
5	1.41471	838.025	Native Silty SAND (SM)	445	31	542.77	850.363	674.638	0	674.638
6	1.41471	988.101	Native Silty SAND (SM)	445	31	573.651	898.744	755.157	0	755.157
7	1.41471	1125.65	Native Silty SAND (SM)	445	31	599.99	940.01	823.838	0	823.838
8	1.41471	1250.8	Native Silty SAND (SM)	445	31	622.018	974.522	881.272	0	881.272
9	1.41471	1363.6	Native Silty SAND (SM)	445	31	639.908	1002.55	927.921	0	927.921
10	1.41471	1464	Native Silty SAND (SM)	445	31	653.78	1024.28	964.09	0	964.09
11	1.41471	1551.83	Native Silty SAND (SM)	445	31	663.71	1039.84	989.986	0	989.986
12	1.41471	1626.83	Native Silty SAND (SM)	445	31	669.733	1049.28	1005.68	0	1005.68
13	1.41471	1688.61	Native Silty SAND (SM)	445	31	671.843	1052.58	1011.19	0	1011.19
14	1.41471	1765.72	Native Silty SAND (SM)	445	31	676.993	1060.65	1024.61	0	1024.61

15	1.41471	2143.6	Native Silty SAND (SM)	445	31	752.087	1178.3	1220.42	0	1220.42
16	1.41471	2341.45	Native Silty SAND (SM)	445	31	781.518	1224.41	1297.16	0	1297.16
17	1.41471	2140.98	Native Silty SAND (SM)	445	31	718.571	1125.79	1133.03	0	1133.03
18	1.41471	1988.97	Native Silty SAND (SM)	445	31	667.666	1046.04	1000.29	0	1000.29
19	1.41471	1833.01	Native Silty SAND (SM)	445	31	616.63	966.081	867.225	0	867.225
20	1.41471	1654.68	Native Silty SAND (SM)	445	31	561.537	879.765	723.572	0	723.572
21	1.41471	1450.49	Native Silty SAND (SM)	445	31	501.926	786.372	568.141	0	568.141
22	1.41471	1215.46	Native Silty SAND (SM)	445	31	437.186	684.943	399.332	0	399.332
23	1.41471	942.128	Native Silty SAND (SM)	445	31	366.466	574.146	214.935	0	214.935
24	1.41471	618.238	Native Silty SAND (SM)	445	31	545.777	855.074	682.477	0	682.477
25	1.41471	220.864	Native Silty SAND (SM)	445	31	746.487	1169.53	1205.82	0	1205.82

Interslice Data

Global Minimum Query (bishop simplified) - Safety Factor: 1.8457

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	0.733086	4930.37	0	0	0
2	2.1569	4929.95	448.062	0	0
3	3.58071	4929.62	932.495	0	0
4	5.00452	4929.35	1429.96	0	0
5	6.42833	4929.15	1920.96	0	0
6	7.85214	4929.02	2389.08	0	0
7	9.27595	4928.95	2820.53	0	0
8	10.6998	4928.95	3203.69	0	0
9	12.1236	4929.02	3528.88	0	0
10	13.5474	4929.16	3788.08	0	0
11	14.9712	4929.36	3974.85	0	0
12	16.395	4929.63	4084.17	0	0

13	17.8188	4929.97	4112.45	0	0
14	19.2426	4930.39	4057.51	0	0
15	20.6664	4930.88	3904.16	0	0
16	22.0902	4931.45	3533.72	0	0
17	23.5141	4932.11	3013.76	0	0
18	24.9379	4932.86	2484.65	0	0
19	26.3617	4933.71	1935.99	0	0
20	27.7855	4934.67	1387.77	0	0
21	29.2093	4935.75	869.621	0	0
22	30.6331	4936.98	419.152	0	0
23	32.0569	4938.37	85.564	0	0
24	33.4807	4939.96	-63.9687	0	0
25	34.9045	4941.81	-1352.6	0	0
26	36.3284	4944	0	0	0

Global Minimum Query (janbu simplified) - Safety Factor: 1.56671

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	0.714139	4930.36	0	0	0
2	2.12885	4929.82	604.215	0	0
3	3.54356	4929.37	1269.83	0	0
4	4.95828	4929	1963.73	0	0
5	6.37299	4928.71	2659.24	0	0
6	7.7877	4928.5	3334.67	0	0
7	9.20242	4928.36	3972.19	0	0
8	10.6171	4928.29	4557.1	0	0
9	12.0318	4928.3	5077.32	0	0
10	13.4466	4928.38	5522.93	0	0
11	14.8613	4928.53	5885.98	0	0
12	16.276	4928.76	6160.23	0	0

13	17.6907	4929.06	6341.1	0	0
14	19.1054	4929.44	6425.61	0	0
15	20.5201	4929.91	6405.57	0	0
16	21.9348	4930.46	6186.69	0	0
17	23.3495	4931.11	5789.96	0	0
18	24.7643	4931.86	5353.11	0	0
19	26.179	4932.71	4876.08	0	0
20	27.5937	4933.69	4378.33	0	0
21	29.0084	4934.81	3892.49	0	0
22	30.4231	4936.1	3461.13	0	0
23	31.8378	4937.58	3142.37	0	0
24	33.2525	4939.32	3020.56	0	0
25	34.6672	4941.4	2199.44	0	0
26	36.082	4944	0	0	0

List Of Coordinates

Distributed Load

X	Y
36.0403	4944
34.0731	4944

External Boundary

X	Y
0	4923.55
44	4923.55
44	4944
24	4944

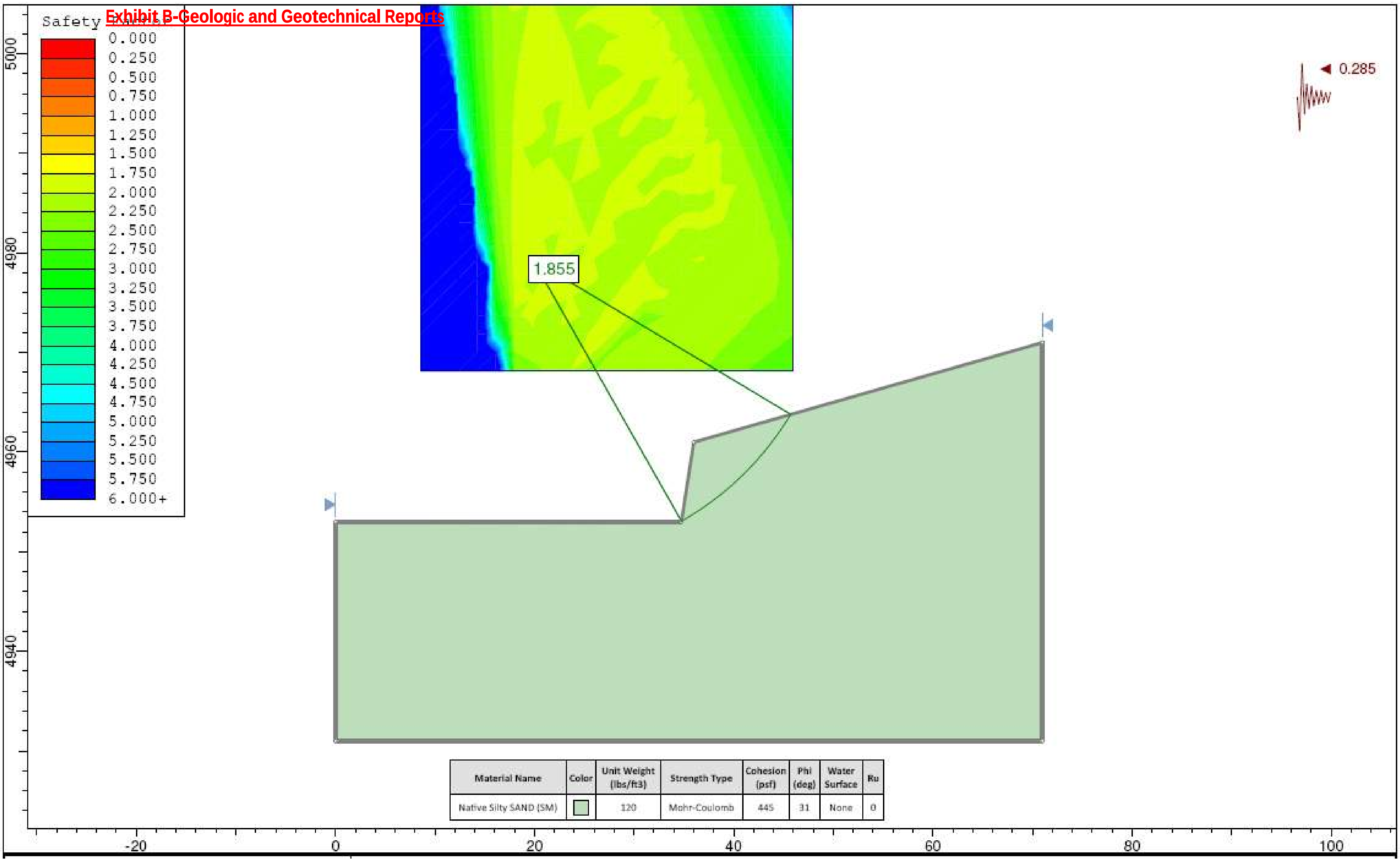
22	4944
20	4940
0	4930

Material Boundary

X	Y
20	4940
23	4939
24	4944

SLIDEINTERPRET 6.033

Project	SLIDE - An Interactive Slope Stability Program		
Analysis Description			
Drawn By	Scale	Company	
Date	5/2/2015, 2:33:07 PM	File Name	Section B-B' PStatic.slim



Material Name	Color	Unit Weight (lbs/ft3)	Strength Type	Cohesion (psf)	Phi (deg)	Water Surface	Ru
Native Silty SAND (SM)		120	Mohr-Coulomb	445	31	None	0

GeoStrata

Dauphine-Savory Piedmont – Lot 2R Section A-A' Pstatic Seismic Force Determination

Rockery Analysis and Design
Matt Rasmussen
Lot 2R
Weber County, Utah

Plate C - 5

Slide Analysis Information

SLIDE - An Interactive Slope Stability Program

Project Summary

File Name: Section A-A' Static Cut Slope
Slide Modeler Version: 6.033
Project Title: SLIDE - An Interactive Slope Stability Program
Date Created: 5/2/2015, 2:19:31 PM

General Settings

Units of Measurement: Imperial Units
Time Units: days
Permeability Units: feet/second
Failure Direction: Right to Left
Data Output: Standard
Maximum Material Properties: 20
Maximum Support Properties: 20

Analysis Options

Analysis Methods Used

Bishop simplified
Janbu simplified

Number of slices: 25
Tolerance: 0.005

Maximum number of iterations: 50
Check malpha < 0.2: Yes
Initial trial value of FS: 1
Steffensen Iteration: Yes

Groundwater Analysis

Groundwater Method: Water Surfaces
Pore Fluid Unit Weight: 62.4 lbs/ft3
Advanced Groundwater Method: None

Random Numbers

Pseudo-random Seed: 10116
Random Number Generation Method: Park and Miller v.3

Surface Options

Surface Type: Circular
Search Method: Grid Search
Radius Increment: 10
Composite Surfaces: Disabled
Reverse Curvature: Create Tension Crack
Minimum Elevation: Not Defined
Minimum Depth: Not Defined

Loading

Seismic Load Coefficient (Horizontal): 0.285

Material Properties

Property	Native Silty SAND (SM)
Color	
Strength Type	Mohr-Coulomb
Unit Weight [lbs/ft3]	120
Cohesion [psf]	445
Friction Angle [deg]	31
Water Surface	None
Ru Value	0

Global Minimums

Method: bishop simplified

FS: 1.854710
Center: 19.824, 4979.316
Radius: 30.224
Left Slip Surface Endpoint: 34.762, 4953.042
Right Slip Surface Endpoint: 45.753, 4963.787
Resisting Moment=264789 lb-ft
Driving Moment=142766 lb-ft
Total Slice Area=47.2829 ft2

Method: janbu simplified

FS: 1.792280
Center: 40.371, 4981.184
Radius: 31.574
Left Slip Surface Endpoint: 26.136, 4953.000

Right Slip Surface Endpoint: 70.176, 4970.765
Resisting Horizontal Force=44174.2 lb
Driving Horizontal Force=24646.9 lb
Total Slice Area=407.525 ft2

Valid / Invalid Surfaces

Method: bishop simplified

Number of Valid Surfaces: 4842
Number of Invalid Surfaces: 9

Error Codes:

Error Code -105 reported for 1 surface
Error Code -106 reported for 8 surfaces

Method: janbu simplified

Number of Valid Surfaces: 4737
Number of Invalid Surfaces: 114

Error Codes:

Error Code -105 reported for 1 surface
Error Code -106 reported for 8 surfaces
Error Code -108 reported for 105 surfaces

Error Codes

The following errors were encountered during the computation:

-105 = More than two surface / slope intersections with no valid slip surface.
-106 = Average slice width is less than 0.0001 * (maximum horizontal extent of soil region). This limitation is imposed to avoid numerical errors which may result from too many slices, or too small a slip region.

-108 = Total driving moment or total driving force < 0.1. This is to limit the calculation of extremely high safety factors if the driving force is very small (0.1 is an arbitrary number).

Slice Data

Global Minimum Query (bishop simplified) - Safety Factor: 1.85471

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	0.439657	67.8347	Native Silty SAND (SM)	445	31	244.078	452.694	12.8045	0	12.8045
2	0.439657	203.24	Native Silty SAND (SM)	445	31	326.049	604.727	265.831	0	265.831
3	0.439657	335.689	Native Silty SAND (SM)	445	31	405.126	751.391	509.919	0	509.919
4	0.439657	374.925	Native Silty SAND (SM)	445	31	426.373	790.799	575.507	0	575.507
5	0.439657	366.176	Native Silty SAND (SM)	445	31	418.237	775.709	550.393	0	550.393
6	0.439657	356.835	Native Silty SAND (SM)	445	31	409.755	759.976	524.209	0	524.209
7	0.439657	346.878	Native Silty SAND (SM)	445	31	400.917	743.584	496.927	0	496.927
8	0.439657	336.281	Native Silty SAND (SM)	445	31	391.713	726.514	468.518	0	468.518
9	0.439657	325.019	Native Silty SAND (SM)	445	31	382.135	708.75	438.953	0	438.953
10	0.439657	313.062	Native Silty SAND (SM)	445	31	372.171	690.27	408.197	0	408.197
11	0.439657	300.378	Native Silty SAND (SM)	445	31	361.81	671.052	376.214	0	376.214
12	0.439657	286.932	Native Silty SAND (SM)	445	31	351.037	651.072	342.961	0	342.961
13	0.439657	272.686	Native Silty SAND (SM)	445	31	339.84	630.305	308.4	0	308.4
14	0.439657	257.595	Native Silty SAND (SM)	445	31	328.203	608.722	272.479	0	272.479
15	0.439657	241.61	Native Silty SAND (SM)	445	31	316.109	586.291	235.148	0	235.148
16	0.439657	224.678	Native Silty SAND (SM)	445	31	303.54	562.979	196.351	0	196.351
17	0.439657	206.735	Native Silty SAND (SM)	445	31	290.476	538.749	156.023	0	156.023
18	0.439657	187.712	Native Silty SAND (SM)	445	31	276.894	513.558	114.099	0	114.099
19	0.439657	167.528	Native Silty SAND (SM)	445	31	262.77	487.361	70.5013	0	70.5013
20	0.439657	146.088	Native Silty SAND (SM)	445	31	248.076	460.109	25.1455	0	25.1455
21	0.439657	123.285	Native Silty SAND (SM)	445	31	232.783	431.744	-22.0613	0	-22.0613
22	0.439657	98.9897	Native Silty SAND (SM)	445	31	216.856	402.205	-71.2231	0	-71.2231

23	0.439657	73.0498	Native Silty SAND (SM)	445	31	200.258	371.421	-122.456	0	-122.456
24	0.439657	45.2809	Native Silty SAND (SM)	445	31	182.947	339.314	-175.891	0	-175.891
25	0.439657	15.457	Native Silty SAND (SM)	445	31	164.876	305.797	-231.672	0	-231.672

Global Minimum Query (janbu simplified) - Safety Factor: 1.79228

Slice Number	Width [ft]	Weight [lbs]	Base Material	Base Cohesion [psf]	Base Friction Angle [degrees]	Shear Stress [psf]	Shear Strength [psf]	Base Normal Stress [psf]	Pore Pressure [psf]	Effective Normal Stress [psf]
1	1.7616	86.9494	Native Silty SAND (SM)	445	31	313.991	562.759	195.983	0	195.983
2	1.7616	247.426	Native Silty SAND (SM)	445	31	340.445	610.172	274.892	0	274.892
3	1.7616	381.982	Native Silty SAND (SM)	445	31	360.607	646.309	335.034	0	335.034
4	1.7616	492.249	Native Silty SAND (SM)	445	31	375.231	672.519	378.656	0	378.656
5	1.7616	593.21	Native Silty SAND (SM)	445	31	387.687	694.844	415.81	0	415.81
6	1.7616	1914.39	Native Silty SAND (SM)	445	31	644.034	1154.29	1180.46	0	1180.46
7	1.7616	2475.09	Native Silty SAND (SM)	445	31	741.326	1328.66	1470.66	0	1470.66
8	1.7616	2604.01	Native Silty SAND (SM)	445	31	752.024	1347.84	1502.57	0	1502.57
9	1.7616	2712.08	Native Silty SAND (SM)	445	31	758.462	1359.38	1521.78	0	1521.78
10	1.7616	2799.31	Native Silty SAND (SM)	445	31	760.749	1363.47	1528.6	0	1528.6
11	1.7616	2865.53	Native Silty SAND (SM)	445	31	758.943	1360.24	1523.21	0	1523.21
12	1.7616	2910.34	Native Silty SAND (SM)	445	31	753.062	1349.7	1505.67	0	1505.67
13	1.7616	2933.14	Native Silty SAND (SM)	445	31	743.078	1331.8	1475.89	0	1475.89
14	1.7616	2933.04	Native Silty SAND (SM)	445	31	728.916	1306.42	1433.65	0	1433.65
15	1.7616	2908.88	Native Silty SAND (SM)	445	31	710.458	1273.34	1378.59	0	1378.59
16	1.7616	2859.09	Native Silty SAND (SM)	445	31	687.524	1232.24	1310.18	0	1310.18
17	1.7616	2781.63	Native Silty SAND (SM)	445	31	659.867	1182.67	1227.68	0	1227.68
18	1.7616	2673.78	Native Silty SAND (SM)	445	31	627.157	1124.04	1130.11	0	1130.11
19	1.7616	2531.92	Native Silty SAND (SM)	445	31	588.945	1055.55	1016.13	0	1016.13
20	1.7616	2351.09	Native Silty SAND (SM)	445	31	544.626	976.123	883.938	0	883.938
21	1.7616	2124.2	Native Silty SAND (SM)	445	31	493.361	884.241	731.02	0	731.02
22	1.7616	1840.68	Native Silty SAND (SM)	445	31	433.942	777.746	553.78	0	553.78
23	1.7616	1483.35	Native Silty SAND (SM)	445	31	364.53	653.34	346.738	0	346.738

24	1.7616	1020.7	Native Silty SAND (SM)	445	31	282.039	505.494	100.678	0	100.678
25	1.7616	378.921	Native Silty SAND (SM)	445	31	180.198	322.966	-203.098	0	-203.098

Interslice Data

Global Minimum Query (bishop simplified) - Safety Factor: 1.85471

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	34.762	4953.04	0	0	0
2	35.2017	4953.3	84.7082	0	0
3	35.6413	4953.56	99.7089	0	0
4	36.081	4953.84	41.7956	0	0
5	36.5207	4954.12	-42.1553	0	0
6	36.9603	4954.42	-126.088	0	0
7	37.4	4954.73	-209.312	0	0
8	37.8396	4955.05	-291.075	0	0
9	38.2793	4955.38	-370.555	0	0
10	38.7189	4955.73	-446.855	0	0
11	39.1586	4956.09	-518.994	0	0
12	39.5983	4956.46	-585.893	0	0
13	40.0379	4956.85	-646.364	0	0
14	40.4776	4957.25	-699.093	0	0
15	40.9172	4957.67	-742.627	0	0
16	41.3569	4958.11	-775.343	0	0
17	41.7965	4958.56	-795.43	0	0
18	42.2362	4959.04	-800.849	0	0
19	42.6759	4959.54	-789.298	0	0
20	43.1155	4960.05	-758.155	0	0
21	43.5552	4960.6	-704.416	0	0

22	43.9948	4961.17	-624.609	0	0
23	44.4345	4961.77	-514.686	0	0
24	44.8741	4962.4	-369.869	0	0
25	45.3138	4963.08	-184.455	0	0
26	45.7535	4963.79	0	0	0

Global Minimum Query (janbu simplified) - Safety Factor: 1.79228

Slice Number	X coordinate [ft]	Y coordinate - Bottom [ft]	Interslice Normal Force [lbs]	Interslice Shear Force [lbs]	Interslice Force Angle [degrees]
1	26.1363	4953	0	0	0
2	27.898	4952.18	689.561	0	0
3	29.6596	4951.48	1409.99	0	0
4	31.4212	4950.9	2129.81	0	0
5	33.1828	4950.44	2826.91	0	0
6	34.9444	4950.08	3490.18	0	0
7	36.706	4949.82	4381.73	0	0
8	38.4676	4949.67	5211.63	0	0
9	40.2292	4949.61	5880.01	0	0
10	41.9908	4949.65	6380.34	0	0
11	43.7524	4949.79	6708.61	0	0
12	45.514	4950.03	6863.13	0	0
13	47.2756	4950.37	6844.51	0	0
14	49.0372	4950.82	6655.73	0	0
15	50.7988	4951.38	6302.32	0	0
16	52.5604	4952.06	5792.71	0	0
17	54.322	4952.86	5138.82	0	0
18	56.0836	4953.8	4356.92	0	0
19	57.8452	4954.89	3468.97	0	0
20	59.6068	4956.15	2504.79	0	0
21	61.3684	4957.6	1505.53	0	0

22	63.13	4959.3	529.851	0	0
23	64.8916	4961.29	-334.388	0	0
24	66.6532	4963.69	-944.954	0	0
25	68.4148	4966.68	-1040.07	0	0
26	70.1764	4970.76	0	0	0

List Of Coordinates

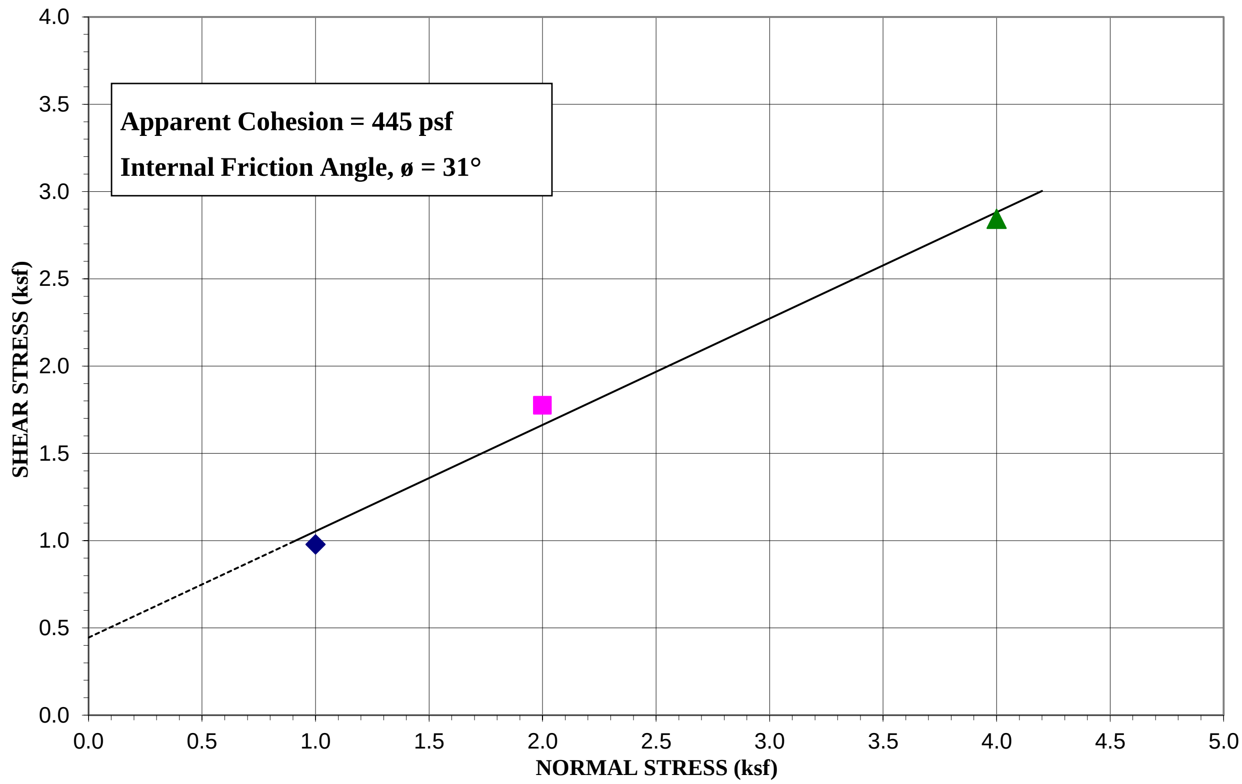
External Boundary

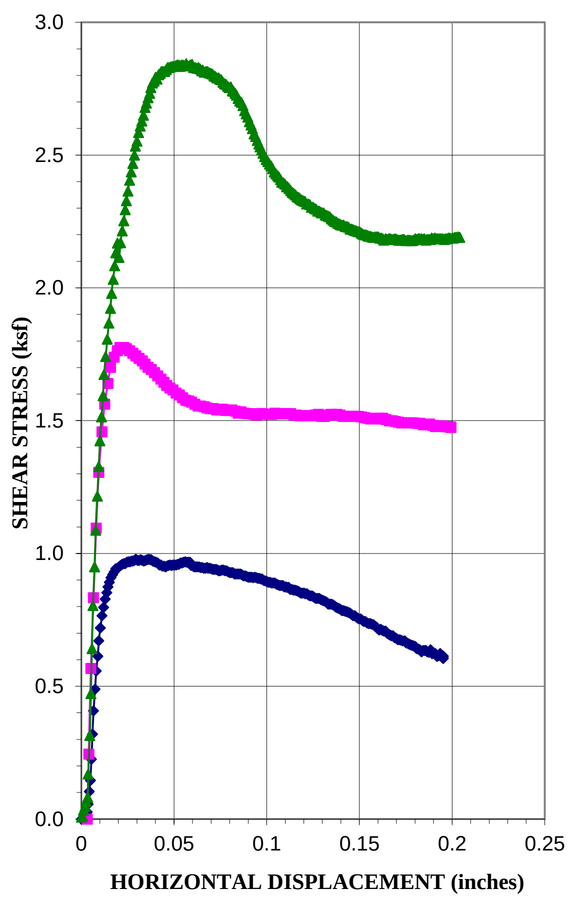
X	Y
0	4931
71	4931
71	4971
36	4961
34.7556	4953
0	4953

Material Boundary

X	Y
34.6	4952
34.7556	4953

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 D-1

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

PROFESSIONAL GEOLOGIST LICENSED # 5242839 TIMOTHY J. THOMPSON 7/9/15 STATE OF UTAH

REGISTERED PROFESSIONAL ENGINEER HIRAM ALBA 175774 STATE OF UTAH

MEMORANDUM

To: **Matt Rasmussen**

From: **Timothy J. Thompson, P.G.**
Hiram Alba P.E., P.G.
Daniel J. Brown, E. I. T.

Date: **July 9, 2015**

Subject: **Review Response for Geological Review – 6472 and 6498 South Bybee Drive, Weber County Parcel Numbers: 07-753-0001 and 07-753-0002 Uintah, Weber County, Utah, SA Project Number 15-140**

GeoStrata has received review questions of our report titled **Memorandum - Review Response for Geological Review - 6472 and 6498 South Bybee Drive, Weber County Parcel Numbers: 07-753-0001 and 07-753-0002 Uintah, Utah, SBI Project Number 2-14-522**, GeoStrata Job Number 910-001 and dated April 24, 2015. This report was prepared for Mr. Matt Rasmussen and submitted to Weber County for review. Mr. David B. Simon, P.G. of Simon Associates LLC (SA) prepared a review of our report. This memorandum was prepared in response to a series of review questions presented in a letter prepared by Mr. Simon and dated May 27, 2015.

SA Review Recommendations

1. *"Item 1 of November 29, 2014, SBI review letter*

   SBI recommended Weber County request GeoStrata submit all plates with correct titles.

   GeoStrata submitted 14 Plates in the April 24, 2015, memorandum and noted that Plate A-5 was titled "Site Specific Geologic Map," and Plate A-6 "Site Geologic Setback Map." However, the April 24, 2015, GeoStrata memorandum did not contain Plate A-5 and contained two plates labeled as Plate A-6, "Site Geologic Setback Map."

   SA recommends Weber County request GeoStrata clarify the apparent discrepancy."

GeoStrata Response: GeoStrata has reviewed the referenced plates and has updated the incorrect title block on Plate A-5. An updated version of the plate has been produced and attached to the end of this letter. As part of this review response, additional plates have been completed. The plates attached to the end of this letter are as follows;

Plate A-1, Site Vicinity Map
Plate A-2, Exploration Location Map
Plate A-3, Site Vicinity Geologic Map
Plate A-4, Site Vicinity Geologic Map Key (Key for Plate A-3)
Plate A-5, Site Geologic Map

Plate A-6, Site Geologic Setback Map
Plate A-7, Hillshade 180° Sun-angle Map, with site boundaries and exploration locations.
Plate A-8, Hillshade 180° Sun-angle Map, without site boundaries and exploration locations.
Plate A-9, Hillshade 90° Sun-angle Map, with site boundaries and exploration locations.
Plate A-10, Hillshade 90° Sun-angle Map, without site boundaries and exploration locations.
Plate A-11, Lineament Map
Plate A-12, Surface fault Rupture Special Study Area Map
Plate A-13 Surface fault Rupture Special Study Areas (Christenson and Shaw, 2008)
Plate A-14 Debris-Flow/Alluvial-Fan Special Study Areas (Christenson and Shaw, 2008)

Plate B-1 and B-2, Trench 1 Hand Log
Plate B-3 and B-4, Trench 3 Hand Log
Plate B-5 and B-6, Trench 2 Hand Log
Plate B-7, Trench 4 Hand Log

Plate C-1, Photograph 40 to 50 Feet Trench 3
Plate C-2, Photograph 45 Feet Trench 3
Plate C-3, Photograph 0 to 10 Feet Trench 1
Plate C-4, Photograph 28 to 33 Feet Trench 2

Appendix D

HydroPlot report titled "Drainage Evaluation for Dauphine'-Savoy-Piedmont Subdivision, Lot #2, Ogden, UT" and dated September 4, 2014

Silverpeak Engineering Grading/Drainage Plan

2. *"Item 2 of November 29, 2014, SBI review letter*

   SA recommended Weber County request GeoStrata submit properly annotated trench logs containing: a) a vertical and horizontal scale, b) indication of the trench corresponding to the log, c) the trench wall documented and, d) trench orientation.

   The trench logs submitted with the April 24, 2015, GeoStrata memorandum do not contain a vertical scale and trench orientations are not noted. SA recommends Weber County request GeoStrata submit trench logs with a vertical scale and the orientation of the trench."

GeoStrata Response: GeoStrata has reviewed the referenced trench logs and added the requested information. Updated versions of the logs for Trenches 1 and 3 have been attached to the end of this letter. Logs for Trenches 2 and 4 have also been attached to this letter as noted in the GeoStrata Response to SA Recommendation Item 1 above (Plates B-5, B-6, and B-7). These logs all have the requested information.

This report was prepared in order to assess residential building Lots 1R and 2R. The Trench 2 log originally presented in our December 10, 2013 report was re-logged during our subsequent fieldwork and an updated Log of Trench 2 is included in this review response in order to assess set back areas on the east side of Lot 1R associated with the trenching we have already conducted at the lot (Trench 1).

In order to further assess set back areas on the east side of the proposed building footprint, on Lot 2R, associated with the trenching we have already conducted at the site (Trench 3), an additional trench was completed. This trench has been included as Trench 4 (Plate B-7).

3. *"Item 4 of November 29, 2014, SBI review letter*

Section 2.1, Purpose and Scope of Work (p. 2), of the GeoStrata December 10, 2013, report indicated GeoStrata reviewed and evaluated aerial photographs covering the site area. SBI suggested Weber County request GeoStrata provide the source, date, flight-line numbers, and scale of aerial photos used.

GeoStrata provided the requested information in their April 24, 2015, memorandum and also provided LiDar hillshade maps. GeoStrata concluded "Based on our review of this Lidar data and our stereo aerial photography review, no visible lineations or other surface fault rupture related geomorphology was observed that would indicate the presence of surface fault ruptures on or adjacent to the subject site."

SA reviewed aerials photographs and also the LiDar hillshade maps provided by GeoStrata and does not agree that there are "... no visible lineations or other surface fault rupture related geomorphology was observed that would indicate the presence of surface fault ruptures on or adjacent to the subject site."

SBI suggests Weber County request GeoStrata evaluate the referenced aerial imagery and submit a lineament map."

GeoStrata Response: GeoStrata has attached the requested lineament map to the end of this letter (Plate A-11). Based on our review of LIDAR data (Wasatch Front LIDAR Elevation Data 2013 to 2014 provided by the AGRC and DEM data from the National Elevation Data Set provided by the USGS) and our stereo aerial photography review (as cited in our prior review response), no visible lineations or other surface fault rupture related geomorphology was observed that would indicate the presence of active surface fault ruptures trending across the subject site.

4. *"Item 5 of November 29, 2014, SBI review letter*

SBI noted that the Utah Geological Survey geologic map referenced in the April 24, 2015, GeoStrata memorandum (Yonkee and Lowe, 2004), had two apparent errors and attached a corrected version, provided by Mr. Jon King of the UGS. Apparently the corrected version was not distributed, and is attached herein for completeness. No recommendations."

GeoStrata Response: Comment acknowledged.

5. "*Item 8 of November 29, 2014, SBI review letter*

   Item 8 in the November 29, 2014, SBI review letter recommended Weber County request further clarification of the alluvial fan and debris flow deposits documented in the trenches T-1 and T-2 presented in the December 10, 2013, GeoStrata report.

   The April 24, 2015, GeoStrata memorandum indicates GeoStrata revisited the site, determined that additional trenching and closer examination of the existing trenches was required, excavated an additional trench (Trench 3) across the proposed building area of lot 2R, deepened, re-cleaned, and re-investigated trenches T-1 and T-2 and consequently updated their geologic interpretations of the geologic units exposed in trench excavations.

