FINAL REPORT

GEOTECHNICAL EVALUATIONS AND DESIGN RECOMMENDATIONS (REVISED)

Permanente Quarry Reclamation Plan Update
Santa Clara County, California

Volume II – Appendices

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APPENDIX 4.A

Updated 2004 Geologic Cross Sections

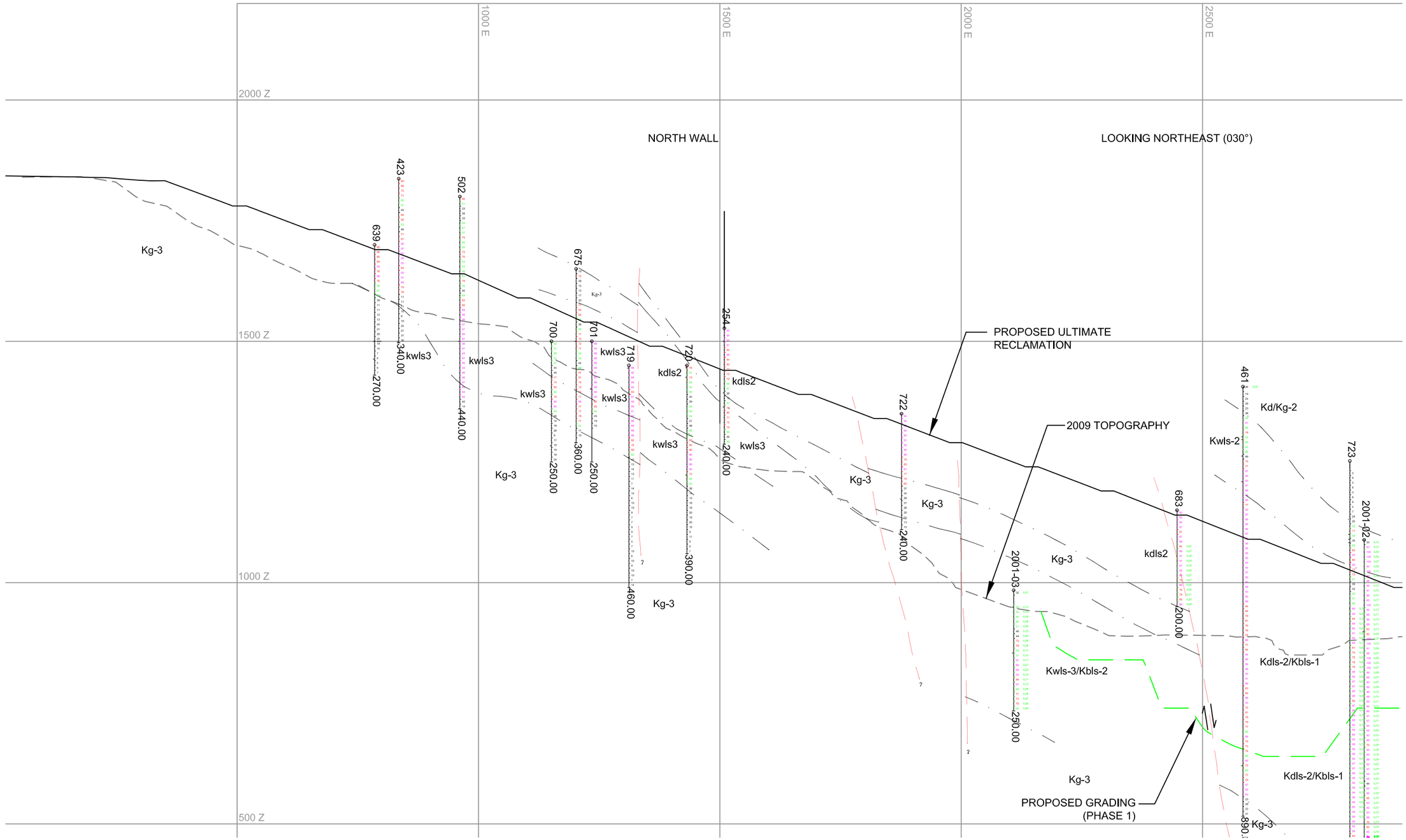

FIGURE **4.A1**

AZIMUTH 120°, SECTION 400

Lehigh Permanente Quarry/CA

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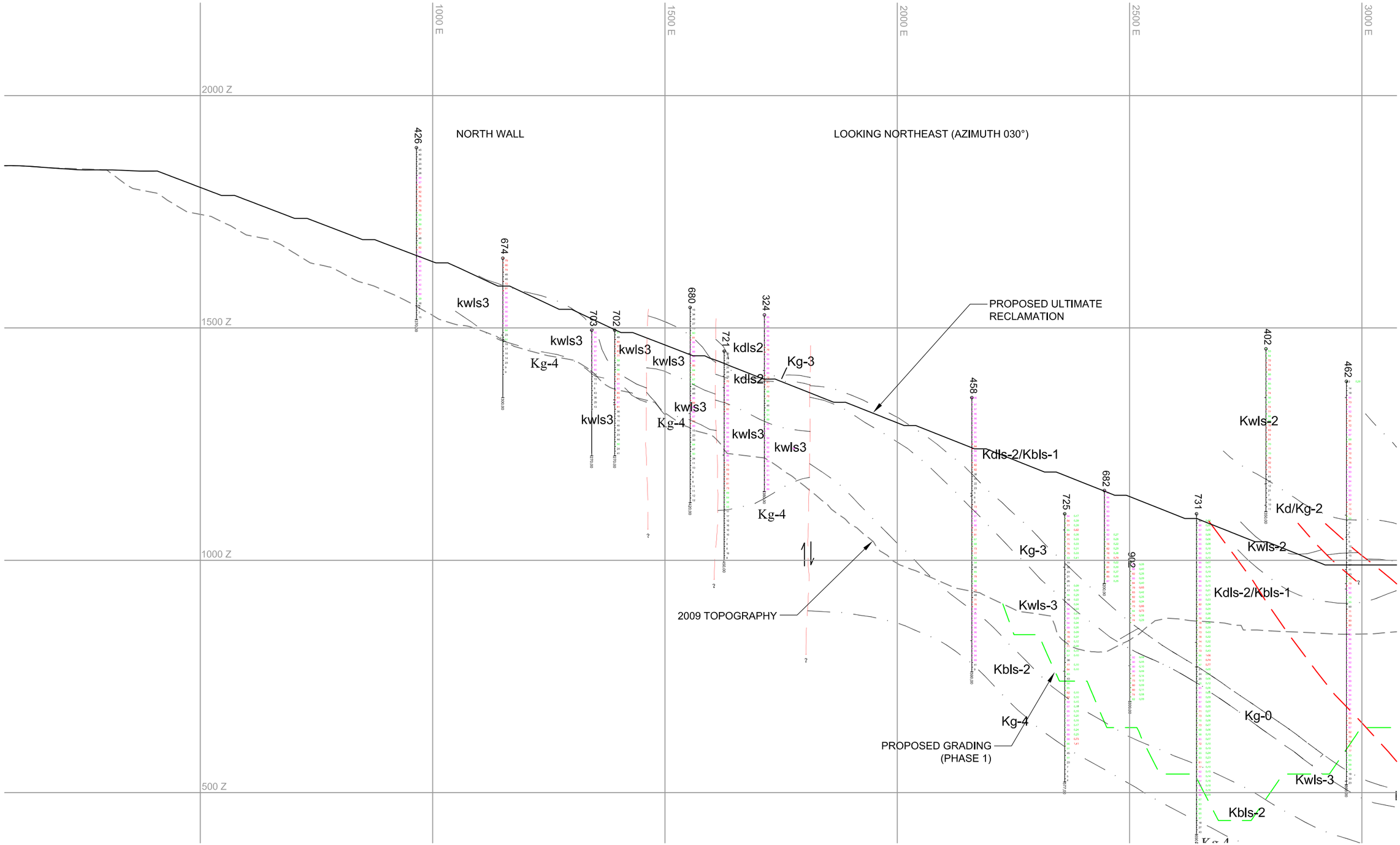