   Apparently, it is the opinion of GeoStrata that the geologic units in T-1 and T-3 are not debris flow deposits as originally documented in their December 10, 2013, report, but are Pleistocene-age lacustrine sediments, Holocene-age colluvium and alluvium, and a pedogenic horizon. GeoStrata concluded that the oldest continuous geologic units documented in T-1 and T-3 (Pleistocene–age lacustrine deposits) were of proper age to preserve evidence of Holocene-aged movement along the Weber segment of the Wasatch Fault, that no fault-related deformation was observed within any of the deposits observed in T-1 and T-3, and that no active surface rupture faults are located underlying the proposed buildable area of Lots 1R and 2R.

   It is standard of practice for trenches to be of adequate length to explore the proposed building site(s) plus any potential setback (Salt Lake County 2002; Christenson and others, 2003; Morgan County, 2010; Draper City, 2010). Trenches should therefore extend beyond the building footprint at least the minimum setback distance for the building type. Using the fault trends shown on Figure A-2 of the April 24, 2015, GeoStrata memorandum, T-1 and T-3 do not fully cover the buildable areas designated on Figure A-2 of the April 24, 2015, GeoStrata memorandum.

   SA recommends Weber County request GeoStrata:

   a. Rectify the apparent shortcoming in regards to exploring the proposed building site(s).

   b. Clarify why the entire length of trenches were not logged/documented.

   c. *Provide data to support their statement that "…no fault-related deformation was observed within any of the deposits observed in T-1 and T-3…"*

GeoStrata Response:

a.) The proposed building areas for Lots 1R and 2R were documented by the logs of the trenches excavated as part of our previous work conducted at the subject site

(Trenches 1 and 3). We have excavated Trench 4 as part of this review response to extend our trench log coverage further east to cover the setback distance of 25 feet requested by Weber County's geologic reviewer. Trench 4 was excavated 40 feet long extending our trench coverage the requested 25 feet setback distance. The trench description of Trench 4 will follow our response to this recommendation. As stated in GeoStrata's Response to SA Recommendation 2 above, the updated log of Trench 2 has been included in this response to extend our trench coverage on the east side of Lot 1R the requested 25 feet setback distance. The trench description of Trench 2 will follow our response to this recommendation.

Trench 2 Description:

Trench 2 was excavated as part of our December 10, 2013 investigation and was re-cleaned, and re-investigated as part of our November 29, 2014 fieldwork and consequently we have updated our geologic interpretations of the geologic units exposed in Trench 2. We have included the updated lot of Trench 2 here so that Trench 2 can be utilized to observe the requested 25 feet setback along the eastern side of Lot 1R. The proposed buildable portion of residential building Lot 1R was initially assessed by observations and logging of Trench 1. Trench 2 was oriented approximately 99° and was excavated approximately 105 feet long, and approximately 6.5 to 11.5 feet deep. A hand log of the trench may be found attached to the end of this letter as Plates B-5 and B-6. The location of Trench 2 may be found on Plate A-2, Exploration Location Map.

Sediments exposed in Trench 2 have been separated into seven stratigraphic units and labeled Unit 1 through Unit 7. The oldest sediment observed at the bottom of the trench was designated as Unit 1, and was observed in the western end of the trench. The youngest two units (Units 6 and 7) were observed to overlie the older units along the entire length of Trench 2. A description of the observed units is presented below.

Unit 1 was observed in approximately the 40 feet of the western end of the trench. Unit 1 was observed to consist of grey to dark grey massive bedded gravel, sand and silt. The gravel clasts were observed to range in size up to approximately 3 inches in diameter and to be rounded to subangular. Most elongated clasts were oriented near horizontal forming an observable fabric. Unit 1 was interpreted as Pleistocene-aged lacustrine gravel deposits. When referring to the geologic mapping completed by Yonkee and Lowe (2004), this deposit most closely matches the description given for Lacustrine gravel-bearing deposits associated with the transgressive phase of the Bonneville lake cycle (Qlg_4), which are described as "clast-supported, moderately to well-sorted, pebble to cobble gravel with some silt to sand in interfluvial areas and away from mountain front; gravels contain rounded to subrounded clasts, and some subangular clasts derived from reworking of mass-wasting and alluvial fan deposits; Deposited in higher energy environments along shorelines and small fan deltas as Lake Bonneville was transgressing; grades westward away from shorelines into fine-grained lacustrine deposits (Qlf_4)".

Unit 2 grades into and overlies Unit 1 and was observed from approximately 43 feet west of the east end of Trench 2 to the west end of the trench. Unit 2 was observed to consist of grey massive bedded gravel, sand and silt similar to Unit 1 but the clasts appeared to coarsen from Unit 1 to Unit 2. The unit was observed to be iron stained. The gravel clasts were observed to range in size up to approximately 3 inches in diameter and to be rounded to subangular. Unit 2 was observed to contain rounded to subrounded cobbles up to 8 inches in diameter. Most elongated clasts were oriented near horizontal forming an observable fabric. Unit 2 was interpreted as Pleistocene-aged lacustrine gravel deposits. When referring to the geologic mapping completed by Yonkee and Lowe (2004), this deposit most closely matches the description given for Lacustrine gravel-bearing deposits associated with the transgressive phase of the Bonneville lake cycle (Qlg_4), which are described as "clast-supported, moderately to well-sorted, pebble to cobble gravel with some silt to sand in interfluvial areas and away from mountain front; gravels contain rounded to subrounded clasts, and some subangular clasts derived from reworking of mass-wasting and alluvial fan deposits; Deposited in higher energy environments along shorelines and small fan deltas as Lake Bonneville was transgressing; grades westward away from shorelines into fine-grained lacustrine deposits (Qlf_4)".

Unit 3 grades into and overlies Unit 2 and was observed from approximately 28 feet west of the east end of Trench 2 to 58 feet west of the east end of Trench 2 (Plate C-4). Unit 3 was observed to consist of grey brown massive bedded gravel, sand and silt similar to Unit 2 but with no iron staining. The gravel clasts were observed to range in size up to approximately 3 inches in diameter and to be rounded to subangular. Unit 3 appears more clast supported than Units 1 or 2. Unit 3 was observed to contain rounded to subrounded cobbles up to 5 inches in diameter. Most elongated clasts were oriented near horizontal forming an observable fabric. Unit 3 was interpreted as Pleistocene-aged lacustrine gravel deposits. When referring to the geologic mapping completed by Yonkee and Lowe (2004), this deposit most closely matches the description given for Lacustrine gravel-bearing deposits associated with the transgressive phase of the Bonneville lake cycle (Qlg_4), which are described as "clast-supported, moderately to well-sorted, pebble to cobble gravel with some silt to sand in interfluvial areas and away from mountain front; gravels contain rounded to subrounded clasts, and some subangular clasts derived from reworking of mass-wasting and alluvial fan deposits; Deposited in higher energy environments along shorelines and small fan deltas as Lake Bonneville was transgressing; grades westward away from shorelines into fine-grained lacustrine deposits (Qlf_4)".

Unit 4 grades into and overlies Unit 3 and was observed from the east end of Trench 2 to approximately 48 feet west of the east end of Trench 2. Unit 4 was observed to consist of grey brown massive bedded gravel, sand and silt similar to Unit 3 but with more silt and sand matrix than Unit 3. The gravel clasts were observed to range in size up to approximately 3 inches in diameter and to be rounded to subangular. Unit 4 was observed to contain rounded to subrounded cobbles up to 5 inches in diameter. Most elongated clasts were oriented near horizontal forming an observable fabric. Unit 3 was interpreted as Pleistocene-aged lacustrine gravel deposits. When referring to the geologic mapping completed by Yonkee and Lowe (2004), this deposit most closely matches the description given for Lacustrine gravel-bearing deposits associated with the transgressive phase of the Bonneville lake cycle (Qlg_4), which are described as "clast-supported, moderately to well-sorted, pebble to cobble gravel with some silt to sand in interfluvial areas and away from mountain front; gravels contain rounded to subrounded clasts, and some subangular clasts derived from reworking of mass-wasting and alluvial fan deposits; Deposited in higher energy environments along shorelines and small fan deltas as Lake Bonneville was transgressing; grades westward away from shorelines into fine-grained lacustrine deposits (Qlf_4)".

Unit 5 grades into and overlies Unit 4 and was observed from the east end of Trench 2 to approximately 45 feet west of the east end of Trench 2. Unit 4 was observed to consist of massive bedded gravel, sand and silt similar to Unit 4 but with more silt and sand matrix than Unit 4. The gravel clasts were observed to range in size up to approximately 3 inches in diameter and to be rounded to subangular. Unit 5 was observed to contain rounded to subrounded cobbles up to 5 inches in diameter. Most elongated clasts were oriented near horizontal forming an observable fabric. Unit 3 was interpreted as Pleistocene-aged lacustrine gravel deposits. When referring to the geologic mapping completed by Yonkee and Lowe (2004), this deposit most closely matches the description given for Lacustrine gravel-bearing deposits associated with the transgressive phase of the Bonneville lake cycle (Qlg_4), which are described as "clast-supported, moderately to well-sorted, pebble to cobble gravel with some silt to sand in interfluvial areas and away from mountain front; gravels contain rounded to subrounded clasts, and some subangular clasts derived from reworking of mass-wasting and alluvial fan deposits; Deposited in higher energy environments along shorelines and small fan deltas as Lake Bonneville was transgressing; grades westward away from shorelines into fine-grained lacustrine deposits (Qlf_4)".

Unit 6 was observed to span the entire length of Trench 2. Unit 6 was observed to consist of dark brown massively bedded gravel, sand and silt with frequent boulders. The gravel clasts were observed to range in size up to approximately 3 inches in diameter and to be rounded to subangular. This unit contained significant organics and was observed to contain rounded to subrounded cobbles up to 8 inches in diameter. Elongated clasts were observed to show no preferred orientation. Based on the organic and nature of the observed sediment, Unit 6 is interpreted as being Holocene-aged colluvium and alluvium deposits composed of re-worked Bonneville deposits sourced from upslope of the trench. When referring to the geologic mapping completed by Yonkee and Lowe (2004), this deposit most closely matches the description given for colluvium and alluvium, undivided (Qac), which is described as "Pebble to boulder gravel and clay – to boulder-rich diamiction; includes hillslope colluvium, small fans, stream alluvium, and small landslide deposits; mapped along some vegetated canyon areas in Wasatch Range".

Unit 7 was observed to span the entire length of Trench 2. Unit 7 was observed to consist of massively bedded silt, sand, gravel, and trace cobble. This unit was dark brown to black in color, contained significant organics, and contained numerous roots. Based on our observations, Unit 7 is interpreted as being a Holocene-aged active soil profile comprising a well-developed O soil horizons.

Based on our observations, Units 1, through 5 are of proper age to preserve evidence of Holocene-aged movement along the Weber segment of the Wasatch Fault. No fault-related deformation was observed within any of the deposits observed in Trench 2. The units were observed to be conformably bedded across the trench exposure and each unit was observed to be undisturbed by fault offset as documented in our log of Trench 2. It is our opinion that no active surface rupture faults are located underlying the area of the site exposed across the length of Trench 2. A hand log showing our updated interpretations of Trench 2 has been attached to the end of this letter as Plates B-5 to B-6.

Trench 4 Description:

The additional trench excavated as part of the fieldwork conducted for this response letter has been designated as Trench 4, and was located to observe the requested 25 feet setback along the eastern side of the proposed building footing location on Lot 2R. Trench 4 was approximately 35 feet long, and was excavated to a depth of 5.0 to 12.0 feet. A hand log of the trench may be found attached to the end of this letter as Plate B-7. The location of Trench 4 may be found on Plate A-2, Exploration Location Map.

Geologic units exposed in Trench 3 have been separated into five stratigraphic units and labeled Unit 1 through Unit 5. The oldest unit observed at the bottom of the trench was designated as Unit 1, and was observed in the eastern end of the trench. The youngest two units (Units 4 and 5) were observed to overlie the older units along the entire length of Trench 2. A description of the observed units is presented below.

Unit 1 was observed to consist of moderately weathered, strong, closely fractured metamorphic schist bedrock. When referring to the geologic mapping completed by Yonkee and Lowe (2004), this unit most closely matches the description given for Early Proterozoic Metamorphic and Igneous Rocks, Muscovite-bearing schist (Xfs), which is described as "grey-brown, strongly foliated, schist to gneiss containing variable amounts of muscovite, biotite, quartz, and feldspar".

Unit 2 was observed along the entire length of Trench 4. Unit 2 was observed consist of grey brown massive bedded gravel, sand and silt. The gravel clasts were observed to range in size up to approximately 3 inches in diameter and to be rounded to angular. Unit 2 was observed to contain rounded to subrangular cobbles up to 8 inches in diameter. Most elongated clasts were oriented near horizontal forming an observable fabric. Unit 2 was interpreted as Pleistocene-aged lacustrine gravel deposits. When referring to the geologic mapping completed by Yonkee and Lowe (2004), this deposit most closely matches the description given for Lacustrine gravel-bearing deposits associated with the transgressive phase of the Bonneville lake cycle (Qlg_4), which are described as "clast-supported, moderately to well-sorted, pebble to cobble gravel with some silt to sand in interfluvial areas and away from mountain front; gravels contain rounded to subrounded clasts, and some subangular clasts derived from reworking of mass-wasting and alluvial fan deposits; Deposited in higher energy environments along shorelines and small fan deltas as Lake Bonneville was transgressing; grades westward away from shorelines into fine-grained lacustrine deposits (Qlf_4)".

Unit 3 was observed to persist for nearly the full length of the trench, with the exception of the eastern-most 9 feet. Unit 3 grades into and overlies Unit 2 and was observed to consist of orange brown silt and sand with occasional fine to medium rounded gravel clasts. Unit 3 was interpreted as representing a lacustrine silt and sand deposit of Pleistocene-age, and correlates to Unit 3 observed in Trench 3. When referring to the geologic mapping completed by Yonkee and Lowe (2004), this deposit most closely matches the description given for Bonneville transgressive fine-grained deposits (Qlf_4), which are described as "Intervals of calcareous clay to silt, and intervals of rhythmically interbedded fine- to medium-sand and silt near mouth of Weber Canyon; deposited in deeper water environments, and as delta bottom set beds during transgression of Lake Bonneville".

Unit 4 was observed to persist for the full length of the trench, and was observed to consist of dark brown massively bedded gravel, sand and silt with frequent boulders. The gravel clasts were observed to range in size up to approximately 3 inches in diameter and to be rounded to subangular. This unit contained significant organics and was observed to contain rounded to subrounded cobbles up to 8 inches in diameter. Elongated clasts were observed to show no preferred orientation. Based on the organic and nature of the observed sediment, Unit 4 is interpreted as being Holocene-aged colluvium and alluvium deposits composed of re-worked Bonneville deposits sourced from upslope of the trench. When referring to the geologic mapping completed by Yonkee and Lowe (2004), this deposit most closely matches the description given for colluvium and alluvium, undivided (Qac), which is described as "Pebble to boulder gravel and clay – to boulder-rich diamiction; includes hillslope colluvium, small fans, stream alluvium, and small landslide deposits; mapped along some vegetated canyon areas in Wasatch Range".

Unit 5 was observed to persist for the full length of Trench 4. Unit 5 was observed to consist of massively bedded silt, sand, gravel, and frequent cobble. This unit was dark brown to black in color, contained significant organics, and contained numerous roots. Based on our observations, Unit 5 is interpreted as being a Holocene-aged active soil profile comprising a well-developed O soil horizons.

Based on our observations, Units 1, 2 and 3 are of proper age to preserve evidence of Holocene-aged movement along the Weber segment of the Wasatch Fault. No fault-related deformation was observed within any of the units observed in Trench 4. The units were observed to be conformably bedded across the trench exposure and each unit was observed to be undisturbed by fault offset as documented in our log of Trench 4. It is our opinion that no active surface rupture faults are located underlying the area of the site exposed across the length of Trench 4. A hand log showing our updated interpretations of Trench 4 has been attached to the end of this letter as Plates B-7.

b.) GeoStrata logged the full length of Trench 1. The survey lines shown on the map are longer than the length of the trench excavation. We extended our log of Trench 3 the full length of the excavation on the west side and as far east as we could, considering field conditions and safety. The east end of Trench 3 was steep and excavated in closely fractured bedrock making footing difficult and logging unsafe.

c.) The logs of Trenches 1 and 3 document up to 5 geologic units that were observed to conformably overlie one another along the length of the two trenches. In Trench 1, Unit 1 was observed to comprise early Pleistocene age lacustrine fine-grained deposits of the Bonneville transgressive phase (Plate C-3). This unit is of sufficient age to assess, in the absence of observable fault related deformation or offsets, that no active faults were present within the area of Trench 1 where this unit was observed. This unit was observed to be continuous across the length of the Trench 1 and was not offset by faults.

In Trenches 3 and 4, Unit 1 was observed to comprise early Proterozoic metamorphic and igneous rocks, Units 2 and 3 were observed to comprise early Pleistocene age lacustrine gravel deposits and Pleistocene age lacustrine fine-grained deposits of the Bonneville transgressive phase (Plate C-1 and C-2). These units are of sufficient age to assess, in the absence of fault related deformation or offsets, that no active faults were present within the area of Trenches 3 and 4 where these sediments were observed. These units were observed to be continuous across the length of the Trenches 3 and 4 and were not offset by faults.

Unit 3 in Trench 3 was observed to grade into Unit 1 in Trench 1 as we observed it from east to west. The logs of these trenches are our documentation that these units were observed to not be displaced by faults.

6. "*Item 9 of November 29, 2014, SBI review letter*

SBI suggested Weber County request GeoStrata delineate the alluvial fan and active channel(s) on the site-specific geologic map.

It appears that one of the plates labeled "Plate 6, Site Geologic Setback Map," may represent the map requested in the November 29, 2014, SBI review letter. The April 24, 2015, GeoStrata memorandum, stated that "… the alluvial fan sediment is largely confined to the channel located south of Trenches T-1 and T-3," and "… that a separate hydrological study has been completed by another firm for the subject site. As part of that study, we understand that a setback has been delineated from either side of the channel. GeoStrata has included this setback on our site specific geologic map (Plate A-5) and on our Site Geologic Setback Map (Plate A-6)."

In the December 10, 2013, GeoStrata report, GeoStrata concluded;

a. "The site was identified as being at an elevated risk of being impacted by alluvial fan flooding/debris flows. Based on our observations, the site has experienced numerous debris flows as well as alluvial fan floods during the Holocene. It is recommended that site grading and catchment basins/earthen barriers be utilized to minimize the risk of the proposed development being impacted by alluvial fan flooding/debris flows. A debris flow analysis was beyond the scope of this project, but should be considered prior to development (Executive Summary, p. 1)."

b. "Due to the potential for alluvial fan flooding and debris flows at the site, strategic grading to create deflection berms and a break in slope away from each residence with slopes great enough and slope heights sufficient to allow alluvial fan flooding/debris flow events from the north and northeast directions to flow around each residence are likely the most feasible forms of mitigation available to the property owner at this time (Executive Summary, p. 1)."

c. "...Based on the presence of mapped and observed past alluvial fan deposits on the subject site, the site does have the potential to be impacted by future alluvial fan flooding and debris flows (p. 17)."

SA recommends Weber County request GeoStrata:

a. Provide Plate A-5, which was not included in the April 24, 2015 GeoStrata memorandum.

b. Clarify which of the two figures labeled Plate 6 "Site Geologic Setback Map," is intended for delineating the alluvial fan and active channel(s).

c. Provide the citation and a copy of "...the separate hydrological study...completed by another firm for the subject site."

d. Provide the setback distance recommended in "...the separate hydrological study...completed by another firm for the subject site."

e. Clarify whether or not the:

i. Site has the potential to be impacted by alluvial fan flooding and debris flows as documented in the December 12, 2013, GeoStrata report, and if not, why.

ii. *Recommendations in the December 12, 2013, GeoStrata report, remain valid and applicable."*

GeoStrata Response:

a.) GeoStrata has reviewed the referenced plate and has updated the incorrect title block on Plate A-5. An updated version of the plate has been produced and attached to the end of this letter.

b.) GeoStrata has attached the Site Geologic Map (Plate A-5) and the Site Geologic Setback Map (Plate A-6) to the end of this letter. The Site Geologic Map (Plate A-5) is intended to delineate the alluvial fan sediments on the site and the Site Geologic Setback Map (Plate A-6) is intended to show the active channel setback based on the hydrology report prepared by HydroPlot titled "Drainage Evaluation for Dauphine'-Savoy-Piedmont Subdivision, Lot #2, Ogden, UT" and dated September 4, 2014 and shown on the Grading/Drainage Plan prepared by Silverpeak Engineering and stamped by Joshua R. Jensen P.E. This report and Grading/Drainage Plan are included in Appendix D of this letter.

c.) The Hydrology report prepared by HydroPlot titled "Drainage Evaluation for Dauphine'-Savoy-Piedmont Subdivision, Lot #2, Ogden, UT" and dated September 4, 2014 is included in Appendix D of this letter.

d.) The drainage easement is labeled on the Grading/Drainage Plan as an existing 50 ' drainage easement but actually measures 75 feet according to the reported scale. The Modified Channel Cross Section detail on the Grading/Drainage Plan shows a minimum channel width of 20 feet and a minimum depth of 3 feet.

e.) i. The site has an ephemeral stream that traverses the middle portion of Lot 2R and the southern portion of Lot 1R. This stream channel is well incised into the alluvial sediments exposed at the subject site and has a well defined stream channel bottom. This stream channel can be seen in the topography shown on Plates A-2 and A-5 as well as the attached hillshade images (Plates A-7 through A-10). This stream is observed by GeoStrata to be a generally straight channel across both lots until it intersects Bybee Drive down hill of the subject site. The near surface sediments in this stream channel were observed in two test pits excavated east of the proposed residence on Lot 2R as shown on Plate A-2 attached to this letter. The sediments observed by GeoStrata were comprised of stream deposits interbedded with debris flow sediments. Each of these interbedded deposits was observed to be approximately 1.5 to 3.0 feet thick.

In our December 12, 2013 report, we stated that alluvial fan sediments were observed at the site and that the risk of alluvial fan flooding and debris flow was present at the site. We did not delineate in our December 12, 2013 report the portions of the subject site that were assessed to be impacted by these hazards. Based on our observations made at the site during our initial site assessment and two subsequent site assessments it is our opinion that stream flooding hazard and debris flow hazards do exist within and adjacent to the ephemeral stream channel. Our observations and mapping of the site have aided us in the development of a site geologic map shown on Plate A-5. No alluvial fan associated with the observed ephemeral stream channel is located on the subject site. Yonkee and Lowe (2004) report the deposits along the observed stream channel as (Qaf_1) younger alluvial-fan sediments (Plate A-3). We have used this unit label for the alluvial deposits we observed and mapped on the site, however it is our opinion that these Qaf_1 sediments are interbedded with (Qal_1) younger stream alluvium sediments as well.

ii. The recommendations made in our December 12, 2013 report that proper site grading and drainage planning and strategic grading to create deflection berms and a break in slope away from each residence to mitigate the debris flow hazard are recommendations that we still believe to be the best approach to mitigate the debris flow and stream flooding hazards at the site without negatively impacting existing residences downstream of Lots 1R and 2R. After assessing the site and the debris flow hazard for the subject site it is our opinion that our recommended mitigation can best be implemented for Lots 2R and 1R through modification of the Broad Hollow stream channel as recommended in the hydrology report prepared by HydroPlot titled "Drainage Evaluation for Dauphine'-Savoy-Piedmont Subdivision, Lot #2, Ogden, UT" and the Silverpeak Engineering Grading /Drainage Plan. Our discussion of our assessment of the debris flow hazard mitigation is as follows:

Fire-related debris flow volumes for the subject property were predicted using the Western USA regression model (Gartner and others, 2008; Giraud and Castleton, 2009; Cannon and others 2010). The model estimates debris flow volumes as:

$$\ln V = 0.59(\ln S) + 0.65(B)1/2 + 0.18(R)1/2 + 7.21$$

where:

V = volume (cubic meters)

S = basin area with slopes greater than or equal to 30% (square kilometers)

B = basin area burned at moderate and high severity (square kilometers)

R = total storm rainfall (millimeters)

Total basin area and the percent of the basin with slopes greater than 30% were given in the 2014 HydroPlot hydrology report (Appendix D). For the purposes of this study, we assumed a 100% burned condition for the basin. Rainfall data were obtained from the NOAA Atlas 14, Volume 1, Version 5 Point Precipitation Frequency Estimates for the subject drainage basin.

Based on this model, the estimated debris flow volume for a rainstorm event with a 10-year recurrence interval and 60 minute duration is 4.0 ac-ft. Applying this volume to a unit rational hydrograph, peak debris flow for the subject property is estimated to be 48.9 cfs. Based on the Silverpeak Engineering Grading /Drainage Plan, they propose improving the existing stream channel and show a cross section of the improved stream channel on page C1.0 (Appendix D). The gradient of the stream channel as shown on their Grading /Drainage Plan will be approximately 14.5%. Velocity of the debris flow at peak flows will be 12.7 feet per second.

The modified channel shown on the Silverpeak Engineering Grading /Drainage Plan is designed to handle peak flows of 50.4 cfs with a minimum freeboard of 1 foot. At this capacity the depth of flow within the channel would be approximately 1.5 feet. This is, in our opinion, adequate for storm water flow through the channel; however, according to Prochaska and others (2008) a freeboard of approximately 3 feet would be more suitable for debris flow confinement within the channel.

Channel depth and berm height should be designed based on the following equations (Prochaska and others, 2008):

$$h_B = h + \Delta h + 3$$

where:

h_B = height of debris flow deflection berm (feet)

h = depth of flow (feet)

Δh = runup height (feet)

and

$$\Delta h = v^2 b / R_c g$$

where:

Δh = runup height (feet)

v = mean flow velocity (feet per second)

b = flow width (feet)

R_c = radius of curvature of the channel (feet)

g = acceleration of gravity

Based on these equations and an anticipated debris flow depth of 1.2 feet, the calculated runup height around the bends in the channel will be 0.1 feet, and the debris flow deflection berm height or channel depth should be at least 4.5 feet.

Hungr and others, (1984) state "The degree of confinement should of course, be considered in relation to the discharge. The suggested criterion for sufficient confinement is a depth-to-width ratio of not less than 0.2. Thus, within a given channel cross section, low discharge surges will deposit at steeper angles than large ones. Trapezoidal channel cross sections with narrow bases should therefore be used where it is necessary to convey a wide range of debris discharge without deposition."

Based on the depth to width ratio given by Hungr and others (1984), the slope and grade of the property, and estimated debris flow volumes and peak flows, we recommend that the channel be modified to consist of a trapezoidal channel with a base width of 2 feet and height or depth of at least 4.5 feet with the sides of the channel sloped at a 2H:1V (horizontal to vertical) gradient. Given these channel dimensions, the depth of flow for an anticipated debris flow would be approximately 1.2 feet, the width of the channel at the top of the flow would be approximately 4.8 feet resulting in a depth-to-width ratio for the modified channel of 0.25. This ratio complies with the recommendation of Hunger and others, (1984) of a minimum depth-to-width ratio of 0.2. These channel cross section dimensions should be consistent across the entire site to prevent deposition of debris flows within the channel. A cross section drawing of the channel cross section is included as Plate A-15.

We would also recommend that the sides of the channel be armored with rip rap to aid in erosion prevention in the conveyance channel as it traverses Lots 2R and 1R.

7. *"Item 12 of November 29, 2014, SBI review letter*

   SBI recommended Weber County request GeoStrata submit Plate A-2 depicting the surface fault rupture hazard special study area as determined by GeoStrata utilizing a distance of 500 feet from the reported location of faults within the Weber segment of the Wasatch Fault Zone. The map was not provided.

   SBI recommends Weber County request GeoStrata submit a map depicting the surface fault rupture hazard special study area, as determined by GeoStrata, utilizing a distance of 500 feet from documented locations of faults within the Weber segment of the Wasatch Fault Zone."

GeoStrata Response: We have prepared the requested map showing the surface fault rupture hazard special study area, as we determine it, utilizing a distance of 500 feet (Plate A-12). It should be noted, as we have stated previously that based on our review of the most up to date sub-meter Lidar data (Wasatch Front LIDAR Elevation Data 2013 to 2014 provided by the AGRC and DEM data from the National Elevation Data Set provided by the USGS) and our stereo aerial photography review (as cited in our prior review response), no visible lineations or other surface fault rupture related geomorphology were observed that would indicate the presence of active surface fault ruptures trending across the subject site. The active fault splay of the Weber segment of the Wasatch fault zone is identified by GeoStrata with its associated scarp as shown on the Lineament Map provided on Plate A-11. Considering that this main splay is the only surface fault rupture that GeoStrata could document, the surface fault rupture hazard special study area, as we determine it, utilizing a distance of 500 feet is only assessed from that fault. We recognize that maps prepared prior to the availability of the Wasatch Front LIDAR Elevation Data 2013 to 2014 provided by the AGRC report two faults trending through the subject site(Yonkee and Lowe, 2004; Christenson and Shaw, 2008). While our mapping of the faults in and adjacent to the subject site differs from these maps, the fieldwork and review responses prepared by GeoStrata to assess the surface fault rupture hazard for the subject site has considered the entire site within the surface fault rupture hazard special study area as presented on the maps cited in our report and review responses.

8. *"Item 14 of November 29, 2014, SBI review letter*

   SA recommended Weber County request the applicant submit a debris flow analysis for the subject property as recommended in the December 10, 2013, GeoStrata report.

   The GeoStrata response in the December 10, 2013, GeoStrata report follows: "GeoStrata has been informed that a hydrological study has been completed for the site, and that recommendations concerning site grading to reduce the potential for the site to be impacted *by alluvial fan flooding/debris flow have been given in reports completed by others. All recommendations presented in these reports should be incorporated into the design of the project."*

SA recommends Weber County request GeoStrata provide the citation and a copy of "…the separate hydrological study…completed by others…" for the subject site."

GeoStrata Response: The citation for the referenced hydrologic study is as follows:

HydroPlot, September 4, 2014, Drainage Evaluation for the Dauphine'-Savoy-Piedmont Subdivision, Lot #2, Ogden, UT, p 3., unpublished consultant report.

The citation for the referenced Grading/drainage plan is as follows:

Silverpeak Engineering, 10-17-2014, Rasmussen Residence Weber Canyon Uinta County, Utah, Wash Grading Plan, Grading/Drainage Plan, p C1.0 - C2.0., Unpublished consultant plan set.

These two documents are provided in Appendix D of this letter.

9. *"Section 2.1, Purpose and Scope of Work (p. 2), of December 10, 2013, GeoStrata report states: "Both sites are located within a fault hazard special study area as delineated by the Surface Fault Rupture Special Study Areas, Wasatch Front and Nearby Areas, Utah map prepared by the Utah Geological Survey (Christenson and Shaw, 2008). In addition, both sites are located within a debris flow special study area as delineated by the Debris-Flow/Alluvial Fan Special Study Areas, Wasatch Front and Nearby Areas, Utah prepared by the Utah Geological Survey (Christenson and Shaw, 2008)."*

   SA recommends Weber County request GeoStrata provide the two referenced maps."

GeoStrata Response: The two referenced maps have been provided on Plates A-13 and A-14.

10. *SA recommends Weber County request GeoStrata provide the method utilized for locating the exploratory trenches and the degree of accuracy inherent in the method used.*

GeoStrata Response: Trenches 1, 2, and 3 were located by means of surveying by Landmark Surveying, Inc. This survey data was provided to GeoStrata for use in preparation of our plates. The accuracy of this survey data is less than 1 inch as reported to us by Landmark Surveying Inc. Trench 4 was located by means of a hand held Topcon GMS-2 GPS. The accuracy of this GPS is less than 3 feet.

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 other 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.

References

Cannon, S. H., Gartner, J.E., Rupert, M.G., Michael, J.A., Rea, A.H., and Parrett, C., 2010, Predicting the Probability and Volume of Postwildfire Debris Flows in the Intermountain Western United States, Geological Society of America GSA Bulletin; January/February 2010; v. 122; no. 1/2; p. 127-144.

Christenson, G.E., and Shaw, L.M., 2008, Geographic Information System database showing geologic-hazard special study areas, Wasatch Front, Utah; Utah Geological Survey Circular 106, j7 P., GIS data, scale 1:24,000.

Gartner, J.E., Cannon, S.H., Santi, P.M. and Dewolfe, V.G., 2008, Empirical Models to Predict the Volumes of Debris Flows Generated by Recent Burned Basins in the Western U.S., Geomorphology 96 (2008) 339-354.

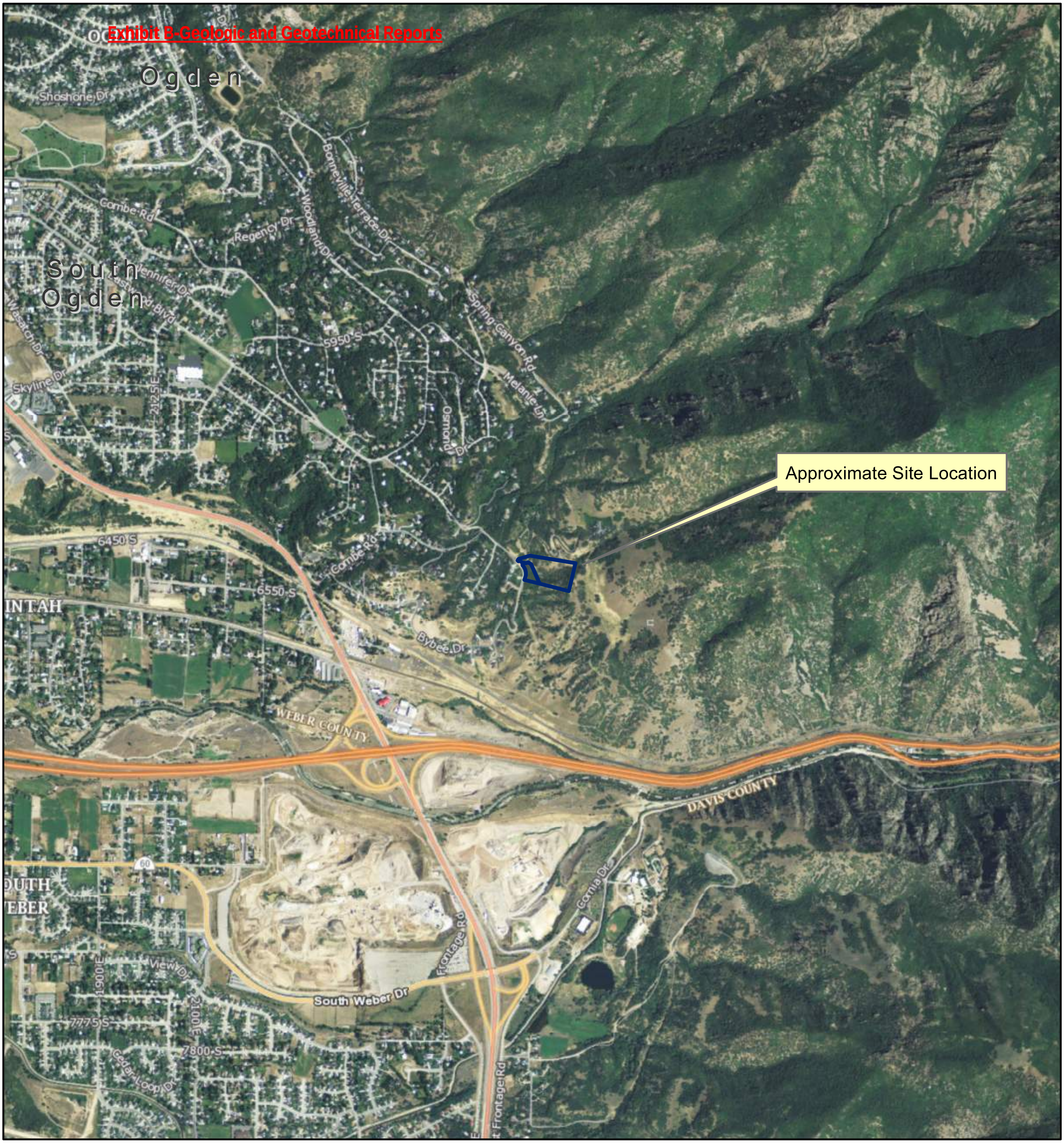
Giraud, R.E. and Castleton, J.J., 2009, Estimation of Potential Debris-Flow Volumes for Centerville Canyon, Davis County, Utah, Utah Geological Survey Report of Investigation 267, 33 p.