FIGURE **4.A2**

AZIMUTH 120°, SECTION 600

Lehigh Permanente Quarry/CA

Golder Associates

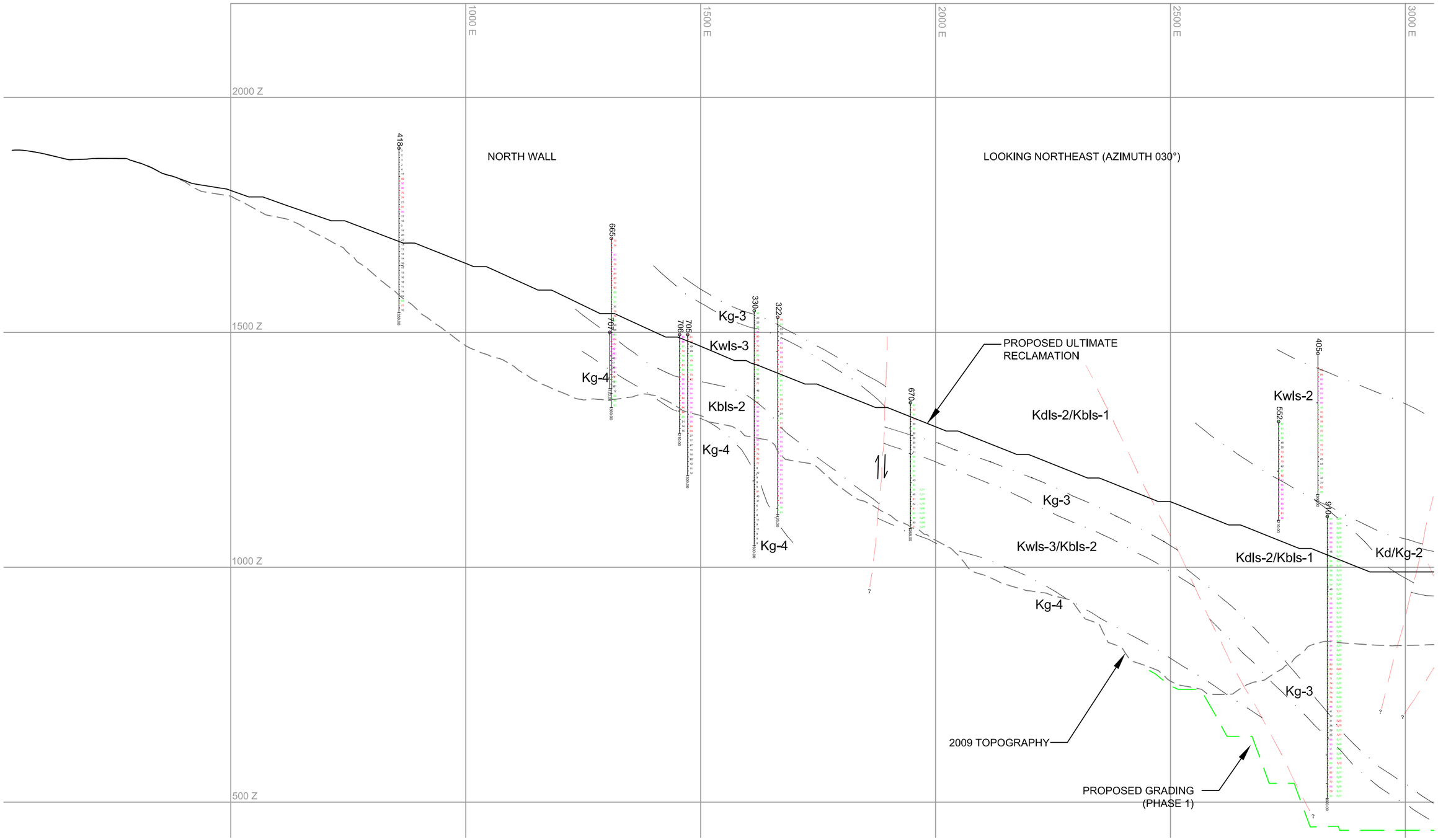

FIGURE **4.A3**

AZIMUTH 120°, SECTION 800

Lehigh Permanente Quarry/CA

Golder Associates

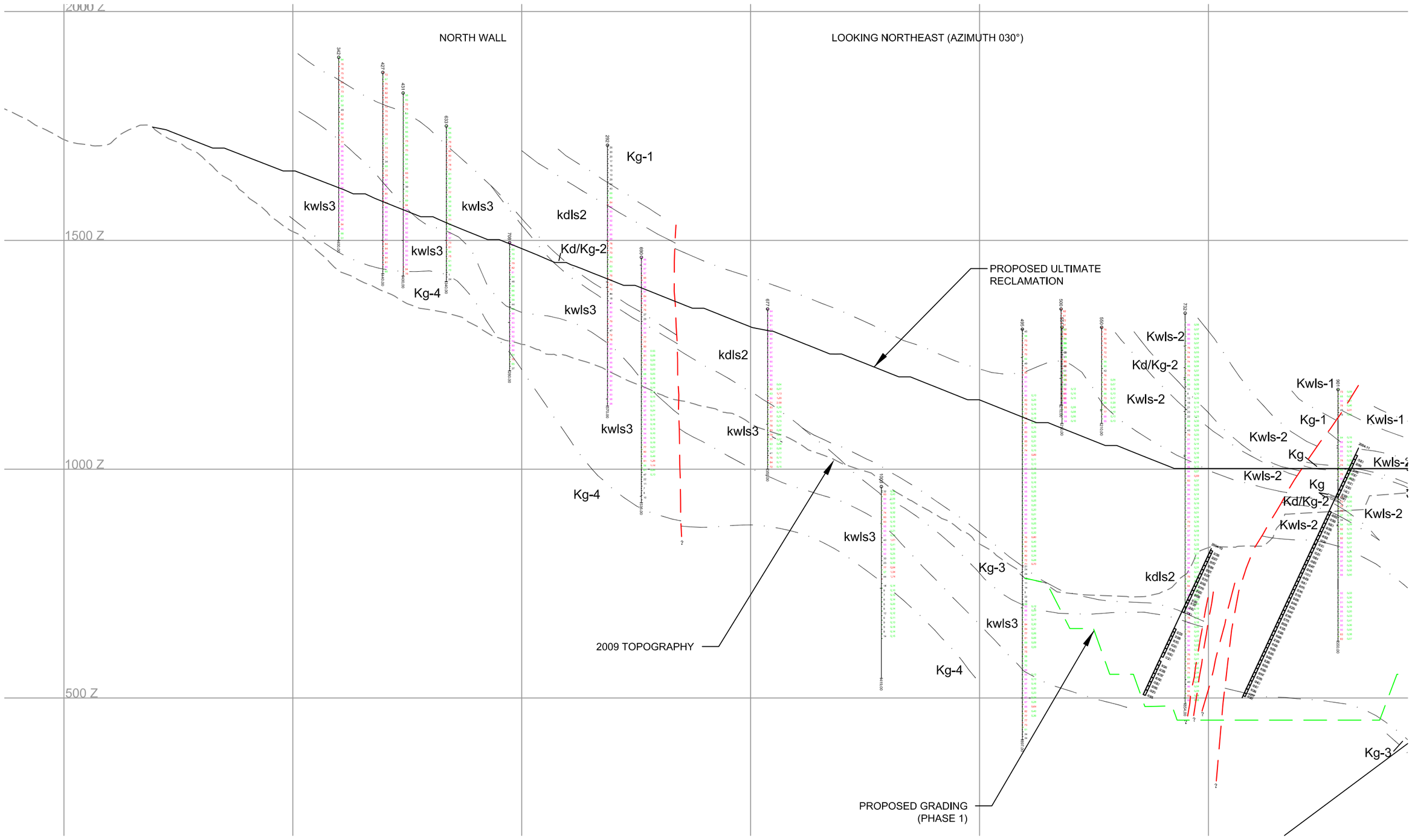

FIGURE **4.A4**

AZIMUTH 120°, SECTION 1000

Lehigh Permanente Quarry/CA

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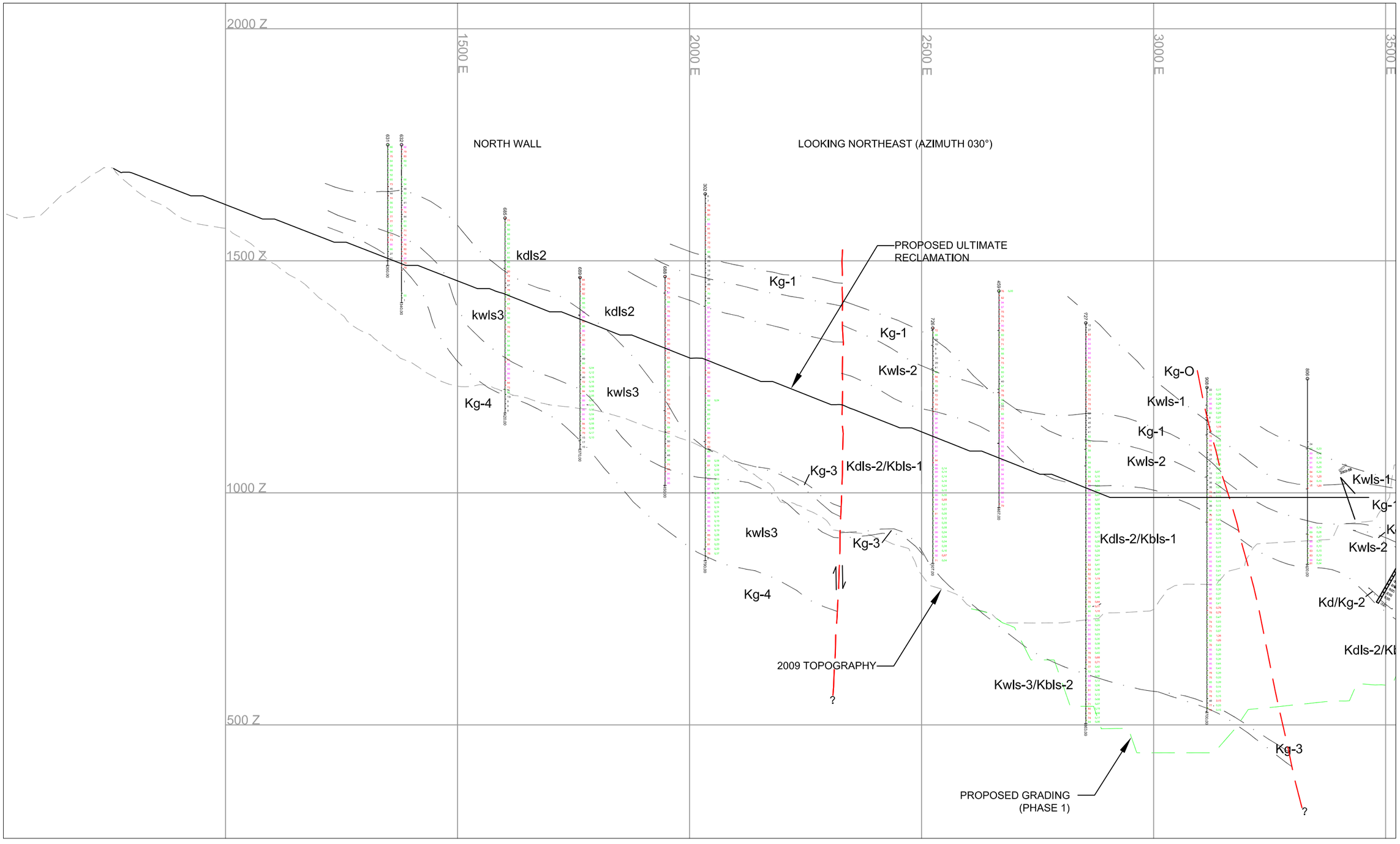

FIGURE **4.A5**

AZIMUTH 120°, SECTION 1200

Lehigh Permanente Quarry/CA

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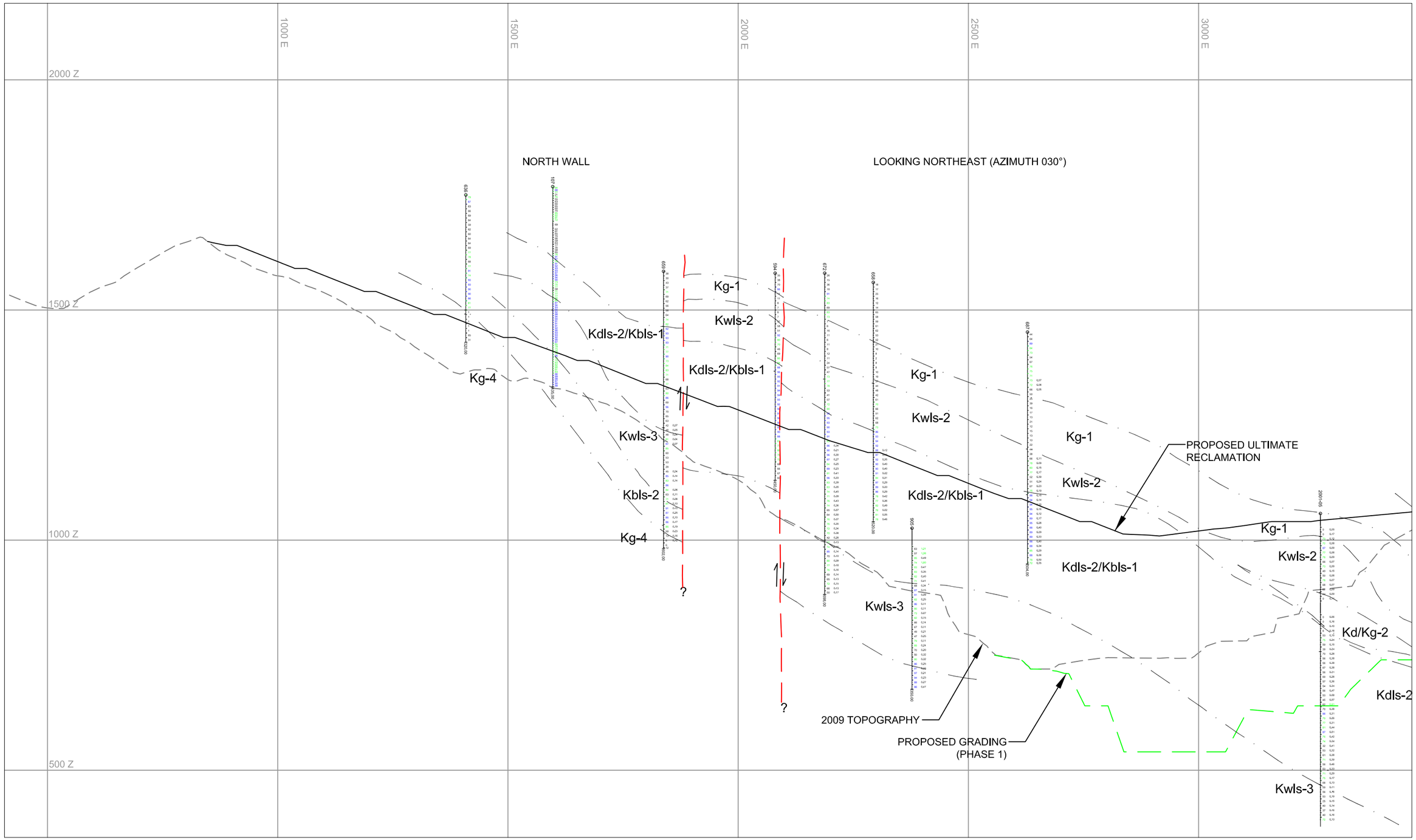

0 200 400
FEET

FIGURE **4.A6**

AZIMUTH 120°, SECTION 1400

Lehigh Permanente Quarry/CA

Golder Associates

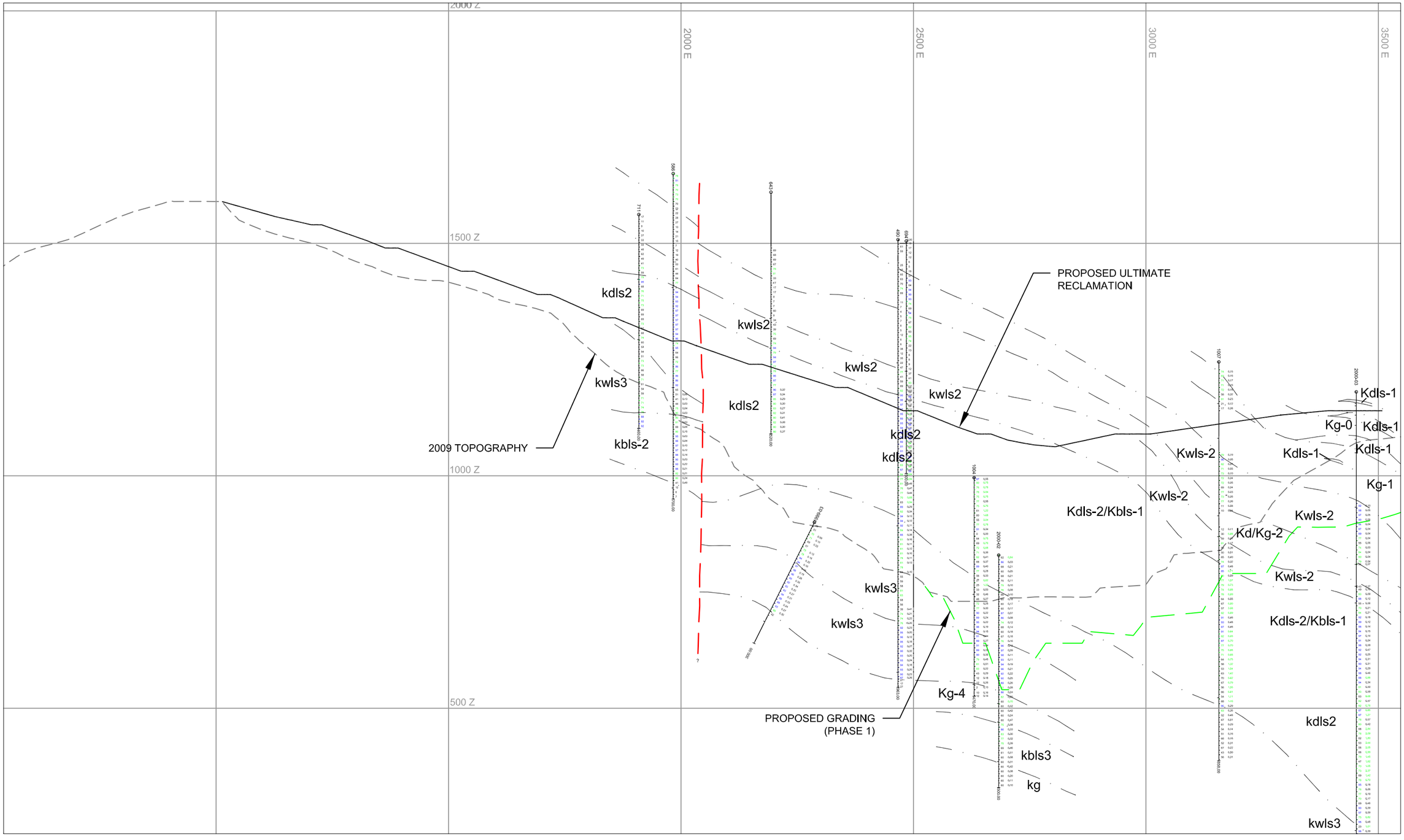

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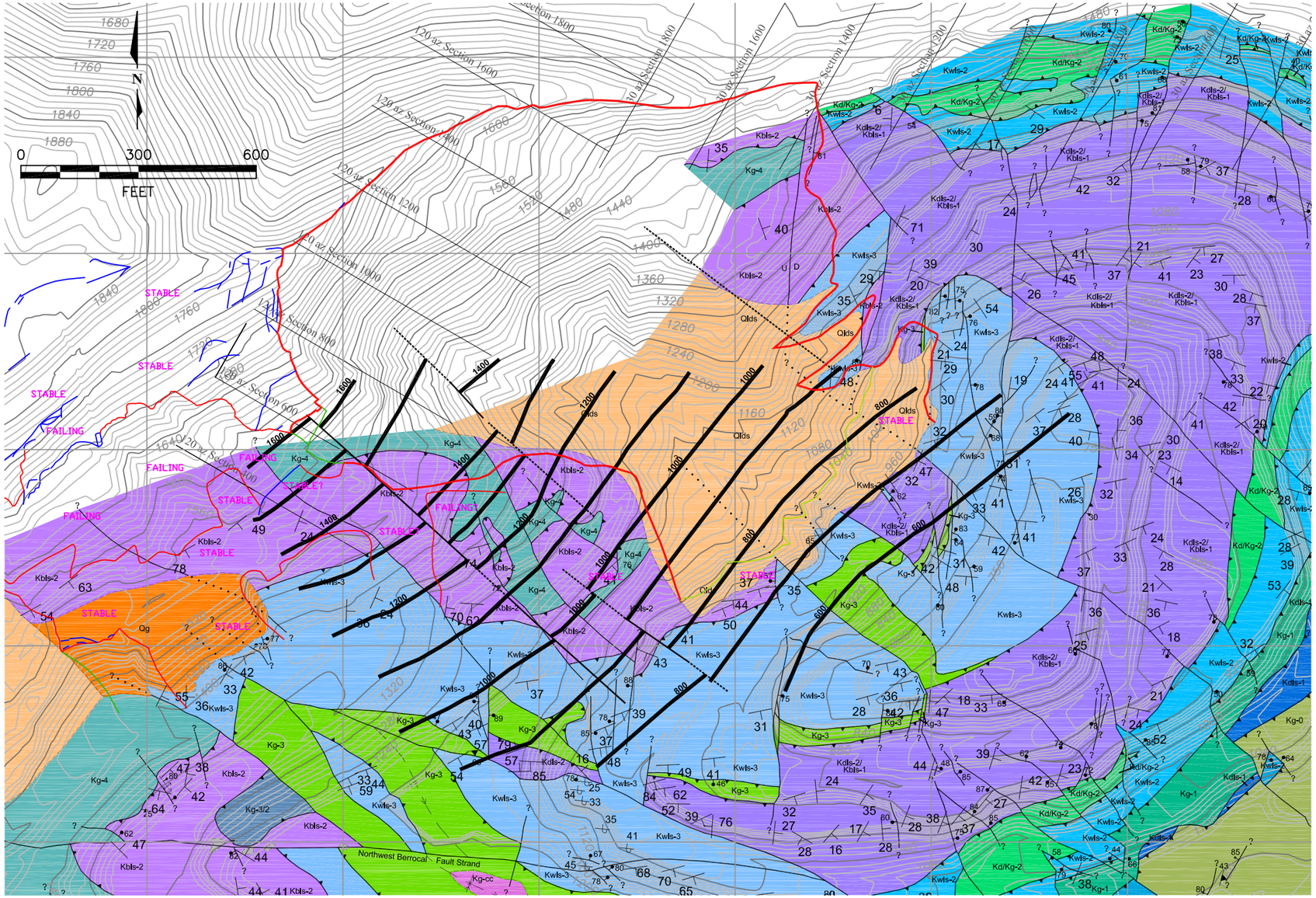
FIGURE **4.A7**

AZIMUTH 120°, SECTION 1600

Lehigh Permanente Quarry/CA

Golder Associates



LEGEND

Quaternary Deposits

- Qlds — Quarry landslide deposits (within surface operation)
- Qg — Waste Material
- Qal — Quaternary and Recent unconsolidated alluvium and gravel deposits

Metamorphosed Igneous and Sedimentary Rocks

?
- Km-1 — Greywacke, shale, and argillite

Early to Middle Cretaceous
- Kg-0 — Metabasalts (Greenstones)
- Kdls-1 — Dark grey Limestone with interbedded Chert
- Kwls-1 — Light grey Limestone with interbedded Chert
- Kg-1 — Metabasalts (Greenstone)
- Kwls-2 / Kd/Kg-2 — LIght grey Limestone with thinly interbedded, variably colored Chert
  Kd/Kg-2 Diorite sill with minor mafic metavolcanic flows
- Kdls-2/ Kbls-1 — Grey Limestone with minor thinly interbedded dark grey to black Chert: Gradational contact.
  Dark grey to black Limestone:
- Kg-3 / Kg-cc — Metabasalts (Greenstones) with lesser Limestone, Greywacke, Chert, and Mudstone
- Kwls-3 — Light grey Limestone with interbedded Chert
- Kg-3/2 — Metabasalts (Greenstones)
- Kbls-2 — Dark grey to black Limestone with minor black Chert
- Kg-4 — Metabasalts (Greenstones)
- Kbls-3 — Black Limestone

ALTERATION

- Bleaching (decalcification?)

SYMBOLS

- Contact, dashed where approximately located, showing dip.
- Fault (high angle), showing dip and relative separation.
- Fault (low angle), sawteeth on upper plate showing dip
- Syncline (inclined), showing inclination of axial plane and plunge of fold.
- Anticline (inclined), showing inclination of axial plane and plunge of fold.
- 70 — Strike and dip of bedding.
- Strike of vertical bedding.
- 32 — Strike and dip of overturned bedding.
- 68 — Strike and dip of foliation.
- Strike of vertical foliation.

- Structure Contours, Controlling Fault for 1987 Failure (CNI, 1998)
- Approx. Limits of 1987 Failure
- Crack (Blue) or Scarp (Red) Mapped iby Golder in 2007

NOTES:
1. Geologic map from Foruria (2004); modified by abbreviating descriptions in legend; adding results of Golder tension crack/scarp mapping completed in June 2007; and adding structure contours from CNI (1997) for controlling fault in 1987 Failure.

FIGURE **4.A8**

NORTH WALL GEOLOGY

Lehigh Permanente Quarry/CA

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APPENDIX 5.A

Geotechnical Core Log Summary Plots and Photographs (MS-01 and MS-02)

PERMANENTE QUARRY RMR SYSTEM - RECORD OF GEOTECHNICAL PARAMETERS

	Project No.	063-7109-400 phase 2										Drilling Method				From		To			Sheet		of			
	Borehole #	ms-inc-1					Azimuth	N80E													Logged by	JL				
	Elevation						Inclination	90													Drill Rig					
N		E					Ref. Point																			

			Run Data																				Rubble/Gouge					
			Recovery & Other Basic Information						JCR		Strength Index		Detailed Discontinuity Data										Gouge			Broken Core		
Core Dia: Depth	ROCK TYPE	RUN	From (ft.)	To (ft.)	Recovery (ft.)	Bedding Dominant (Y/N)	RQD (ft.)	Natural Fracture Count	Average	Minimum	Strength Index	Weathering Index	Depth (ft.)	Type	Count	α	Shape	Roughness	Infill	Thickness (mm)	JRC	JCR	From	To	Type	From	To	ADDITIONAL TESTING OR COMMENTS, SAMPLES COLLECTED
	SANDY SILT WITH GRAVEL	1	0.0	2.0	2.0	N	0.0	N/A			S5	W4																
	GREENSTONE WITH SANDY SILT AND GRAVEL	2	2.0	5.0	2.6	N	0.0	N/A			S6	W4																silty greenstone with iron oxides causing discoloration
	GREENSTONE	3	5.0	7.0	2.0	N	0.0	N/A			R1	W4																muddy layers starting to develop
	GREENSTONE	4	7.0	10.0	2.9	N	0.0	10			R3	W3																sampled 8-8.5
	GREENSTONE	5	10.0	12.5	2.3	N	0.0	6			R2	W3.5	11.6	J2	1	45	IR	R	CLAY	1-2	10	15						gougy zones and decreasing iron oxide to ~15'
	GREENSTONE	6	12.5	14.0	1.2	N	0.0	3			R2	W3																
	GREENSTONE	7	14.0	16.0	2.0	N	0.0	10			R2	W3																
	GREENSTONE	8	16.0	18.0	1.2	N	0.0	0			R2/S4	W4																17.3 - distinct contact between R2 greenstone and S4 gouge
	GREENSTONE	9	18.0	21.5	3.6	N	0.0	5			R2	W4																
	GREENSTONE	10	21.5	24.0	2.5	N	0.0	10			R2	W4																
	GREENSTONE	11	24.0	25.0	1.0	N	1.0	0			R3	W4																only unnatural fractures
	NO RECOVERY	12	25.0	25.5	0.0	N		N/A			N/A	N/A																
	GREENSTONE	13	25.5	29.0	3.6	N	3.0	2			R4	W3	26.5	J1	1	48	IR	R	CLAY	1-2	7	8						sampled 26.1-26.8
													28.6	J2	1	51	IR	R	CLAY	2-3	10	12						small recoveries are assumed to be from the top of the run
	GREENSTONE	14	29.0	34.0	4.9	N	0.0	2			R2.5	W3	28.5	J2	1	53	IR	R	CLAY	1	15	16						soft, gougy, irregular
													28.8	J2	1	50	IR	R	CLAY	1	15	21						
	GREENSTONE	15	34.0	36.5	0.9	N	0.0	N/A			R1	W4																
	GREENSTONE	16	36.5	38.0	1.4	N	0.0	N/A			R1	W4																
	GREENSTONE	17	38.0	39.0	1.0	N	0.0	N/A			R1	W4																
	GREENSTONE	18	39.0	41.5	2.3	N	1.0	0			R3	W3																sampled 41.3-41.7
	GREENSTONE	19	41.5	44.0	2.4	N	0.0	1			R2.5	W3	43	J2	1	44	IR	R	CLAY	2	15	15						
	GREENSTONE	20	44.0	44.5	0.5	N	0.0	0			N/A	N/A																loose redrill fragments on top of soft gouge
	GREENSTONE	21	44.5	47.5	3.0	N	0.0	0			R2	W4																
	GREENSTONE	22	47.5	50.5	2.8	N	0.0	25			R2	W4																
	GREENSTONE	23	50.5	52.0	1.3	N	0.0	10			R2	W4																no loggable joints or fractures, but multiple small, irregular cracks are
	NO RECOVERY	24	52.0	52.5	0.0	N		N/A			N/A	N/A																common throughout the rock
	GREENSTONE	25	52.5	53.5	0.8	N	0.0	N/A			S2	W5																
	NO RECOVERY	26	53.5	54.0	0.0	N		N/A			N/A	N/A																greenstone gravel suspended in a soft gouge matrix
	NO RECOVERY	27	54.0	55.0	0.0	N		N/A			N/A	N/A																
	GREENSTONE	28	55.0	59.0	3.8	N	0.9	2			R3	W3	56.2	J2	1	55	IR	R	CLAY	1-3	9	8						
													57.1	J3	2	49	IR	R	CLAY	1-4	18	8						

PERMANENTE QUARRY RMR SYSTEM - RECORD OF GEOTECHNICAL PARAMETERS

Project No.	063-7109-400 phase 2	**Drilling Method**		From		To		**Sheet**		**of**	
Borehole #	ms-inc-1	**Azimuth**	N80E					**Logged by**	JL		
Elevation		**Inclination**	90					**Drill Rig**			
N	**E**	**Ref. Point**									

			Run Data																				Rubble/Gouge					
			Recovery & Other Basic Information						JCR		Strength Index		Detailed Discontinuity Data										Gouge			Broken Core		
Core Dia: Depth	ROCK TYPE	RUN	From (ft.)	To (ft.)	Recovery (ft.)	Bedding Dominant (Y/N)	RQD (ft.)	Natural Fracture Count	Average	Minimum	Strength Index	Weathering Index	Depth (ft.)	Type	Count	α	Shape	Roughness	Infill	Thickness (mm)	JRC	JCR	From	To	Type	From	To	ADDITIONAL TESTING OR COMMENTS, SAMPLES COLLECTED
	NO RECOVERY	29	59.0	60.5	0.0	N		N/A			N/A	N/A																redrill, rubble, mud and gouge
	GREENSTONE	30	60.5	61.5	0.9	N	0.0	N/A			S1	W5																sampled 60.5-61.5
	GREENSTONE	31	61.5	62.5	0.5	N	0.0	N/A			N/A	N/A																
	GREENSTONE	32	62.5	64.0	1.1	N	0.0	N/A			S1	W5																
	GREENSTONE	33	64.0	67.5	0.6	N	0.0	N/A			S1	W5																
	GREENSTONE	34	67.5	68.5	0.7	N	0.0	0			S4	W4																getting a bit more competent greenstone
	GREENSTONE	35	68.5	74.0	1.1	N	0.0	N/A			S1	W4.5																
	GREENSTONE	36	74.0	76.5	0.8	N	0.0	N/A			S1	W5																back to greenstone gouge and loose angular fragments
	GREENSTONE	37	76.5	79.0	2.2	N	0.0	N/A			S2	W4.5																washed greenstone fragments (mud matrix assumed to have been
	GREENSTONE	38	79.0	80.0	0.7	N	0.0	N/A			S2	W4																washed and suspended in the mud into the sump)
	GREENSTONE	39	80.0	81.0	1.0	N	0.0	N/A			S2/R1	W4																
	GREENSTONE	40	81.0	82.0	0.2	N	0.0	N/A			N/A	N/A																washed greenstone cobble
	GREENSTONE	41	82.0	83.0	0.1	N	0.0	N/A			N/A	N/A																
	GREENSTONE	42	83.0	84.0	0.1	N	0.0	N/A			N/A	N/A																
	GREENSTONE	43	84.0	87.0	2.8	N	0.0	N/A			R1	W4																sampled 84.5-85
	GREENSTONE	44	87.0	87.5	0.5	N	0.0	N/A			N/A	N/A																washed greenstone fragments
	GREENSTONE	45	87.5	88.5	0.8	N	0.0	N/A			S3	W5																greenstone gouge with greenstone rock fragments
	GREENSTONE	46	88.5	91.0	2.3	N	0.0	N/A			S3	W4																
	NO RECOVERY	47	91.0	91.5	0.0	N		N/A			N/A	N/A																
	NO RECOVERY	48	91.5	94.0	0.0	N		N/A			N/A	N/A																
	GREENSTONE	49	94.0	98.0	4.0	N	1.2	25			R2	W3.5	96.5	J2	1	34	IR	R	CLAY	50	7	0-2						sampled 97.7-98
	GREENSTONE	50	98.0	100.0	1.9	N	0.6	25			R3	W3	98.9	J3	2	54	PL	SM-R	CLAY	2-6	5	6						
	GREENSTONE	51	100.0	102.5	2.5	N	1.1	25			R2.5	W3																
	GREENSTONE	52	102.5	104.0	1.0	N	0.0	N/A			N/A	N/A																90% washed greenstone fragments with some clay at the bottom
	GREENSTONE	53	104.0	106.5	2.4	N	0.0	25			R3	W3																of the run
	GREENSTONE	54	106.5	109.5	1.3	N	0.0	N/A			R3	N/A																
	GREENSTONE	55	109.5	113.0	3.2	N	0.0	50			R2.5	W4																greenstone fragments in a weathered greenstone gouge matrix
	NO RECOVERY	56	113.0	114.0	0.0	N		N/A			N/A	N/A																
	GREENSTONE	57	114.0	116.5	2.1	N	0.0	25			R3	W3																
	GREENSTONE	58	116.5	119.0	1.8	N	0.0	N/A			S4	W4																60% greenstone gouge, 40% greenstone fragments. Rock that
	GREENSTONE	59	119.0	120.0	1.2	N	0.0	50			R3	W3																remains is heavily weathered/fractured

PERMANENTE QUARRY RMR SYSTEM - RECORD OF GEOTECHNICAL PARAMETERS

Project No.	063-7109-400 phase 2			**Drilling Method**		From	To	**Sheet**		**of**	
Borehole #	ms-inc-1	**Azimuth**	N80E					**Logged by**	JL		
Elevation		**Inclination**	90					**Drill Rig**			
N	**E**	**Ref. Point**									

Core Dia: Depth	ROCK TYPE	RUN	Run Data: Recovery & Other Basic Information: From (ft.)	To (ft.)	Recovery (ft.)	Bedding Dominant (Y/N)	RQD (ft.)	Natural Fracture Count	JCR: Average	Minimum	Strength Index: Strength Index	Weathering Index	Detailed Discontinuity Data: Depth (ft.)	Type	Count	α	Shape	Roughness	Infill	Thickness (mm)	JRC	JCR	Rubble/Gouge: Gouge: From	To	Type	Broken Core: From	To	ADDITIONAL TESTING OR COMMENTS, SAMPLES COLLECTED
	GREENSTONE	60	120.0	122.5	2.0	N	0.5	25			R3	W3	121	J2	1	71	PL	R	CLAY	1-2	7	18						
													121.6	J3	1	21	PL	R	CLAY	1-3	3	18						
	NO RECOVERY	61	122.5	124.0	0.0	N		N/A			N/A	N/A																
	GREENSTONE	62	124.0	125.0	1.0	N	0.0	N/A			S3	W4																60% gouge
	GREENSTONE	63	125.0	127.5	1.5	N	0.0	25			R3	W3	126.7	J2	2-3	60-75	IR	R	CLAY	1-2	10	15						
	GREENSTONE	64	127.5	130.0	2.1	N	0.4	25			R2	W3.5	128.4	J2	1	62	IR	R	CLAY	1-3	6	15						
	GREENSTONE	65	130.0	130.5	0.8	N	0.0	25			R2	W3.5																sampled 128.3-129
	GREENSTONE	66	130.5	132.0	1.5	N	0.0	25			R2	W3.5	131.1	J1	1	66	IR	R	CLAY	5	12	6						gouge filled incomplete, unloggable fractures throughout
	GREENSTONE	67	132.0	134.0	1.0	N	0.0	N/A			R2	W4																80% washed greenstone fragments 20% gouge
	NO RECOVERY	68	134.0	137.0	0.0	N		N/A			N/A	N/A																
	GREENSTONE	69	137.0	138.0	0.7	N	0.0	25			R2.5	W3.5																15% gouge
	GREENSTONE	70	138.0	140.0	1.5	N	0.5	N/A			R2.5	W3.5	139.1	J2	1	28	PL	R	CLAY	1-2	5	20						heavily fractured gougy lower part of core.
	GREENSTONE	71	140.0	140.5	0.9	N	0.0	10			R2.5	W4																15% gouge mostly on the outside of the core
	GREENSTONE	72	140.5	143.0	2.4	N	0.0	50			R3	W4																
	GREENSTONE	73	143.0	144.0	0.9	N	0.0	25			R2.5	W3.5																
	GREENSTONE	74	144.0	146.5	2.5	N	0.0	50			R2	W4																
	GREENSTONE	75	146.5	150.5	3.6	N	0.0	25			R2	W3	148.8	J2	1	61	PL	R	CLAY	2-4	15	5						sampled 150-150.5
													149.7	J2	2	56	PL	R	CLAY	1-3	15	5						
	GREENSTONE	76	150.5	154.0	3.5	N	1.0	25			R1.5	W3.5	153.2	J2	1	25	PL	R	CLAY	2-4	12	5						
	GREENSTONE	77	154.0	159.0	5.0	N	0.9	50			R2	W3	157.2	J2	1	31	PL	S	CALCIT	1-2	2	20						
													156.8	J2	1	39	PL	S-R	CLAY	1-2	6	15						
													156.4	J2	1	38	PL	S-R	CLAY	1-2	8	15						
	GREENSTONE	78	159.0	162.0	2.7	N	0.0	50			R2.5	W3																rock is darker in color, and increased calcite veining
	GREENSTONE	79	162.0	162.5	0.5	N	0.0	25			R2.5	W3																sampled 159-159.5
	GREENSTONE	80	162.5	164.0	0.4	N	0.0	N/A			N/A	N/A																heavily fractured, some redrill
	GREENSTONE	81	164.0	165.0	0.5	N	0.0	N/A			R2.5	W3.5																washed greenstone fragments, redrill, rubble.
	GREENSTONE	82	165.0	166.5	1.0	N	0.0	10			R2	W3.5	165.9	J2	1	53	PL	R	CLAY	1-2	5	15						50% washed greenstone fragments
	GREENSTONE	83	166.5	168.0	1.5	N	1.0	10			R3	W3																
	GREENSTONE	84	168.0	170.5	2.5	N	0.4	25			R2	W3.5	168.4	J2	1	31	PL	S	CLAY	1-2	3	18						
													169.6	J3	1	35	PL	R	CLAY	1-3	7	15						
	NO RECOVERY	85	170.5	171.0	0.0	N		N/A			N/A	N/A																

PERMANENTE QUARRY RMR SYSTEM - RECORD OF GEOTECHNICAL PARAMETERS

Project No.	063-7109-400 phase 2			**Drilling Method**		From	To
Borehole #	ms-inc-1	**Azimuth**	N80E				
Elevation		**Inclination**	90				
N	**E**	**Ref. Point**					