HydroPlot, September 4, 2014, Drainage Evaluation for the Dauphine'-Savoy-Piedmont Subdivision, Lot #2, Ogden, UT, p 3., unpublished consultant report.

Hungr, O., Morgan, G.C., and Kellerhals, R., 1984, Quantitative analysis of debris torrent hazards for design of remedial measures, Canadian Geotechnical Journal, v. 21, p. 663-677.

Silverpeak Engineering, 10-17-2014, Rasmussen Residence Weber Canyon Uinta County, Utah, Wash Grading Plan, Grading/Drainage Plan, p C1.0 - C2.0., Unpublished consultant plan set.

Yonkee, A., Lowe, M., 2003, Geologic Map of the Ogden 7.5' Quadrangle, Weber and Davis Counties, Utah, Utah Geological Survey Map 200.



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

N

1:24,000

Base Map: Utah AGRC Hybrid Basemap

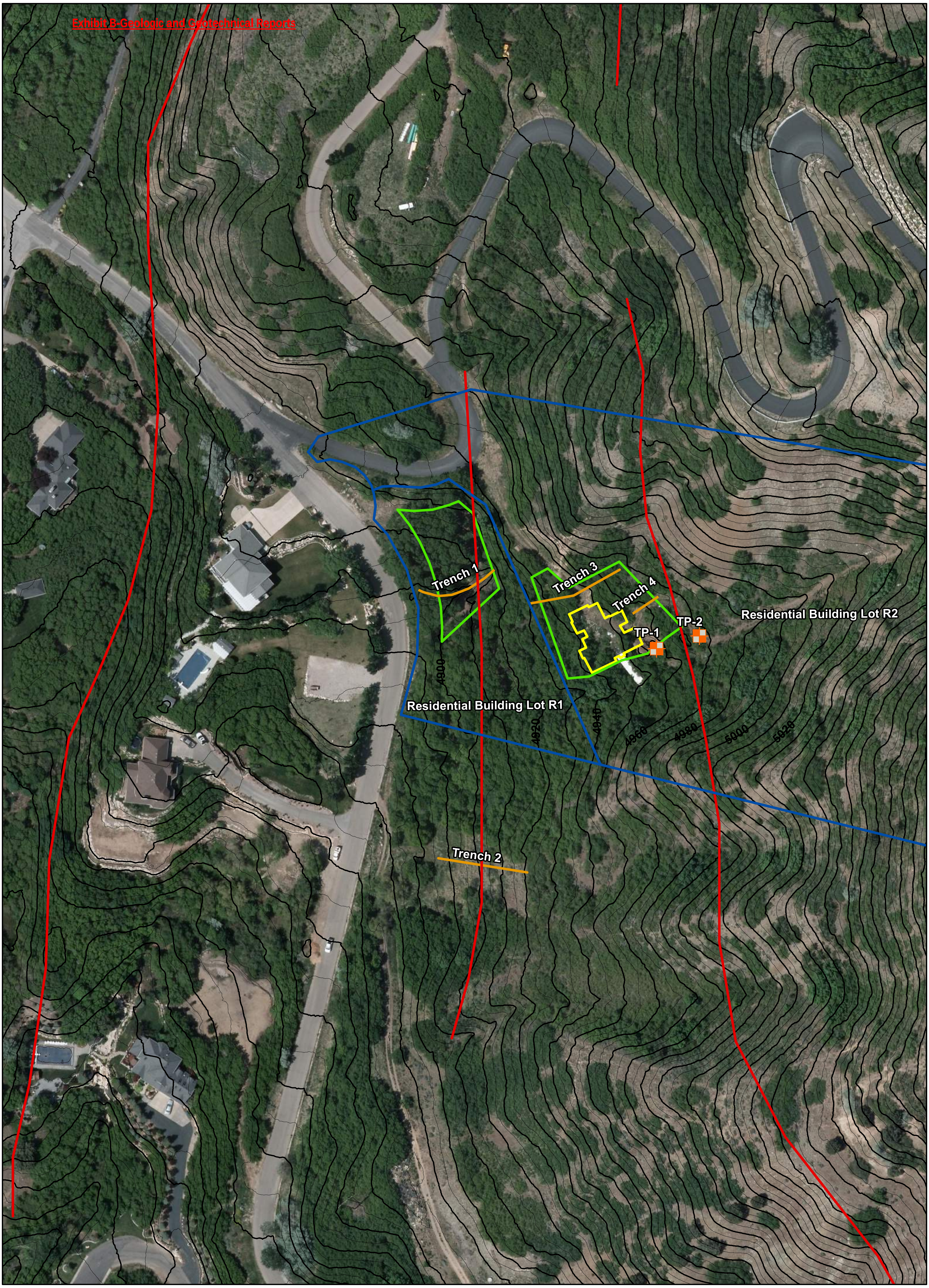
All Locations are Approximate

GeoStrata

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

Site Vicinity Map

Plate A-1



Legend

- Fault (Yonkee & Lowe 2004)
- Fault Trench
- Test Pit
- Proposed Buildable Area
- Proposed Building Footprint
- 5 Foot Contours

0 30 60 120 180 240 Feet

1:1,200

Base Map: 2012 HRO 6 inch Orthophotography obtained from the State of Utah AGRC. Contours derived from 2013 -2014 Wasatch Front LiDAR obtained from the State of Utah AGRC.

All Locations are Approximate

N

GeoStrata Engineering & Geosciences

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

Exploration Location Map

Plate A-2

0 500 1,000 2,000 3,000 4,000 Feet

1:24,000

Base Map: Yonkee, W.A. and Lowe, M., 2004,
Geologic map of the Ogden 7.5 minute quadrangle, Utah
Geological Survey Open-File Report M-200, 42p., 2pl., scale 1:24,000

All Locations are Approximate

N

Legend

Site Boundary

Geologic Unit descriptions provided on plate A-4

GeoStrata

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

Geologic Map

Plate A-3

Exhibit B-Geologic and Geotechnical Reports

Quaternary Surficial Deposits

Units are subdivided based on dominant process (l- lacustrine, d- deltaic, a- alluvial, m- mass wasting, g- glacial), and on relative age (1- Holocene (younger), 2- Holocene (older), 3- Lake Bonneville regressive, 4- Lake Bonneville transgressive, and 5- pre-Lake Bonneville).

Units with form X/Y indicates thin (generally less than 3 meters [10 ft] thick) deposits of X overlying deposits of Y.

Qlg3 Lacustrine gravel-bearing deposits, Bonneville regressive– *Clast-supported, moderately to well-sorted, pebble to cobble gravel and gravelly sand, interlayered with some silt and sand; deposited and reworked in higher energy environments along the Provo and regressive shorelines near the mountain front; mapped at elevations below Provo shoreline; thickness less than 6 meters (20 ft).*

Qlf3 Lacustrine fine-grained deposits, Bonneville regressive– *Medium sand to silt deposited and reworked in moderate-energy environments near and below Provo shoreline away from mountain front in southern part of quadrangle; also includes calcareous clay, silt, and fine sand deposited in deeper water environments in the subsurface within western part of quadrangle; thickness of deposits near shoreline generally less than 6 meters (20 ft).*

Qlg4 Lacustrine gravel-bearing deposits, Bonneville transgressive– *Clast-supported, moderately to well-sorted, pebble to cobble gravel, with some silt to sand in interflueve areas and away from mountain front; gravels contain rounded to subrounded clasts, and some subangular clasts derived from reworking of mass-wasting and alluvial-fan deposits; deposited in higher energy environments along shorelines and small fan deltas as Lake Bonneville was transgressing; grades westward away from shorelines into fine-grained lacustrine deposits (Qlf4); total thickness locally as much as 60 meters (200 ft).*

Qlf4 Lacustrine fine-grained deposits, Bonneville transgressive– *Intervals of calcareous clay to silt, and intervals of rhythmically interbedded fine to medium sand and silt near mouth of Weber Canyon; deposited in deeper water environments, and as delta bottomset beds during transgression of Lake Bonneville; total thickness, including subsurface deposits, locally as much as 150 meters (500 ft).*

Qd3 Deltaic deposits, Bonneville regressive– *Main part of unit includes foreset beds of rhythmically interlayered, gently inclined, fine to medium sand and silt, and topset beds of clast-supported, moderately to well-sorted, pebble and cobble gravel and gravelly sand; gravels contain rounded to subrounded clasts; deposited when Lake Bonneville was at and regressing from Provo shoreline; forms large, gently westward-inclined surface that was locally reworked along regressive shorelines; total thickness locally as much as 30 meters (100 ft). Unit also includes moderately to well-sorted, pebble and cobble gravel in smaller terraces more than 30 meters (100 ft) above modern stream level that are graded to delta deposits and shorelines above the Gilbert level; exposed thickness of terrace gravels up to 6 meters (20 ft).*

Qd4 Deltaic deposits, Bonneville transgressive– *Topset beds of clast-supported, moderately to well-sorted, pebble gravel and gravelly sand; contains abundant subrounded to rounded basement clasts; deposited as Lake Bonneville was near a transgressive shoreline at an elevation of about 1,520 meters (5,000 ft); thickness of topset beds 2 to 4 meters (7 - 13 ft).*

Qal Stream alluvium, undivided– *Mostly clast-supported, moderate- to well-sorted, pebble and cobble gravel, gravelly sand, and silty sand; deposited along modern channels and inactive benches; mapped where active channels and benches are too narrow to map separately; exposed thickness less than 12 meters (40 ft).*

Qal1 Younger stream alluvium, Holocene– *Clast-supported, moderate- to well-sorted, pebble and cobble gravel, gravelly sand, and silty sand; deposited along modern channels and flood plains; mapped where fluvial processes are currently or episodically active; exposed thickness less than 6 meters (20 ft).*

Qal2 Older stream alluvium, Holocene– *Clast-supported, moderately to well-sorted, pebble and cobble gravel, gravelly sand, and silty sand; deposited along inactive flood plains and terraces 3 to 9 meters (10-30 ft) above modern stream level; mapped where fluvial processes are generally no longer active; exposed thickness less than 6 meters (20 ft).*

Qat2 Older alluvial terrace deposits, Holocene– *Clast-supported, moderately to well-sorted, pebble and cobble gravel and gravelly sand; contains subangular to rounded clasts; forms terraces 9 to 15 meters (30-50 ft) above modern stream level that appear graded to base levels below the Gilbert shoreline; exposed thickness less than 6 meters (20 ft).*

Qag4 Alluvial gravel of Ogden Canyon–*Clast-supported, moderately sorted, pebble to boulder alluvial gravel, with some lacustrine sand layers at top of unit; gravel contains angular to subrounded clasts and is weakly to strongly cemented by calcite; present in small erosional remnants along Ogden Canyon; original thickness as much as 60 meters (200 ft).*

Qaf Alluvial-fan deposits, undivided– *Mixture of clast-supported, moderately sorted, pebble to cobble gravel and sand deposited by streams, and matrix-supported, poorly sorted, pebble to boulder gravel to diamicton deposited by debris flows; mapped where deposits lack cross-cutting relations and relative age is uncertain; exposed thickness less than 9 meters (30 ft).*

Qaf1 Younger alluvial-fan deposits, Holocene– *Mixture of gravel and sand deposited by streams, and diamicton deposited by debris flows; forms fans having distinct levees and channels at mouths of mountain-front canyons; exposed thickness less than 6 meters (20 ft).*

Qaf2 Older alluvial-fan deposits, Holocene– *Mixture of gravel and sand deposited by streams, and diamicton deposited by debris flows; forms fans with poorly preserved levees that are slightly incised by modern stream channels; exposed thickness less than 6 meters (20 ft).*

Qaf3 Alluvial-fan deposits, Bonneville regressive– *Mixture of gravel and sand deposited by streams, and diamicton deposited by debris flows; contains mostly angular to subrounded clasts plus some recycled, well-rounded lacustrine clasts; forms fans having subdued morphology that are graded to the Provo or other regressive shorelines and are incised by modern stream channels; exposed thickness less than 9 meters (30 ft).*

Qaf4 Alluvial-fan deposits, Bonneville transgressive– *Mixture of gravel deposited by streams and diamicton deposited by debris flows; gravel contains mostly angular to subrounded clasts; locally weakly cemented with calcite; fans have subdued morphology, display top surfaces graded to the Bonneville shoreline, and are deeply incised by modern stream channels; total thickness of some composite fans as much as 60 meters (200 ft).*

Qms Landslide deposits, undivided– *Unsorted, unstratified deposits of angular boulders, sand, silt, clay, and bedrock blocks; deposits generally found on steeper slopes that are covered by thick vegetation and display hummocky topography; deposits formed by single to multiple slides, slumps, and flows; mapped where lack of cross-cutting relations prevents relative age determination; queried where hummocky topography is more subdued; thickness uncertain.*

Qms1 Younger landslide deposits, Holocene– *Unsorted, unstratified mixtures of gravel, sand, silt, and clay redeposited by slides, slumps, and flows; deposits display distinctly hummocky topography and fresh scarps, and are currently or have been recently active; many of these deposits are within older slide complexes.*

Qms2 Older landslide deposits, Holocene– *Unsorted, unstratified mixtures of mostly sand, silt, and clay redeposited by single to multiple slides, slumps, and flows; deposits display subdued hummocky topography but lack fresh scarps and are mostly inactive; deposits found mostly along moderate slopes where rivers and streams have incised into finer grained lacustrine and deltaic deposits; unit also includes slides of boulder-rich diamicton that reactivated parts of older slide complexes in the Wasatch Range.*

Qms3 Landslide deposits, Bonneville regressive– *Mixture of silt, fine sand, and minor gravel redeposited in a flow slide and lateral spread as a result of liquefaction, probably during large earthquake(s); deposits display disrupted bedding, landslide-related lineaments and scarps, and hummocky topography; one large deposit is present in the quadrangle and formed after regression from the Provo level but before major downcutting by streams.*

Qms5 Landslide deposits, pre-Bonneville to Bonneville transgressive– *Unsorted, unstratified deposits of angular boulders, sand, silt, clay, and bedrock blocks; deposited by multiple slides, slumps, and flows; parts of these slides are covered by Lake Bonneville deposits and reworked along the Bonneville shoreline, and parts of some slides are interlayered with Bonneville-transgressive lacustrine deposits.*

Qmf Debris-flow deposits, undivided– *Matrix- to clast-supported cobble and boulder gravel with variable amounts of sand, silt, and clay matrix; surfaces variably rubbly and commonly have levees and channels; includes multiple events graded to various levels above modern channels; unit grades into alluvial fans at mouths of canyons, and into colluvium, talus, and slide deposits at higher elevations in source areas; thickness probably less than 9 meters (30 ft).*

Qmt Talus– *Deposits of angular pebble to boulder fragments with little or no matrix and little to no vegetation cover, which have accumulated at bases of some steep bedrock slopes and cliffs; thickness uncertain in most areas, but probably less than 15 meters (50 ft).*

Qma Avalanche deposits– *Diamicton and vegetative debris that have accumulated from repeated avalanches along moderately steep, northerly facing chutes at higher elevations; only one relatively large deposit mapped.*

Qc Colluvium– *Weakly to non-layered, variably sorted, matrix- to clast-supported, pebble to boulder gravel and diamicton of local origin; contains angular to subangular clasts in variable amounts of clay, silt, and sand matrix; deposits formed mostly by creep and slope wash, also includes small landslides, talus, debris cones, minor alluvium, and small bedrock exposures; found mostly along vegetated slopes in Wasatch Range, and locally covering scarps along the Wasatch fault zone; thickness probably less than 15 meters (50 ft) in most areas.*

Qac Colluvium and alluvium, undivided– *Pebble to boulder gravel and clay- to boulder-rich diamicton; includes hillslope colluvium, small fans, stream alluvium, and small landslide deposits; mapped along some vegetated canyon areas in Wasatch Range; thickness probably less than 15 meters (50 ft) in most areas.*

Qgr Rock-glacier deposits– *Bouldery debris with little or no matrix; displays hummocky forms with cross-slope ridges and little or no vegetation; present near bases of some cirque headwalls at higher elevations near Mount Ogden.*

Qgty Glacial till, younger– *Boulders to pebbles in sparse sandy to silty matrix; displays distinct moraine crests and limited soil development; present in upper part of cirque basin northeast of Mount Ogden.*

Qgto Glacial till, older– *Boulders to pebbles in variable amounts of sandy to silty matrix; displays more subdued moraine crests and greater soil development compared to younger till; present within cirque basins near Mount Ogden; probably late Pinedale age (about 25 to 10 ka).*

Qf Artificial fill– *Excavated and reworked debris; only larger areas mapped along rail and roadways in Weber Canyon, and near an abandoned landfill.*

Basin Fill

Qb Quaternary basin fill– *Weakly to non-consolidated mixture of alluvial and lacustrine clay, silt, sand, gravel, marl, and thin tuffaceous layers; includes two thicker, gravel-bearing zones corresponding to the Sunset and Delta aquifers; shown only on cross sections; up to 400 meters (1,300 ft) thick.*

Tb Late Tertiary basin fill– *Weakly to strongly consolidated mixture of conglomerate, sandstone, mudstone, tuffaceous sandstone, tuff, and lacustrine limestone; only shown on cross sections; up to 2,400 meters (8,000 ft) thick.*

Tertiary Igneous Rocks

Td Tertiary igneous dikes– *Dark colored, non-foliated dikes composed of altered hornblende, biotite, and feldspar phenocrysts in a fine-grained, highly altered matrix; interpreted to be Tertiary age.*

Cretaceous Altered and Deformed Rocks

Kc Chloritic gneiss, cataclasite, and mylonite– *Dark- to gray-green, variably fractured and altered gneiss, intensely fractured cataclasite, and mylonite to phyllonite with micaceous cleavage; derived by greenschist-facies alteration and varying degrees of cataclastic and plastic deformation that overprinted protoliths from the Farmington Canyon Complex; contains variable amounts of fine-grained, recrystallized chlorite, muscovite, and epidote; found within shear zones and along the Ogden floor thrust.*

Kfx Imbricated fault rocks– *Intensely deformed, complexly imbricated fault-zone rocks derived from a mixture of Farmington Canyon Complex and Cambrian sedimentary rock protoliths; contains fault-bounded slices of limestone and shale with intense cleavage and tight folds, and mixed cataclasite to mylonite; mapped along parts of the Ogden floor thrust.*

K(?)q Quartz veins and pods– *Veins and pods of quartz with minor chlorite, epidote, muscovite, and hematite; veins and pods cross cut gneissic foliation and are locally associated with chlorite alteration within rocks of the Farmington Canyon Complex; only larger bodies mapped; interpreted to be mostly related to Cretaceous alteration.*

Paleozoic Sedimentary Rocks

Mg Gardison Limestone– *Ledge- to cliff-forming, medium- to dark-gray, thin- to thick-bedded, fossiliferous limestone to dolomitic limestone; contains local chert lenses and widespread fragments of fossil corals, crinoids, and brachiopods; top not exposed in quadrangle but about 200 meters (660 ft) thick in nearby areas.*

Db Beirdneau Formation– *Overall slope-forming, yellow- to red- to light-gray, interlayered, sandy to silty dolomite and limestone, fine- to medium-grained sandstone, shale, flat-pebble conglomerate, and sedimentary breccia; uppermost part consists of argillaceous limestone and shale; about 50 to 100 meters (170-330 ft) thick, but thickness varies due to widespread minor faulting and folding.*

Dhw Hyrum Dolomite and Water Canyon Formation, undivided– *Hyrum consists of ledge-forming, medium- to dark-gray, medium- to thick-bedded, dolomite and minor silty limestone; Water Canyon consists of slope-forming, light- to yellow-gray, sandy to silty dolomite; unit is about 50 to 100 meters (170-330 ft) thick.*

Of Fish Haven Dolomite– *Cliff-forming, medium- to dark-gray, medium- to thick-bedded, slightly fossiliferous dolomite; about 40 to 80 meters (130-260 ft) thick.*

Og Garden City Formation– *Ledge- and slope-forming, tan to light-gray, thin- to thick-bedded, silty dolomite, dolomite, silty limestone, and siltstone; has well-layered appearance; some layers are slightly fossiliferous and some layers contain siltstone-filled cracks; about 60 to 120 meters (200-400 ft) thick, but thickness varies due to widespread minor faulting.*

Csn St. Charles and Nounan Formations, undivided– *St. Charles consists mostly of cliff-forming, light- to dark-gray, massive-weathering dolomite, with a thin interval of sandy dolomite and sandstone corresponding to the Worm Creek Quartzite Member at its base; Nounan consists of cliff-forming, light- to dark-gray, massive-weathering, dolomite and minor silty dolomite with local twiggy structures; unit is about 300 to 450 meters (1,000-1,500 ft) thick.*

Cb Bloomington Formation– *Slope-forming, orange-gray to brown, thin-bedded, interlayered, shaley limestone, shale, fine-grained limestone with abundant orange-weathering silty ribbons, flat-pebble conglomerate, oncolitic limestone, and oolitic limestone; about 30 to 60 meters (100-200 ft) thick, but thickness varies due to widespread minor faulting.*

Cm Maxfield Formation, undivided– *Total thickness about 180 to 300 meters (600-1000 ft), but total thickness and thicknesses of individual members vary due to widespread deformation.*

Cmu Upper limestone and dolomite member– *Upper part consists mostly of cliff-forming, light- to dark-gray, medium- to thick-bedded, dolomite, oolitic dolomite, and minor limestone, with widespread twiggy structures; lower part consists mostly of ledge-forming, light- to medium-gray, thin- to thick-bedded, oolitic limestone, fine-grained limestone with yellow-weathering silty ribbons, and minor dolomite; distinctive interval of interlayered dark-gray cherty dolomite and light-gray boundstone found near top of the member; about 100 to 150 meters (330-500 ft) thick.*

Cma Middle argillaceous limestone member– *Overall slope-forming, overall brown to orange-gray, thin- to medium-bedded, interlayered, argillaceous limestone with black, clay-filled cracks, shale with limestone nodules, fine-grained limestone with orange-weathering silty ribbons, oolitic limestone, oncolitic limestone, and flat-pebble conglomerate; about 40 to 80 meters (130-260 ft) thick.*

Cml Lower limestone member– *Ledge-forming, light- to medium-gray, thin- to medium-bedded limestone with abundant orange-weathering silty ribbons and minor oolitic limestone; thin interval of shaley limestone near middle of member separates upper and lower ledges; about 40 to 80 meters (130-260 ft) thick.*

Co Ophir Shale, undivided– *Total thickness of about 90 to 200 meters (300-700 ft), but total thickness and thicknesses of individual members vary widely due to intense deformation.*

Cou Upper shale member– *Slope-forming, gray-brown to olive-drab, variably calcareous, silty to micaceous shale (or argillite), with some thin, silty limestone beds; generally poorly exposed and strongly deformed; probably about 40 to 80 meters (130-260 ft) thick.*

Com Middle limestone member– *Ledge-forming, light- to medium-gray, thin- to medium-bedded limestone with abundant orange-weathering silty ribbons and minor oolitic limestone; probably about 6 to 20 meters (20-70 ft) thick.*

Col Lower shale member– *Slope-forming, brown- to olive-drab, silty to micaceous shale (or argillite), with some fine-grained sandstone layers at base; generally poorly exposed and strongly deformed; probably about 40 to 100 meters (130-330 ft) thick.*

Ct Tintic Quartzite– *Main part of formation consists of cliff-forming, white to tan, thin- to thick-bedded, quartz-rich, well-cemented sandstone (orthoquartzite) with some lenses of quartz-pebble conglomerate and thin layers of argillite; argillite intervals increase in abundance and quartz pebbles decrease in abundance toward the top of the formation; basal part of the formation consists of heterogeneous mixture of green to purple to tan, arkosic sandstone, quartz-pebble conglomerate, and micaceous siltstone; about 400 to 450 meters (1,300-1,500 ft) thick.*

Early Proterozoic Metamorphic and Igneous Rocks

Xf Farmington Canyon Complex, undivided– *Shown only on cross sections.*

Units exposed in footwall of Ogden floor thrust

Xfgf Granitic gneiss of Ogden footwall– *Light- to pink-gray, moderately to strongly foliated, hornblende-bearing granitic gneiss; unit also contains widespread, variably deformed pegmatitic dikes and some pods of amphibolite.*

Xfh Hornblende-plagioclase gneiss– *Dark-gray to black, moderately to strongly foliated, hornblende-plagioclase gneiss, with minor garnet, quartz, and biotite in some layers; garnet grains up to 2.5 centimeters (1 inch) in size.*

Xfs Muscovite-bearing schist– *Gray-brown, strongly foliated, schist to gneiss containing variable amounts of muscovite, biotite, quartz, and feldspar, with minor garnet in some layers; muscovite grains are up to 2.5 centimeters (1 inch) in size; unit also contains some thin layers of hornblende-plagioclase gneiss.*

Units exposed in hanging wall of Ogden floor thrust

Xfa Meta-gabbro and amphibolite– *Black to green-black, non- to strongly foliated, pyroxene-bearing meta-gabbro to amphibolite with varying amounts of plagioclase; forms pods in granitic gneiss but only larger bodies mapped.*

Xfgh Granitic gneiss of Ogden hanging wall– *Light- to pink-gray, moderately to strongly foliated, fine- to medium-grained, hornblende-bearing granitic gneiss with rare orthopyroxene; gneiss is locally fractured and displays red hematite alteration; gneiss cut by variably deformed, light-colored pegmatitic dikes; unit also contains small pods of meta-gabbro and amphibolite; gradational contacts with migmatitic gneiss.*

Xfm Migmatitic gneiss– *Medium- to light-pink-gray, strongly foliated and layered, migmatitic, quartzo-feldspathic gneiss with widespread garnet and biotite; gneiss cut by widespread, variably deformed, pegmatitic dikes; unit also contains widespread amphibolite layers, granitic gneiss bands, and some thin layers of biotite-rich schist; gradational contacts with granitic gneiss.*

Xfb Biotite-rich schist– *Medium-gray to dark-brown, strongly foliated, biotite-rich schist with widespread garnet and sillimanite; displays alternating biotite-rich and quartz-feldspar-rich bands that are rotated into complex fold patterns; schist cut by variably deformed, garnet-bearing pegmatite dikes; unit also contains some thin layers of amphibolite, quartz-rich gneiss, and granitic gneiss; gradational contacts with migmatitic gneiss.*

Xfq Quartz-rich gneiss– *Milky- to green-white, quartz gneiss with lesser amounts of plagioclase and chrome-green mica; locally contains thin layers of biotite-rich schist and amphibolite.*

Xfu Meta-ultramafic and mafic rocks– *Dark-green to black, variably foliated, pyroxene-, amphibole-, and olivine-bearing ultramafic rock, hornblendite, and amphibolite.*

MAP AND CROSS-SECTION SYMBOLS

Contact–*Dashed where location approximate; dotted where concealed.*

Scratch Contact–*Used between subunits and combined unit.*

Normal Fault–*Dashed where location approximate; dotted where concealed; solid bar and ball on downthrown side; arrows show relative movement on cross section.*

Normal Fault–*Concealed; inferred and delineated from geophysical data; open ball and bar on downthrown side; arrows show relative movement on cross section.*

Steeply Dipping Fault–*High-angle fault with normal apparent stratigraphic throw; actual offset may be more complex; dashed where location approximate; dotted where concealed; U and D show up and down on throw.*

Thrust Fault–*Dotted where concealed; teeth on upper plate; arrows show relative movement on cross section.*

Lineament–*Related to liquefaction and possible ground cracks in Qms3*

Quartz veins related to K(?)q

Moraine Crests

Landslide Scarp

Erosional Scarp–*Related to river terraces incised into Lake Bonneville delta along Weber River.*

Fold Axial Traces–*Location approximate; dotted where concealed.*

anticline

syncline

Strike and Dip of bedding

inclined

overturned

Trend and Plunge of minor fold

Strike and Dip of cleavage

Strike and Dip of high-grade metamorphic foliation

Trend and Plunge of mineral lineation

Prospect Pit

Gravel Pit

Shorelines

Regressive shoreline of Lake Bonneville

Provo shoreline of Lake Bonneville

Bonneville shoreline of Lake Bonneville

Transgressive shoreline of Lake Bonneville

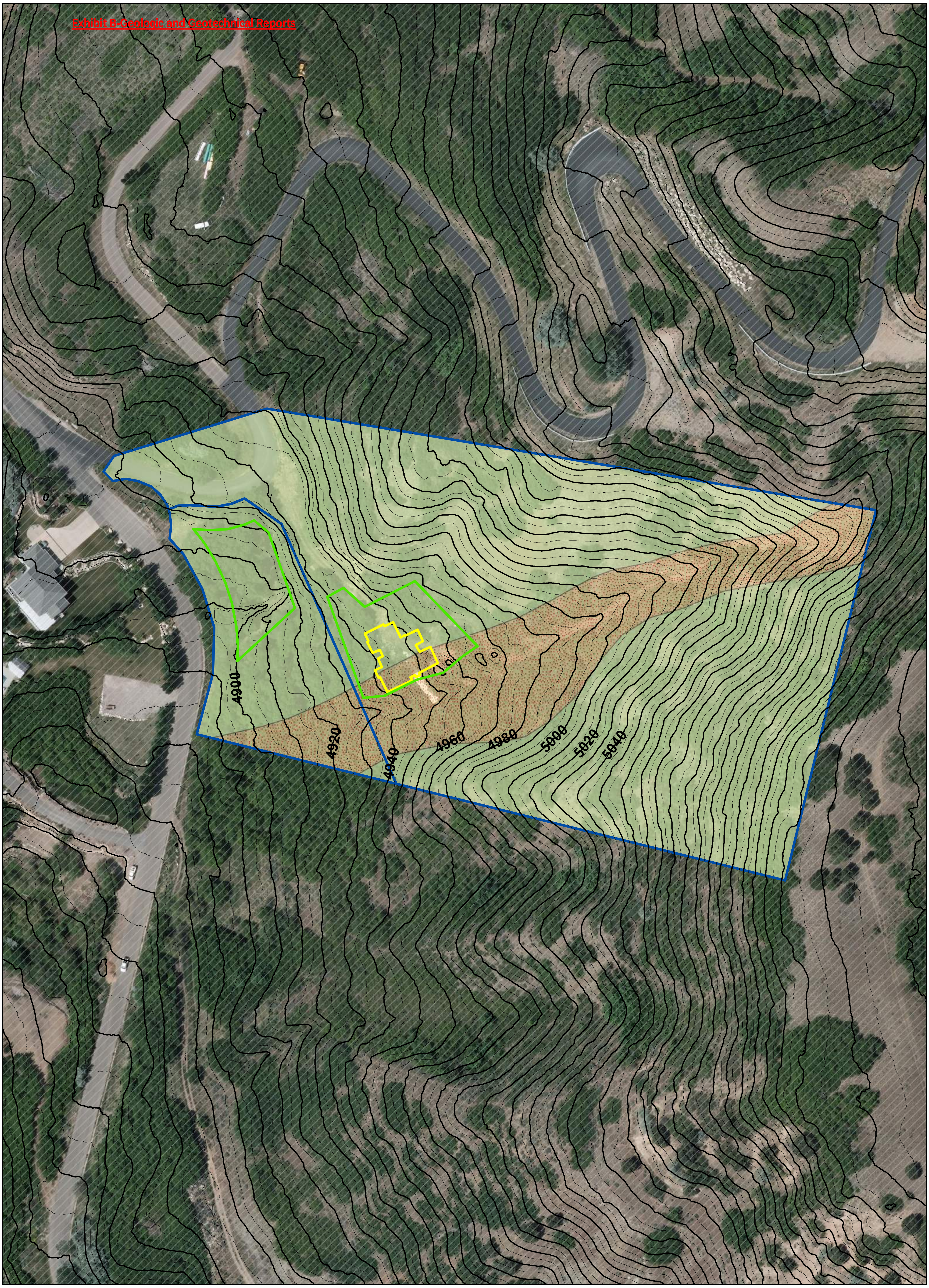
Yonkee, W.A. and Lowe, M., 2004, Geologic map of the Ogden 7.5 minute quadrangle, Utah Geological Survey Open-File Report M-200, 42p., 2pl., scale 1:24,000

GeoStrata

Description of Geologic Map Units

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

Plate A - 4



Legend

- Proposed Buildable Area
- Proposed Building
- 5 Foot Contours
- Site Boundary
- Not Mapped
- Qaf1 - Younger alluvial fan deposits
- Qlf4 - lacustrine fine-grained deposits, Bonneville transgressive

0 25 50 100 150 200 Feet

1:1,200

Base Map: 2012 HRO 6 inch Orthophotography obtained from the State of Utah AGRC. Contours derived from 2013 -2014 Wasatch Front LiDAR obtained from the State of Utah AGRC.

All Locations are Approximate

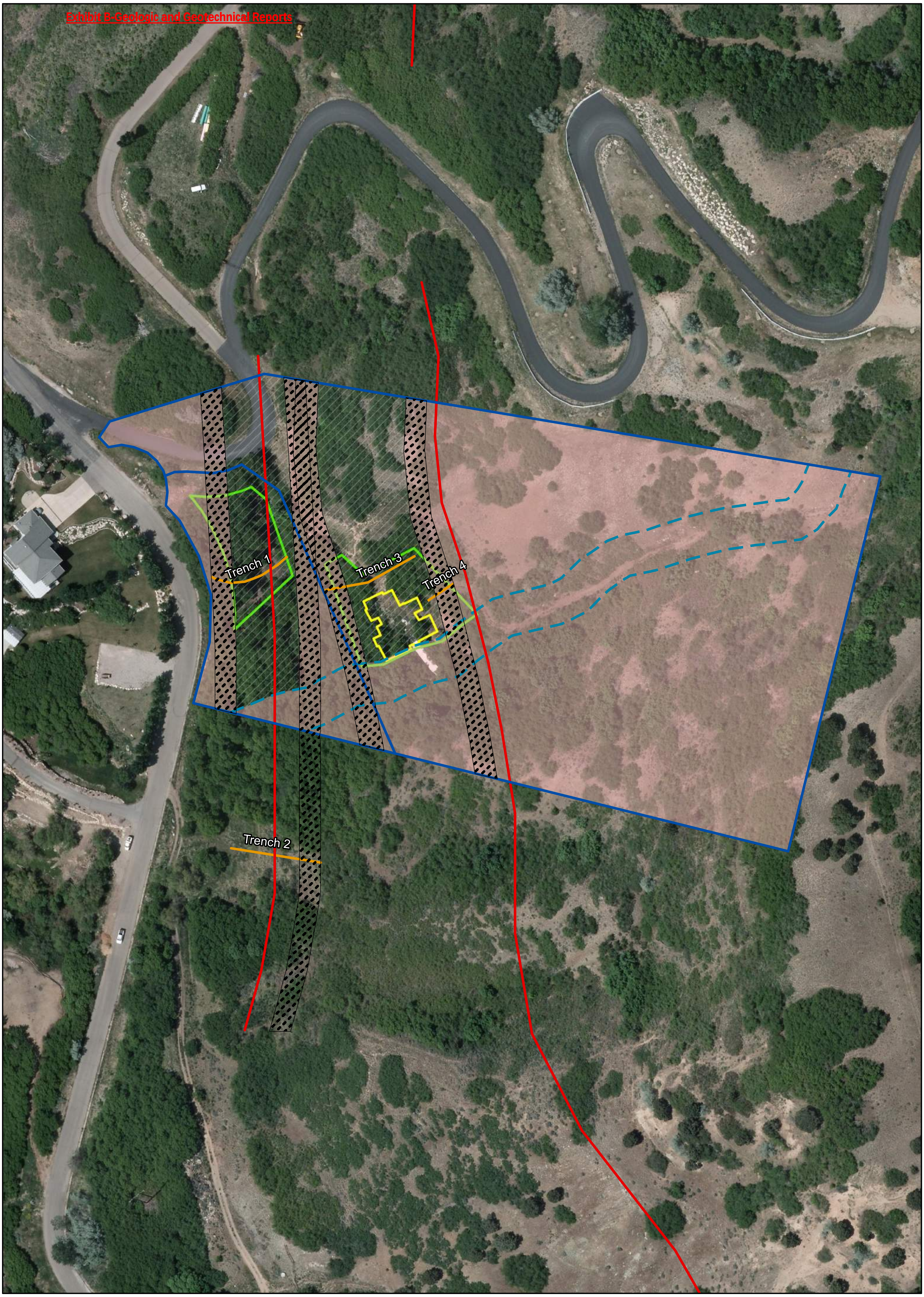
N

GeoStrata

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

Site Geologic Map

Plate A-5



Legend

- 25ft Fault Setback Zone
- Site Boundary
- Fault (Yonkee & Lowe 2004)
- Fault Trench
- Drainage Setback
- Buildable Area
- Non-Buildable Area
- 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

1:1,200

Base Map: 2013 -2014 Wasatch Front LiDAR obtained from the State of Utah AGRC.

All Locations are Approximate

Legend

- Site Boundary
- Fault (Yonkee & Lowe 2004)
- Fault Trench
- Test Pit
- Proposed Buildable Area
- Proposed Building Footprint

GeoStrata

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

Hillshade 180

Plate A-7

0 25 50 100 150 200 Feet

1:1,200

Base Map: 2013 -2014 Wasatch Front LiDAR obtained from the State of Utah AGRC.

All Locations are Approximate

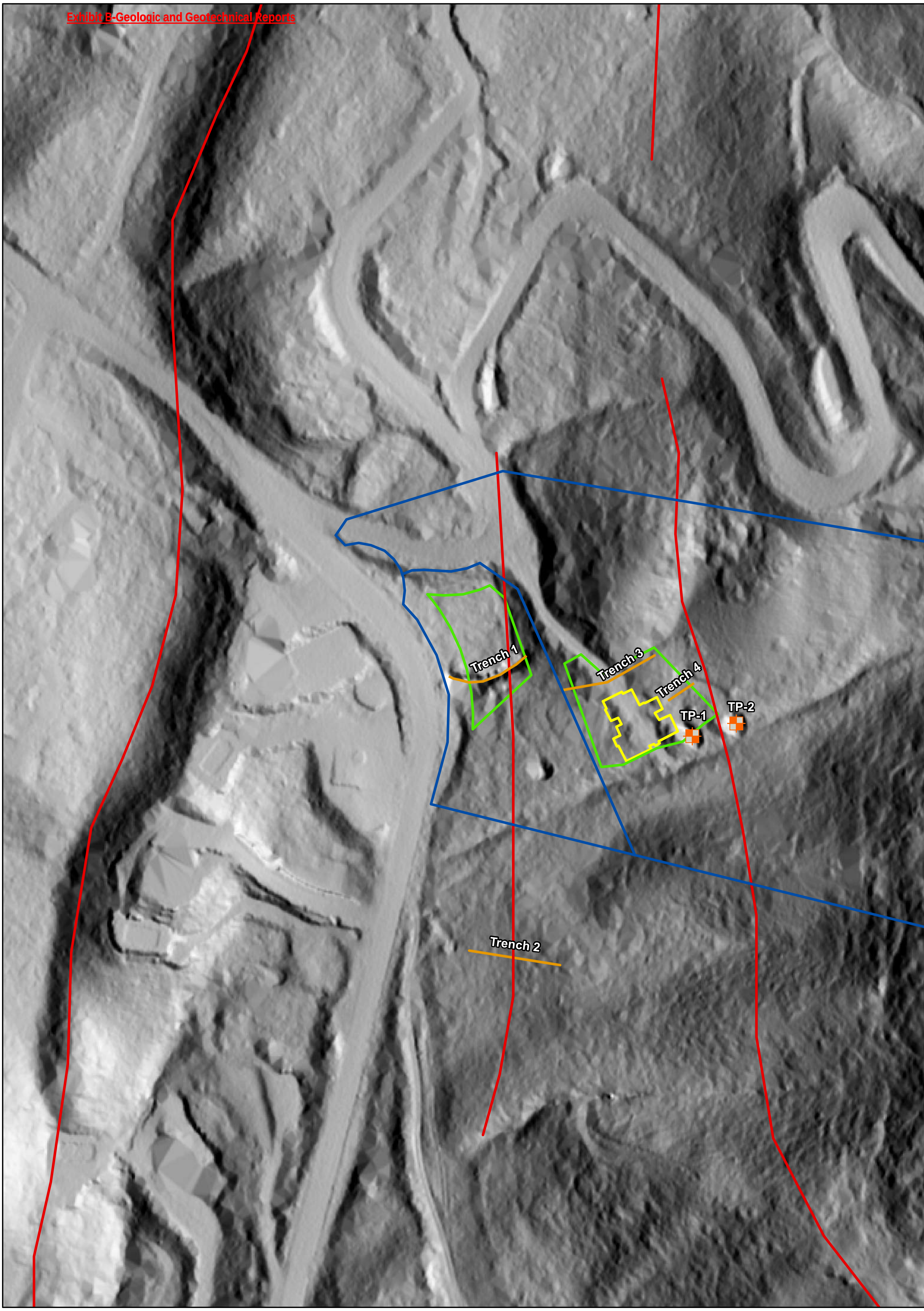
N

GeoStrata

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

Hillshade 180

Plate A-8



0 25 50 100 150 200
Feet

1:1,200

Base Map: 2013 -2014 Wasatch Front LiDAR obtained from the State of Utah AGRC.

All Locations are Approximate

N

Legend

- Site Boundary
- Fault (Yonkee & Lowe 2004)
- Fault Trench
- Test Pit
- Proposed Buildable Area
- Proposed Building Footprint

GeoStrata

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

Hillshade 90

Plate A-9

0 25 50 100 150 200 Feet

1:1,200

Base Map: 2013 -2014 Wasatch Front LiDAR obtained from the State of Utah AGRC.

All Locations are Approximate

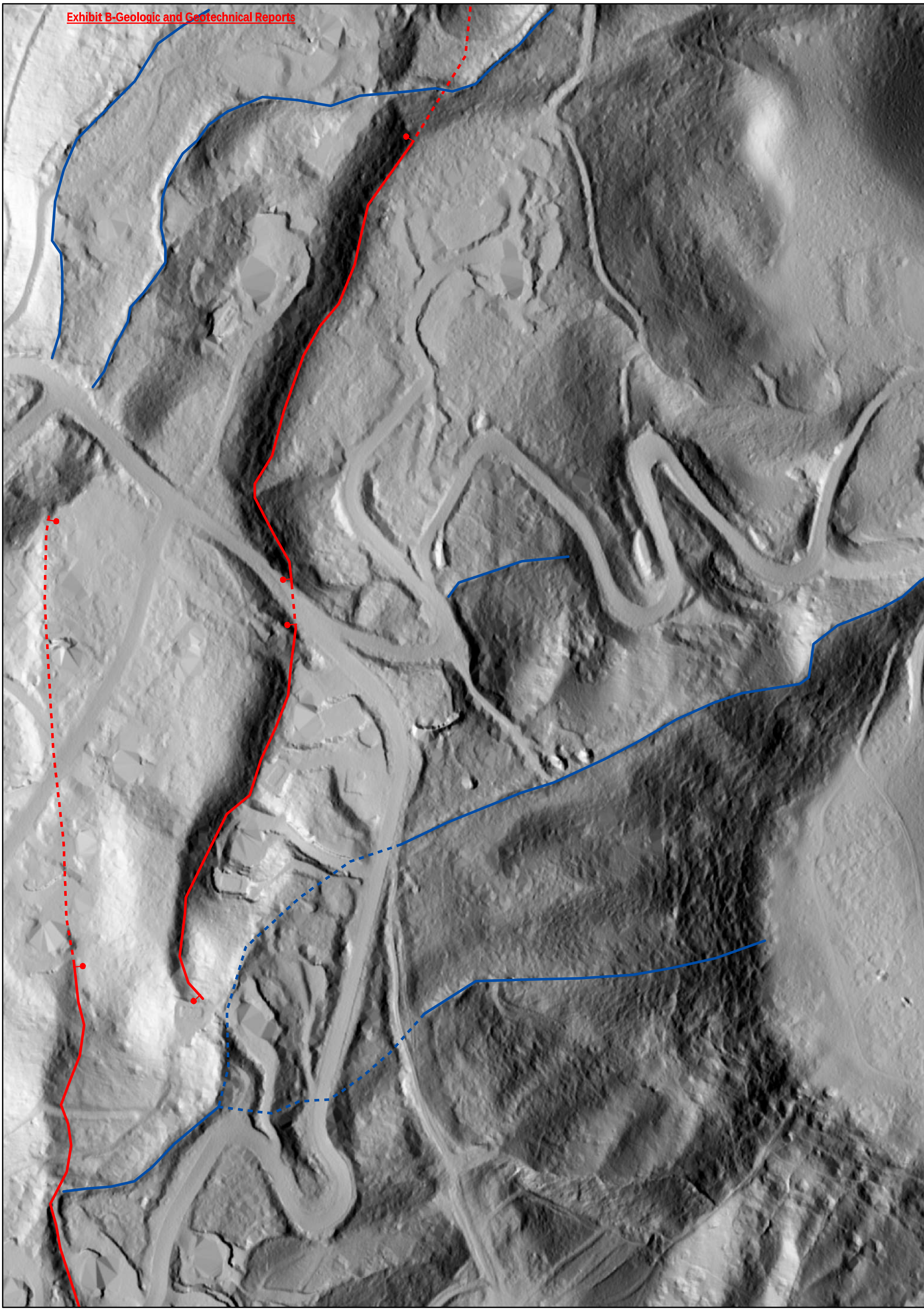
N

GeoStrata

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

Hillshade 90

Plate A-10



0 40 80 160 240 320 Feet

1:2,000

Base Map: 2013 -2014 Wasatch Front LiDAR obtained from the State of Utah AGRC.

All Locations are Approximate

N

GeoStrata

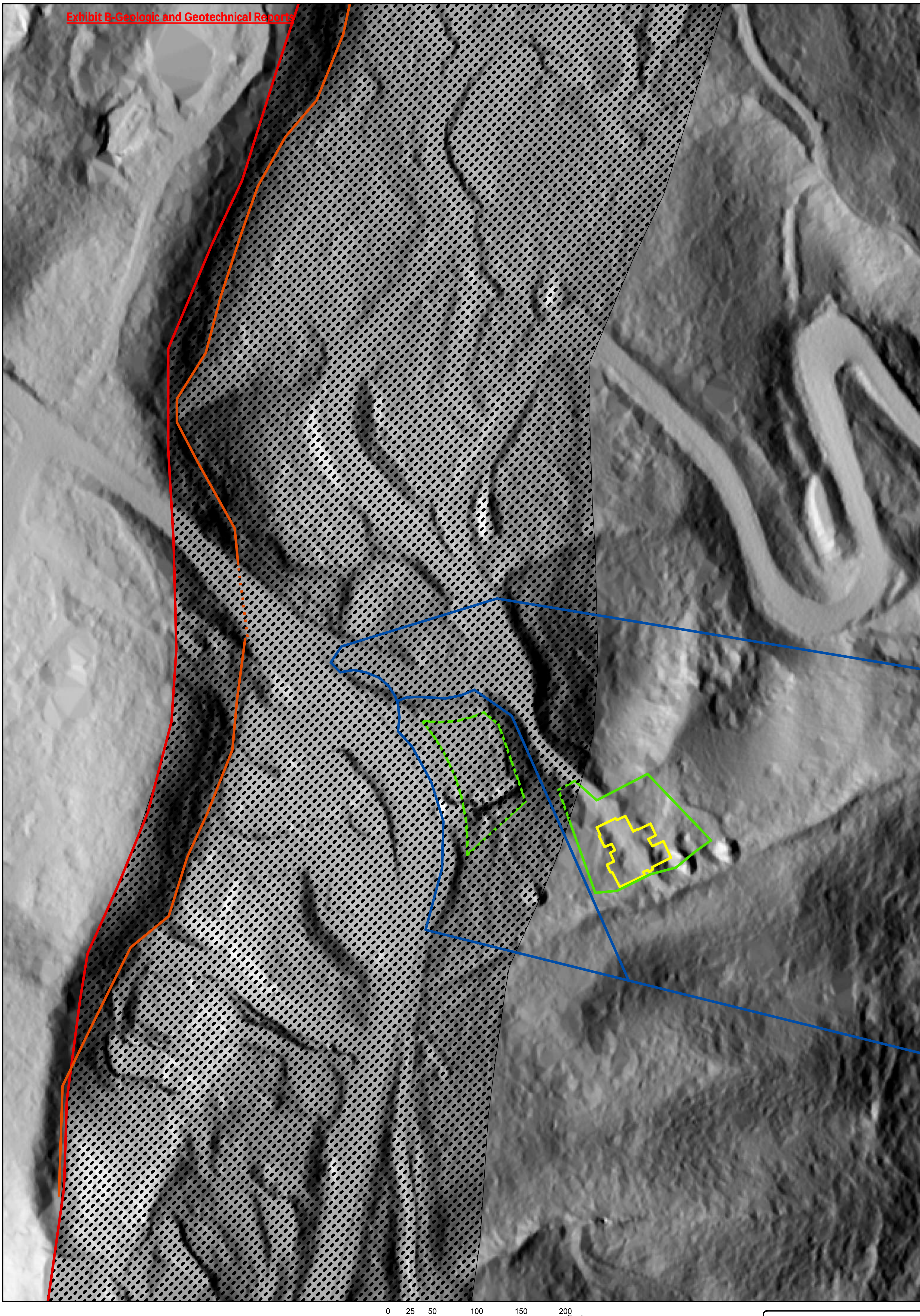
Legend

- Concealed, Fault
- Concealed, Stream
- Well Located, Fault
- Well Located, Stream

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

Lineament Map

Plate A-11



1:1,200

Base Map: 2013 -2014 Wasatch Front LiDAR obtained from the State of Utah AGRC.

All Locations are Approximate

GeoStrata

Legend

- 500ft Fault Setback Zone
- Site Boundary
- Proposed Buildable Area
- Proposed Building Footprint
- Fault (Yonkee & Lowe 2004)

GeoStrata Digitized Fault

- Inferred
- Well Located

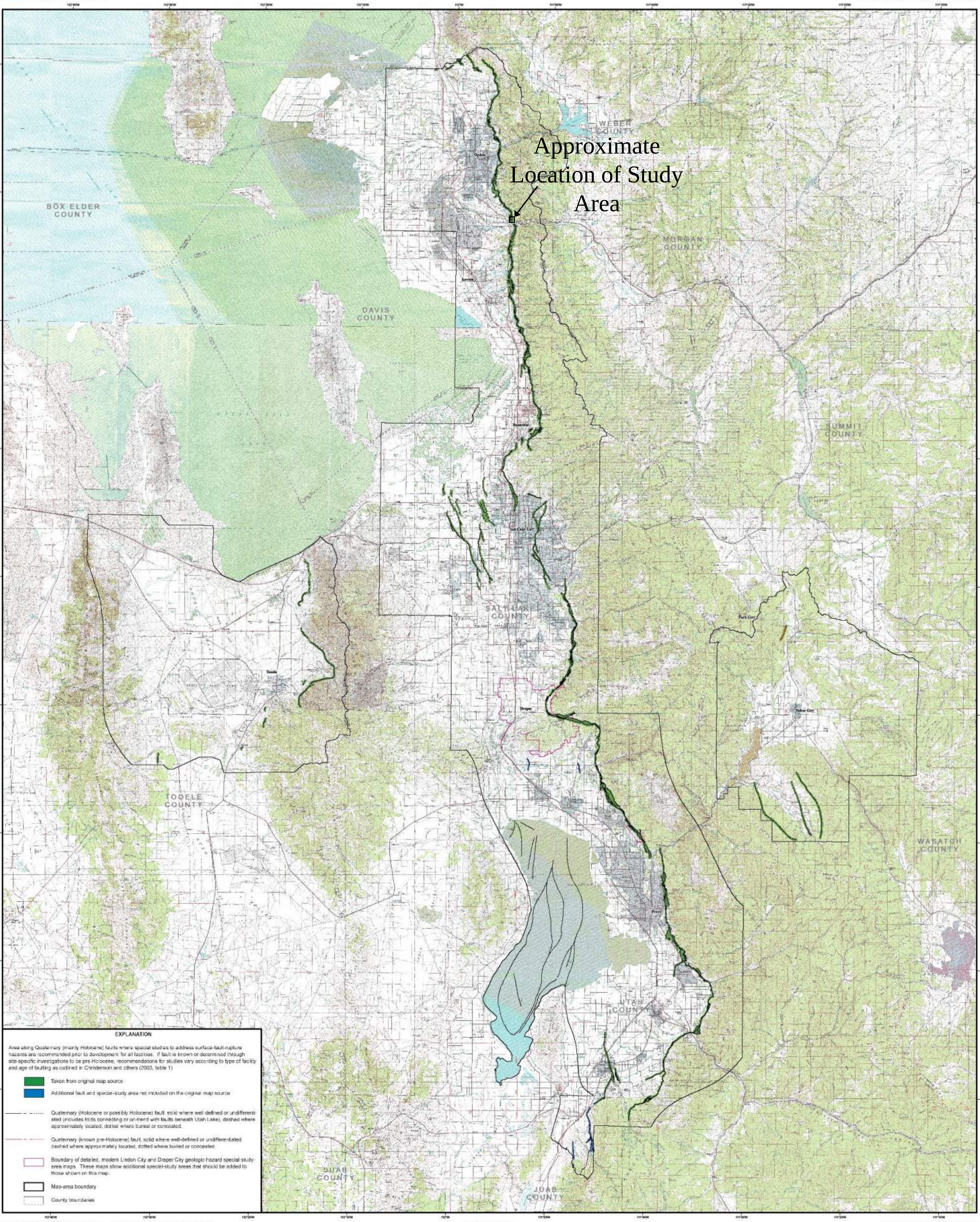
Matt Rassmusen
Dauphine-Savory Piedmont Subdivision
South Weber, Utah
Project Number: 910-001

Surface Fault Rupture Hazard Map

Plate A-12

DNR
UTAH GEOLOGICAL SURVEY
a division of
Utah Department of Natural Resources

Supplement Map to Utah Geological Survey Circular 106
Surface Fault Rupture Special Study Areas, Wasatch Front, Utah



This map is a compilation of existing digital and hard-copy county maps and data, based on information provided in Utah Geological Survey (UGS) Circular 106 (see report for list of county and technical data sources); the UGS does not warrantee the content or accuracy of the original maps.

The GIS data provided in Circular 106 is for use at 1:24,000 scale only. This overview map at a scale of 1:200,000 is for general representation only, and should not be relied upon for other purposes.

Special studies for critical facilities should evaluate all hazards, even where outside special-study areas are shown on this map.

This map does not preclude the need for site-specific study.

Although this product represents the work of professional scientists, the Utah Department of Natural Resources, Utah Geological Survey, makes no warranty, expressed or implied, regarding its suitability for a particular use, and does not guarantee the accuracy or completeness of the data. The Utah Department of Natural Resources, Utah Geological Survey, shall not be liable under any circumstances for any direct, indirect, special, incidental, or consequential damages with respect to claims by users of this product.

SEE ORIGINAL CITY OR COUNTY MAPS (PURPLE OUTLINES SHOW NEW MAPS AVAILABLE FOR LINDON CITY AND DRAPER CITY) FOR OFFICIAL SPECIAL-STUDY-AREA BOUNDARIES, AND SEE CITY OR COUNTY ORDINANCES AND REGULATIONS TO DETERMINE ACTUAL SPECIAL-STUDY REQUIREMENTS, WHICH MAY VARY FROM SPECIAL STUDIES RECOMMENDED HERE.

Utah Geological Survey
1594 West North Temple, Suite 3110
P.O. Box 146100, Salt Lake City, UT 84114-6100
Phone: 801-537-3300 Fax: 801-537-3400
geology.utah.gov

Base from U.S. Geological Survey 1:100,000 Digital Raster Graphic.
Geologic data and base map in NAD 1983.

SCALE 1:200,000

Contour Interval 40 Feet

SURFACE FAULT RUPTURE SPECIAL STUDY AREAS, WASATCH FRONT AND NEARBY AREAS, UTAH

Compiled by Gary E. Christenson and Lucas M. Shaw
2008

This overview map is based on Geographic Information System (GIS) data provided in UGS Circular 106. Circular 106 provides digital GIS data that requires specialized GIS software to view, analyze, and print. This supplemental overview map was created to illustrate the extent of the GIS data coverage and is for general informational purposes only.

LOCATION

GeoStrata

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

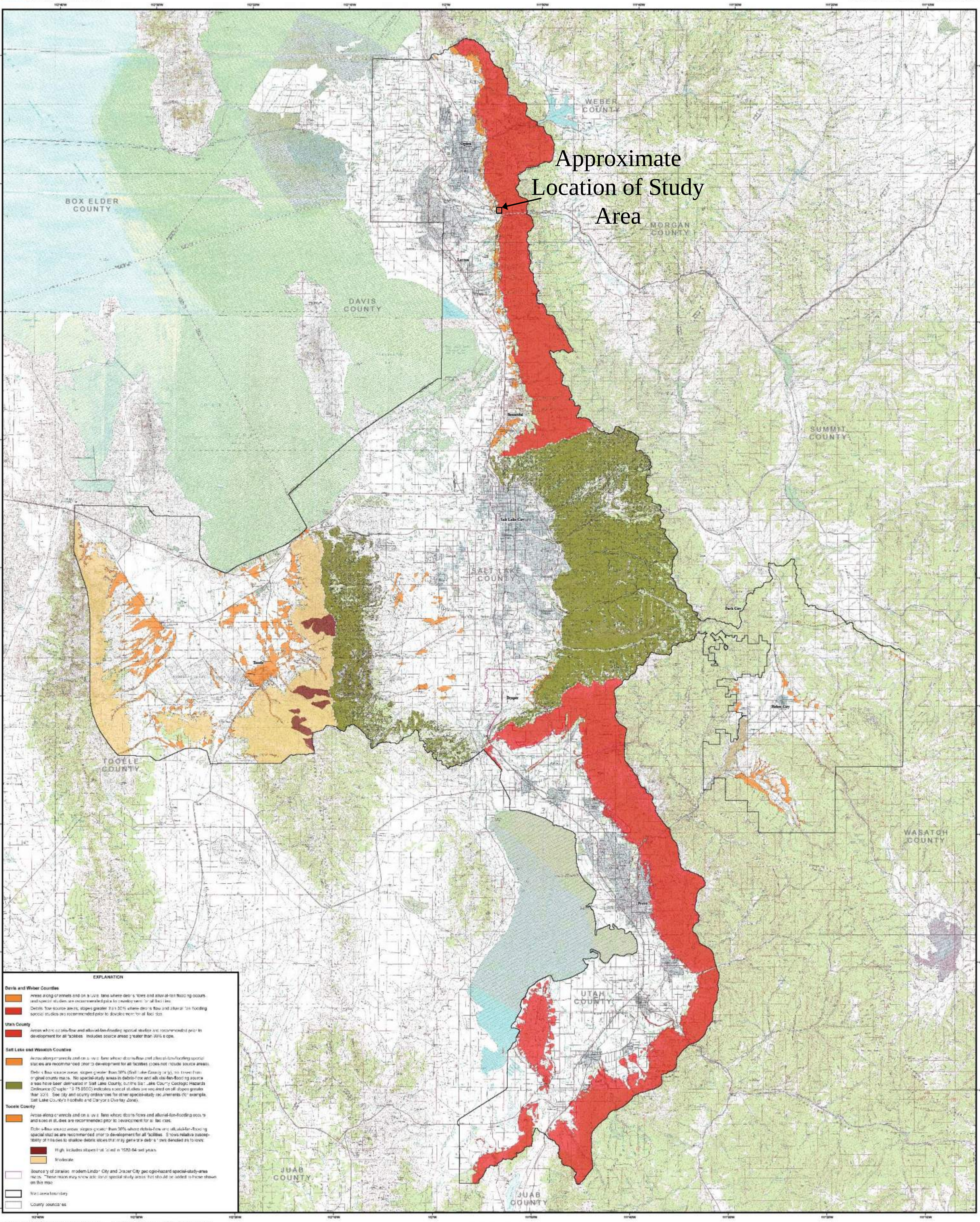
Surface Fault Rupture Special Study Areas

Plate A-13

Exhibit B-Geologic and Geotechnical Reports

UTAH GEOLOGICAL SURVEY
a division of
Utah Department of Natural Resources

Supplement Map to Utah Geological Survey Circular 106
Debris-Flow/Alluvial-Fan Special Study Areas, Wasatch Front, Utah



This map is a compilation of existing digital and hard-copy county maps and data, based on information provided in Utah Geological Survey (UGS) Circular 106 (see report for list of county and technical data sources); the UGS does not warrantee the content or accuracy of the original maps.

The GIS data provided in Circular 106 is for use at 1:24,000 scale only. This overview map at a scale of 1:200,000 is for general representation only, and should not be relied upon for other purposes.

Special studies for critical facilities should evaluate all hazards, even where outside special-study areas are shown on this map.

This map does not preclude the need for site-specific study.

Although this product represents the work of professional scientists, the Utah Department of Natural Resources, Utah Geological Survey, makes no warranty, expressed or implied, regarding its suitability for a particular use, and does not guarantee the accuracy or completeness of the data. The Utah Department of Natural Resources, Utah Geological Survey, shall not be liable under any circumstances for any direct, indirect, special, incidental, or consequential damages with respect to claims by users of this product.

SEE ORIGINAL CITY OR COUNTY MAPS (PURPLE OUTLINES SHOW NEW MAPS AVAILABLE FOR LINDON CITY AND DRAPER CITY) FOR OFFICIAL SPECIAL-STUDY-AREA BOUNDARIES, AND SEE CITY OR COUNTY ORDINANCES AND REGULATIONS TO DETERMINE ACTUAL SPECIAL-STUDY REQUIREMENTS, WHICH MAY VARY FROM SPECIAL STUDIES RECOMMENDED HERE.

Utah Geological Survey
1594 West North Temple, Suite 3110
P.O. Box 146100, Salt Lake City, UT 84114-6100
Phone: 801-537-3300 Fax: 801-537-3400
geology.utah.gov

Base from U.S. Geological Survey 1:100,000 Digital Raster Graphic. Geologic data and base map in NAD 1983.

SCALE 1:200,000

Contour Interval 40 Feet

DEBRIS-FLOW/ALLUVIAL-FAN SPECIAL STUDY AREAS, WASATCH FRONT AND NEARBY AREAS, UTAH

Compiled by Gary E. Christenson and Lucas M. Shaw
2008

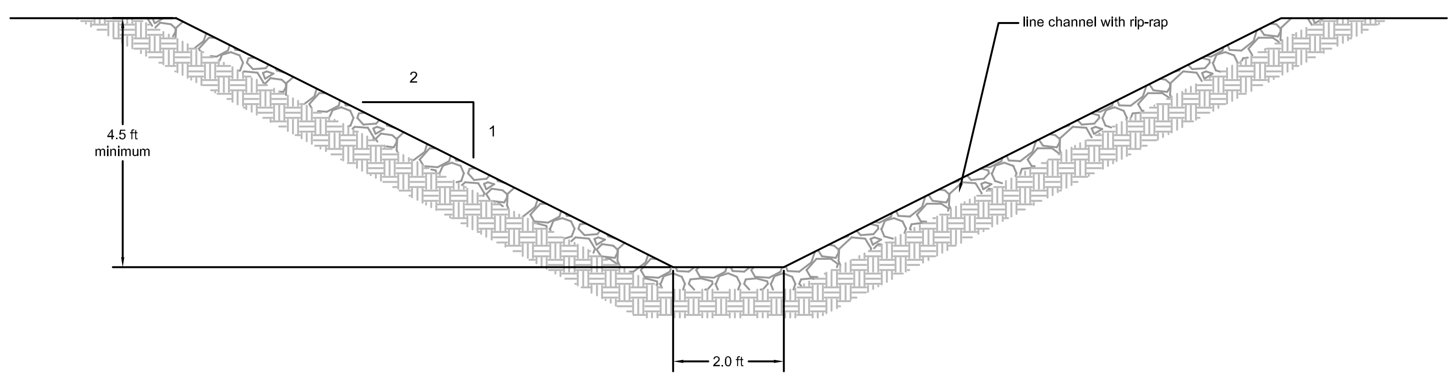
This overview map is based on Geographic Information System (GIS) data provided in UGS Circular 106. Circular 106 provides digital GIS data that requires specialized GIS software to view, analyze, and print. This supplemental overview map was created to illustrate the extent of the GIS data coverage and is for general informational purposes only.