			Run Data																			**Rubble/Gouge**						
			Recovery & Other Basic Information						**JCR**		**Strength Index**		**Detailed Discontinuity Data**										**Gouge**			**Broken Core**		
Core Dia: Depth	**ROCK TYPE**	**RUN**	**From (ft.)**	**To (ft.)**	**Recovery (ft.)**	**Bedding Dominant (Y/N)**	**RQD (ft.)**	**Natural Fracture Count**	**Average**	**Minimum**	**Strength Index**	**Weathering Index**	**Depth (ft.)**	**Type**	**Count**	**α**	**Shape**	**Roughness**	**Infill**	**Thickness (mm)**	**JRC**	**JCR**	**From**	**To**	**Type**	**From**	**To**	**ADDITIONAL TESTING OR COMMENTS, SAMPLES COLLECTED**
	GREENSTONE	86	171.0	171.5	0.5	N	0.0	N/A			N/A	N/A																
	GREENSTONE	87	171.5	172.0	0.5	N	0.0	N/A			N/A	N/A																
	GREENSTONE	88	172.0	174.0	1.4	N	0.0	25			R1	W3.5																
	GREENSTONE	89	174.0	177.0	2.3	N	0.5	25			R2	W3.5	175	J2	1	30	PL	R	CLAY	1-2	5	15						sampled 174.7-175.2
													176.2	J2	5-10	54	IR	R	CLAY	4-5	15	2						
	GREENSTONE	90	177.0	181.0	3.9	N	0.0	25			R2	W3.5	178.4	J1	1	59	CURVE	R	CLAY	2-3	10	18						other fractures throughout the core are unnatural
													178.7	J2	1	50	PL	R	CLAY	1-2	6	15						
	NO RECOVERY	91	181.0	181.5	0.0	N		N/A			N/A	N/A																
	GREENSTONE	92	181.5	183.0	1.1	N	0.0	N/A			N/A	N/A																washed greenstone fragments
	GREENSTONE	93	183.0	184.0	0.1	N	0.0	N/A			N/A	N/A																
	GREENSTONE	94	184.0	186.5	2.3	N	0.0	25			R3	W3	185.2	J1	1	26	PL	R	CLAY	8-10	7	2						
	GREENSTONE	95	186.5	190.0	3.3	N	0.5	25			R2	W3.5	ALL	J2	10	35-45	PL	R	N/A	1	6	20						clean, rough fractures throughout with <1mm separation are
	GREENSTONE	96	190.0	191.0	1.0	N	0.0	N/A			R1	W4																suspected unnatural, although true origination is unknown
	GREENSTONE	97	191.0	192.5	1.5	N	0.0	N/A			R1	W4																
	GREENSTONE	98	192.5	193.0	0.5	N	0.0	N/A			N/A	N/A																>50% washed greenstone fragments and redrill
	GREENSTONE	99	193.0	194.0	0.7	N	0.0	N/A			R1	W4																
	GREENSTONE	100	194.0	199.0	5.0	N	0.0	0			R1	W4																sampled 198.6-199
	GREENSTONE	101	199.0	200.5	1.4	N	0.0	N/A			RS4	W4																intact 5' core is very soft and weathered. No distinct natural fractures
	GREENSTONE	102	200.5	203.0	2.5	N	1.2	1			R3	W3	201.2	J2	1	38	PL	R	CLAY	1	8	19						
	GREENSTONE	103	203.0	205.5	2.2	N	0.0	25			R2.5	W3																
	GREENSTONE	104	205.5	207.5	1.8	N	0.0	N/A			S3	W4																
	GREENSTONE	105	207.5	209.0	2.2	N	0.0	10			R1.5	W3.5																60% greenstone fragments in a greenstone gouge matrix
	GREENSTONE	106	209.0	211.5	2.5	N	0.0	25			R2.5	W3																multiple randomly oriented fractures with unknown origins
	GREENSTONE	107	211.5	212.5	0.8	N	0.0	0			S5	W4																
	GREENSTONE	108	212.5	213.0	0.0	N	0.0	N/A			N/A	N/A																washed fragments
	NO RECOVERY	109	213.0	214.0	0.0	N		N/A			N/A	N/A																
	GREENSTONE	110	214.0	215.0	0.2	N	0.0	N/A			R2	W3.5																
	GREENSTONE	111	215.0	216.0	0.7	N	0.0	N/A			S4	W4																
	GREENSTONE	112	216.0	216.5	0.3	N	0.0	N/A			R1/S4	W4																
	GREENSTONE	113	216.5	217.5	0.5	N	0.0	N/A			S4	W4																
	NO RECOVERY	114	217.5	218.5	0.0	N		N/A			N/A	N/A																

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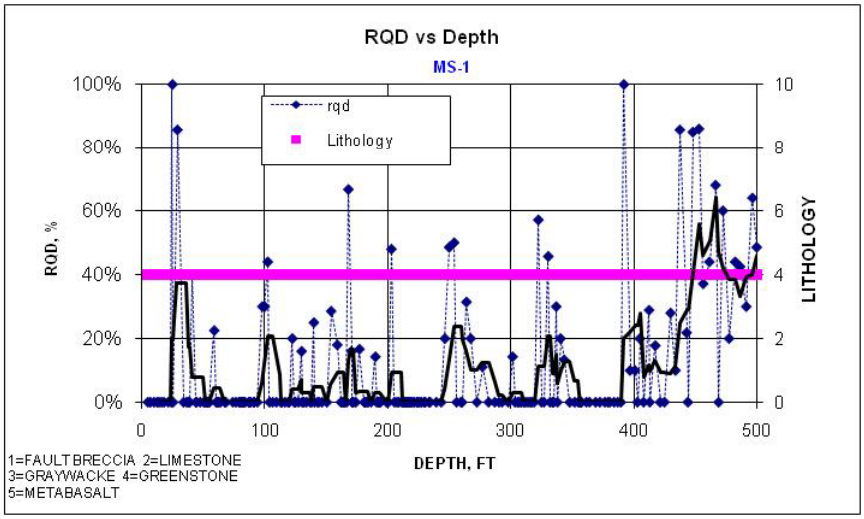
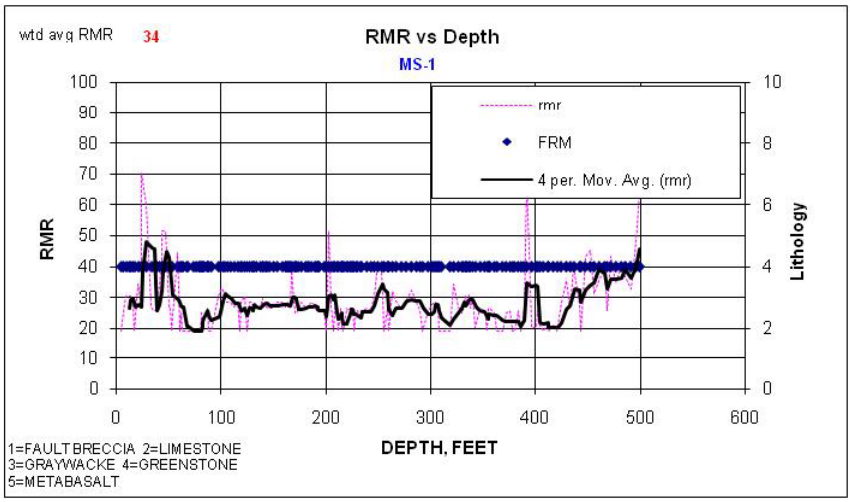
Project No.	063-7109-400 phase 2			**Drilling Method**		From		To		**Sheet**		**of**
Borehole #	ms-inc-1	**Azimuth**	**N80E**							**Logged by**	JL	
Elevation		**Inclination**	90							**Drill Rig**		
N	**E**	**Ref. Point**										

			Run Data																				Rubble/Gouge					
			Recovery & Other Basic Information						JCR		Strength Index		Detailed Discontinuity Data										Gouge			Broken Core		
Core Dia: Depth	ROCK TYPE	RUN	From (ft.)	To (ft.)	Recovery (ft.)	Bedding Dominant (Y/N)	RQD (ft.)	Natural Fracture Count	Average	Minimum	Strength Index	Weathering Index	Depth (ft.)	Type	Count	α	Shape	Roughness	Infill	Thickness (mm)	JRC	JCR	From	To	Type	From	To	ADDITIONAL TESTING OR COMMENTS, SAMPLES COLLECTED
	GREENSTONE	115	218.5	220.0	1.1	N	0.0	N/A			N/A	N/A																60% washed fragments 40% gouge
	GREENSTONE	116	220.0	221.5	1.3	N	0.0	N/A			R1.5	W3.5																
	GREENSTONE	117	221.5	223.5	2.0	N	0.0	25			R2	W3																more competent rock, but still no loggable fractures
	GREENSTONE	118	223.5	224.5	0.4	N	0.0	N/A			R2	W3.5																
	GREENSTONE	119	224.5	226.0	0.9	N	0.0	N/A			R2	W3.5																
	GREENSTONE	120	226.0	227.5	1.3	N	0.0	N/A			S3/R2	W4																
	GREENSTONE	121	227.5	229.5	2.0	N	0.0	50			R1	W3.5																
	GREENSTONE	122	229.5	230.5	0.7	N	0.0	N/A			R1.5	W4																calcite veins and inclusions
	GREENSTONE	123	230.5	233.5	3.0	N	0.0	50			R1	W3.5																
	GREENSTONE	124	233.5	234.5	1.0	N	0.0	50			R1	W3																heavily fractured, slightly washed, some redrill
	GREENSTONE	125	234.5	239.5	5.0	N	0.0	50			R2	W3	235.9	J2	2	37	PL	R	CLAY	1-2	9	12						sampled 234.5-235
													236.2	J1	1	39	PL	R	CLAY	2-3	6	8						
	GREENSTONE	126	239.5	243.5	4.0	N	0.0	50			R1.5	W3.5	242.5	J2	1	60	PL	R	CLAY	2-3	15	12						
	GREENSTONE	127	243.5	246.5	2.8	N	0.6	10			R2.5	W3	243.9	J2	1	31	PL	R	CLAY	1-2	10	15						
													244.3	J2	1	42	PL	R	CLAY	1-2	10	15						
													244.7	J1	1	47	PL	R	CLAY	2-4	7	5						
													244.9	J1	1	47	PL	R	CLAY	2-4	7	5						
	GREENSTONE	128	246.5	250.0	3.3	N	1.7	5			R3	W2.5	249.1	J1	1.5	29	PL	R	CLAY	2-4	6	15						possibly lithic fragments (argillic?) in greenstone matrix.
	GREENSTONE	129	250.0	254.0	4.0	N	2.0	10			R3	W3	252.7	J1	1	36	PL	R	CLAY	1-3	5	12						sampled 250-250.5
	GREENSTONE	130	254.0	256.0	1.5	N	0.0	N/A			S4/R1	W4																washed greenstone fragments and gouge





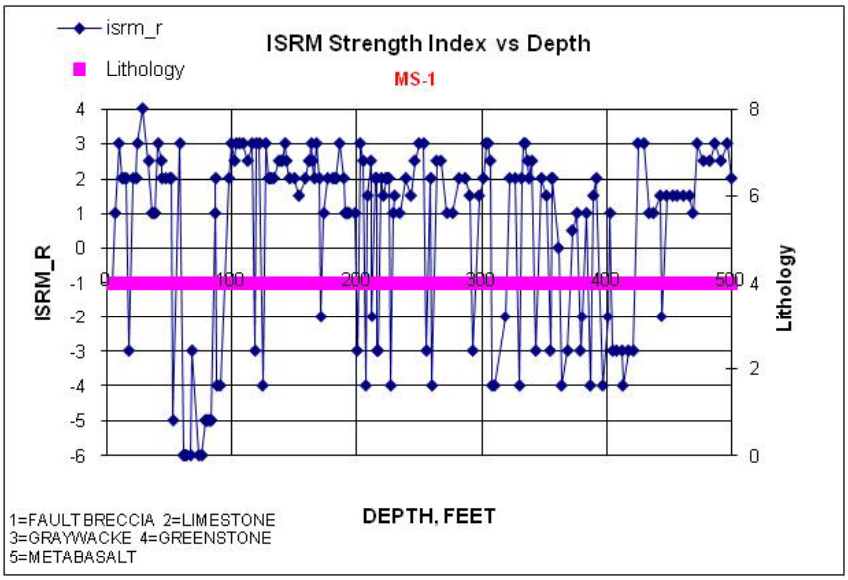


FIGURE **A1**

GEOTECHNICAL CORE LOGGING DATA, COREHOLE MS-1

LEHIGH HANSON/MAIN SLIDE/CA

PERMANENTE QUARRY RMR SYSTEM - RECORD OF GEOTECHNICAL PARAMETERS

Project No.	063-7109-400 phase 2			Drilling Method		From		To		Sheet		of	
Borehole #	MS-2	Azimuth	N80E							Logged by			
Elevation		Inclination	60							Drill Rig			
N	E	Ref. Point											

Core Dia: Depth	ROCK TYPE	RUN	Run Data: Recovery & Other Basic Information: From (ft.)	To (ft.)	Recovery (ft.)	Bedding Dominant (Y/N)	RQD (ft.)	Natural Fracture Count	JCR: Average	Minimum	Strength Index: Strength Index	Weathering Index	Detailed Discontinuity Data: Depth (ft.)	Type	Count	α	Shape	Roughness	Infill	Thickness (mm)	JRC	JCR	Rubble/Gouge: Gouge: From	To	Type	Broken Core: From	To	ADDITIONAL TESTING OR COMMENTS, SAMPLES COLLECTED
	SANDY SILT	1	0.0	1.8	0.9	N	0.0	100			S4	W4																fine pebbles in coarse sandy silt material
	GREENSTONE	2	1.8	5.0	2.2	N	0.0	50			S6	W5																highly weathered greenstone, going to clay, hard but very friable.
	GREENSTONE	3	5.0	10.0	4.7	N	0.0	50			S5	W5																highly weathered to sandy silt with solid chunks and visible structures
	GREENSTONE	4	10.0	13.0	1.1	N	0.0	50			S3	W5																sandy silt with coarse pebbles, no preserved structures
	GREENSTONE	5	13.0	18.0	3.1	N	0.0	50			S3	W5																coarse fragments in sandy silt, color change from olive drab green
	GREENSTONE	6	18.0	21.0	0.0	N	0.0																					to pistachio green at 16.7
	GREENSTONE	7	21.0	22.0	0.5	N	0.0	50																				greenstone gravel recovered, little to no fines
	GREENSTONE	8	22.0	23.5	1.5	N	0.0	50			S4	W5																solid greenstone fragments in minimal sandy silt
	GREENSTONE	9	23.5	26.5	1.8	N	0.0	25			R1	W4	24.6	J2	1	35	PL	SM	CLAY	2	6.0	6						increasingly intact, but weathered
													25.7	J2	1	40	PL	R	CLAY	1	10.0	6						
	GREENSTONE	10	26.5	29.0	3.2	N	0.0	15			R1	W4	26.3	J2	1	35	PL	R	CLAY	1	10.0	12						
													26.7	J2	1	40	PL	R	CLAY	8	10.0	0						weak, broken but solid greenstone
													27.3	J2	1	50	C	R	CLAY	1	8.0	6						
													27.8	J2	1	45	PL	R	CLAY	1	6.0	12						
													28.3	J2	1	45	PL	R	CLAY	1	4.0	6						
	GREENSTONE	11	29.0	33.0	3.9	N	0.0	25			R1	W4																heavily fractured, friable greenstone
	GREENSTONE	12	33.0	35.0	1.9	N	1.9	0			R1	W4																weak, friable, highly weathered greenstone
	GREENSTONE	13	35.0	37.5	2.5	N	2.5	2			R1	W4	36.2	J2	1	45	IR	VR	OX	0	16.0	6						very weak, highly fractured, weathered
													36.6	J1	1	30	PL	R	CLAY	2	10.0	6						
	GREENSTONE	14	37.5	40.0	2.2	N	0.0	25			R0	W4																greenstone pieces in thin clay infill, falls apart into rubble
	GREENSTONE	15	40.0	43.0	1.4	N	0.9	10			R1	W4																weak, friable.
	GREENSTONE	16	43.0	45.0	0.0	N	0.0																					rubble recovered
	NO RECOVERY	17	45.0	46.5	0.0	N																						
	NO RECOVERY	18	46.5	48.0	0.0	N																						
	GREENSTONE	19	48.0	49.0	0.0	N	0.0																					rubble recovered
	GREENSTONE	20	49.0	51.0	1.8	N	1.8	0			R2	W3																highly fractured but solid core, crumbles with moderate effort
	GREENSTONE	21	51.0	52.5	1.1	N	0.0	100			S4	W4																greenstone gouge with coarse gravel
	GREENSTONE	22	52.5	55.0	2.5	N	2.5	0			R2	W3																highly fractured but solid core, crumbles with moderate effort
	GREENSTONE	23	55.0	56.5	1.4	N	0.0	50			R1	W4																solid pieces in gougy soft material
	GREENSTONE	24	56.5	58.5	2.0	N	0.0	10			R1	W4																solid pieces in gougy soft material
	GREENSTONE	25	58.5	61.0	0.9	N	0.0	100			S5	W4																solid pieces in gougy soft material