LOCATION

Matt Rassmusen
Dauphine-Savory Piedmont Subdivisior
South Weber, Utah
Project Number: 910-001
Debris-Flow/Alluvial-Fan Special Study Areas

Plate A-14

Channel Cross Section



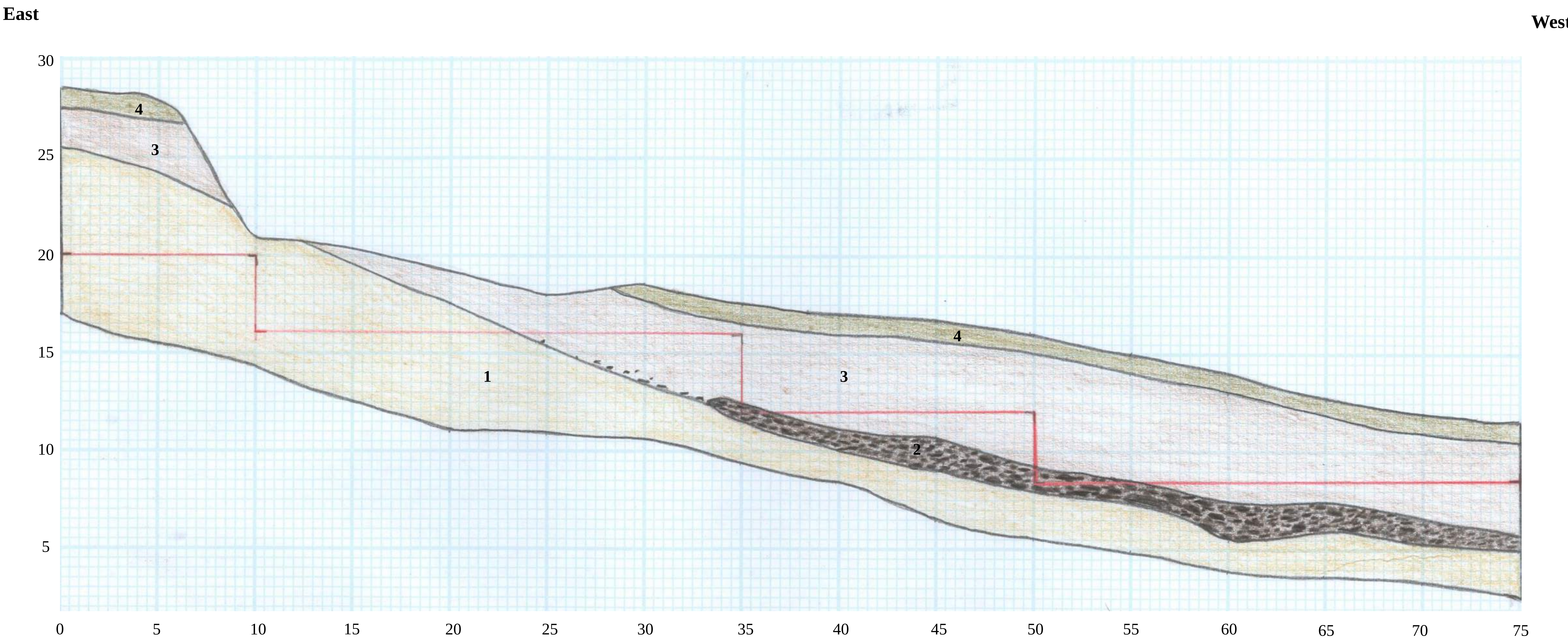
NOT TO SCALE

GeoStrata

Matt Rassmussen
Dauphine-Savory Piedmont Subdivision
south Weber, UT
Project Number: 910-001

Plate
A-15

TRENCH 1 SOUTH WALL



Trench 1 Legend
Unit 1 - Pleistocene-Age Lacustrine Fine-Grained Deposits, Transgressive Bonneville
Unit 2 – Pleistocene/Holocene-Age Stream Alluvium Deposits
Unit 3 - Holocene-Age Colluvium and Alluvium
Unit 4 – Holocene-Age Topsoil

Distance (ft)

1 inch = 5 feet
Horizontal Scale = Vertical Scale

Trench Orientation
0 to 55 feet 60°
55 to 90 feet 105°

logged by T. Thompson

Fault Study
Dauphine-Savory Piedmont Subdivision
Ogden, Utah
Project Number: 910-001

Trench 1 South Wall Trench Log
0 to 75 Feet

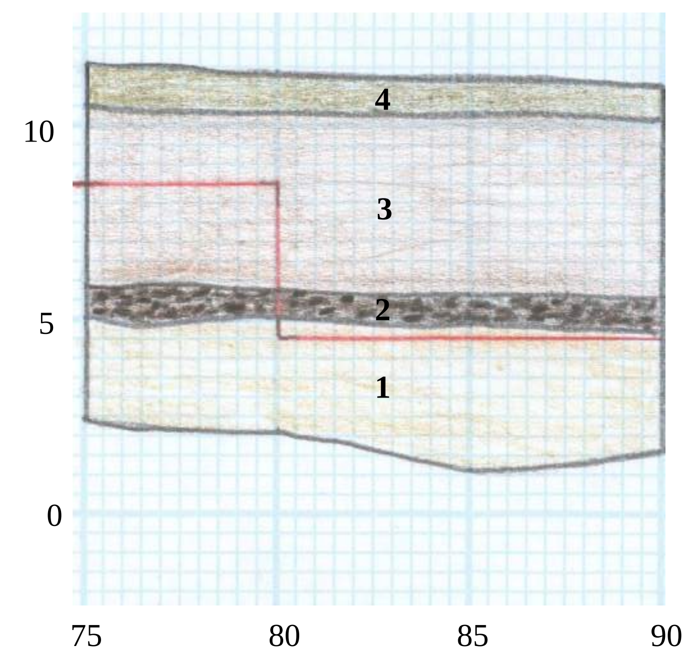
GeoStrata

Plate
B-1

TRENCH 1 SOUTH WALL

East

West



Trench 1 Legend
Unit 1 - Pleistocene-Age Lacustrine Fine-Grained Deposits, Transgressive Bonneville
Unit 2 – Pleistocene/Holocene-Age Stream Alluvium Deposits
Unit 3 - Holocene-Age Colluvium and Alluvium
Unit 4 – Holocene-Age Topsoil

Distance (ft)

1 inch = 5 feet
Horizontal Scale = Vertical Scale

Trench Orientation
0 to 55 feet 60°
55 to 90 feet 105°

logged by T. Thompson

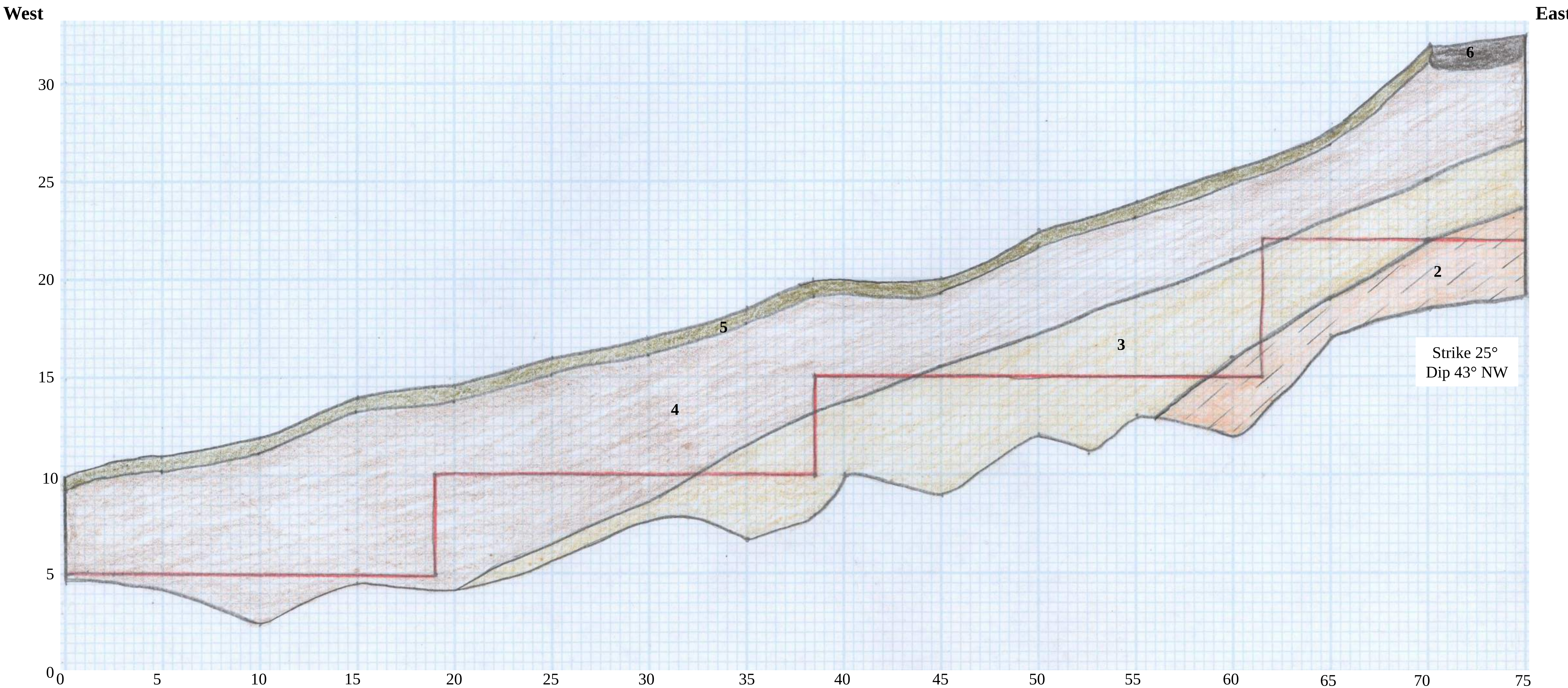
Fault Study
Dauphine-Savory Piedmont Subdivision
Ogden, Utah
Project Number: 910-001

Trench 1 South Wall Trench Log
75 to 90 Feet

GeoStrata

Plate
B-2

TRENCH 3 NORTH WALL



Trench 3 Legend
Unit 1 – BEDROCK - Early Proterozoic Metamorphic and Igneous Rocks
Unit 2 – Pleistocene-Age Lacustrine Gravel Deposits, Transgressive Bonneville
Unit 3 – Pleistocene-Age Lacustrine Fine-Grained Deposits, Transgressive Bonneville
Unit 4 – Holocene-Age Colluvium and Alluvium
Unit 5 – Holocene-Age Topsoil
Unit 6 – Holocene-Age Historical Fill Soils

Distance (ft)

1 inch = 5 feet
Horizontal Scale = Vertical Scale

Trench Orientation
0 to 75 feet 80°
75 to 110 feet 62°

logged by T. Thompson

Fault Study
Dauphine-Savory Piedmont Subdivision
Ogden, Utah
Project Number: 910-001

Trench 3 North Wall Trench Log
0 to 75 Feet

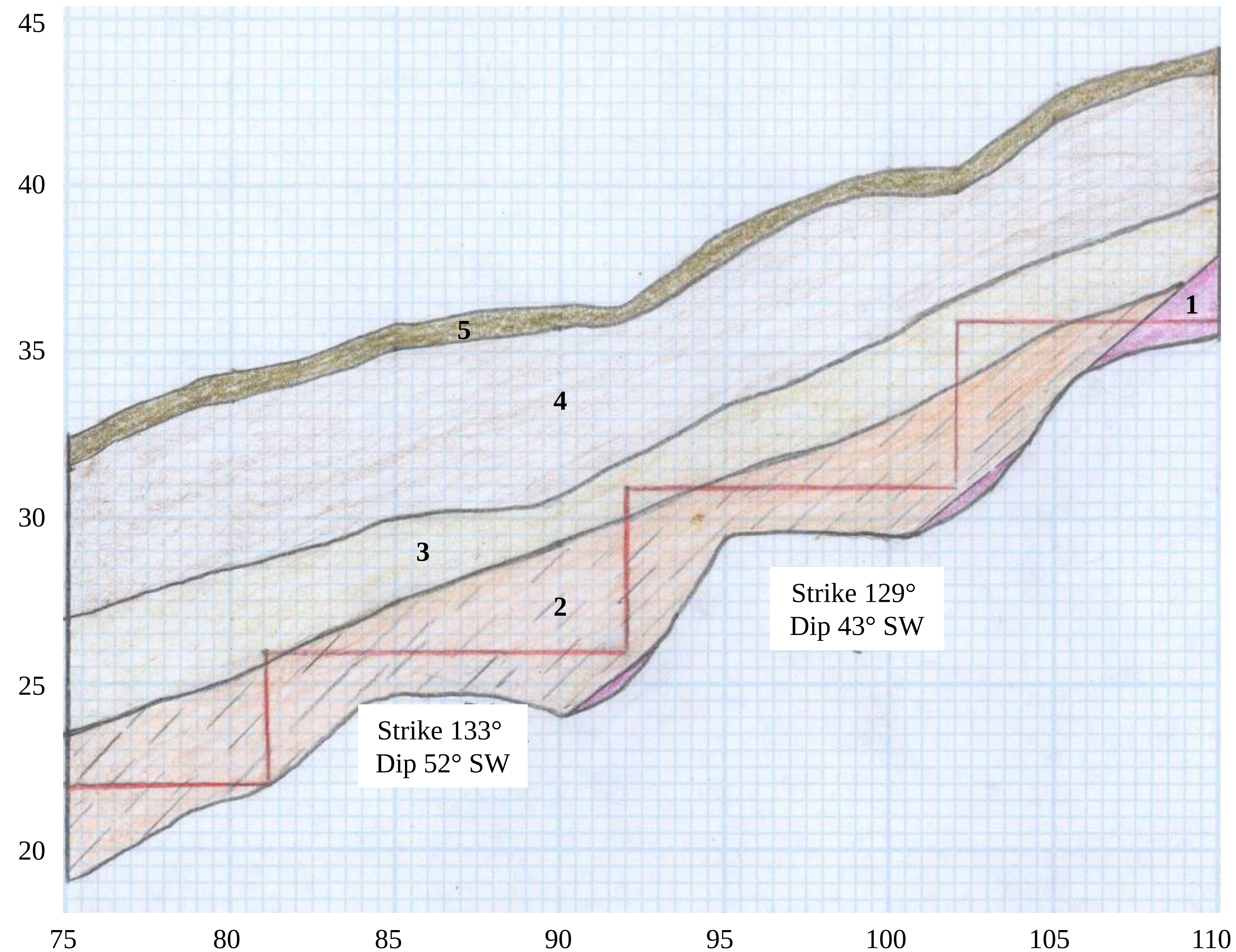
GeoStrata

Plate B-3

TRENCH 3 NORTH WALL

West

East



Trench 3 Legend
Unit 1 – BEDROCK - Early Proterozoic Metamorphic and Igneous Rocks
Unit 2 – Pleistocene-Age Lacustrine Gravel Deposits, Transgressive Bonneville
Unit 3 – Pleistocene-Age Lacustrine Fine-Grained Deposits, Transgressive Bonneville
Unit 4 – Holocene-Age Colluvium and Alluvium
Unit 5 – Holocene-Age Topsoil
Unit 6 – Holocene-Age Historical Fill Soils

Distance (ft)

1 inch = 5 feet
Horizontal Scale = Vertical Scale

Trench Orientation
0 to 75 feet 80°
75 to 110 feet 62°

logged by T. Thompson

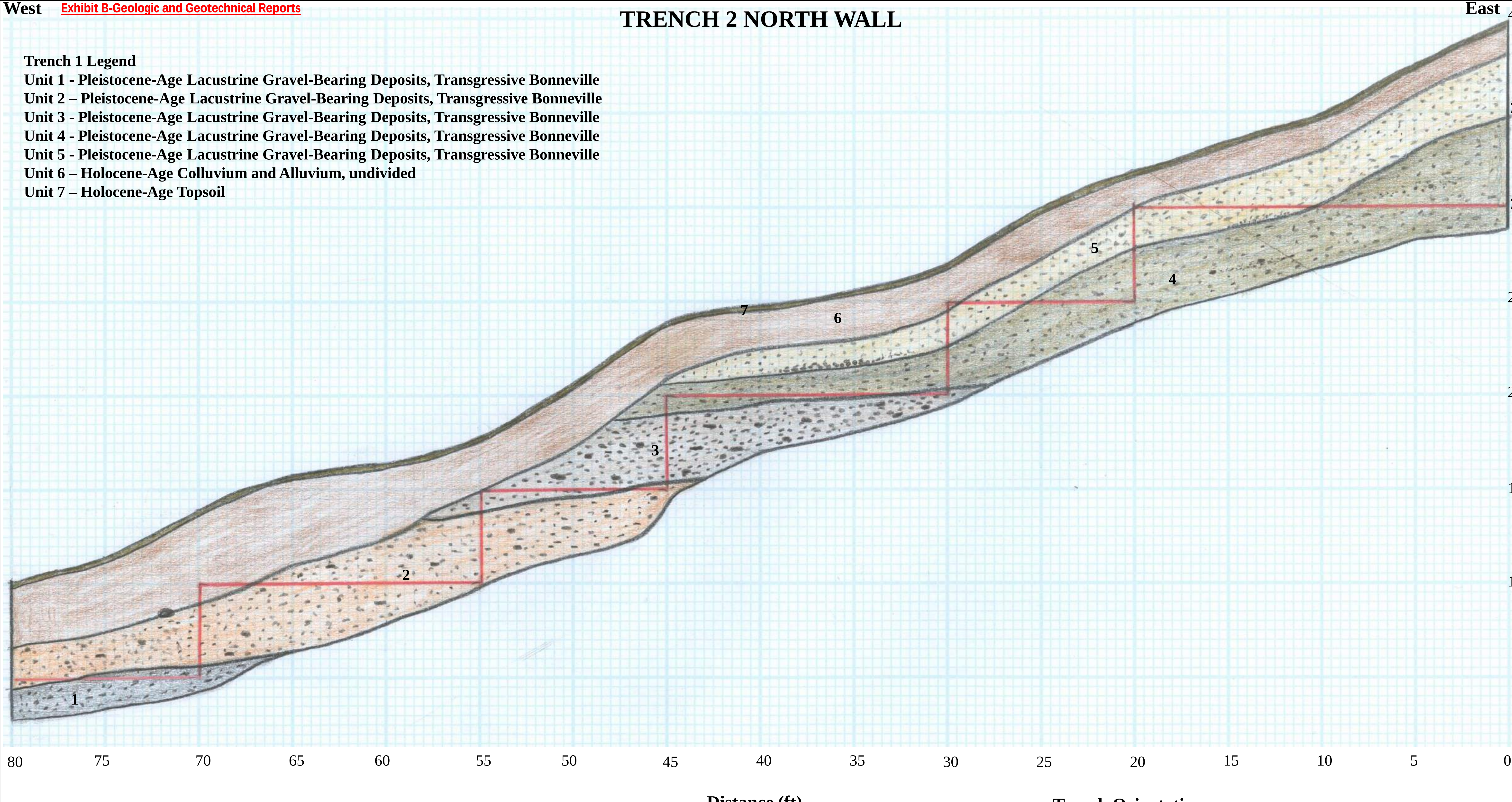
Fault Study
Dauphine-Savory Piedmont Subdivision
Ogden, Utah
Project Number: 910-001

Trench 3 North Wall Trench Log
75 to 110 Feet

GeoStrata

Plate B-4

TRENCH 2 NORTH WALL



1 inch = 5 feet
Horizontal Scale = Vertical Scale

Trench Orientation
0 to 105 feet 99°

logged by T. Thompson

Fault Study
Dauphine-Savory Piedmont Subdivision
Ogden, Utah
Project Number: 910-001

Trench 2 North Wall Trench Log
0 to 80 Feet

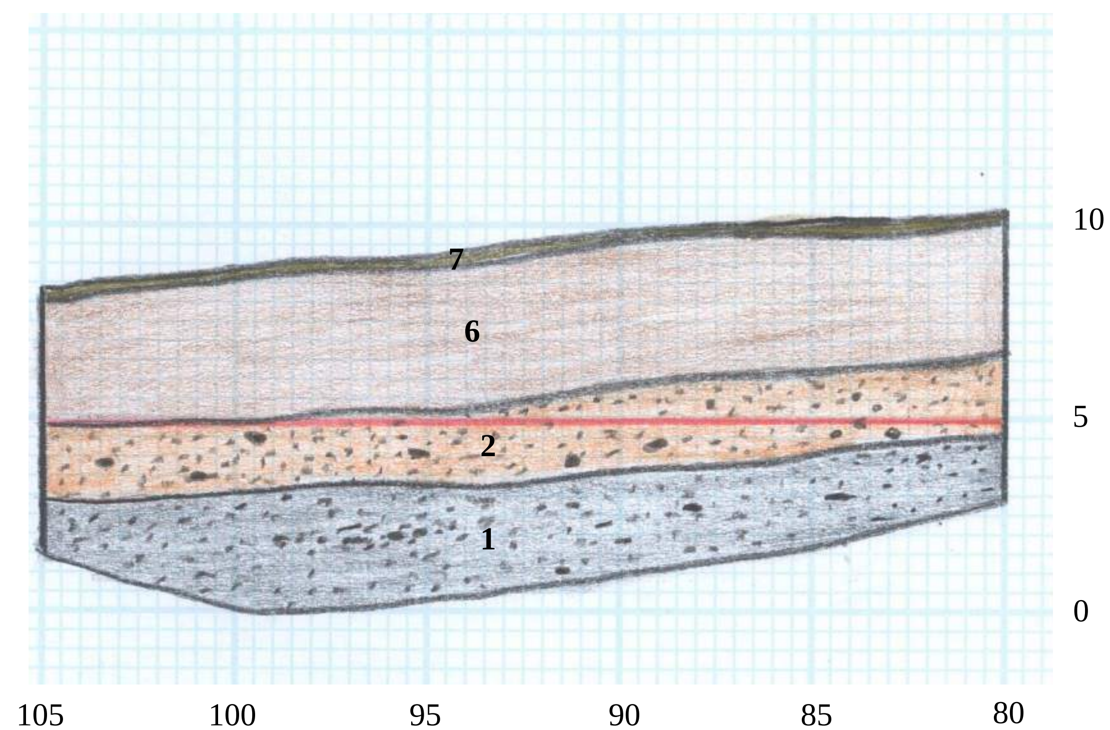
GeoStrata

Plate B-5

TRENCH 2 NORTH WALL

East

West



Trench 1 Legend
Unit 1 - Pleistocene-Age Lacustrine Gravel-Bearing Deposits, Transgressive Bonneville
Unit 2 – Pleistocene-Age Lacustrine Gravel-Bearing Deposits, Transgressive Bonneville
Unit 6 - Holocene-Age Colluvium and Alluvium
Unit 7 – Holocene-Age Topsoil

Distance (ft)

1 inch = 5 feet
Horizontal Scale = Vertical Scale

Trench Orientation
0 to 105 feet 99°

logged by T. Thompson

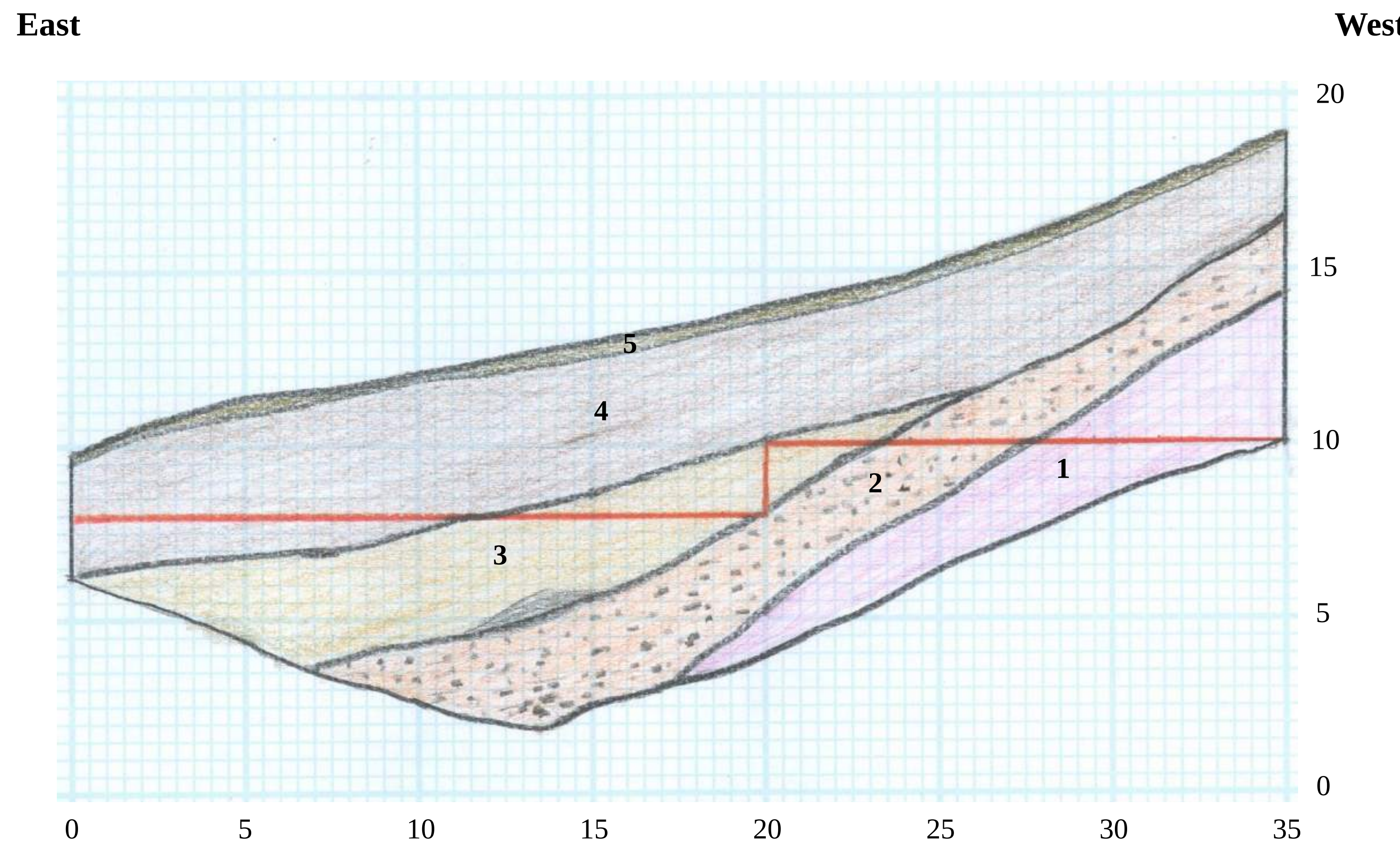
Fault Study
Dauphine-Savory Piedmont Subdivision
Ogden, Utah
Project Number: 910-001

Trench 2 North Wall Trench Log
80 to 105 Feet

GeoStrata

Plate
B-6

TRENCH 4 NORTH WALL



Trench 1 Legend
Unit 1 – BEDROCK - Early Proterozoic Metamorphic and Igneous Rocks
Unit 2 – Pleistocene-Age Lacustrine Gravel Deposits, Transgressive Bonneville
Unit 3 – Pleistocene-Age Lacustrine Fine-Grained Deposits, Transgressive Bonneville
Unit 4 – Holocene-Age Colluvium and Alluvium
Unit 5 – Holocene-Age Topsoil

Distance (ft)

1 inch = 5 feet
Horizontal Scale = Vertical Scale

Trench Orientation
0 to 35 feet 57°

logged by T. Thompson

Fault Study
Dauphine-Savory Piedmont Subdivision
Ogden, Utah
Project Number: 910-001

Trench 4 North Wall Trench Log
0 to 35 Feet

Plate B-7

40 to 50 Feet in Trench 3

GeoStrata

45 feet in Trench 3

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

Plate C - 2

0 to 10 Feet in Trench 1

GeoStrata

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

Plate
C - 3

28 to 33 Feet in Trench 2

Project:	Matt Rasmussen – Uintah Open Channel flow Calculatoins	Project No.:	14-041
By:	J. Jensen	Reviewed By:	
Date:	10/15/2014	Sheet:	1

Design Data is based upon report dated September 4th, 2014 by HydroPlot. This report states that the 500 year and 100 year flood volumes are Approx. 21 cfs, and 12 cfs

Manning Coefficient = 1.486

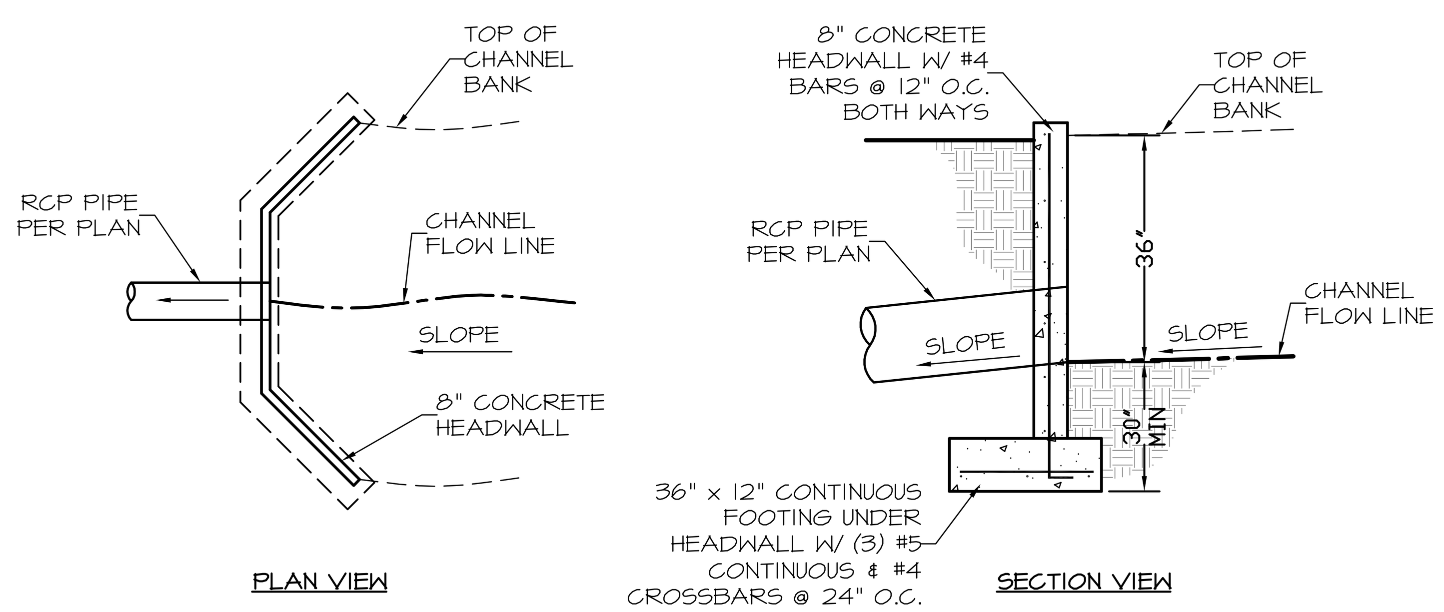
PIPE INFORMATION

Description	D (in)	SLOPE	A (ft)	P (ft)	n	Q allow (cfs)
Required pipe size for 500 year storm	18	0.2	1.767	4.712	0.013	46.98
Required pipe size for 100 year storm	15	0.2	1.227	3.927	0.013	28.89

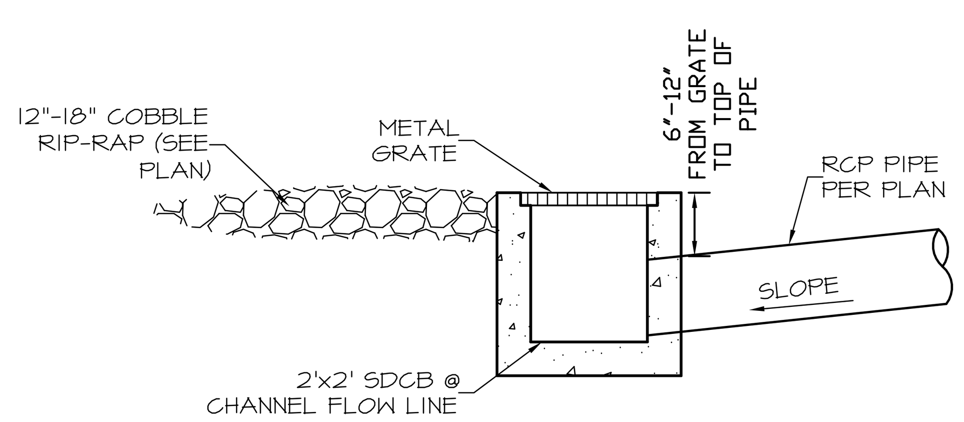
Channel Information

Description	Top w idth	SLOPE	A (ft)	P (ft)	n	Q allow (cfs)
20' min w ide x 2' min deep	20	0.02	15	21	0.050	50.38
Channel w ith 1' freeboard						

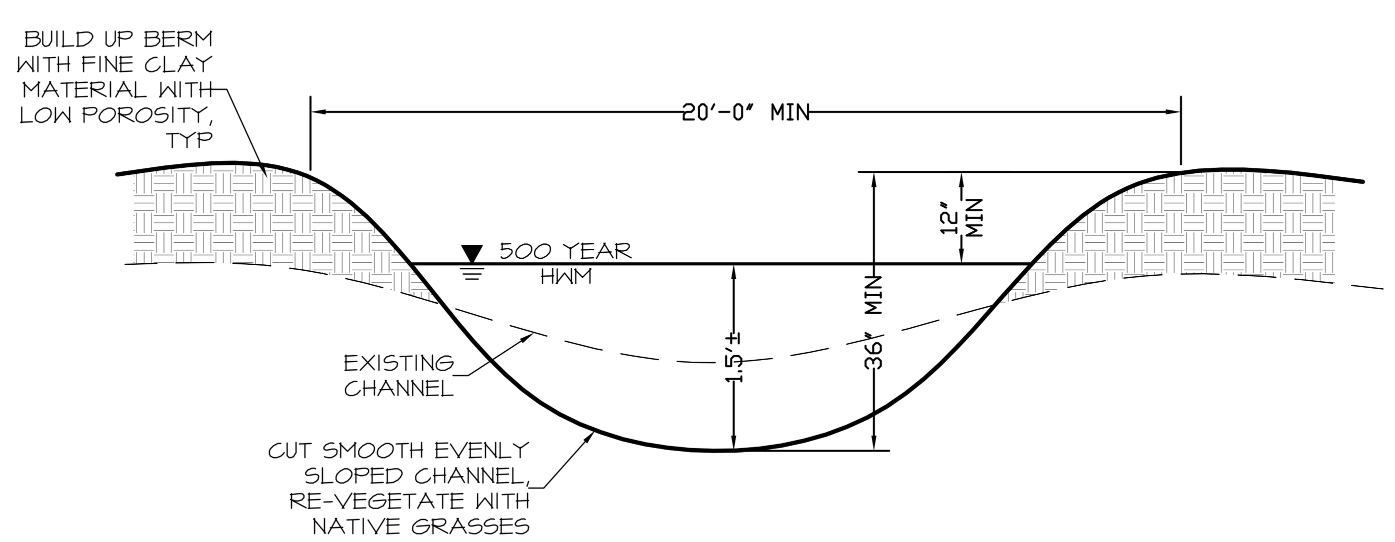
Conclusion: Provide a 3' deep x 20 wide, or wider channel flow is modeled at 2' deep, to allow 1' freeboard



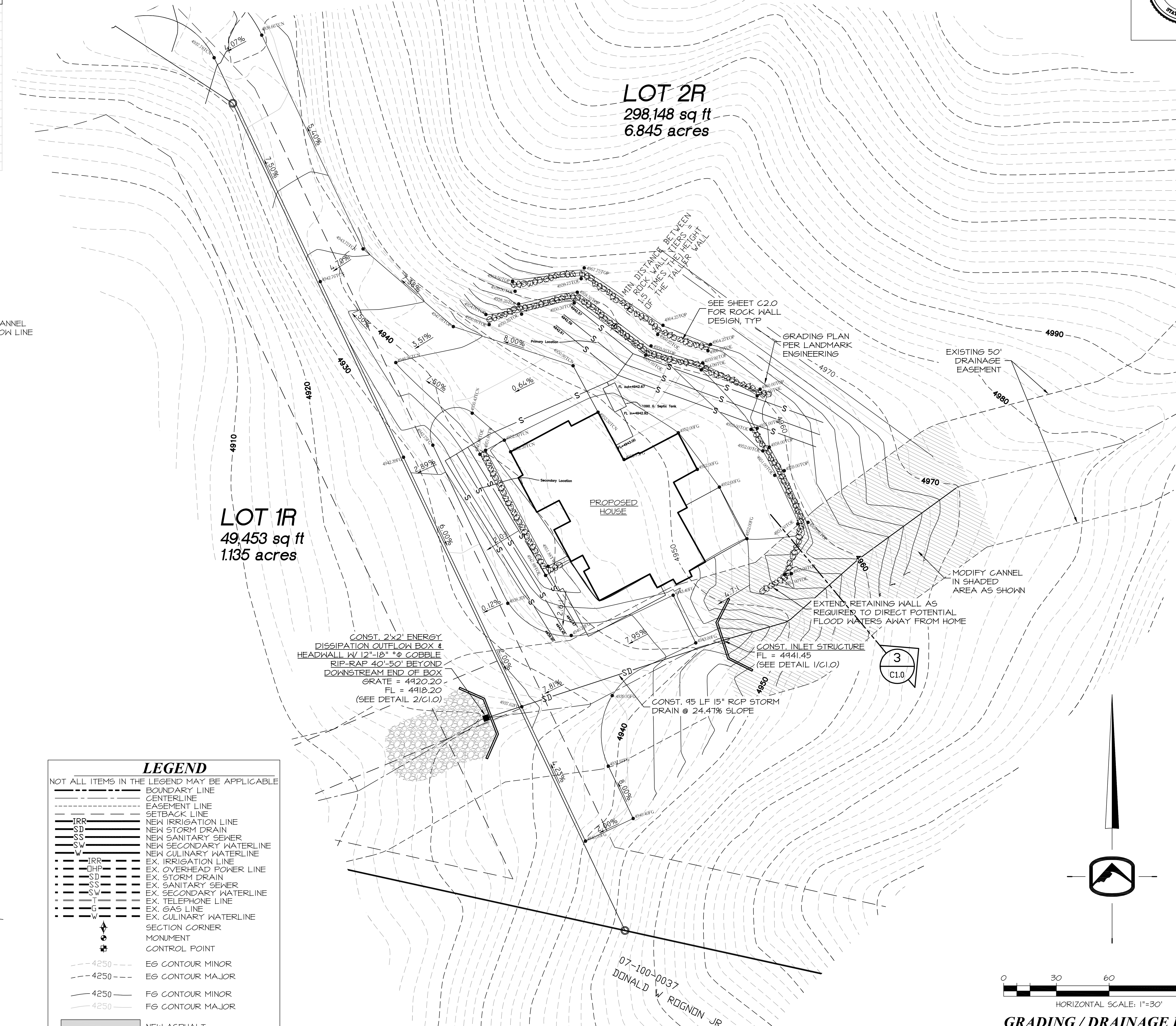
INLET STRUCTURE DETAIL (1 / C1.0)
NOT TO SCALE



OUTLET STRUCTURE DETAIL (2 / C1.0)
NOT TO SCALE



MODIFIED CHANNEL CROSS SECTION (3 / C1.0)
NOT TO SCALE



LEGEND

NOT ALL ITEMS IN THE LEGEND MAY BE APPLICABLE

- BOUNDARY LINE
- CENTERLINE
- EASEMENT LINE
- SETBACK LINE
- NEW IRRIGATION LINE (IRR)
- NEW STORM DRAIN (SD)
- NEW SANITARY SEWER (SS)
- NEW SECONDARY WATERLINE (SW)
- NEW CULINARY WATERLINE (W)
- EX. IRRIGATION LINE (IRR)
- EX. OVERHEAD POWER LINE (OHP)
- EX. STORM DRAIN (SD)
- EX. SANITARY SEWER (SS)
- EX. SECONDARY WATERLINE (SW)
- EX. TELEPHONE LINE (T)
- EX. GAS LINE (G)
- EX. CULINARY WATERLINE (W)
- SECTION CORNER
- MONUMENT
- CONTROL POINT
- 4250 EG CONTOUR MINOR
- 4250 EG CONTOUR MAJOR
- 4250 FG CONTOUR MINOR
- 4250 FG CONTOUR MAJOR
- NEW ASPHALT
- EXISTING ASPHALT
- 30" HIGH BACK CURB
- 30" RELEASE GUTTER

0 30 60 120
HORIZONTAL SCALE: 1"=30'

GRADING / DRAINAGE PLAN

CALL BLUESTAKES
@ 1-800-662-4111
AT LEAST 48 HOURS PRIOR TO COMMENCING ANY CONSTRUCTION

SEAL: LICENSED PROFESSIONAL ENGINEER No. 375250 JOSHUA R. JENSEN STATE OF UTAH

REVISED:

DATE: --/--/--
PROJECT: ----
DRAWN BY: C.D.
PLOT: 10-17-2014

DRAWING DESCRIPTION: WASH GRADING PLAN

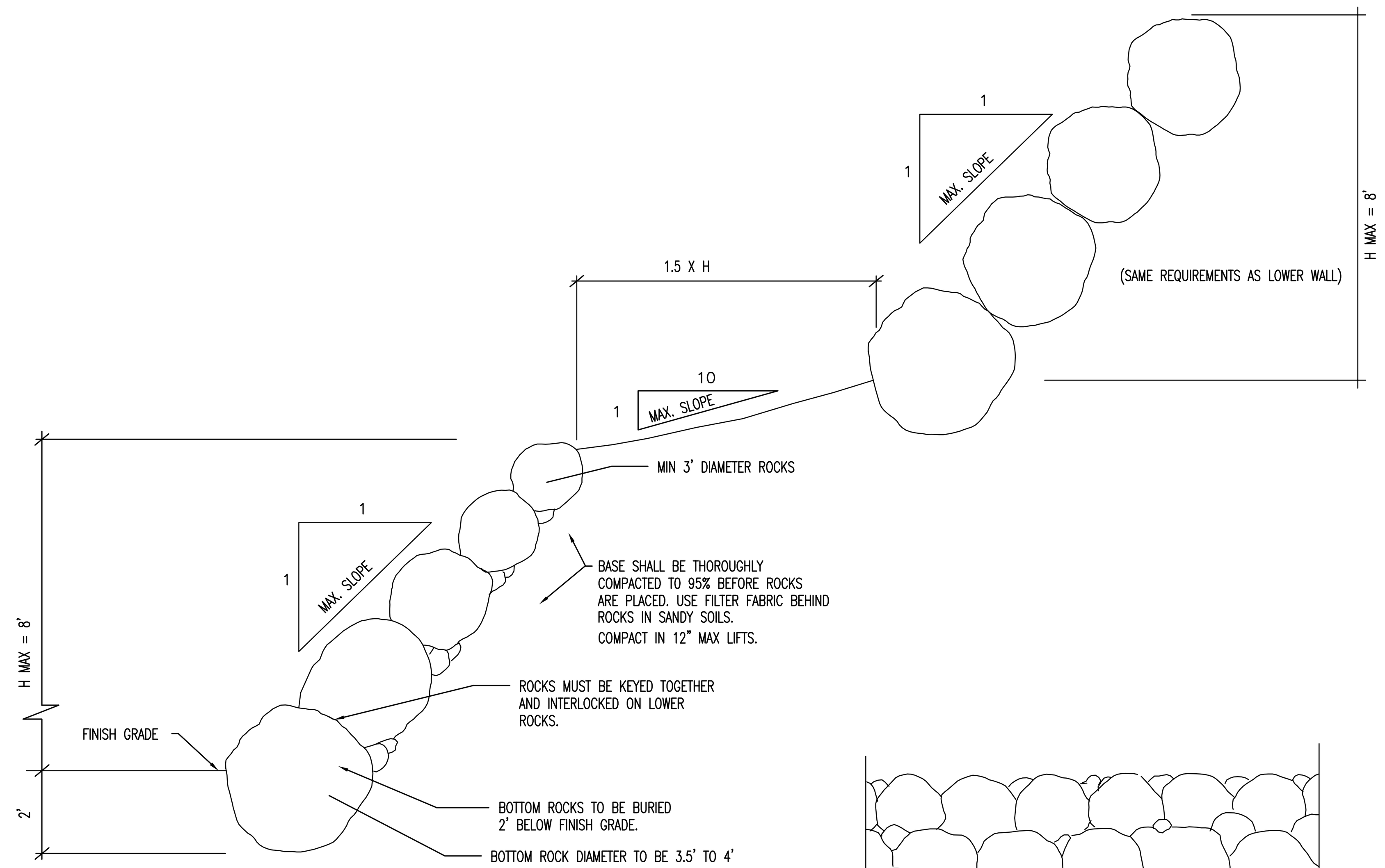
177 E. ANTELOPE DR. #B
LAYTON, UT 84041
PHONE: (801) 499-5054
FAX: (801) 499-5065

SILVERPEAK ENGINEERING

RASMUSSEN RESIDENCE
WEBER CANYON
UINTAH, UTAH

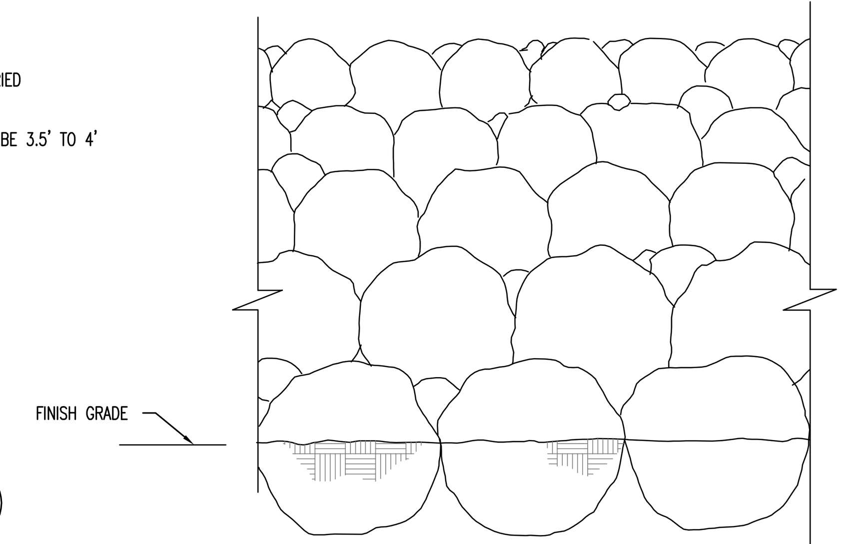
SHEET NUMBER: C1.0
WASH GRADING PLAN

\\SILVERPEAK\Public\Silverpeak Projects\2014 Projects\14-041 Rasmussen Residence, Uintah Utah\Civil\3236house-to civil R2.dwg 10/17/2014 3:38:32 PM



NOTE:
THE ROCKS SHALL BE HARD, DURABLE, ANGULAR, FIELD STONES AND SHALL INTERLOCK WITH ADJACENT ROCKS.
THE ROCKS SHALL BE SET SO AS NOT TO EXCEED A 1 TO 1 SLOPE AS SHOWN. LARGE IRREGULARITIES BETWEEN STONES SHALL BE FILLED WITH ROCK SPALLS OF SUITABLE SIZE, RAMMED TIGHTLY INTO PLACE FROM THEE BOTTOM TO THE TOP.

ROCK RETAINING WALL SECTION (A)
SCALE: NONE



ELEVATION VIEW

GENERAL SITE NOTES

GENERAL

1. ALL CONSTRUCTION SHALL BE IN CONFORMANCE WITH CURRENT EDITION OF THE INTERNATIONAL BUILDING CODE AND SUPPLEMENTS UNLESS HIGHER STANDARD IS CALLED FOR.
2. THE CONTRACTOR SHALL VERIFY ALL DIMENSIONS AND CONDITIONS AT THE SITE.
3. THE CONTRACTOR SHALL BE RESPONSIBLE FOR SAFETY AND PROTECTION WITHIN AND ADJACENT TO THE JOB SITE.
4. DO NOT SCALE DRAWINGS. IF DIMENSIONS ARE IN QUESTION, THE CONTRACTOR SHALL BE RESPONSIBLE FOR OBTAINING CLARIFICATION FROM THE ENGINEER BEFORE CONTINUING WITH CONSTRUCTION.
5. THE TYPICAL DETAILS SHALL BE USED WHEREVER APPLICABLE UNLESS OTHERWISE NOTED ON THE DRAWINGS. NOTES AND DETAILS ON DRAWINGS SHALLTAKE PRECEDENCE OVER GENERAL NOTES AND TYPICAL DETAILS.
6. ALL OMMISSIONS OR CONFLICTS BETWEEN THE VARIOUS ELEMENTS OF THE WORKING DRAWINGS AND/OR SPECIFICATIONS SHALL BE BROUGHT TO THE ATTENTION OF THE STRUCTURAL ENGINEER BEFORE PROCEEDING WITH ANY WORK INVOLVED. IN CASE OF CONFLICT, FOLLOW MOST STRINGENT REQUIREMENT AS DETERMINED BY STRUCTURAL ENGINEER WITHOUT COST TO OWNER.
7. OBSERVATION VISITS TO THE JOB SITE BY SILVERPEAK ENGINEERING FIELD REPRESENTATIVES SHALL NEITHER BE CONSTRUED AS INSPECTION NOR APPROVAL OF CONSTRUCTION.

SITE WORK

1. CONTRACTOR SHALL FURNISH ALL LABOR, MATERIAL, AND EQUIPMENT NECESSARY TO COMPLETE ALL WORK AS SHOWN ON THE DRAWINGS AND SPECIFIED HEREIN. WORK SHALL INCLUDE CLEARING, REMOVAL AND DISPOSAL OF UNSUITABLE MATERIALS, GRADING, EXCAVATING, BACKFILLING, AND ALL RELATED ITEMS. ALL WORK SHALL COMPLY WITH APPLICABLE CODES AND ORDINANCES OF FEDERAL, STATE, REGIONAL AND LOCAL GOVERNING AUTHORITIES HAVING JURISDICTION.

2. BARRICADE OPEN EXCAVATIONS OCCURING AS PART OF THIS WORK AND POST WITH WARNING LIGHTS.

3. CONDUCT ALL OPERATIONS TO ENSURE MINIMUM INTERFERENCE WITH ROADS, WALKS, AND OTHER ADJACENT OCCUPIED OR USED FACILITIES.

4. EXPLOSIVES ARE PROHIBITED ON THE PROJECT SITE UNLESS OTHERWISE DIRECTED BY THE OWNER.

5. BURNING ON PROPERTY WILL BE PERMITTED ONLY AT DESIGNATED AREAS AND TIMES DIRECTED BY OWNER. ATTEND BURNING MATERIALS UNTIL FIRES HAVE BEEN EXTINGUISHED.

6. THE CONTRACTOR SHALL CONTACT UTILITY COMPANIES AND OBTAIN ALL EXISTING UNDERGROUND UTILITY LOCATION INFORMATION PRIOR TO EXCAVATION WORK. LOCATE AND MARK EXISTING UNDERGROUND UTILITIES IN AREAS OF WORK. PROTECT ACTIVE UTILITIES FROM DAMAGE DURING CONSTRUCTION. SHOULD UNCHARTED, OR INCORRECTLY CHARTED, PIPING OR OTHER UTILITIES BE ENCOUNTERED DURING EXCAVATIONS, CONSULT UTILITY OWNER IMMEDIATELY FOR DIRECTIONS. REPAIR DAMAGED UTILITIES TO SATISFACTION OF UTILITY OWNER. OWNER SHALL NOT BE LIABLE FOR ANY DAMAGE TO UNDERGROUND UTILITIES.

7. TEST BORING RESULTS INDICATING SUBSURFACE CONDITIONS ARE NOT INTENDED AS REPRESENTATIONS OR WARRANTIES OF ACCURACY OR CONTINUITY BETWEEN SOIL BEARINGS. IT IS EXPRESSLY UNDERSTOOD THAT OWNER WILL NOT BE RESPONSIBLE FOR INTERPRETATIONS OR CONCLUSIONS DRAWN THEREFROM BY CONTRACTOR. DATA ARE MADE AVAILABLE FOR CONVENIENCE OF CONTRACTOR.

8. TOPSOIL IS DEFINED AS FERTILE, FRIABLE, NATURAL SOIL OF LOAMY CHARACTER, FREE OF CLAY, SUBSOIL, CLAY LUMPS, OR STONES IN EXCESS OF 2" IN GREATEST DIMENSION. TOPSOIL SHALL BE TYPICAL OF THE PROJECT LOCALITY AND SHALL CONTAIN NO CHEMICALS HARMFUL TO PLANT GROWTH.

9. FILL IS DEFINED AS MATERIAL FOR FILLING AND BACKFILLING THAT SHALL BE CLEAN SUBSOIL FREE OF CLAY, ROCK OR GRAVEL LARGER THAN 2" IN GREATEST DIMENSION, TOPSOIL, DEBRIS, WASTE, FROZEN MATERIALS, VEGETABLE AND OTHER DELETERIOUS MATTER PREVENTING UNIFORM CONTROLLABLE COMPACTION.

10. SOIL TESTS PERFORMED SHALL INCLUDE:

A. OPTIMUM MOISTURE - MAXIMUM DENSITY CURVE (FOR EACH SOIL ENCOUNTERED).

B. COMPRESSIVE STRENGTH AND/OR BEARING TEST (OF EACH SOIL STRATA)

C. FIELD DENSITY TEST

D. TEST REPORTS ON BORROW MATERIAL

E. CONTRACTOR SHALL EMPLOY CONSULTANTS OR TESTING SERVICES TO PERFORM INSPECTIONS AND TESTS NECESSARY TO ASSURE THE SPECIFIED COMPACTION AND OTHER MINIMUM REQUIREMENTS.

F. A COPY OF ALL SOIL TEST RESULTS SHALL BE SUBMITTED TO THE OWNER FOR ITS RECORD.

11. UNLESS OTHERWISE SPECIFIED, CONTRACTOR SHALL CLEAR AND DISPOSE ALL VEGETATION WITH THE LIMITS OF CONSTRUCTION AREAS AS SHOWN ON THE DRAWINGS.

12. ALL TREES, BUSHES, ETC., SHALL BE CUT WITH THE STUMPS HAVING AT LEAST 6 INCHES OF PROJECTION ABOVEGROUND; SO THEY WILL NOT BE MISSED DURING GRUBBING OPERATIONS. DISPOSAL OF VEGETATION INCLUDING LIMBS, PULP OR FIREWOOD, SHALL BE BY BURNING COMPLETELY, OR OTHERWISE REMOVING AND DISPOSING OF AS DIRECTED.

13. ALL CONSTRUCTION AREAS ON WHICH WORK IS TO BE PERFORMED, INCLUDING EXCAVATION, EMBANKMENT, ROADS, PARKING AREAS, OPERATING AREAS, OR OTHER AREAS AS SHOWN ON DRAWINGS SHALL BE STRIPPED OF ALL TOP SOIL AND DEBRIS TO A DEPTH OF 4". THIS MATERIAL CAN BE STOCKPILED, RAKED, AND CLEANED OF DEBRIS, AND REUSED AS FILL AT THE DISCRETION OF THE OWNER.

14. CONTRACTOR SHALL REMOVE FROM THE CONSTRUCTION AREA ALL STUMPS, INCLUDING THEIR ROOT STRUCTURE, DOWN TIMBER AND DEBRIS (INCLUDING CONCRETE SLABS, FOUNDATIONS, STRUCTURES, ETC.) ALL MATERIAL LYING ON THE SURFACE OR PARTIALLY BURIED SHALL BE REMOVED. FULLY RECOVERED MATERIALS NEED NOT BE REMOVED UNLESS SO ORDERED BY THE OWNER. DISPOSAL OF GRUBBING MATERIALS SHALL BE BY HAULING OFF SITE, OR BURNING.

15. (NOT USED)

16. CONTRACTOR SHALL BE RESPONSIBLE FOR ESTABLISHING AND MAINTAINING A BENCHMARK FOR USE IN SITE PREPARATION.

17. THE CONTOUR LINES AND ELEVATIONS ON THE TOPOGRAPHICAL DRAWINGS SHOWING EXISTING ELEVATIONS ARE ONLY APPROXIMATE; THEREFORE, THE CONTRACTOR SHALL BE SOLELY RESPONSIBLE FOR ESTIMATING THE AMOUNT OF GRADING, EARTHWORK, AND FILL MATERIAL REQUIRED. OWNER SHALL NOT BE RESPONSIBLE FOR THE ACCURACY OF CONTOUR LINES OF ELEVATIONS SHOWING EXISTING ELEVATIONS.

18. EXCAVATION FOR TRENCHES

A. DIG TRENCHES TO A WIDTH TO SUFFICIENTLY PROVIDE AMPLE WORKING ROOM. PROVIDE 6" TO 9" CLEARANCE ON BOTH SIDES OF PIPE OR CONDUIT.

B. EXCAVATE TRENCHES TO DEPTH INDICATED OR REQUIRED. CARRY DEPTH OF TRENCHES FOR PIPING TO ESTABLISH INDICATED FLOW LINES AND INVERT ELEVATIONS. BEYOND BUILDING PERIMETER, KEEP BOTTOMS OF TRENCHES SUFFICIENTLY BELOW FINISH GRADE TO AVOID FREEZE-UPS.

C. FOR PIPES, CONDUIT, TANKS AND OTHER MECHANICAL/ELECTRICAL WORK INDICATED TO RECEIVE SUBBASE, EXCAVATE TO SUBBASE DEPTH INDICATED, OR, IF NOT OTHERWIDE INDICATED, TO 6" BELOW BOTTOM OF WORK TO BE SUPPORTED.

D. DO NOT BACKFILL TRENCHES UNTIL ALL TESTS AND INSPECTIONS HAVE BEEN COMPLETED.

19. STABILITY OF EXCAVATION

A. SLOPE SIDES OF EXCAVATION TO COMPLY WITH LOCAL CODES AND ORDINANCES HAVING JURISDICTION. SHORE AND BRACE WHERE SLOPING IS NOT POSSIBLE BECAUSE OF SPACE RESTRICTIONS OR STABILITY OF MATERIAL EXCAVATED. MAINTAIN SIDES AND SLOPES OF EXCAVATION IN SAFE CONDITION UNTIL COMPLETION OF BACKFILLING.

C. MAINTAIN SHORING AND BRACING IN EXCAVATIONS REGARDLESS OF TIME PERIOD EXCAVATIONS WILL BE OPEN. CARRY DOWN SHORING AND BRACING AS EXCAVATION PROCESSES

D. REMOVE SHEETING, SHORING AND BRACING IN STAGES TO AVOID DISTURBANCE TO UNDERLYING SOILS AND DAMAGE TO STRUCTURES, PAVEMENTS, FACILITIES, AND UTILITIES.

E. REPAIR OR REPLACE, ADJACENT WORK DAMAGED OR DISPLACED THROUGH INSTALLATION OR REMOVAL OF SHORING AND BRACING WORK.

20. PREVENT SURFACE WATER AND SUBSURFACE OR GROUND WATER FROM FLOWING INTO EXCAVATIONS AND FROM FLOODING PROJECT SITE AND SURROUNDING AREA. REMOVE WATER TO PREVENT SOFTENING OF FOUNDATION BOTTOMS, UNDERCUTTING FOOTINGS, AND SOIL CHANGES DETRIMENTAL TO STABILITY OF SUBGRADES AND FOUNDATIONS. PROVIDE AND MAINTAIN PUMPS, SUMPS, SUCTION AND DISCHARGE LINES, TEMPORARY DRAINAGE DITCHES, AND OTHER DEWATERING SYSTEM COMPONENTS NECESSARY TO CONVEY WATER AWAY FROM EXCAVATION.

21. STOCKPILE SATISFACTORY EXCAVATED MATERIALS WHERE DIRECTED BY OWNER, UNTIL REQUIRED FOR BACKFILL OR FILL. PLACE, GRADE AND SHAPE STOCKPILES FOR PROPER DRAINAGE AND LOCATE STOCKPILES AWAY FROM EDGE OF EXCAVATIONS. DISPOSE OF EXCESS SOIL MATERIAL AND WASTE MATERIALS AS SPECIFIED HEREIN.

22. FILL MATERIAL MUST BE DEPOSITED AND SPREAD IN UNIFORM HORIZONTAL LIFTS, NOT MORE THAN 8" THICK, LOOSE MEASUREMENT, AND THESE LIFTS ARE TO BE KEPT APPROXIMATELY LEVEL. EACH LIFT SHALL BE COMPACTED TO 95% OF THE STANDARD PROCTOR MAXIMUM DRY DENSITY (ASTM-D-1557). FIELD DENSITY TESTS (ASTM-D-1556) SHALL BE PERFORMED AT REGULAR INTERVALS TO CHECK ADEQUACY OF THE COMPACTION. MOISTURE CONTENT SHALL NOT VARY MORE THAN 3% ABOVE OR BELOW OPTIMUM.

23. REMOVAL OF UNSUITABLE MATERIAL

A. UNSUITABLE MATERIAL IN SOFT SPOTS SHALL BE REMOVED TO THE DEPTH REQUIRED TO PROVIDE A FIRM FOUNDATION AND SHALL BE REPLACED WITH A MATERAIL EQUAL TO OR BETTER THAN THE BEST SUBGRADE MATERIAL ON THE SITE. THE IN-PLACE MATERIALS, I.E. NATURAL OR EXCAVATED AREAS, SHALL BE PROOF ROLLED AND TOP 6 INCHES SHALL BE BROUGHT UP TO 95% OF THE STANDARD PROCTOR MAXIMUM DRY DENSITY (ASTM-D-1557).

B. UNSUITABLE MATERIAL SHALL BE DEFINED AS ANY SOIL CONTAINING LOOSE SANDS, SILTS, DEBRIS AND/OR ORGANIC MATERIAL OR ANY KIND SUCH AS MUCK, PEAT, ORGANIC SILT TOPSOIL, SOD, OR VEGETABLE MATTER.

C. AREAS REQUIRING IMPORTATION OF FILL MATERIAL SHALL BE BROUGHT TO ROUGH GRADE ELEVATIONS IN LIFTS NOT TO EXCEED 8.0 INCHES LOOSE (APPROXIMATELY 6.0 INCHES COMPACTED), AND EACH LIFT SHALL BE COMPACTED TO REQUIRED DENSITY AND REQUIRED MOISTURE.

D. THE MOISTURE CONTENT FOR ALL MATERIALS TO BE COMPACTED SHALL BE BROUGHT TO APPROXIMATE OPTIMUM CONDITIONS BY THE ADDITION OF WATER, BY THE BLENDING OF DRY MATERIAL, OR BY AERATION OF THE EXISTING MATERIAL.

STRUCTURAL FILL

1. MATERIAL PLACED AS FILL TO SUPPORT FOUNDATIONS SHOULD BE NON-EXPANSIVE GRANULAR SOIL. THE NATURAL GRAVEL EXCLUSIVE OF TOPSOIL, ORGANIC, OVER-SIZE AND OTHER DELETERIOUS MATERIAL IS GENERALLY SUITABLE FOR USE AS STRUCTURAL FILL IF IT MEETS THE REQUIREMENTS INDICATED BELOW.

MATERIALS RECOMMENDED FOR IMPORTED STRUCTURAL FILL

FILL TO SUPPORT	RECOMMENDATIONS
FOOTINGS	NON-EXPANSIVE GRANULAR SOIL PASSING NO. 200 SIEVE < 35% LIQUID LIMIT < 30% MAXIMUM SIZE 4 INCHES
SLAB SUPPORT	NON-EXPANSIVE GRANULAR SOIL PASSING NO. 200 SIEVE < 50% LIQUID LIMIT < 30% MAXIMUM SIZE 6 INCHES

2. COMPACTION OF MATERIALS PLACED AT THE SITE SHOULD EQUAL OR EXCEED THE MINIMUM DENSITIES AS INDICATED BELOW WHEN COMPARED TO THE MAXIMUM DRY DENSITY AS DETERMINED BY ASTM D-1557.

MATERIALS RECOMMENDED FOR IMPORTED STRUCTURAL FILL

FILL TO SUPPORT	RECOMMENDATIONS
FOOTINGS	> 95%
CONCRETE FLATWORK & PAVEMENT	> 90%
LANDSCAPING	> 85%
RETAINING WALL BACKFILL	95%

TO FACILITATE THE COMPACTION PROCESS, THE FILL SHOULD BE COMPACTED AT A MOISTURE CONTENT WITHIN 2 PERCENT OF THE OPTIMUM MOISTURE CONTENT.
THE BASE COURSE SHOULD BE COMPACTED TO AT LEAST 90 PERCENT OF THE MAXIMUM DRY DENSITY AS DETERMINED BY ASTM D-1557.
FILL PLACED FOR THE PROJECT SHOULD BE FREQUENTLY TESTED FOR COMPACTION

3. ALL EARTH WORK SHALL CONFORM WITH THE SITE GEOTECHNICAL REPORT IF SUCH A REPORT HAS BEEN PRODUCED.

CALL BLUESTAKES
@ 1-800-662-4111
AT LEAST 48 HOURS PRIOR TO COMMENCING ANY CONSTRUCTION

SEAL: LICENSED PROFESSIONAL ENGINEER No. 375250 JOSHUA R. JENSEN STATE OF UTAH

REVISED:
DATE: --/--/--
PROJECT: ----
DRAWN BY: C.D.
PLOT: 10-17-2014

DRAWING DESCRIPTION: ROCK WALL DETAILS

SILVERPEAK ENGINEERING
177 E. ANTELOPE DR. #B
LAYTON, UT 84041
PHONE: (801) 499-5054
FAX: (801) 499-5065

RASMUSSEN RESIDENCE
WEBER CANYON
UINTAH, UTAH

SHEET NUMBER: C2.0
ROCK WALL DETAILS

September 4, 2014

HYDROPLOT
1843 Blaine Ave.
Salt Lake City, Utah 84108-2905
Office/Fax: (801) 576-9259
Cell: (801) 608-2414
E-mail: hdiwater@gmail.com

Mr. Matthew Rasmussen
2927 Melanie Lane
Ogden, Utah 84403

Re: Drainage Evaluation for Dauphine'-Savoy-Piedmont Subdivision, Lot #2, Ogden, UT

Dear Matt:

HydroPlot has completed the drainage evaluation for Lot #2 of the Dauphine'-Savoy-Piedmont Subdivision in Ogden, Utah. The drainage evaluation was based on the need to determine the flow rates from various return period storms for an ungauged watershed.

The watershed is located in the foothills of the Wasatch Range just southeast of Ogden, Weber County, Utah. The subject property is positioned on the bench of the Bonneville level of the foot hills at about 6500 Bybee Drive in unincorporated Weber County, Utah. Figure 1 shows the location of the watershed on a USGS base map. The watershed is call Broad Hollow.

The Broad Hollow watershed is relatively undisturbed with a heavily vegetated cover consisting of scrub oak, sage brush, and native grasses and weeds. Soils consist of coarse grained sandy gravelly materials with some silts and very little clay. Most of these soils are derived from alluvial fan and debris flow deposits. Based on these soil gradations, the infiltration rate for these soils is expected to be rapid to vary rapid. Together with the vegetative cover, the runoff potential is low.

Runoff flow rates were determined using the methods proposed by Kenney, Wilkowske, and Wright (2007). This study was conducted by the USGS in cooperation with the Utah Department of Transportation and the Utah Division of Water Rights and Water Resources. The method uses regional regression equations to determine the estimate peak flows for ungauged watershed for the 2-, 5-, 10-, 25-, 50-, 100-, 200-, and 500-year recurrence or return period events. The regression equations are based on parameters such as the drainage area, area of herbaceous plants, precipitation type, and elevation of the watershed.

Figure 1 shows the site area and the drainage that flows through the Lot #2 area. Table 1 presents the watershed characteristics. Based on these values, the regression estimates for the runoff peak flows for the various return periods are presented in Table 2.

These flow estimates were compared to flow estimates determined using the NRCS curve number method based on a 24-hour storm. Given the soil information, the hydrologic soil group is either A or B. Based on the vegetative cover of approximately 60%, the curve number from juniper-sage-grass type vegetation community is estimated to be about 50. Precipitation for the 10-year event is estimated to be 3.34 inches. Based on the watershed characteristics, the time of concentration was determined to be about 50 minutes. Using the triangular hydrograph calculations based on the NRCS curve number runoff relationship, the peak flow was estimated to be 3.73 cfs for the 10-year event. Therefore, the two methods show estimates of the same order of magnitude.

Based on these calculations, the runoff potential from the watershed is somewhat limited, though the long return period storms will result in runoff that will need to be directed away from the proposed residences.

If you have any questions, please give me a call.

Sincerely,

Thomas J. Suchoski, PG
Hydrologist

Enc.: Table 1 and 2, and Figure 1

Ref:

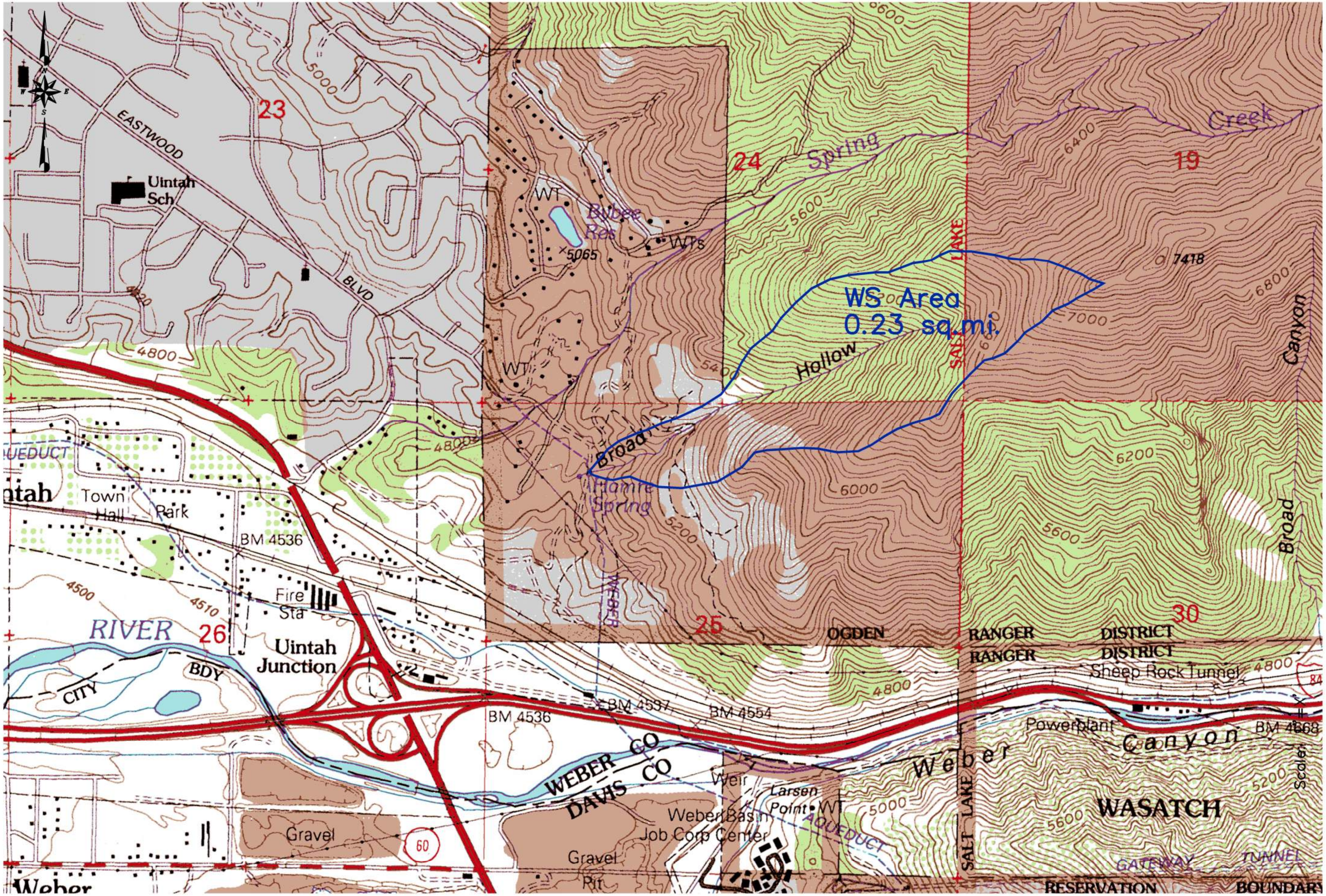
Kenney, T.A., Wilkowske, C.D., and Wright, S.J., 2007, Methods for estimating magnitude and frequency of peak flows for natural streams in Utah: U.S. Geological Survey Scientific Investigations Report 2007-5158, 28 p.