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Project No.	063-7109-400 phase 2			**Drilling Method**		From	To	**Sheet**		**of**	
Borehole #	MS-2	**Azimuth**	**N80E**					**Logged by**			
Elevation		**Inclination**	60					**Drill Rig**			
N	**E**	**Ref. Point**									

			Run Data																				Rubble/Gouge					
			Recovery & Other Basic Information						JCR		Strength Index		Detailed Discontinuity Data										Gouge			Broken Core		
Core Dia: Depth	ROCK TYPE	RUN	From (ft.)	To (ft.)	Recovery (ft.)	Bedding Dominant (Y/N)	RQD (ft.)	Natural Fracture Count	Average	Minimum	Strength Index	Weathering Index	Depth (ft.)	Type	Count	α	Shape	Roughness	Infill	Thickness (mm)	JRC	JCR	From	To	Type	From	To	ADDITIONAL TESTING OR COMMENTS, SAMPLES COLLECTED
	NO RECOVERY	26	61.0	63.0	0.0	N																						
	GREENSTONE	27	63.0	64.0	0.8	N	0.0	50			S5	W4																firm gravelly gouge
	GREENSTONE	28	64.0	66.5	2.2	N	0.5	25			R1	W4																heavily fractured, but solid core
	GREENSTONE	29	66.5	68.5	2.0	N	0.0	50			R1	W4																heavily fractured, clay cemented greenstone
	GREENSTONE	30	68.5	69.5	0.7	N	0.0	50			S5	W4																gouge with gravel pieces
	GREENSTONE	31	69.5	70.0	0.4	N	0.0	10			R2	W4																highly fractured, but solid core
	GREENSTONE	32	70.0	71.0	0.3	N	0.0	10			R2	W4																
	GREENSTONE	33	71.0	73.0	0.8	N	0.0	10			S6	W4																
	GREENSTONE	34	73.0	73.5	0.5	N	0.0	5			R1	W4																
	GREENSTONE	35	73.5	75.0	1.5	N	0.0	10			R1	W4																
	GREENSTONE	36	75.0	76.5	1.4	N	0.0	10			R1	W4																
	GREENSTONE	37	76.5	79.0	2.7	N	0.0	25			R1.5	W4																
	GREENSTONE	38	79.0	83.0	0.7	N	0.0	10			R1.5	W4																
	GREENSTONE	39	83.0	84.0	0.5	N	0.0	10			R1.5	W4																
	GREENSTONE	40	84.0	86.0	0.6	N	0.0	50			R1.5	W4																
	NO RECOVERY	41	86.0	87.5	0.0	N																						
	NO RECOVERY	42	87.5	89.0	0.0	N																						
	GREENSTONE	43	89.0	91.0	1.5	N	0.0	50			R1	W4																
	GREENSTONE	44	91.0	93.0	2.0	N	0.0	0			R2	W4																
	GREENSTONE	45	93.0	95.5	2.5	N	2.5	0			R2	W4																solid, highly weathered, breaks apart easily
	GREENSTONE	46	95.5	97.0	0.8	N	0.7	0			R3	W4																lost circulation at 97'
	GREENSTONE	47	97.0	99.5	2.7	N	2.2	10			R2	W4																
	GREENSTONE	48	99.5	102.0	1.8	N	0.0	25			R2	W4																
	GREENSTONE	49	102.0	103.0	0.8	N	0.0	25			R2	W4																
	GREENSTONE	50	103.0	107.5	1.8	N	0.0	50			R2	W4																
	NO RECOVERY	51	107.5	108.5	0.0	N																						
	GREENSTONE	52	108.5	110.0	0.0	N	0.0	50			R1	W4																
	GREENSTONE	53	110.0	111.0	1.0	N	0.0	0			R1	W4																
	GREENSTONE	54	111.0	113.0	2.0	N	0.0	0			R2.5	W4																gray clasts, subrounded within greenstone
	GREENSTONE	55	113.0	118.0	4.9	N	4.9	0			R3	W3																soft, easily broken up by hand, greenstone fragments
	GREENSTONE	56	118.0	119.5	1.0	N	0.0	50			S4	W4																

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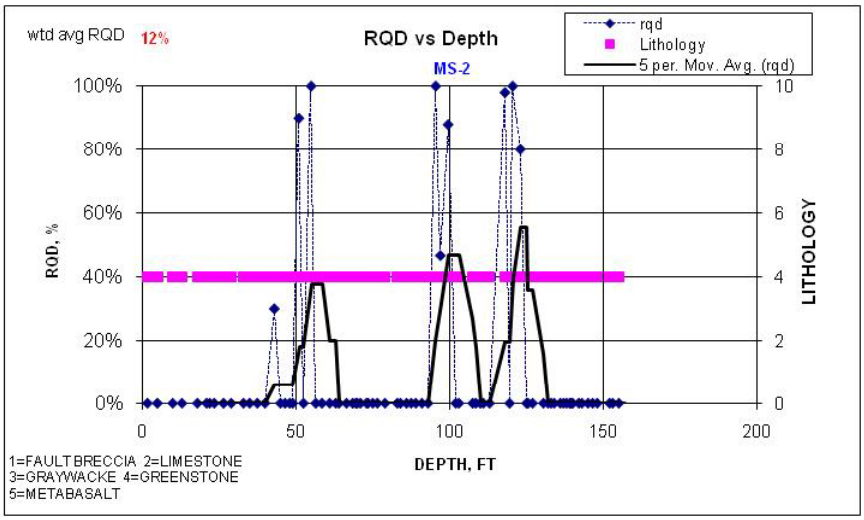
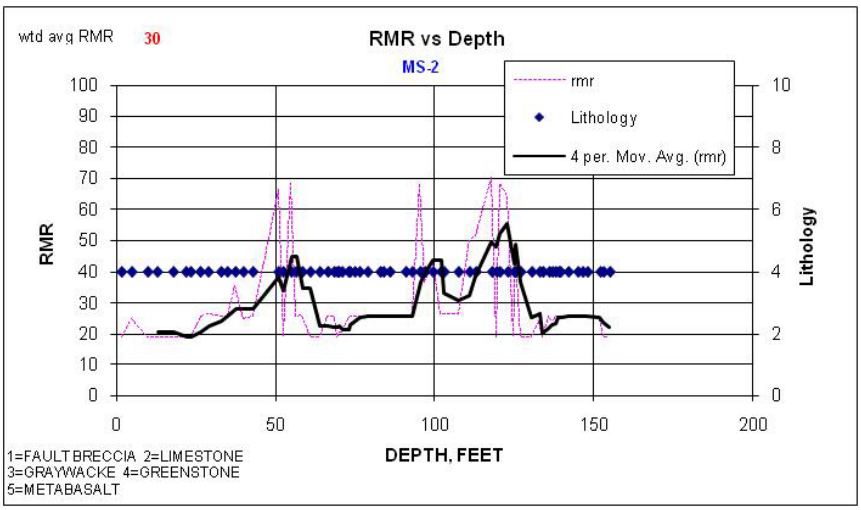
Borehole #	MS-2	Azimuth	N80E					Logged by			
Elevation		Inclination	60					Drill Rig			
N	E	Ref. Point									

Core Dia: Depth	ROCK TYPE	RUN	Run Data: Recovery & Other Basic Information: From (ft.)	To (ft.)	Recovery (ft.)	Bedding Dominant (Y/N)	RQD (ft.)	Natural Fracture Count	JCR: Average	Minimum	Strength Index: Strength Index	Weathering Index	Detailed Discontinuity Data: Depth (ft.)	Type	Count	α	Shape	Roughness	Infill	Thickness (mm)	JRC	JCR	Rubble/Gouge: Gouge: From	To	Type	Broken Core: From	To	ADDITIONAL TESTING OR COMMENTS, SAMPLES COLLECTED
	GREENSTONE	57	119.5	120.5	1.0	N	1.0	0			R2	W4																
	GREENSTONE	58	120.5	123.0	2.7	N	2.0	0			R2	W4																
	GREENSTONE	59	123.0	125.0	0.9	N	0.0	20			S4	W4																
	GREENSTONE	60	125.0	125.5	0.5	N	0.0	0			S5	W4																
	GREENSTONE	61	125.5	127.0	1.1	N	0.0	20			S5	W4																
	GREENSTONE	62	127.0	130.5	1.4	N	0.0	25			S5	W4																soft, rubbly greenstone gouge material
	NO RECOVERY	63	130.5	132.0	0.0	N																						hole collapsing
	GREENSTONE	64	132.0	133.0	0.3	N	0.0	0																				
	GREENSTONE	65	133.0	134.0	0.6	N	0.0	25			S5	W4																soft gougy greenstone with solid breccia
	GREENSTONE	66	134.0	136.0	1.9	N	0.0	50			R1.5	W4																sampled 134.1-134.8
	GREENSTONE	67	136.0	137.0	0.1	N	0.0																					gravelly mud recovered
	GREENSTONE	68	137.0	138.0	0.8	N	0.0	50			R1	W4																
	GREENSTONE	69	138.0	139.0	0.3	N	0.0	0			R1.5	W4																
	GREENSTONE	70	139.0	139.5	0.3	N	0.0	0			R1.5	W4																
	NO RECOVERY	71	139.5	140.0	0.0	N																						
	GREENSTONE	72	140.0	142.0	1.4	N	0.0	0			R1	W4																
	NO RECOVERY	73	142.0	143.0	0.0	N																						
	GREENSTONE	74	143.0	145.0	0.7	N	0.0	25			R1	W4																some redrill on top of soft gougy greenstone
	GREENSTONE	75	145.0	146.5	0.8	N	0.0	0			R1	W4																
	GREENSTONE	76	146.5	148.0	0.4	N	0.0	0			R1	W4																75% redrill
	GREENSTONE	77	148.0	152.0	1.6	N	0.0	0			R0.5	W4																50% redrill
	GREENSTONE	78	152.0	153.0	1.0	N	0.0	0			S5	W4																
	GREENSTONE	79	153.0	155.0	1.2	N	0.0	0			S5	W4																
	NO RECOVERY	80	155.0	157.0	0.0	N																						





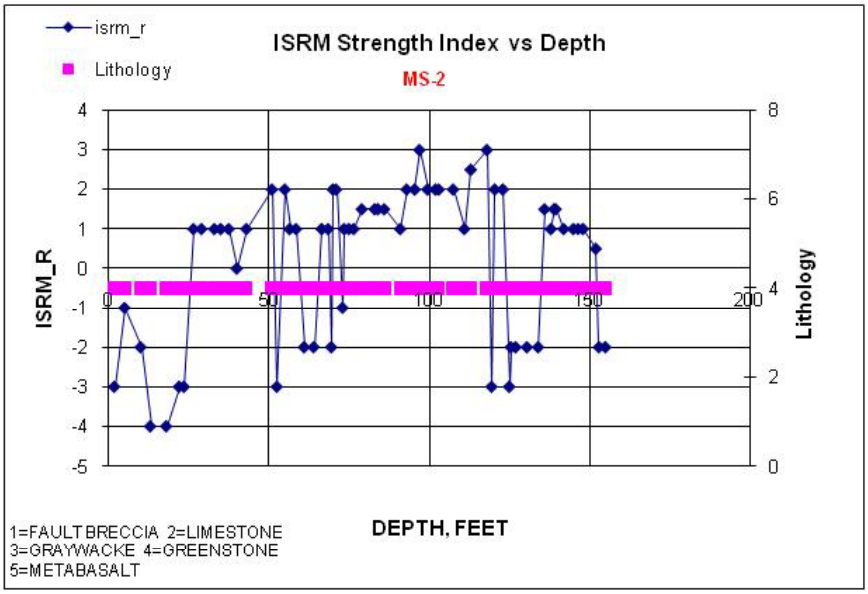


FIGURE **A2**

GEOTECHNICAL CORE LOGGING DATA1, COREHOLE MS-2

LEHIGH HANSON/MAIN SLIDE/CA

MS-INC-1 CORE PHOTOS

MS-NC-1 0-10 Box 1 of 46

MS-NC-1 10-20.5 Box 2 of 46
TOP
12.5
14
16
18
Bottom

MS-INC-I 20.5-29.5 Box 3 of 46
Top
21.5
24
25.5
27
29

MS-inc-1 29.5-40 Box 4 of 46
TOP
34
35
38
39

MS-inc-1 40-49.3 Box 5 of 46
TOP
41.5
44
44.5
44.5
47.5
Bottom

MS-inc-I 49.3-67.5 Box 6 of 46
Top
50.5
52
52.5
53.5
54
55
59
60.5
61.5
62.5
64
67.5