TABLE 1 – Watershed Characteristics

Parameter	Broad Hollow WS
Mean Basin Elevation (ft)	6010
Drainage Area (sq. mi.)	0.23
Area covered by Herbaceous plants (%)	17.2
Area covered by forest (%)	44.0
Mean Annual Precipitation (in)	26.6
Average Basin Slope (%)	60.4
Slopes greater than 30% (%)	93.9

TABLE 2 – Peak Flow Estimates

Return Period	Broad Hollow WS Peak Flow (cfs)
2-year	1.06
5-year	2.77
10-year	4.43
25-year	6.64
50-year	9.25
100-year	11.7
200-year	14.7
500-year	20.6



Broad Hollow Drainage
Weber County, Utah

Matthew Rasmussen
Ogden, Utah

FIGURE 1. Broad Hollow Drainage Location & Topography

FIGURE 1.DWG Rassmussen — South Ogden 9/2014

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

MEMORANDUM

To: **Matt Rassmussen**

From: **Timothy J. Thompson, P.G.**
Hiram Alba, P.E., P.G.
Daniel J. Brown, E.I.T.

REGISTERED PROFESSIONAL ENGINEER 09/08/15 HIRAM ALBA 175774 STATE OF UTAH

LICENSED PROFESSIONAL GEOLOGIST # 5242839 TIMOTHY J. THOMPSON 9/8/15 STATE OF UTAH

Date: **September 8, 2015**

Subject: **Review Response for Third Geological Review Matt Rasmussen Hillside Review 6472 South Bybee Drive, Ogden, Utah, 84403 SA Project No. 15-140**

GeoStrata has received review questions of our report titled **Review Response for Geological Review – 6472 and 6498 South Bybee Drive, Weber County Parcel Numbers: 07-753-0001 and 07-753-0002 Uintah, Weber County, Utah, SA Project Number 15-140**, GeoStrata Job Number 910-001 and dated July 9, 2015. This report was prepared for Mr. Matt Rasmussen and submitted to Weber County for review. Mr. Alan Taylor of Taylor Geotechnical (TG) prepared a review of our report. This memorandum was prepared in response to a series of review questions prepared by Mr. Taylor and dated August 5, 2015.

TG Review Comments

1. *Respond to geological comments in the Simon Associates, LLC (SA) third geologic review letter by SA dated August 4, 2015.*

GeoStrata Response: A response to review comments from Simon Associates, LLC (SA) has been prepared and submitted.

2. *Specify all variables used in calculating debris flow volume for the property in the July 9, 2015, GeoStrata Memorandum, such as:*

    a. *S (basin area with slopes greater than or equal to 30%, sq km);*

    b. *B (basin area burned at moderate and high severity, sq km); and,*

    c. *Rainfall data obtained from the NOAA Atlas 14, Volume 1, Version 5 Point Precipitation Frequency Estimates for the subject drainage basin (i.e. R, total storm rainfall, mm) (i.e., presumably "... a rainstorm event with a 10-year recurrence interval and 60 minute duration).*

GeoStrata Response: As per review comment 4 of the SA August 4, 2015 geologic review, for calculation of fire related debris flow volume, the more conservative result from the different equations from Giraud and Castleton (2009) and Cannon and others (2010) should be used at the subject site. For reference, the Giraud and Castleton (2009) regression model for the Western U.S. is:

$$\ln V = 0.59(\ln S) + 0.65(B)^{1/2} + 0.18(R)^{1/2} + 7.21$$

where:
V = volume (cubic meters)
S = basin area with slopes greater than or equal to 30% (square kilometers)
B = basin area burned at moderate and high severity (square kilometers)
R = total storm rainfall (millimeters)

The regression model from Cannon and others (2010) is:

$$\ln V = 7.2+0.6(\ln A) + 0.7(B)^{1/2} + 0.2(T)^{1/2}+0.3$$

where:
V = volume (cubic meters)
A = basin area with slopes greater than or equal to 30% (square kilometers)
B = basin area burned at moderate and high severity (square kilometers)
T = total storm rainfall (millimeters)

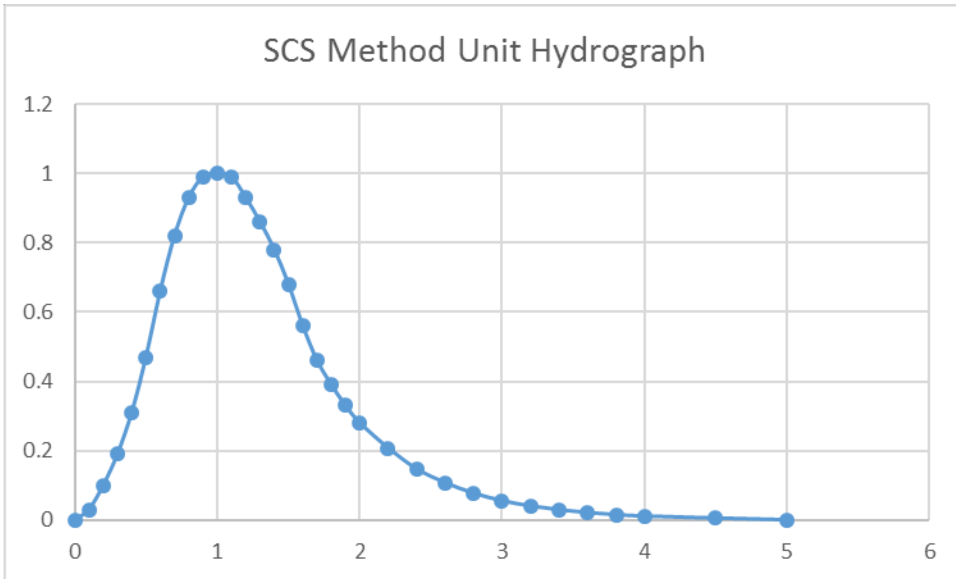
A printout of our calculations, showing inputs and outputs for the regression model is included as Plate 1. Based on our calculations, the fire related debris flow volume predicted by the Cannon and others (2010) intermountain western United States post-wildfire debris flow regression model for a maximum rainstorm event with a 10-year recurrence interval and a 60 minute duration is 6.2 acre-feet.

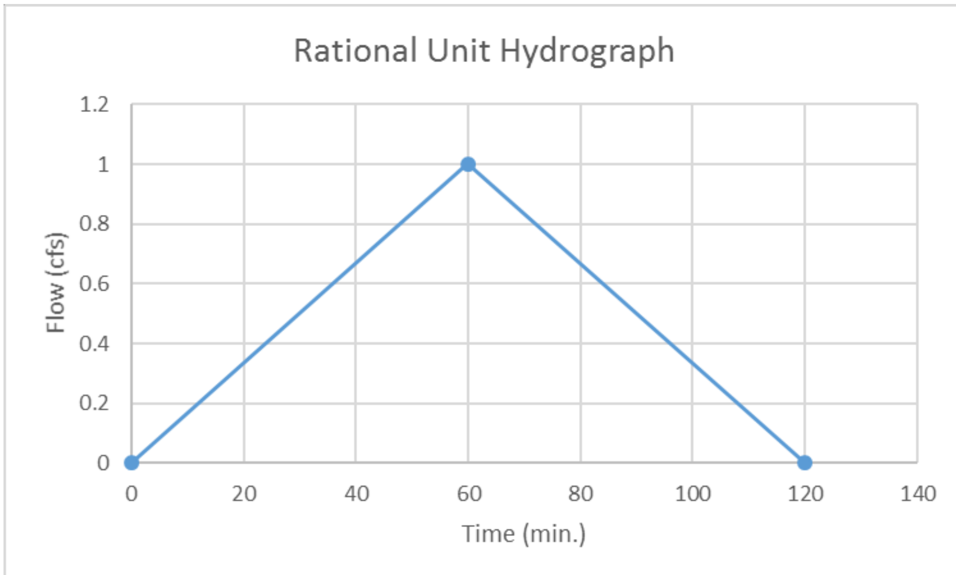
3. Provide hand calculations to support the estimated debris flow volume of 4-acre feet (i.e., associated with "… a rainstorm event with a 10-year recurrence interval and 60 minute duration).

GeoStrata Response: A printout of our calculations, showing inputs and outputs for the Cannon and others (2010) regression model is included as Plate 1.

4. Provide a copy of the "…unit rational hydrograph…" used to estimate a peak debris flow volume of 48.9 cfs for the property and provide hand calculations and data to validate a peak debris flow volume of 48.9 cfs.

GeoStrata Response: Unit hydrographs from the SCS method and the rational method of hydrological analysis are presented below.





It is assumed that when the reviewer asks for data relating to "peak debris flow volume of 48.9 cfs" that it does not refer to the volume of a debris flow, but to the rate of flow.

Our analysis shows that the peak flow calculated from the rational unit hydrograph gives a more conservative result; therefore, this method was used in the design of the channel cross section.

As per review comment 5 of the SA August 4, 2015 geologic review, debris flows that could result from rapid snowmelt/rainfall were analyzed. According to our analysis, the maximum potential debris flow volume is estimated to be 16.1 ac-ft. With this modified debris flow volume, our calculation for the maximum flow rate has also been modified to 193.6 cfs. Hand calculations are attached as Plate 2.

5. Provide hand calculations that substantiate "Velocity of the debris flow at peak flows will be 12.7 feet per second."

GeoStrata Response: As the debris flow volume and flow rates have changed, so has the calculated debris flow velocity at peak flows. The updated calculation for debris flow velocity at peak flow is 13.0 feet per second. Calculations are attached as Plate 3.

6. Provide hand calculations, including derivation of all variables, for the channel depth and run-up height based on the equations in Prochaska and others, 2008. Additionally, GeoStrata should clarify why equation (10) and not equation (3) in Prochaska and others, 2008 was utilized in the run-up height analysis.

GeoStrata Response: It is assumed that the reviewer is referring to equation (4) from Prochaska and others (2008) and not equation (3) as equation (3) is a formula developed by Gartner and others (2007) for the prediction of debris flow volumes from recently burned drainage basins in the western United States. Equation (4) from Prochaska and others (2008) is a model to predict the runup height on a berm within a debris basin where the debris flow is perpendicular to the berm. Equation (10) calculates the superelevation height of a debris flow within a channel and was used in our analysis because it applies to the subject property.

The following table presents the inputs and outputs utilized in our calculations for superelevation height and the height of the debris flow deflection berm.

Velocity (v)	13.0	**ft/sec**
Flow width (b)	11.0	**ft**
Radius of curvature (Rc)	221.8	**ft**
Acceleration of gravity (g)	32.2	**ft/s^2**
Superelevation height (Δh)	0.26	**ft**
Depth of flow (h)	2.5	**ft**
Height of debris flow deflection berm (hB)	5.7	**ft**

7. Provide cross sections and velocity of the channel upslope and down slope of the property along with the channel gradient. It should be noted that the regression model used by GeoStrata to calculate the height of the debris flow deflection berm is based on the following assumptions (Prochaska and others, 2008), i) The cross sectional area of flow behind the deflection berm is at least as large as the cross sectional area of flow in the natural channel upstream of the berm, and; ii) Flow velocity behind the berm is similar to flow velocity in the channel upstream of the berm.

GeoStrata Response: A cross section of the natural channel upstream of the property is attached as Plate 4. The channel downstream of the subject property has been modified by various developments, including Bybee Drive and several residences, and any analysis of the channel downstream of the subject property is outside of the scope of this study. The velocity of the peak debris flow in the natural channel upstream of the subject property is estimated to be 13.6 feet per second. Cross sectional area of the flow upstream of the subject property is 14.3 square feet, and cross sectional area of flow within the modified channel is 14.9 feet squared.

8. Provide an explanation of how a debris flow would impact the property at the storm drain inlet structure located on the Silverpeak site grading plan.

GeoStrata Response: If the storm drain inlet structure is built as designed in the October 2014 Silverpeak Engineering Grading / Drainage Plan, a maximum debris flow event would likely fill the pipe with sediment and then jump the channel.

9. Provide recommendations substantiated with hand calculations related to the debris flow and the storm drain structures so that they can be clearly depicted on the site grading plan.

GeoStrata Response: GeoStrata recommends that either the pavement for the firetruck turn around be redesigned so that it does not encroach on the channel, or that a culvert designed by a civil engineer be constructed to the dimensions specified in our channel cross section.

10. Provide the elevation(s) of the top of the diversion structure/retaining wall.

GeoStrata Response: The elevation of the bottom of the retaining wall drawn on the Silverpeak Grading / Drainage Plan is 4951 ft. At that point in the channel, the top of the deflection berm should be constructed at or below this elevation.

11. Provide the minimum height of the reinforced concrete foundation for the proposed residential structure (it is important that the wood frame of the structure is not compromised by potential debris flow.

GeoStrata Response: The design of the channel is intended to divert debris flow from impacting the proposed residence. Our analysis indicates that all debris flows will be contained within the designed channel, therefore, no additional height of foundation walls is being recommended for the structure.

12. Provide structural mitigation for reducing impacts of potential debris flow on the proposed structure (i.e., restriction of basement windows on the uphill (east) side of the home, etc.).

GeoStrata Response: See GeoStrata response to comment 11.

13. Provide the debris flow setback from the drainage for the proposed structure, including all supporting calculations.

GeoStrata Response: The easement designed in the hydrology report as presented on the Grading / Drainage Plan by Silverpeak Engineering is 50 feet wide and centered on the drainage. The width of the top of the channel as designed is 26 feet. It is the opinion of GeoStrata that the designed setback of 50 feet, along the drainage, with the designed channel cross section of 26 feet is sufficient to mitigate the debris flow hazard.

14. Provide hand calculation to corroborate the statement: "At this capacity the depth of flow within the channel would be approximately 1.5 feet.

GeoStrata Response: The calculation of the depth of flow within the channel is an iterative process where the depth is iterated until the output velocity and cross sectional area of the flow in the channel match the predicted peak flow. This was done using the inputs and outputs presented on Plate 3.

15. Substantiate that the proposed changes to the drainage channel do not increase the debris flow risk to downslope (west) properties.

GeoStrata Response: The drainage channel has been a conveyance structure for water, alluvial sediment, and debris flow sediment that have been transported from the canyon east of the subject site to the alluvial fan which is located west of the subject site on the valley floor. The proposed changes to the channel are intended to reduce the hazard associated with avulsion of water and sediment flow from the channel as flows transport through the channel and across the subject property. The proposed changes to the drainage channel do not increase the amount of water and sediment that may enter the channel from the canyon up-gradient of the subject site to the east, nor do the proposed changes change the release point of the existing channel on the downstream side of the subject site. The purpose of our investigation is to provide for safe conveyance of the debris flows across the subject property. Our design accomplishes this goal. The property owner cannot be held responsible to damage to other properties that have not been appropriately mitigated for this hazard.

Impacts to properties downstream from the subject property were not assessed for this study as this is outside of the scope. It is the opinion of GeoStrata that these properties will be negatively impacted by a debris flow event. The channel has been significantly modified by the construction of Bybee Drive and several residential properties west of the subject site. Future flow of water and sediment west of the subject property is not predictable in our opinion and we recommend that Weber County assess the debris flow hazard associated with these properties in order to provide hazard mitigation.

16. Stipulate who will be responsible for maintaining the storm drain structures shown on the Silverpeak grading plan.

GeoStrata Response: It is assumed that the property owner will be responsible for maintenance of the private storm drain structures on the subject property. This should be stipulated by the property owner.

17. Provide a recommended maintenance program and schedule for maintaining the storm drain structures shown on the Silverpeak grading plan.

GeoStrata Response: Maintenance of storm drain structures is outside of the scope of this study.

18. GeoStrata should provide a gradation for the rip-rap recommended in the channel in accordance with Prochaska 2008.

GeoStrata Response: In accordance with Prochaska and others (2008), the recommended riprap size for the channel is 24 inches.

19. Show all applicable recommendations on the civil engineering site grading plan and structural plans for the proposed residential structure.

GeoStrata Response: GeoStrata recommends that all applicable debris flow hazard mitigation recommendations be incorporated into the final civil engineering site grading plan and structural plans for the proposed structure.

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 other 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.

References

Cannon, S. H., Gartner, J.E., Rupert, M.G., Michael, J.A., Rea, A.H., and Parrett, C., 2010, Predicting the Probability and Volume of Postwildfire Debris Flows in the Intermountain Western United States, Geological Society of America GSA Bulletin; January/February 2010; v. 122; no. 1/2; p. 127-144.

Giraud, R.E. and Castleton, J.J., 2009, Estimation of Potential Debris-Flow Volumes for Centerville Canyon, Davis County, Utah, Utah Geological Survey Report of Investigation 267, 33 p.

HydroPlot, September 4, 2014, Drainage Evaluation for the Dauphine'-Savoy-Piedmont Subdivision, Lot #2, Ogden, UT, p 3., unpublished consultant report.

Hungr, O., Morgan, G.C., and Kellerhals, R., 1984, Quantitative analysis of debris torrent hazards for design of remedial measures, Canadian Geotechnical Journal, v. 21, p. 663-677.

Silverpeak Engineering, 10-17-2014, Rasmussen Residence Weber Canyon Uinta County, Utah, Wash Grading Plan, Grading/Drainage Plan, p C1.0 - C2.0., Unpublished consultant plan set.

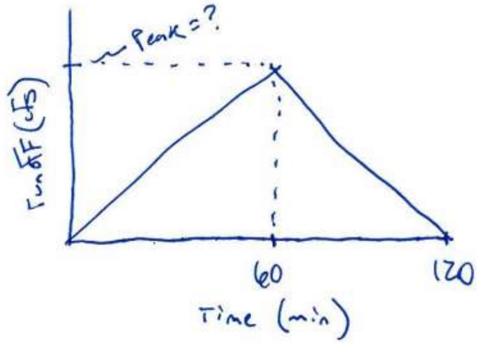
Yonkee, A., Lowe, M., 2003, Geologic Map of the Ogden 7.5' Quadrangle, Weber and Davis Counties, Utah, Utah Geological Survey Map 200.

ln V = 7.2+ 0.6(ln A) + 0.7(B)^(1/2) + 0.2(T)^(1/2) + 0.3

V	Volume
A	Area with slopes greater than 30%
B	Area burned at moderate to high severity
T	Total storm rainfall

Broad Hollow WS

B	0.60	**sq km**		
A	0.56	**sq km**		
T-2 year	16.7	**mm**		
T-5 year	22.6	**mm**		
T-10 year	27.9	**mm**		
T-100 year	53.6	**mm**		
V-2 year	6042.183	**m^3**	4.9	**ac-ft**
V-5 year	6907.303	**m^3**	5.6	**ac-ft**
V-10 year	7677.514	**m^3**	6.2	**ac-ft**
V-100 year	11533.87	**m^3**	9.4	**ac-ft**



A - area
V - volume
h - height (peak runoff)
b - base (storm duration x2)

$V = 16.1$ ac-ft
$= 701{,}316$ ft^3

$A = \frac{1}{2}bh$

$V = \frac{1}{2}bh$

$h = V / \frac{1}{2}b$

$$h = 701{,}316\ \text{ft}^3 \Big/ \tfrac{1}{2}(120\ \text{min})\left(\frac{60\ \text{sec}}{\text{min}}\right)$$

$= 193.6$ cfs

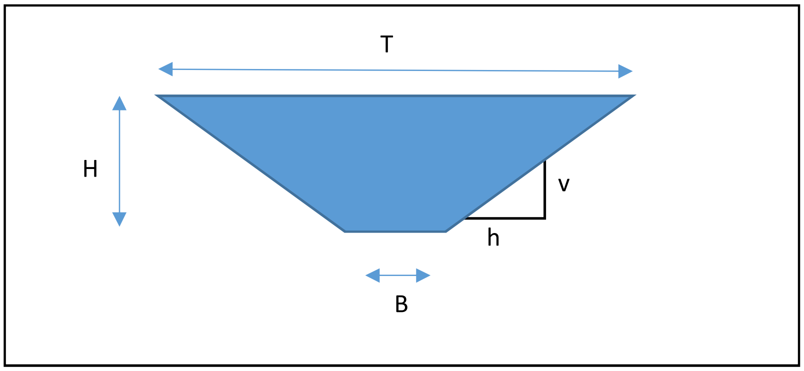
Hand Calculations – Flow Rate

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

Plate 2

Trapezoidal channel

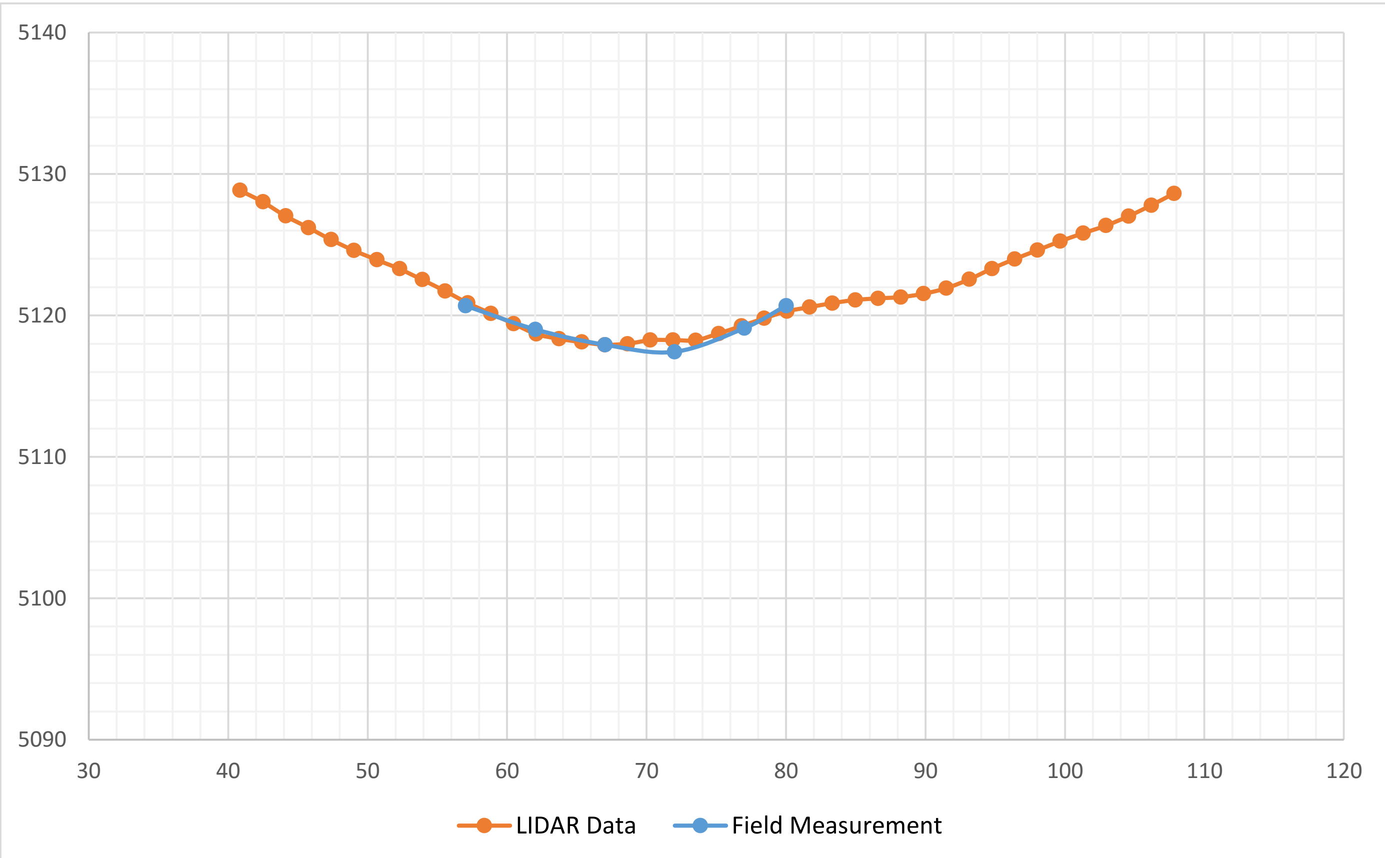
H	2.490
B	1
T	10.96
A	14.89
P	12.14
h	2
v	1



k	1.49
n	0.050
A	14.9
P	12.1
S	0.144718

$$V = \frac{k}{n} \times \frac{A^{2/3}}{P} \times S^{1/2}$$

V **13.0 ft/s**



Natural Upstream Channel Cross Section

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

Plate 4

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

MEMORANDUM

PROFESSIONAL GEOLOGIST # 5242839 TIMOTHY J. THOMPSON 9/4/15 LICENSED STATE OF UTAH

To: **Matt Rasmussen**

From: **Timothy J. Thompson, P.G.**
Hiram Alba P.E., P.G.
Daniel J. Brown, E.I.T.

Date: **September 4, 2015**

Subject: **Review Response for Third Geological Review Matt Rasmussen Hillside Review 6472 South Bybee Drive, Ogden, Utah, 84403 SA Project No. 15-140**

GeoStrata has received review questions of our report titled **Review Response for Geological Review – 6472 and 6498 South Bybee Drive, Weber County Parcel Numbers: 07-753-0001 and 07-753-0002 Uintah, Weber County, Utah, SA Project Number 15-140**, GeoStrata Job Number 910-001 and dated July 9, 2015. This report was prepared for Mr. Matt Rasmussen and submitted to Weber County for review. Mr. David B. Simon, P.G. of Simon Associates LLC (SA) prepared a review of our report. This memorandum was prepared in response to a series of review questions presented in a letter prepared by Mr. Simon and dated May 27, 2015.

SA Recommendations

The May 27, 2015, SA review letter contained ten items for which SA recommended Weber County request additional data and/or clarification. It is our opinion that the July 9, 2015, GeoStrata memorandum adequately responds to eight of the items in the May 27, 2015 SA geologic review letter. SA recommends Weber County not consider the geologic submittals complete from a geologic perspective until GeoStrata adequately addresses the following items:

1. *Item 5 from May 27, 2015, SA Geologic Review Letter:*

   a. *In their July 9, 2015 memorandum, GeoStrata states (first paragraph on page 5) "As stated in GeoStrata's response to SA Recommendation 2 above, the updated log of Trench 2 has been included in this response to extend our trench coverage on the east side of Lot 1R the requested 25 feet setback distance."*

   GeoStrata Trench T-2 is located about 275 feet to the south of Lot 1R. It is SA's opinion T-2 is located too far to the south to be representative of geologic conditions at Lot 1R, particularly in regards to evaluating surface-fault-rupture potential.

   Geologic mapping and paleoseismic trenching have shown that patterns of ground deformation resulting from past surface faulting on normal faults in Utah are highly variable, and may change significantly over short distances along the strike (trend) of the fault.

While a single trench provides data at a specific fault location, multiple trenches are often required to characterize variability of the fault, to provide a more comprehensive understanding of faulting at a particular site, and/or to adequately document the absence of faulting.

For that reason, it is standard practice that subsurface data generally not be extrapolated more that about 300 feet (100± meters) without additional subsurface information. Accordingly, SA recommends:

i. Excavation of a trench near Lot 1R, of adequate length to explore the proposed building site(s) plus any potential setback to the east of the building envelope (Salt Lake County 2002; Christensen and others, 2003; Morgan County, 2010; Draper City, 2010).

GeoStrata Response:

As per instructions of Dana Q. Shuler P.E., CFM in an email dated August 19, 2015 this review comment is not to be addressed at this time.

ii. At least 25 feet be utilized as the potential setback distance.

GeoStrata Response:

As per instructions of Dana Q. Shuler P.E., CFM in an email dated August 19, 2015 this review comment is not to be addressed at this time.

iii. A scoping meeting prior to commencement of field work to allow Weber County to evaluate the geologist's investigative approach. At the scoping meeting, the consultant should present the purpose of the field work and the location of the proposed trench(es), which meet the minimum standard of practice. To expedite the process and due to Weber County's familiarity with the proposed development, the site plan could be emailed to Weber County and the scoping meeting completed via telephone.

GeoStrata Response:

As per instructions of Dana Q. Shuler P.E., CFM in an email dated August 19, 2015 this review comment is not to be addressed at this time.

iv. A field review by Weber County of the trench(es) to allow Weber County the opportunity to evaluate subsurface data (i.e., age and type of sediments; presence/absence of faulting, etc.) with the consultant, and verify the investigation is adequate.

GeoStrata Response:

As per instructions of Dana Q. Shuler P.E., CFM in an email dated August 19, 2015 this review comment is not to be addressed at this time.

b. The descriptions of Unit 4, Trench T-2 (page 6) and Unit 5 (page 7), in the July 9, 2015, GeoStrata memorandum appear to reference incorrect geologic units. SA recommends Weber County request GeoStrata clarify the apparent discrepancies.

GeoStrata Response:

The two unit descriptions noted in the SA review comment have a typo that incorrectly referred to Unit 3 instead of Units 4 and 5 in one sentence in each unit description. The corrected sentence from each unit description should read "Unit 4 was interpreted as Pleistocene-aged lacustrine gravel deposits" for Unit 4 and "Unit 5 was interpreted as Pleistocene-aged lacustrine gravel deposits" for Unit 5.

2. *Item 6b from May 27, 2015 SA GeoLogic Review Letter:*

Response "b" on page 11 of the July 9, 2015, GeoStrata memorandum states: "GeoStrata has attached the Site Geologic Map (Plate A-5) and the Site Geologic Setback Map (Plate A-6) to the end of this letter. The Site Geologic Map (Plate A-5) is intended to delineate the alluvial fan sediments on the site and the Site Geologic Setback Map (Plate A-6) is intended to show the active channel setback based on the hydrology report prepared by HydroPlot titled "Drainage Evaluation for Dauphine'-Savoy-Piedmont Subdivision, Lot #2, Ogden, UT" and dated September 4, 2014 and shown on the Grading/Drainage Plan prepared by Silverpeak Engineering and stamped by Joshua R. Jensen P.E. This report and Grading/Drainage Plan are included in Appendix D of this letter."

There appears to be an inconsistency between the calculated drainage setback as shown on GeoStrata Plate A-6, Site Geologic Setback Map (attached), and site geologic conditions as shown on GeoStrata Plate A-5, Site Geologic Map (attached). Plate A-6 depicts the drainage setback coinciding with the proposed building foot print, northwest of the drainage setback line. SA recommends Weber County request GeoStrata clarify the apparent discrepancy.

GeoStrata Response:

GeoStrata has revised the Site Geologic Setback Map to more accurately reflect the location of the drainage easement delineated in the Grading/Drainage Plan prepared by Silverpeak Engineering. The updated map is attached as Plate 1.

3. *Item 6d from May 27, 2015, SA Geologic Review Letter:*

Response "d" on page 12 of the July 9, 2015, GeoStrata memorandum states: " The drainage easement is labeled on the Grading/Drainage Plan as an existing 50 ' drainage easement but actually measures 75 feet according to the reported scale. The Modified Channel Cross Section detail on the Grading/Drainage Plan shows a minimum channel width of 20 feet and a minimum depth of 3 feet."

SA recommends Weber County request GeoStrata clarify whether the existing drainage easement is 50 feet of 75 feet wide.

GeoStrata Response:

The existing drainage easement is 50 feet wide. The discrepancy for the easement width came as a result of the scale being incorrect on the Grading / Drainage Plan by Silverpeak Engineering. It is labeled on their drawing as being 1 inch equal to 30 feet, when it should be 1 inch equal to 20 feet. This mistake was verified with Joshua Jensen, P.E. of Silverpeak Engineering.

4. *Item 6e(ii) from May 27, 2015, SA Geologic Review Letter:*

On page 13 of the July 9, 2015, GeoStrata memorandum, GeoStrata states:

Fire-related debris flow volumes for the subject property were predicted using the Western USA regression model (Gartner and others, 2008; Giraud and Castleton, 2009; Cannon and others 2010). The model estimates debris flow volumes as:

$$\ln V = 0.59(\ln S) + 0.65(B)^{1/2} + 0.18(R)^{1/2} + 7.21$$

Giraud and Castleton, 2009, utilize the Western U.S. regression model of Gartner and others (2008) for fire related debris flows:

$$\ln V = 0.59(\ln S) + 0.65(B)^{1/2} + 0.18(R)^{1/2} + 7.21$$

It is noteworthy that the regression model in Gartner and others (2008) and Giraud and Castleton (2009) is not the same as the regression equation in Cannon and others (2010) for fire related debris flows:

$$\ln V = 7.2+0.6(\ln A) + 0.7(B)^{1/2} + 0.2(T)^{1/2}+0.3$$

SA recommends Weber County request GeoStrata evaluate the fire related debris volume using the regression models from Giraud and Castleton (2009) and Cannon and others (2010); the most conservative results should be used at the subject site (hand calculations should be provided).

GeoStrata Response:

GeoStrata has evaluated the fire related debris volume using the regression model from Cannon and others (2010). A printout of our calculations, showing inputs and outputs for the regression model is included as Plate 2. Based on our calculations, the fire related debris flow volume predicted by the Cannon and others (2010) intermountain western United States post-wildfire debris flow regression model for a maximum rainstorm event with a 10-year recurrence interval and a 60 minute duration is 6.2 acre-feet.

5. *The July 9, 2015, GeoStrata memorandum provides debris flow analysis only for fire-related debris flows. SA recommends Weber County request GeoStrata provide an analysis of debris flows that could result from rapid snowmelt/rainfall. That analysis should:*

   a. Include hand calculations.

   b. Include derivation of all variables, including sediment bulking, and;

   c. Account for all processes that trigger snowmelt/rainfall debris flows.

GeoStrata Response:

GeoStrata has completed an analysis of debris flows that could result from rapid snowmelt/rainfall. Our analysis included a field observation of the existing channel, the measurement of cross sections in the field, plotting the measured cross section using both field data and sub-meter Wasatch Front LiDAR elevation data obtained from the State of Utah AGRC, and determining the total volume of bulked sediment in the existing channel.

A field investigation was conducted to observe the conditions of the existing channel and to measure cross sections of the channel bottom at selected representative points along the length of the channel. Photographs from various points along the length of the channel, including the locations of the measured cross sections, are included as Plate 4 to Plate 10. Cross sections of the channel were measured in the field at 3 representative points along the length of the channel. A map showing the locations of each of the cross sections is included as Plate 11. 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 presence of heavy vegetation.