MS-inc-1 67.5-87 Box 7 of 46
Top
76.5
79
80
81
82
82 A-1
83
83 A-1
84
87

MS-inc-1 87-99.1 Box 8 of 46

MS-hc-1 99.1-109.5 Box 9 of 46
TOP
100
102.5
104
109.5
D-3
106.5

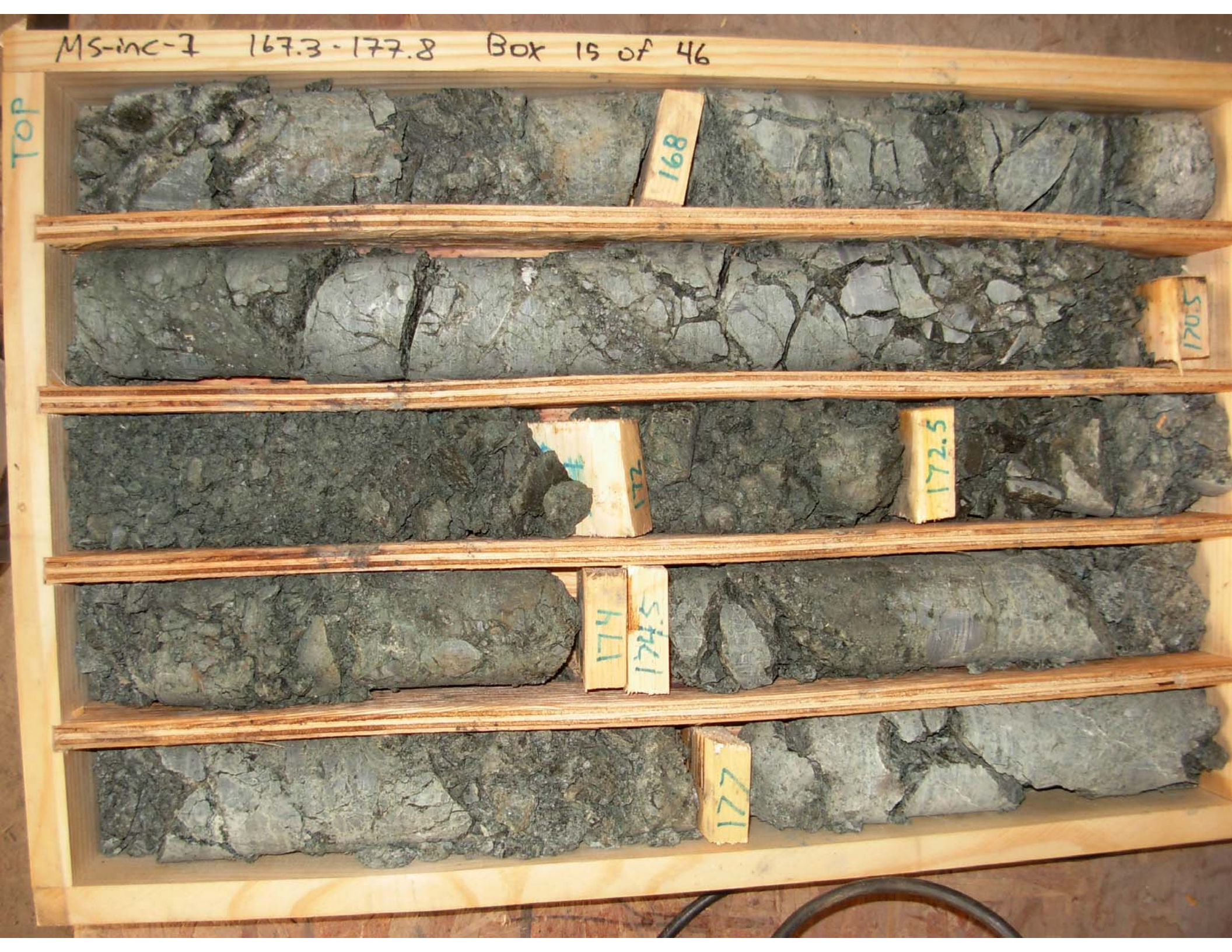
MS-MC-1 109.5-121 Box 10 of 46

MS-inc-I 121-134 Box 11 of 46
TOP
122.5
124
125
127.5
130
130.5
132

MS-MC-1 134-145.6 Box 12 of 46

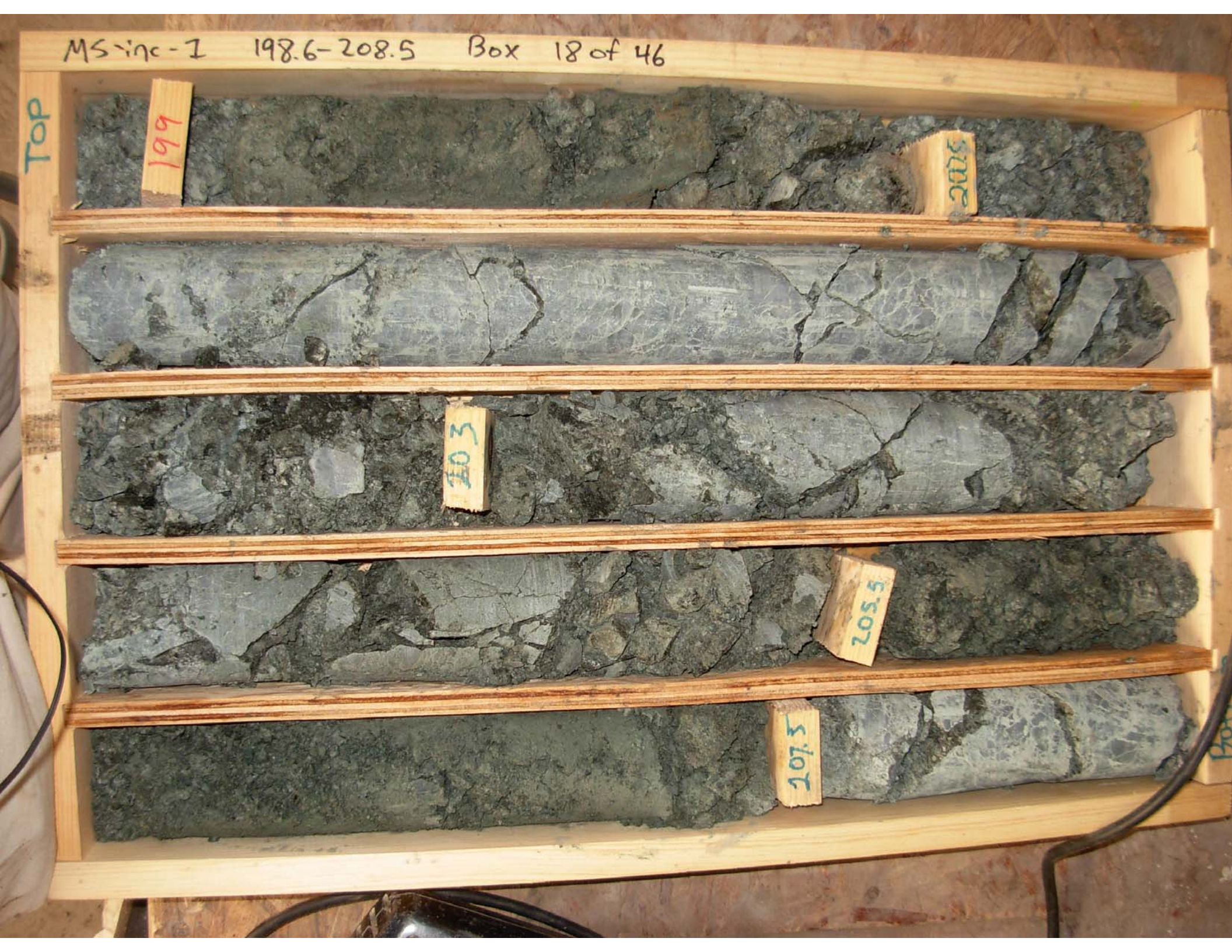
MS-inc-1 145.6-155.9 Box 13 of 46
146.5
150.5
154

MS-inc-1 155.9-167.3 Box 14 of 46
TOP
159
162.5
164
166.5


MS-inc-7 167.3 - 177.8 Box 15 of 46
TOP
168
170.5
172
172.5
174
174.5
177

MS-inc-1 177.8- 189.7 Box 16 of 46
TOP
181
181.5
183
184
186.5
Bottom

MS-inc-1 189.7-198.6 Box 17 of 46
top
190
191
192.5
193
193
D-.5
194


MS-inc-1 198.6-208.5 Box 18 of 46
Top
199
203
205.5
207.5

MS-inc-I 208.5-222 Box 19 of 46
TOP
209
211.5
213
214
215
216.5
217.5
218.5
220
221.5

Ms-inc-1 222-232.5 Box 20 of 46
TOP
223.5
224.5
226
227.5
229.5

MS-INC-1 232.5-242.3 Box 21 of 46
TOP
233.5
234.5
235.5

MS-inc-1 242.3-251.5 Box 22 of 46
TOP
243.5
246.5
250

MS-inc-1 251.5-261.5 Box 23 of 46
TOP
254
256
259.5
260.5

Ms-inc-1 261.5-271.5 Box 24 of 46
Top
264
267.5

MS-inc-1 271.5-280.4 Box 25 of 46
Top
272.5
Bottom

MS-inc-1 280.4-290.3 Box 26 of 46

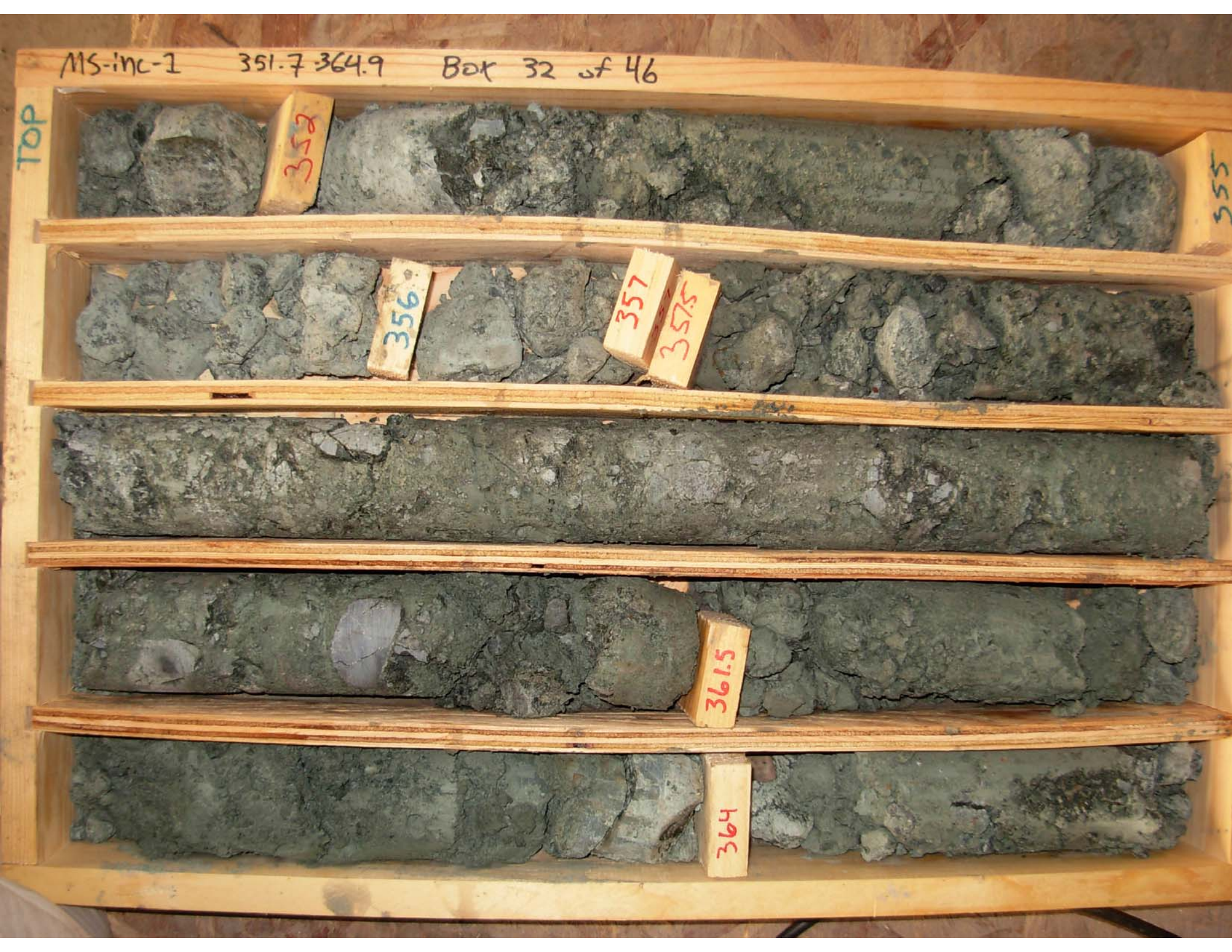
MS-inc-1 290.3-300.3 Box 27 of 46

MS-inc-1 300.3-320.2 Box 28 of 46
303.5
305.5
307
308.5
310.5
312
314
316
317
319

MS-inc-1 320.2-330.9 Box 29 of 46
TOP
322.5
325
327
330.5
Bottom

Ms-inc-1 330.9-340.8 Box 30 of 46
TOP
332
334
335
338
340.5

MS-inC-1 340.8-351.7 Box 31 of 46
TOP
343.5
348
Bottom


MS-inc-1 351.7-364.9 Box 32 of 46
TOP
355
356
357
357.5
361.5
364

MS-inc-1 364.9-374.3 Box 33 of 46
Top
369
372.5
Bottom

MS-inc-I 374.3 - 387.2 Box 34 of 46
TOP
376.5
379
380.5
384
387
Bottom

MS-Inc-1 387.2-397 Box 35 of 46
TOP
389.5
392
397
Bottom

MS-inc-1 397-408.4 Box 36 of 46
TOP
403
405
408

MS-inc-1 408.4-418.2 Box 37 of 46
413
417.5
418.5

MS-MC-1 418.2-427.4 Box 32 of 46
top
bottom
421.5
425

MS-inc-1 427.7-439.1 Box 39 of 46
Top
430
434
439.5

MS-inc-I 439.1-449.1 Box 40 of 46
Top
443
444
448
Bottom

MS-inc-1 449.1-458.5 Box 41 of 46

MS-inc-1 458.5-467.5 Box 42 of 46
TOP
461.5

MS-inc-1 467.5-476.6 Box 43 of 46
Top
467
Bottom

MS-Inc-1 476.6-486.5 Box 44 of 46
Top
477.5
482.5
486.5
Bottom

MS-inc-1 426.5-496.5 Box 45 of 46
TOP
Bottom
495
496.5

MS-inc-I 496.5-500 Box 46 of 46
MS-inc-I 45 of 46

MS-INC-2 CORE PHOTOS

Bottom
Sample
18
5
10
13
MS-2 Box 1 of 12
Top

MS-2 Box 2 of 12
18
21
22
23.5
26.5

MS-2 Box 3 of 12
Top

43
51
40
49
37.5
48
46.5
45
MS-2 Box 4 of 12

MS-2 Box 5 of 12
Top
575
585

MS-2 Box 6 of 12

MS-2 Box 5 of 12

MS2 Bot 7 of 12
83
89
87.5
Top

MS-2 Box 8 of 12

MS-2 Box 9 of 12

MS-2 Box 10 of 12
Top
118
1193
1205
1273

MS-2 Box 11 of 12
TOP
134
137
138
135
133

MS-2 Box 12 of 12
TOP
145
146
147

APPENDIX 5.B

Laboratory Testing Data

Unconfined Compressive Strength Testing

UNCONFINED COMPRESSIVE STRENGTH
ASTM D 7012; Method C (Previously ASTM D 2938)

CLIENT: Golder Associates

JOB NO.: 2003-125

LOCATION:

DATE TESTED: 4/20/09 HN

PROJECT: Hanson Permanente Main Slide

Specimen ID Boring, Depth(ft.), Rock type	Diameter (in.)	Length (in.)	Mass (gms)	Wet Density (pcf)	Failure Load (lb)	Failure Types **	Compressive Strength (psi)
MS-INC-1, 250.0-250.5, Greenstone	2.399	4.954	1020.00	173.5	1,803	C	400
MS-INC-1, 128.3-129.0, Greenstone	2.398	3.972	824.00	175.0	2,453	C	*530

Notes and Comments:

* Indicates regardless of ASTM D 7012 method C, sample with L/D < 2.0.
was tested and correction factor for short sample was applied to the calculation.

$C=Ca/[0.88+0.24b/h]$

Ca = Failure Load / Surface Area

b = Sample Diameter

h = Sample Length

** Failure types S: Shear Failure, M: Matrix Failure, F: Failure due to Fracture/Bedding, V: Void Failure, C: Combination

Data Entered By: HN Date: 04/20/2009

Data Checked By: CW Date: 04/21/09

Filename: GOUCS125

ADVANCED TERRA TESTING, Inc. ATT

Point Load Testing

AXIAL PCINT LOAD TEST
ASTM D 5731

CLIENT: Golder Associates

JOB NO.: 2003-125

PROJECT: Hanson Permanente Main Slide

DATE TESTED: 4/15/09 BL

Specimen ID Boring, Depth, Rock type	Length (in.)	Diameter (in.)	De^2 (in^2)	Gauge Failure Load (psig)	P (lb)	Is	F	Is(50)	C	Compressive Strength (psi)	Loading with respect to Fracture	Failure Mode
MS-Inc-1, 26.1-26.8, Greenstone	1.775	2.406	5.438	126	260.8	48.0	1.1	51.4	25.0	1,280	Parallel	F
MS-Inc-1, 159.0-159.5, Greenstone	1.931	2.385	5.864	84	173.9	29.7	1.1	32.3	24.9	800	Parallel	C
MS-Inc-1, 264.0-264.5, Greenstone	2.257	2.395	6.883	11	22.8	3.3	1.1	3.7	24.9	90	Parallel	F

Notes:

L: Sample Length
D: Sample Diameter
De^2: Exquivalent Diameter = 4*L*D/pi
Piston Area (in^2): 2.07
P: Gauge Failure Load * Piston area (2.07 in^2)
Is: Point Load Index Strength = P/De^2
F: Size Correction Factor to 2.0 in = (De/2.0)^0.45
Is(50): Size Corrected Index Strength = F* Is
C: Factor to Estimate Compressive Strength related to Core Diameter
Compressive Strength in psi = C * Is(50)

Failure Modes:
F: Fracture Controlled
S: Substance Controlled
C: Combination Substance & Fracture

Data Entered By: BKL Date: 04/15/2009
Data Checked By: HV Date: 4/15/2009
Filename: GOPA125A

ADVANCED TERRA TESTING, INC. ATT

DIAMETRAL POINT LOAD TEST
ASTM D 5731

CLIENT: Golder Associates

JOB NO.: 2003-125

PROJECT: Hanson Permanente Main Slide

DATE TESTED: 4/17/09 BL

Specimen ID Boring, Depth, Rock Type	Length (in.)	Diameter (in.)	De^2 (in^2)	Gauge Failure Load (psig)	P (lb)	Is	F	Is(50)	C	Compressive Strength (psi)	Loading with respect to Fracture	Failure Mode
MS-2, 134.1-134.8,Greenstone	3.155	2.418	5.847	13	26.9	4.6	1.1	5.0	25.0	130	N/A	S
MS-Inc-1, 319.2-319.7,Greenstone	3.725	2.380	5.664	29	60.0	10.6	1.1	11.5	24.8	280	N/A	S

Notes:

L: Sample Length
D: Sample Diameter
De^2: Exquivalent Diameter = D^2
Piston Area (in^2): 2.07
P: Gauge Failure Load * Piston area (in^2)
Is: Point Load Index Strength = P/De^2
F: Size Correction Factor to 2.0 in = (De/2.0)^0.45
Is(50): Size Corrected Index Strength = F* Is
C: Factor to Estimate Compressive Strength related to Core Diameter
Compressive Strength in psi = C * Is(50)

Failure Modes:
F: Fracture Controlled
S: Substance Controlled
C: Combination Substance & Fracture

Data Entered By: BKL Date: 04/17/2009
Data Checked By: HN Date: 4/17/09
Filename: GOPDMS2A

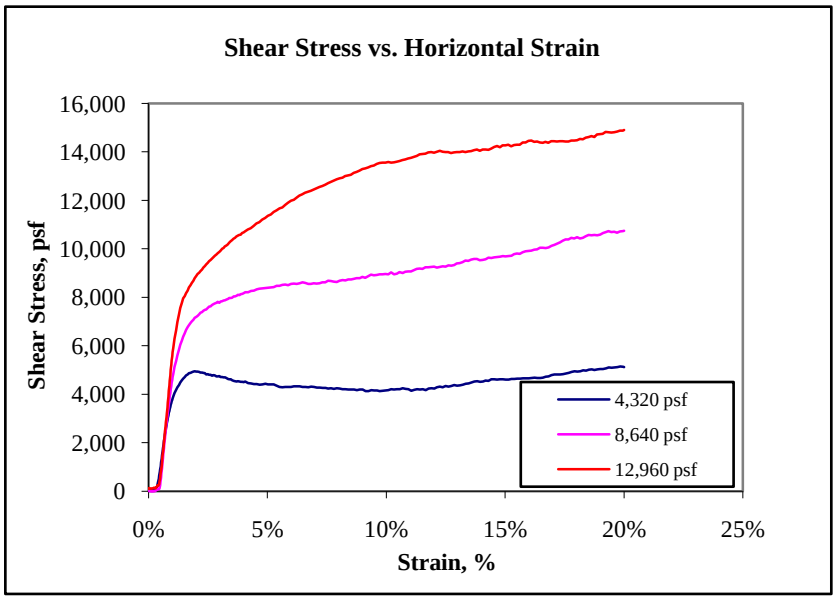
ADVANCED TERRA TESTING, INC. ATT

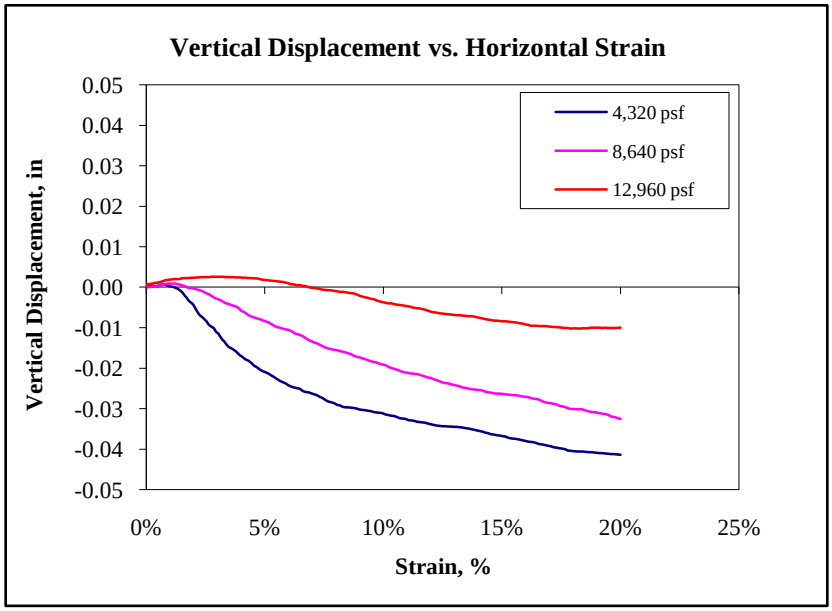
Direct Shear Testing

Sample # =	MS-INC-1 Greenstone @ 338.7-339.2'		Sample # =	MS-INC-1 Greenstone @ 338.7-339.2'		Sample # =	MS-INC-1 Greenstone @ 338.7-339.2'	
Point #	1		Point #	2		Point #	3	
Load =	30	psi	Load =	60	psi	Load =	90	psi
	Initial			**Initial**			**Initial**	
Height =	2.982	cm	Height =	2.982	cm	Height =	2.982	cm
Diameter =	6.350	cm	Diameter =	6.350	cm	Diameter =	6.350	cm
Wet Weight =	213.90	g	Wet Weight =	213.90	g	Wet Weight =	213.90	g
Area =	31.7	cm^2	Area =	31.7	cm^2	Area =	31.7	cm^2
Sample Area =	4.91	in^2	Sample Area =	4.91	in^2	Sample Area =	4.91	in^2
Sample Area =	0.03	ft^2	Sample Area =	0.03	ft^2	Sample Area =	0.03	ft^2
Volume =	94.4	cm^3	Volume =	94.4	cm^3	Volume =	94.4	cm^3
Moisture Content =	6.4%		Moisture Content =	6.4%		Moisture Content =	6.4%	
Specific Gravity =	-		Specific Gravity =	-		Specific Gravity =	-	
Dry Weight of Solids =	201.03	g	Dry Weight of Solids =	201.03	g	Dry Weight of Solids =	201.03	g
Wet Density =	2.27	g/cm^3	Wet Density =	2.27	g/cm^3	Wet Density =	2.27	g/cm^3
Dry Density =	2.13	g/cm^3	Dry Density =	2.13	g/cm^3	Dry Density =	2.13	g/cm^3
Wet Density =	141.3	pcf	Wet Density =	141.3	pcf	Wet Density =	141.3	pcf
Dry Density =	132.8	pcf	Dry Density =	132.8	pcf	Dry Density =	132.8	pcf
Initial Normal Stress =	4,320	psf	Initial Normal Stress =	8,640	psf	Initial Normal Stress =	12,960	psf
Failure Normal Stress =	4,426	psf	Failure Normal Stress =	9,203	psf	Failure Normal Stress =	14,843	psf
Failure Shear Stress =	4,953	psf	Failure Shear Stress =	8,378	psf	Failure Shear Stress =	13,553	psf
Failure Strain =	1.9%		Failure Strain =	4.9%		Failure Strain =	10.0%	
Normal Stress at Large Disp. =	5,785	psf	Normal Stress at Large Disp. =	11,568	psf	Normal Stress at Large Disp. =	17,353	psf
Large-Disp. Shear Stress =	5,134	psf	Large-Disp. Shear Stress =	10,746	psf	Large-Disp. Shear Stress =	14,903	psf
Strain at Large Disp.=	20.0%		Strain at Large Disp.=	20.0%		Strain at Large Disp.=	20.0%	

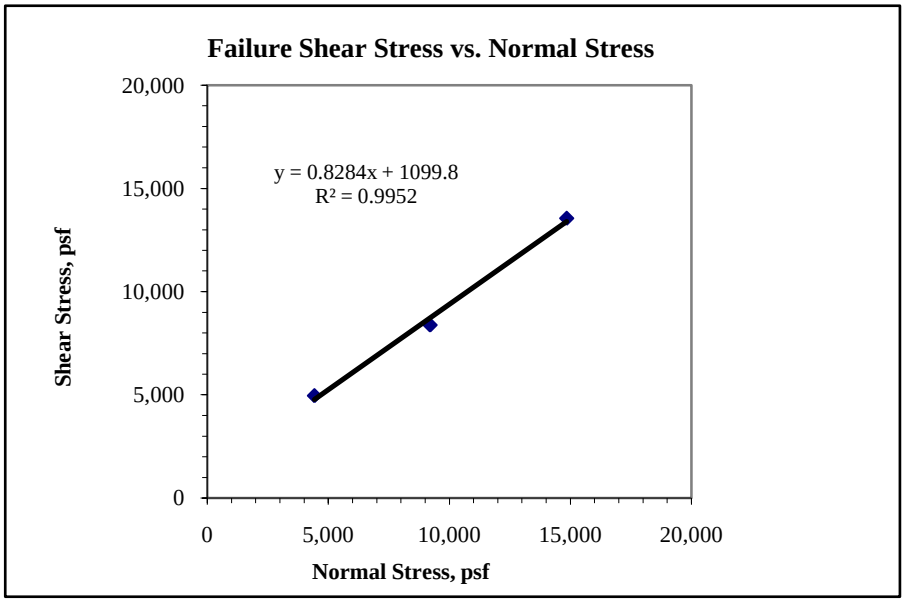
Notes:
-Samples were remolded to "dense" condition at "appropriate moisture," per Rhonda Knupp's instruction.
-Samples were inundated after consolidation and before shearing.
-There was only enough material to make one specimen. For Samples 1 and 2, the material was remolded, sheared, then dried back to recompact to the same initial moisture and density.

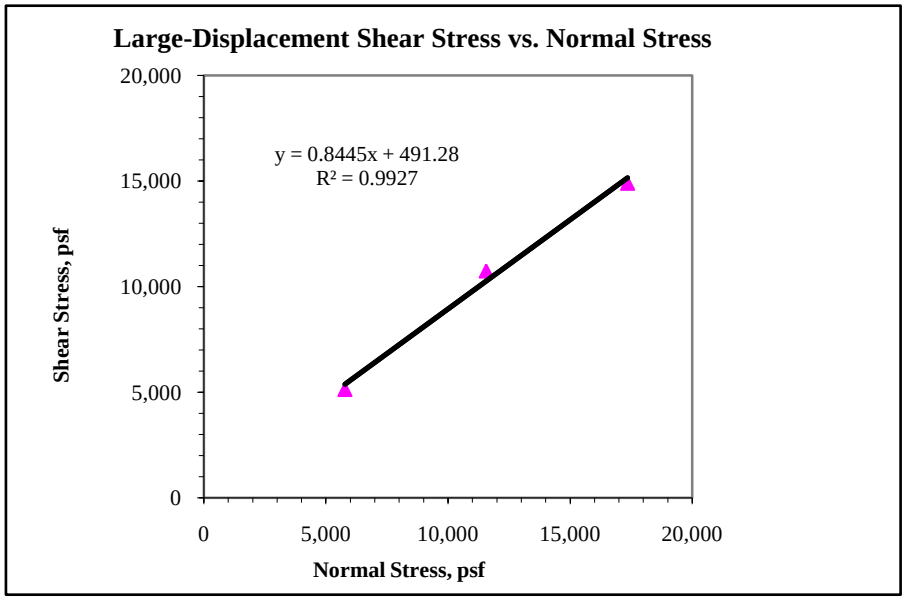
Golder Associates, Inc. **Denver, Colorado**	**Title:** **DIRECT SHEAR TEST REPORT** **SAMPLE DATA AND CALCULATIONS**				
Job Short Title: **Permanente**					
Sample Number: **MS-INC-1 Greenstone @ 338.7-339.2'**	**Reviewed:** **JEO**	**Date:** **04/17/09**	**Job Number:** **063-7109.100**	**Figure:** **1**	





Golder Associates, Inc. Denver, Colorado	Title: STRESS AND VERTICAL DISPLACEMENT VS. STRAIN			
Job Short Title: Permanente				
Sample Number: MS-INC-1 Greenstone @ 338.7-339.2'	Reviewed: JEO	Date: 04/17/09	Job Number: 063-7109.100	Figure: 2





Failure		Large-Displacement	
ϕ =	39.6 degrees	ϕ =	40.2 degrees
c =	1,100 psf	c =	491 psf

Golder Associates, Inc. **Denver, Colorado**	**Title:** **DIRECT SHEAR TESTING** **FAILURE ENVELOPES**
Job Short Title: **Permanente**	

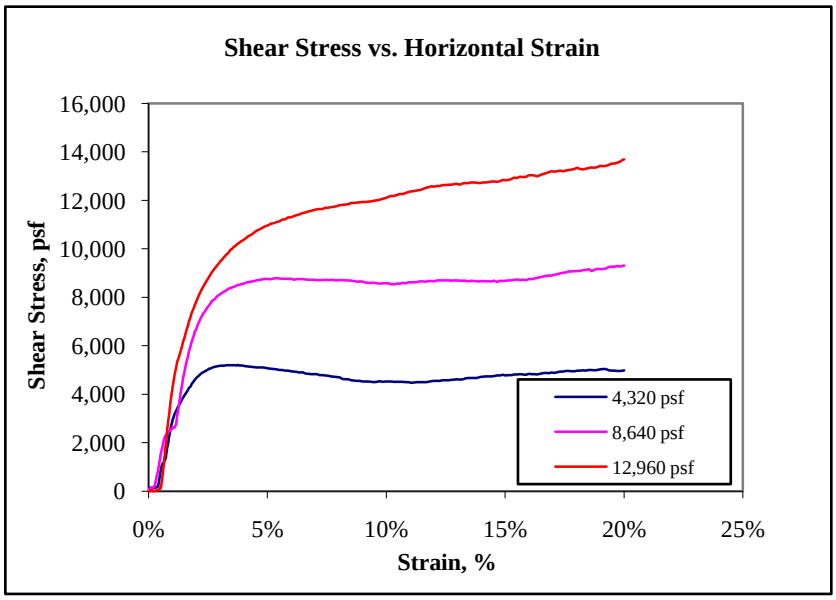
Sample Number:	Reviewed:	Date:	Job Number:	Figure:
MS-INC-1 Greenstone @ 338.7-339.2'	JEO	04/17/09	063-7109.100	3

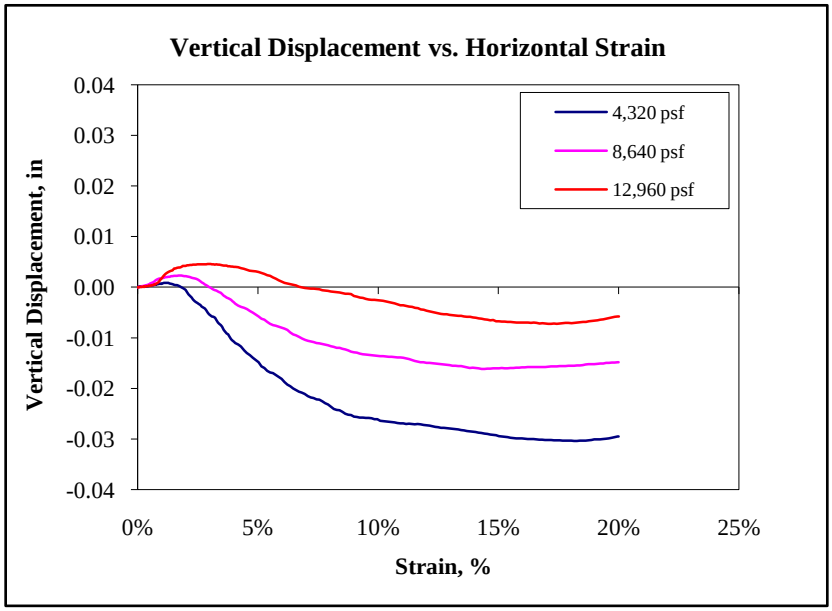
GOLDER ASSOCIATES INC.
DATE * post shear
JOB NO. 1013-7119
PROJECT PERMANENTE ~~DPT~~ 90 psi
SAMPLE NO. MS-INC-1 GREENSTONE @ 338.7-339.2
PROCTOR 698 1557 METHOD A B C
ATTERBERG SPG SIEVE HYDRO

Sample # =	MS-INC-1 Greenstone @ 358.0-358.5'		Sample # =	MS-INC-1 Greenstone @ 358.0-358.5'		Sample # =	MS-INC-1 Greenstone @ 358.0-358.5'	
Point #	1		Point #	2		Point #	3	
Load =	30	psi	Load =	60	psi	Load =	90	psi
	Initial			**Initial**			**Initial**	
Height =	2.982	cm	Height =	2.982	cm	Height =	2.982	cm
Diameter =	6.350	cm	Diameter =	6.350	cm	Diameter =	6.350	cm
Wet Weight =	228.00	g	Wet Weight =	228.00	g	Wet Weight =	228.00	g
Area =	31.7	cm^2	Area =	31.7	cm^2	Area =	31.7	cm^2
Sample Area =	4.91	in^2	Sample Area =	4.91	in^2	Sample Area =	4.91	in^2
Sample Area =	0.03	ft^2	Sample Area =	0.03	ft^2	Sample Area =	0.03	ft^2
Volume =	94.4	cm^3	Volume =	94.4	cm^3	Volume =	94.4	cm^3
Moisture Content =	8.2%		Moisture Content =	8.2%		Moisture Content =	8.2%	
Specific Gravity =	-		Specific Gravity =	-		Specific Gravity =	-	
Dry Weight of Solids =	210.72	g	Dry Weight of Solids =	210.72	g	Dry Weight of Solids =	210.72	g
Wet Density =	2.41	g/cm^3	Wet Density =	2.41	g/cm^3	Wet Density =	2.41	g/cm^3
Dry Density =	2.23	g/cm^3	Dry Density =	2.23	g/cm^3	Dry Density =	2.23	g/cm^3
Wet Density =	150.7	pcf	Wet Density =	150.7	pcf	Wet Density =	150.7	pcf
Dry Density =	139.2	pcf	Dry Density =	139.2	pcf	Dry Density =	139.2	pcf
Initial Normal Stress =	4,320	psf	Initial Normal Stress =	8,640	psf	Initial Normal Stress =	12,960	psf
Failure Normal Stress =	4,576	psf	Failure Normal Stress =	9,281	psf	Failure Normal Stress =	14,929	psf
Failure Shear Stress =	5,210	psf	Failure Shear Stress =	8,798	psf	Failure Shear Stress =	12,093	psf
Failure Strain =	3.8%		Failure Strain =	5.4%		Failure Strain =	10.0%	
Normal Stress at Large Disp. =	5,783	psf	Normal Stress at Large Disp. =	11,568	psf	Normal Stress at Large Disp. =	17,474	psf
Large-Disp. Shear Stress =	4,987	psf	Large-Disp. Shear Stress =	9,314	psf	Large-Disp. Shear Stress =	13,697	psf
Strain at Large Disp.=	20.0%		Strain at Large Disp.=	20.0%		Strain at Large Disp.=	20.0%	