Within the canyon, occasional angular boulders of up to approximately 18 inches in diameter were observed and appeared to have been deposited as a result of the rock fall processes within the canyon. Boulders were not observed within the channel below the mouth of the canyon. Two test pits were excavated for the 2013 GeoStrata geotechnical report for the subject property within the channel. Maximum observed particle diameter within the test pits consisted of cobbles up to 10” in diameter in test pit TP-1 and cobbles up to 6” in diameter in test pit TP-2. The test pit logs are attached as Plate 12 and Plate 13.

Plots of each of the cross sections that were analyzed for this investigation are included as Plate 14 through Plate 17. Total stored sediment was estimated using the geometry of each of the cross sections. The table below summarizes the results of our investigation.

Cross Section	Channel Segment Length (ft)	Stored Sediment (ft^3/ft)	Stored Sediment (ft^3)	Debris Flow Volume (ac-ft)
1	882.4	28	24707.2	0.6
2	614.5	8	4916	0.1
3	1010.1	18	18181.8	0.4
4	1558.0	86	133988	3.1
				4.2

Based on these calculations, a debris flow event resulting from rapid snowmelt/rainfall should have a total volume of 4.2 ac-ft. This value is based on breaking the channel into four segments and assuming that stored sediment in each of the segments is represented in the cross sections that are presented.

In order be conservative, we have elected to estimate the total stored sediment for the entire length of the channel to be 86 ft^3/ft, the maximum observed stored sediment, and that 100% of the stored sediment is mobilized in a debris flow event with a 50% bulking rate (debris flows consisting of 50% sediment and 50% water). Using these assumptions, the maximum potential debris flow event is estimated to be 16.1 ac-ft.

Applying this volume to a unit rational hydrograph, peak debris flow for the subject property is estimated to be 193.6 cfs. Based on the Silverpeak Engineering Grading /Drainage Plan, they propose improving the existing stream channel and show a cross section of the improved stream channel on page C1.0. The gradient of the stream channel as shown on their Grading /Drainage Plan will be approximately 14.5%. Velocity of the debris flow at peak flows will be 13.0 feet per second.

Based on equations from Prochaska and others (2008) mentioned in the July 9, 2015 GeoStrata review response document, the superelevation height around the bends in the channel across the property will be 0.26 ft, and the berm height or channel depth should be at least 6.0 feet.

Based on the depth to width ratio given by Hungr and others (1984), the slope and grade of the property, and estimated debris flow volumes and peak flows, we recommend that the channel be modified to consist of a trapezoidal channel with a base width of 1 foot and depth of at least 6.0 feet with the sides of the channel sloped at a 2H:1V (horizontal to vertical) gradient. Given these channel dimensions, the depth of flow for an anticipated debris flow would be approximately 2.5 feet, the width of the channel at the top of the flow would be approximately 11.0 feet resulting in a depth-to-width ratio for the modified channel of 0.23. This ratio complies with the recommendation of Hunger and others, (1984) of a minimum depth-to-width ratio of 0.2. These channel cross section dimensions should be consistent across the entire site to prevent deposition of debris flows within the channel. A cross section drawing of the channel cross section is included as Plate 3.

6. *Item 6e(ii) from May 27, 2015, SA Geologic Review Letter; On page 13 of the July 9, 2015, GeoStrata memorandum it states:*

"Total basin area and the percent of the basin with slopes greater than 30% were given in the 2014 HydroPlot hydrology report (Appendix D)."

The water shed area is shown on Figure 1 of the September 4, 2014, HydroPlot report. SA recommends Weber County request GeoStrata submit HydroPlot Figure 1 ("Broad Hollow Drainage Location & Topography") with bar Scale.

GeoStrata Response:

As per instructions of Dana Q. Shuler P.E., CFM in an email dated August 19, 2015 this review comment is not to be addressed at this time.

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 other 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.

References

Cannon, S. H., Gartner, J.E., Rupert, M.G., Michael, J.A., Rea, A.H., and Parrett, C., 2010, Predicting the Probability and Volume of Postwildfire Debris Flows in the Intermountain Western United States, Geological Society of America GSA Bulletin; January/February 2010; v. 122; no. 1/2; p. 127-144.

Christenson, G.E., and Shaw, L.M., 2008, Geographic Information System database showing geologic-hazard special study areas, Wasatch Front, Utah; Utah Geological Survey Circular 106, j7 P., GIS data, scale 1:24,000.

Gartner, J.E., Cannon, S.H., Santi, P.M. and Dewolfe, V.G., 2008, Empirical Models to Predict the Volumes of Debris Flows Generated by Recent Burned Basins in the Western U.S., Geomorphology 96 (2008) 339-354.

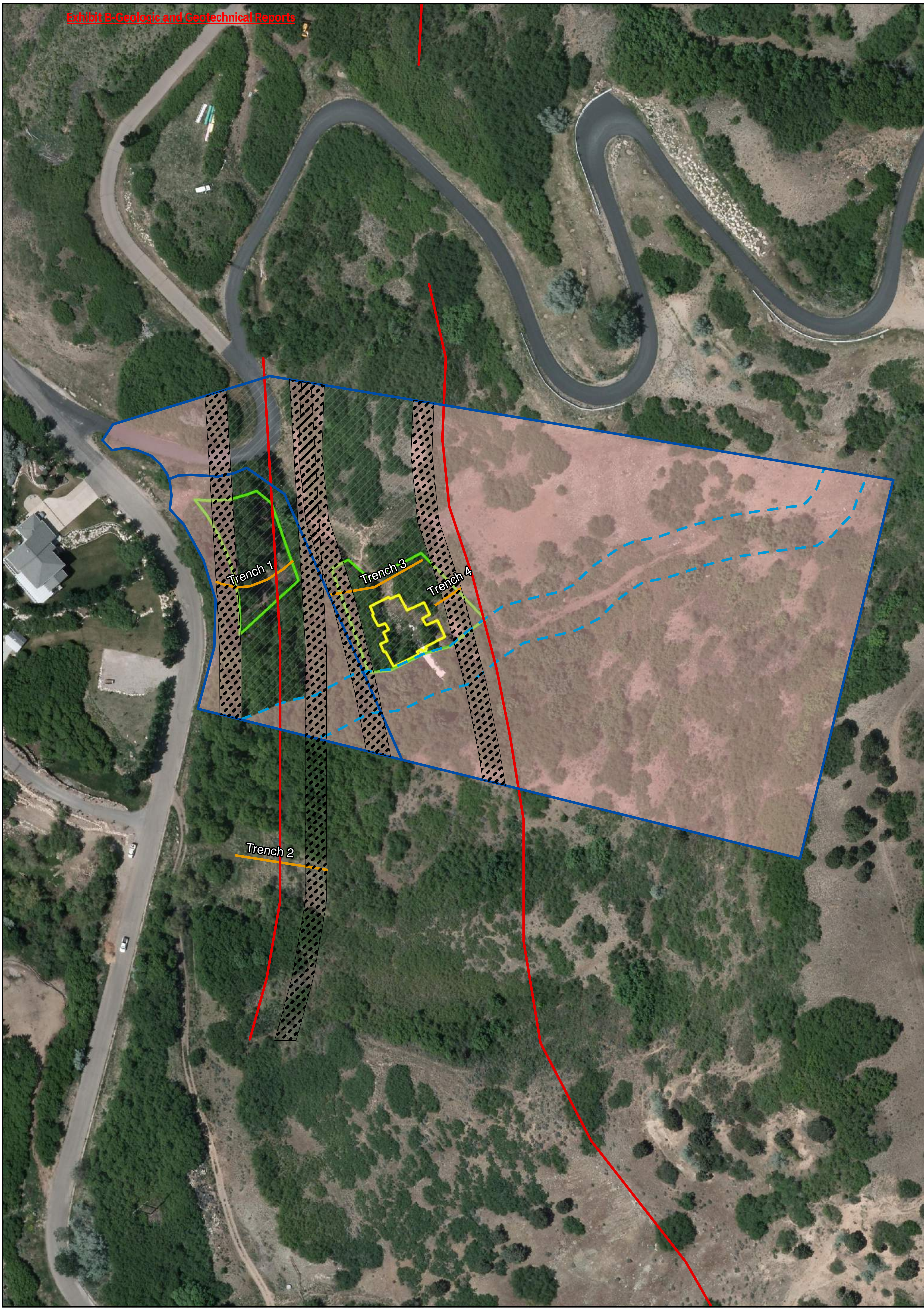
Giraud, R.E. and Castleton, J.J., 2009, Estimation of Potential Debris-Flow Volumes for Centerville Canyon, Davis County, Utah, Utah Geological Survey Report of Investigation 267, 33 p.

HydroPlot, September 4, 2014, Drainage Evaluation for the Dauphine'-Savoy-Piedmont Subdivision, Lot #2, Ogden, UT, p 3., unpublished consultant report.

Hungr, O., Morgan, G.C., and Kellerhals, R., 1984, Quantitative analysis of debris torrent hazards for design of remedial measures, Canadian Geotechnical Journal, v. 21, p. 663-677.

Silverpeak Engineering, 10-17-2014, Rasmussen Residence Weber Canyon Uinta County, Utah, Wash Grading Plan, Grading/Drainage Plan, p C1.0 - C2.0., Unpublished consultant plan set.

Yonkee, A., Lowe, M., 2003, Geologic Map of the Ogden 7.5' Quadrangle, Weber and Davis Counties, Utah, Utah Geological Survey Map 200.



Legend

- 25ft Fault Setback Zone
- Site Boundary
- Fault (Yonkee & Lowe 2004)
- Fault Trench
- Drainage Setback
- Buildable Area
- Non-Buildable Area
- 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 1

Intermountain Western US Post Wildfire Debris Flow Volume Regression Model
Cannon and others (2010)

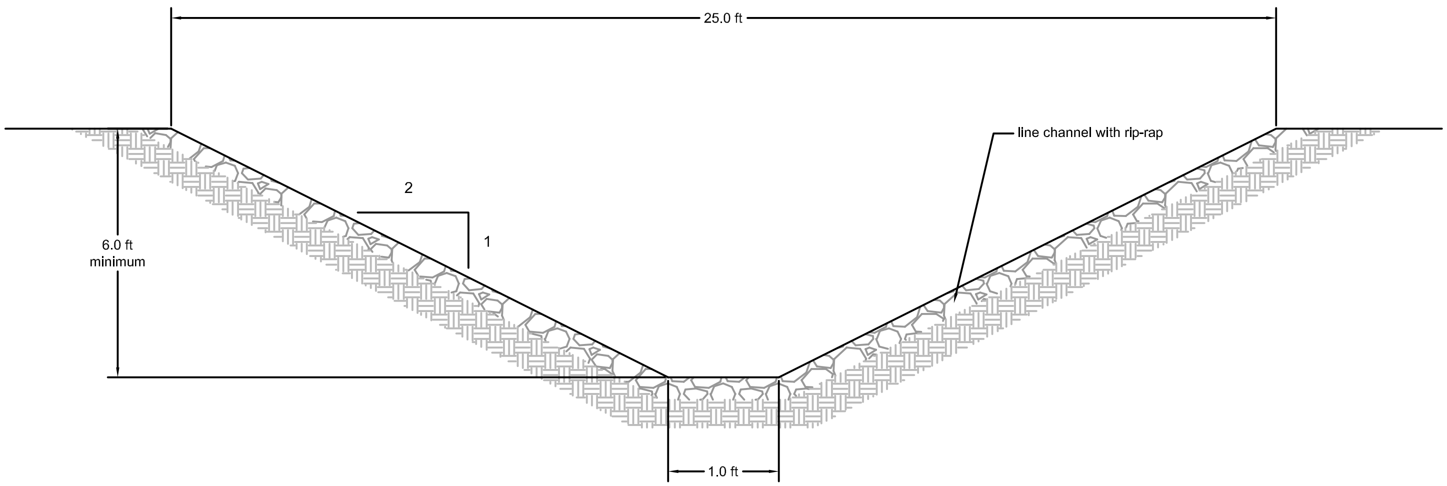
ln V = 7.2+ 0.6(ln A) + 0.7(B)^(1/2) + 0.2(T)^(1/2) + 0.3

V	Volume
A	Area with slopes greater than 30%
B	Area burned at moderate to high severity
T	Total storm rainfall

Broad Hollow WS

B	0.60	**sq km**		
A	0.56	**sq km**		
T-2 year	16.7	**mm**		
T-5 year	22.6	**mm**		
T-10 year	27.9	**mm**		
T-100 year	53.6	**mm**		
V-2 year	6042.183	**m^3**	4.9	**ac-ft**
V-5 year	6907.303	**m^3**	5.6	**ac-ft**
V-10 year	7677.514	**m^3**	6.2	**ac-ft**
V-100 year	11533.87	**m^3**	9.4	**ac-ft**

Channel Cross Section



NOT TO SCALE

Matt Rassmussen
Dauphine-Savory Piedmont Subdivision
south Weber, UT
Project Number: 910-001

Plate
3

Cross Section 1 – Upstream View

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

Plate 4

Cross Section 1 – Cross-Stream View

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

Plate 5

GeoStrata

Cross Section 2 – Upstream View

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

Plate 6

Between Cross Section 1 and Cross Section 2 – Upstream View

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

Plate 7

GeoStrata

Cross Section 3 – Upstream View

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

Plate 8

GeoStrata

Cross Section 3 – Upstream View

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

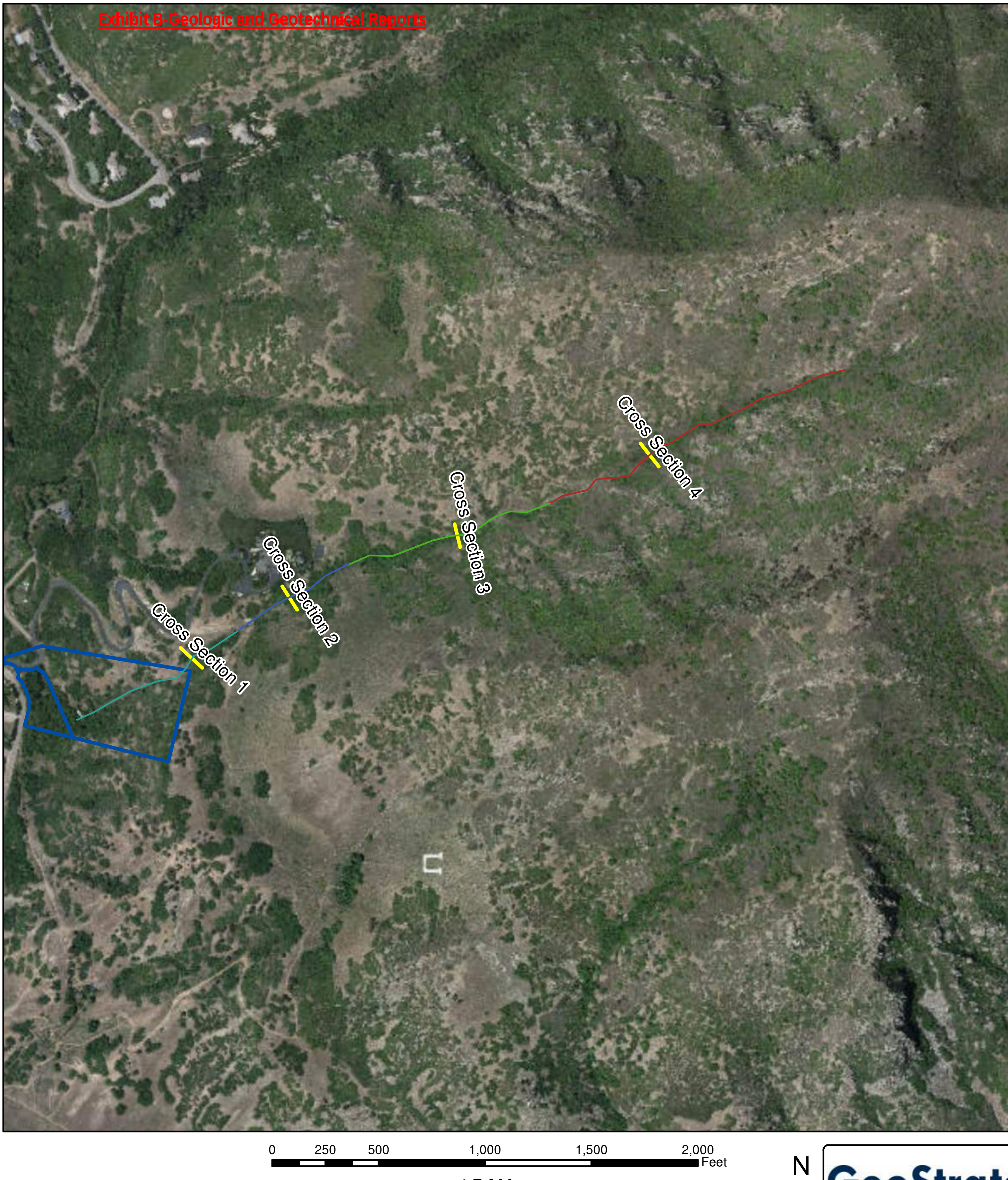
Plate 9

GeoStrata

Cross Section 3 – Downstream View

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

Plate 10



Base Map: Utah AGRC Imagery BaseMap

Legend

- Channel Segment 1
- Channel Segment 2
- Channel Segment 3
- Channel Segment 4
- Cross Section
- Site Boundary

GeoStrata

Matt Rasmussen
Dauphine-Savory Piedmont Subdivision
South Weber, UT
Project Number: 910-001

Cross Section Location Map

Plate 11

DATE	
STARTED:	10/22/13
COMPLETED:	10/22/13
BACKFILLED:	10/22/13

Matt Rassmusen
Dauphine-Savory Piedmont Subdivision
Weber County, UT
Project Number 910-001

GeoStrata Rep: S. Seal
Rig Type: Trackhoe

TEST PIT NO: **TP-1**
Sheet 1 of 1

LOCATION
NORTHING EASTING ELEVATION

Depth (feet)	Samples	Unified Soil Classification	Material Description	Dry Density (pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
0			TOPSOIL; Clayey SAND with gravel, cobbles, and boulders - with roots and pinholes throughout					
2		SM	Silty SAND with gravel and cobbles - dense, brown, moist to slightly moist, gravel is subrounded, cobbles observed up to 10" in diameter					
~6.5	Grab				3.2	12.3	NP	NP
8	Grab	GP-GM	Poorly Graded GRAVEL with silt and sand - dense, brown, moist to slightly moist, gravels are subrounded, gravel observed up to 3" in diameter		0.8	7.9	NP	NP
9.5			@ 9.5 ft - material is angular, gravel observed up to 6" in diameter					
11			Bottom of Test Pit @ 11 Feet					

Moisture Content and Atterberg Limits: Plastic Limit — Moisture Content — Liquid Limit (10 20 30 40 50 60 70 80 90)

SAMPLE TYPE
- GRAB SAMPLE
- 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
- MEASURED
- ESTIMATED

NOTES:

Plate 12

DATE		
STARTED:	10/22/13	
COMPLETED:	10/22/13	
BACKFILLED:	10/22/13	

Matt Rassmusen
Dauphine-Savory Piedmont Subdivision
Weber County, UT
Project Number 910-001

GeoStrata Rep: S. Seal
Rig Type: Trackhoe

TEST PIT NO:
TP-2
Sheet 1 of 1

LOCATION

NORTHING | EASTING | ELEVATION

Depth (feet)	Samples	USCS	Material Description	Dry Density (pcf)	Moisture Content %	Percent minus 200	Liquid Limit	Plasticity Index
0			TOPSOIL; Silty SAND with gravel, cobble, and boulders - with roots and pinholes throughout					
	Grab	SP-SM	Poorly Graded SAND with silt, gravel, and cobbles - dense, brown, moist to slightly moist, gravel is subrounded to subangular, cobbles observed up to 6" in diameter		2.0	10.9	NP	NP
	Grab	GP	Poorly Graded GRAVEL with sand and cobbles - dense, brown, moist to slightly moist, gravel is subangular, gravel observed up to 6" in diameter		0.8	3.8	NP	NP
11			Bottom of Test Pit @ 11 Feet					

Depth scale: METERS 0, 1, 2, 3, 4; FEET 0, 5, 10

Moisture Content and Atterberg Limits
Plastic Limit — Moisture Content — Liquid Limit
10 20 30 40 50 60 70 80 90

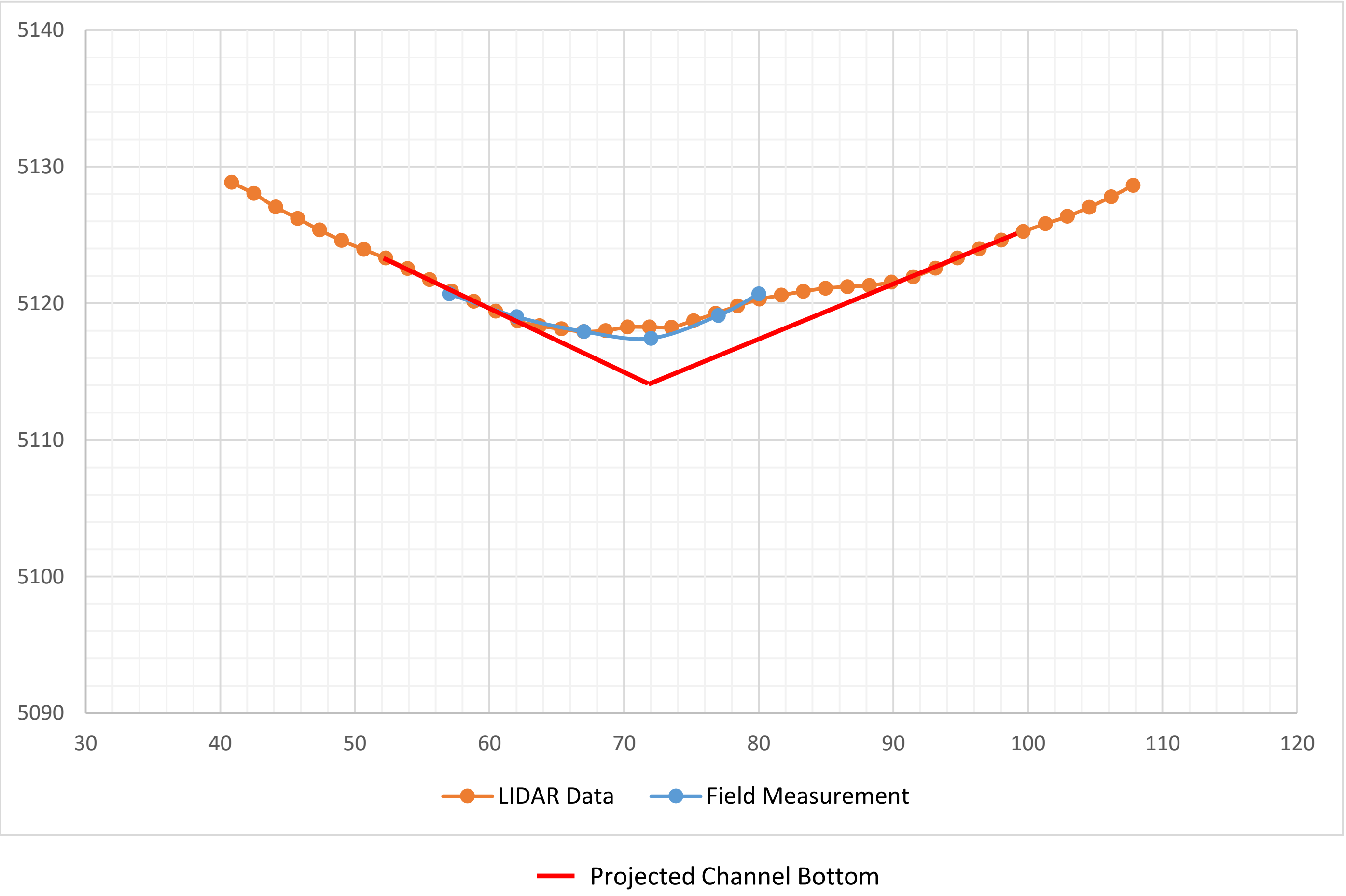
GeoStrata

SAMPLE TYPE
- GRAB SAMPLE
- 3" O.D. THIN-WALLED HAND SAMPLER

WATER LEVEL
- MEASURED
- ESTIMATED

NOTES:

Plate
13

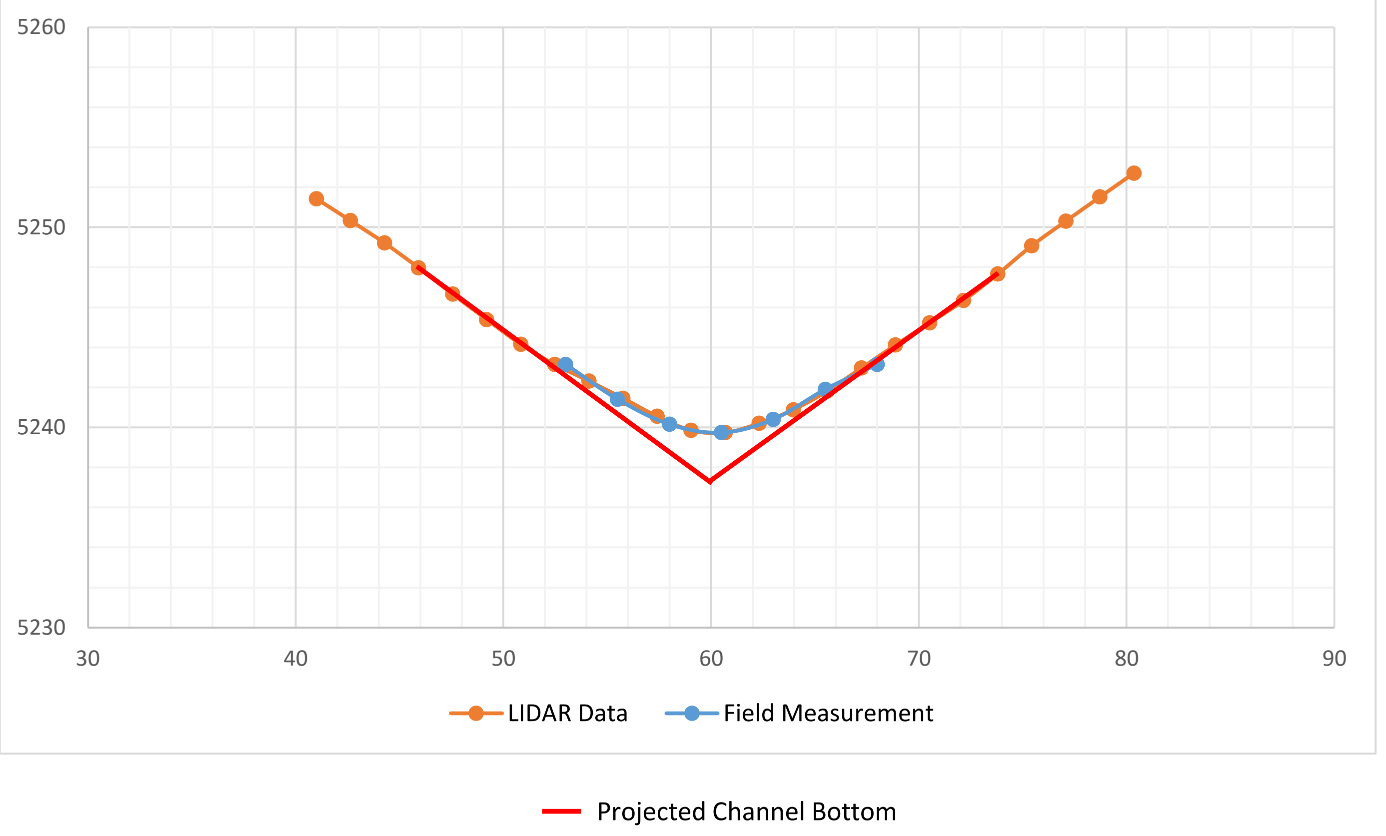


GeoStrata

Cross Section 1

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

Plate 14

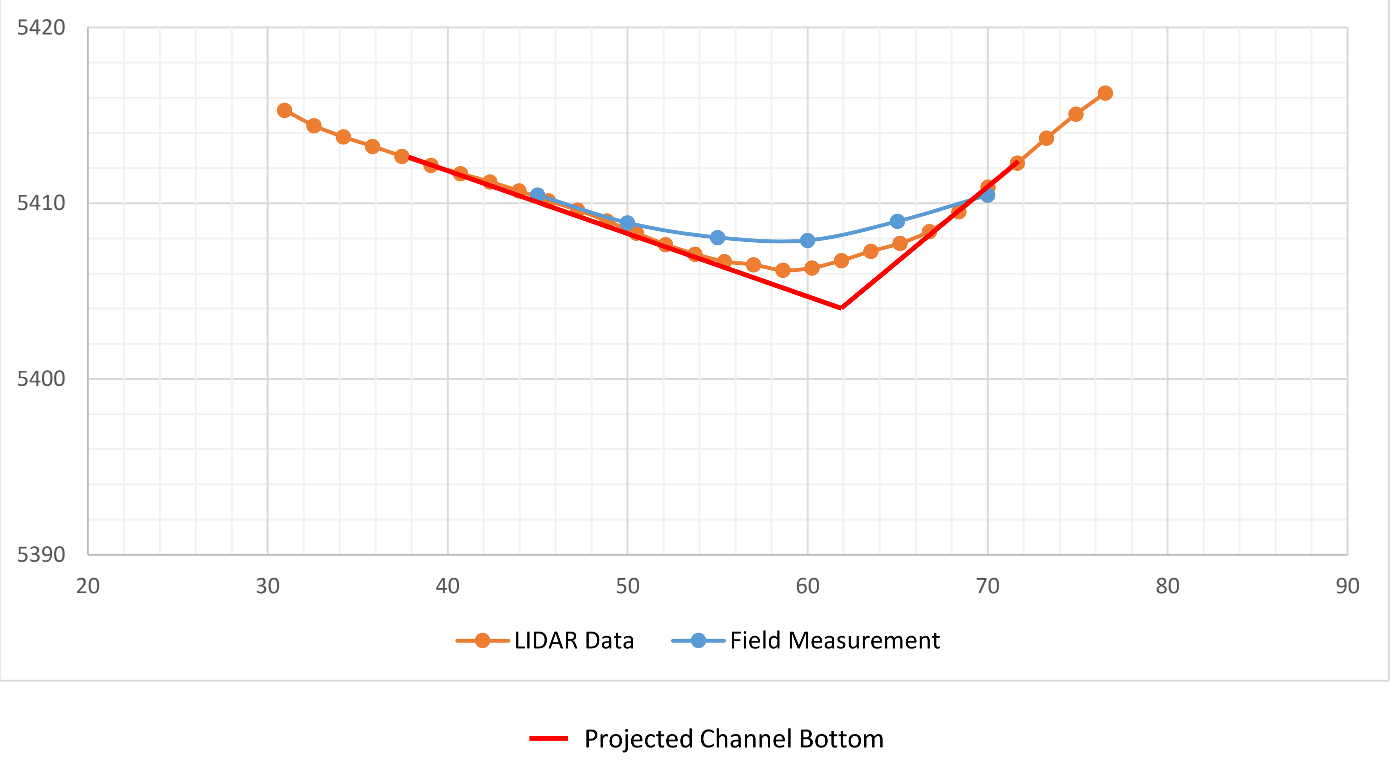


GeoStrata

Cross Section 2

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

Plate 15

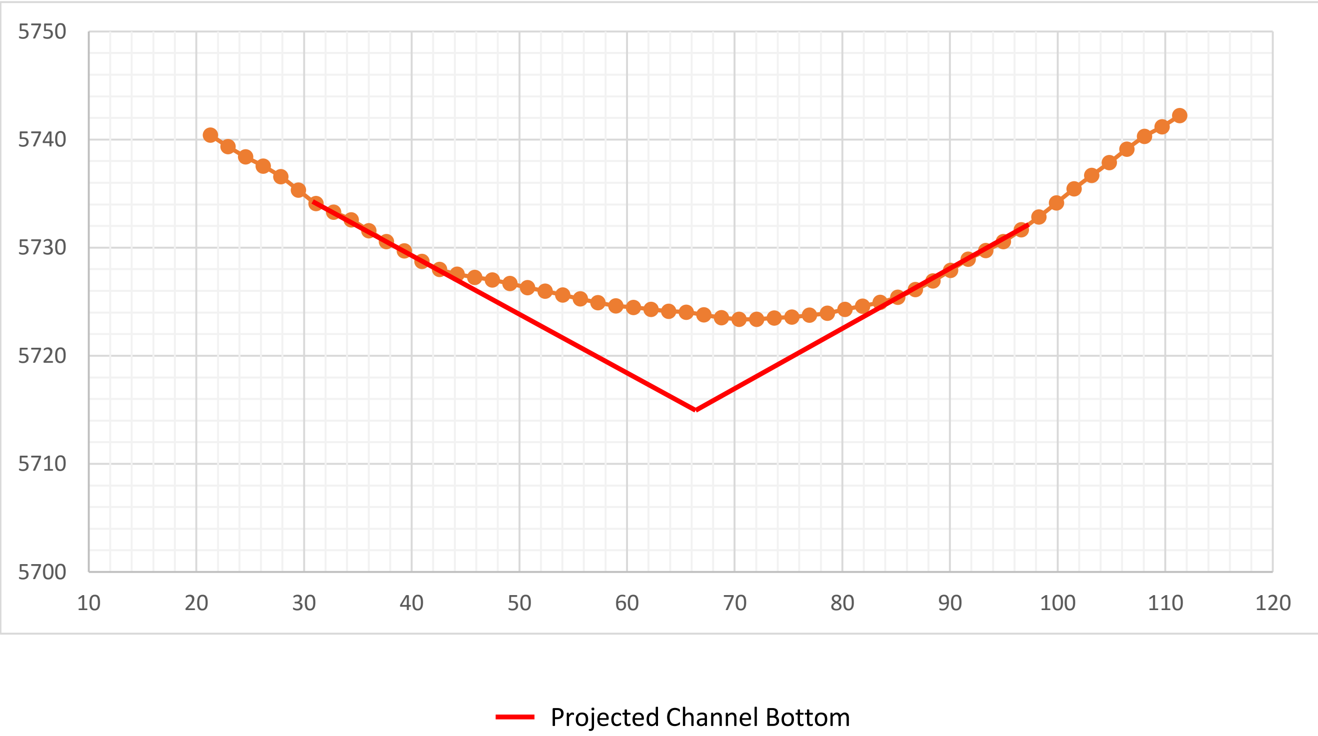


GeoStrata

Cross Section 3

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

Plate 16



Cross Section 4

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

Plate 17