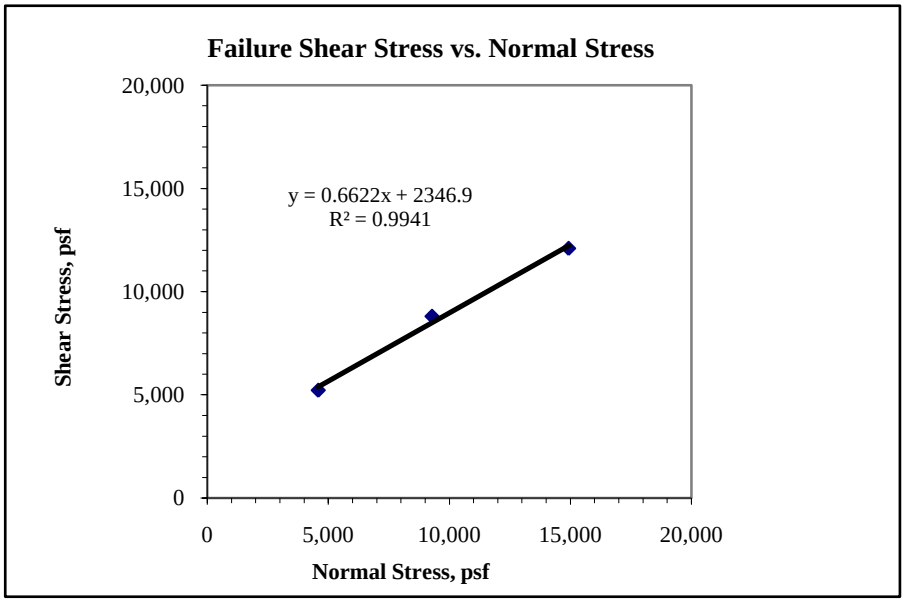
Note: -Samples were remolded to "dense" condition at "appropriate moisture," per Rhonda Knupp's instruction.
-Samples were inundated after consolidation and before shearing.

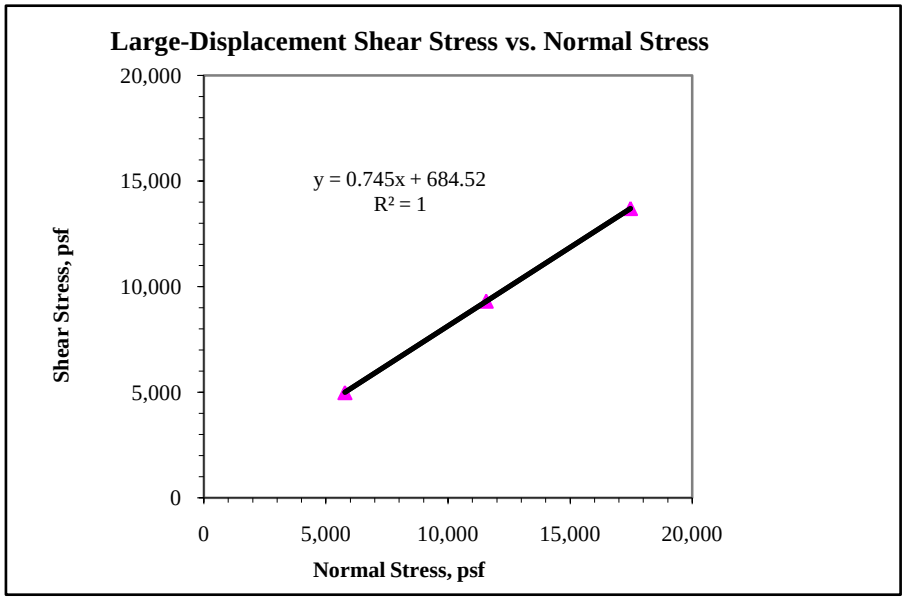
Golder Associates, Inc. **Denver, Colorado**	**Title:** **DIRECT SHEAR TEST REPORT** **SAMPLE DATA AND CALCULATIONS**				
Job Short Title: **Permanente**					
Sample Number: **MS-INC-1 Greenstone @ 358.0-358.5'**	**Reviewed:** **JEO**	**Date:** **4/15/2009**	**Job Number:** **063-7109.100**	**Figure:** **1**	





Golder Associates, Inc. Denver, Colorado	Title: STRESS AND VERTICAL DISPLACEMENT VS. STRAIN			
Job Short Title: Permanente				
Sample Number: MS-INC-1 Greenstone @ 358.0-358.5'	Reviewed: JEO	Date: 04/15/09	Job Number: 063-7109.100	Figure: 2





Failure		Large-Displacement	
ϕ =	33.5 degrees	ϕ =	36.7 degrees
c =	2,347 psf	c =	685 psf

Golder Associates, Inc. **Denver, Colorado**		**Title:** **DIRECT SHEAR TESTING FAILURE ENVELOPES**		
Job Short Title: **Permanente**				
Sample Number: **MS-INC-1 Greenstone @ 358.0-358.5'**	**Reviewed:** **JEO**	**Date:** **04/15/09**	**Job Number:** **063-7109.100**	**Figure:** **3**

GOLDER ASSOCIATES INC.
* post-shear
DATE
JOB NO. 063-7109
PROJECT PERMANENTE
SAMPLE NO. MS-INC-1 GREENSTONE @ 358-358.5
PROCTOR 698 1557 METHOD A B C
ATTERBERG SPG SIEVE HYDRO

APPENDIX 5.C

Seismic Displacement Calculations

Summary of Dynamic Deformation Analysis - Main Slide

Selected Notations			
M_w =	Moment magnitude	k_y =	Yield acceleration
a_{brk} =	Peak Horizontal Acceleration at the bedrock	U =	Dynamic deformation along critical slide surface
a_{max} =	Peak Horizontal Acceleration at the crest of slope		

Earthquake Characterization		
M_w	a_{brk} g	a_{max} (Reference 1) g
7.1	0.60	0.60

Deformation Calculation (Reference 2)							
SITE	Section	Failure Description	k_y g	k_y/a_{max}	Slope Deformation, U (in) (Bray and Travasarou)		
					84% Exc.	16% Exc.	50% Exc.
Main Slide	Az 120° Section 1000	Reclaimed	0.15	0.25	4	14	7
	Stability Section	Reclaimed	0.165	0.28	3	12	6

References:

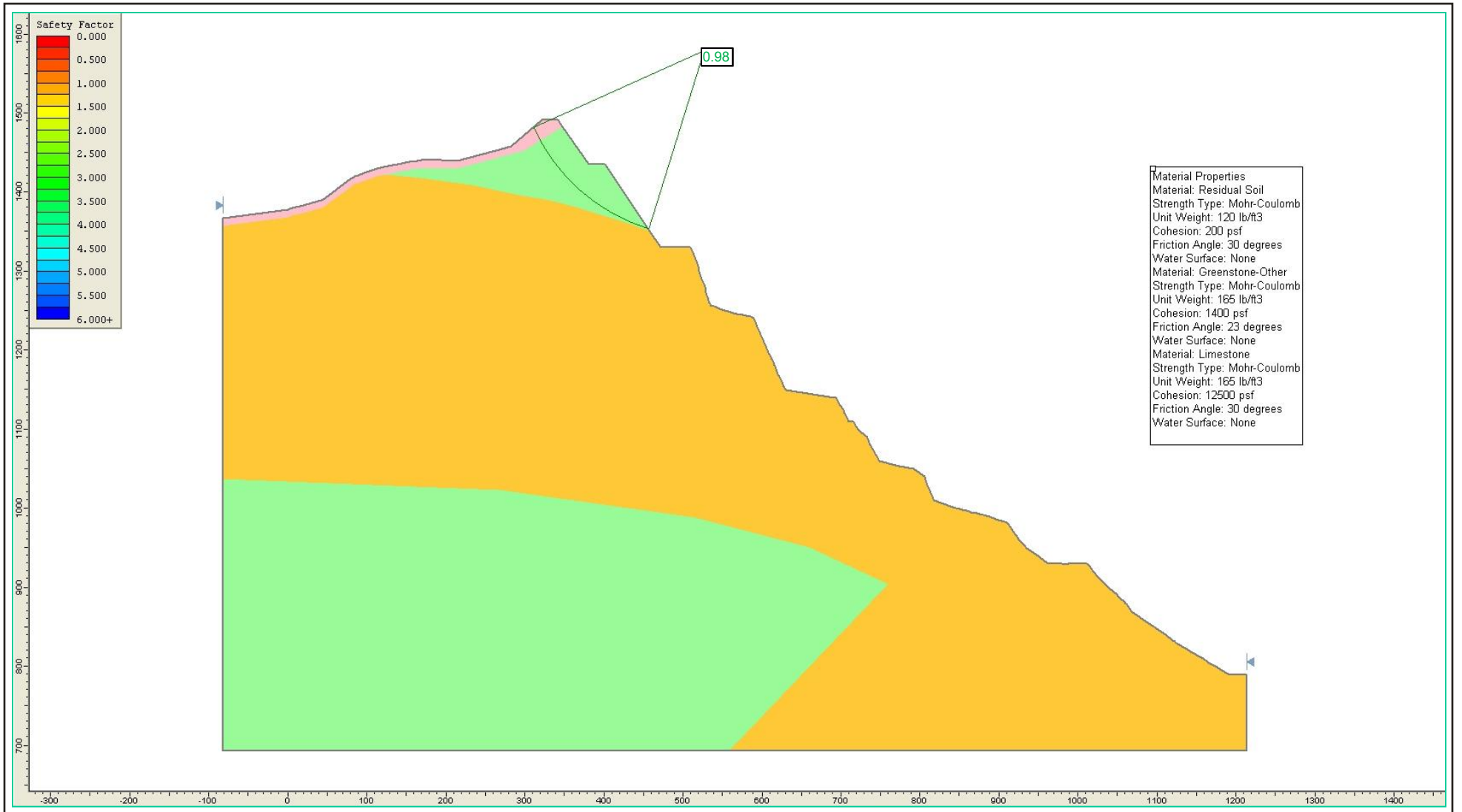
1. Seed, H. B. and Idriss, I. M. (1982), Ground Motions and Soil Liquefaction During Earthquakes Monograph No. 5, Earthquake Engineering Research Institute, Berkeley, California.
2. Bray, J. D. and Travasarou, T. (2007), Simplified Procedure for Estimating Earthquake-Induced Deviatoric Slope Displacements Journal of the Geotechnical and Geoenvironmental Engineering, ASCE, Vol. 133, No. 4, pp. 381-392.

Note: This spreadsheet is only intended to estimate seismic deformation under the above shown earthquake events and sections, assuming potential failure mass is a Newmark rigid sliding block.

APPENDIX 6.A

Scenic Easement - Slope Stability Output

PROJECT NO. 063-7109904 DRAWN: AJS REVIEWED BY: KGH DATE: 07-07-11 FILE LOCATION:

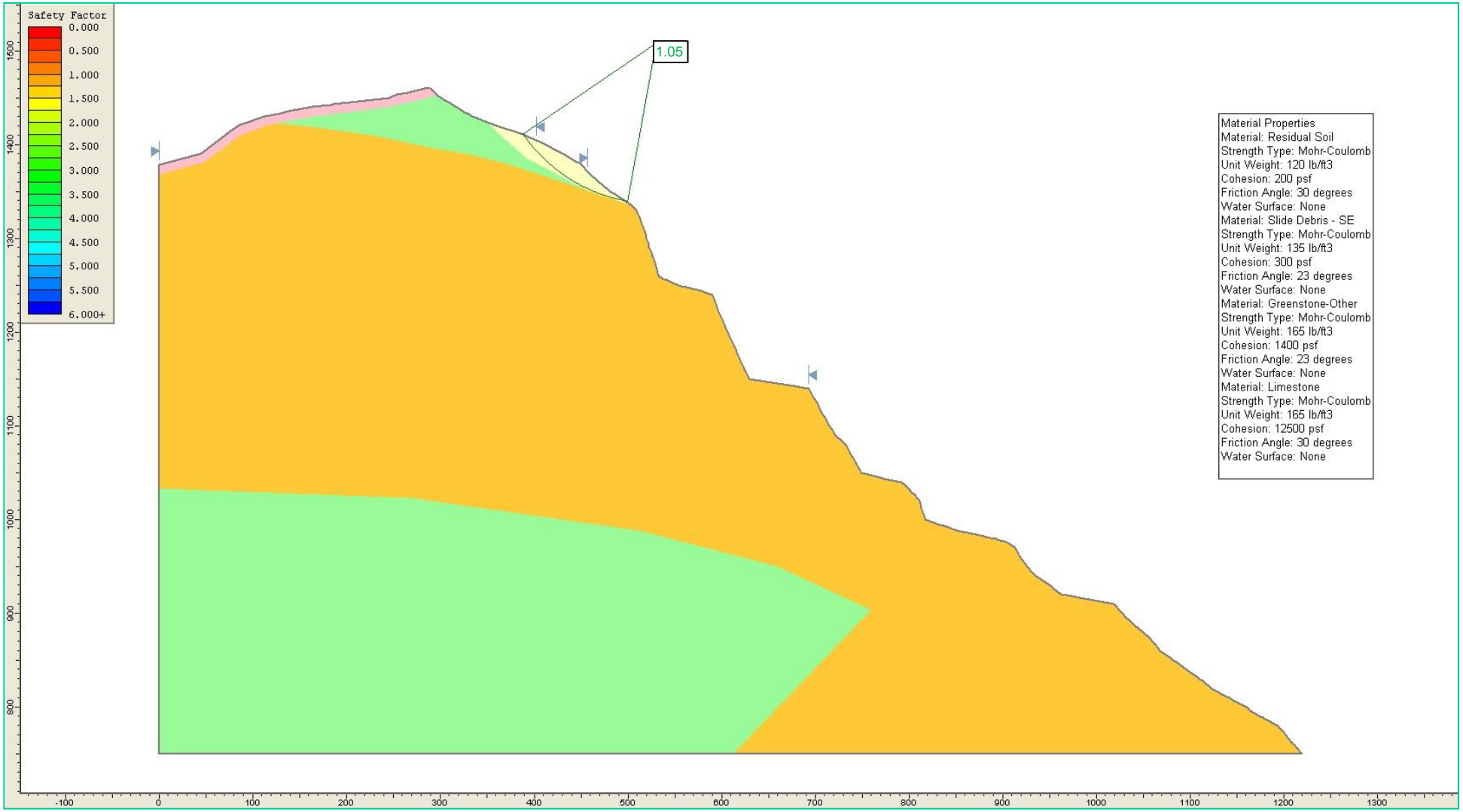


SECTION SE1 – PRE-FAILURE/BACK ANALYSIS
CONDITION: STATIC
FAILURE MODE: CIRCULAR
BACK CALCULATED Kg-1 STRENGTH: c = 1400 psf; ϕ = 23 degrees

Golder Associates		PRE-FAILURE CONDITION SCENIC-EASEMENT SLIDE LEHIGH SOUTHWEST CEMENT COMPANY, CA	
Drawn: AJS	App'd: KGH	Date: JULY, 2011	Figure: 6A-1

Project No.: 063-7109 Revision No.: 2

PROJECT NO. 063-7109904 DRAWN: AJS REVIEWED BY: KGH DATE: 07-07-11 FILE LOCATION:

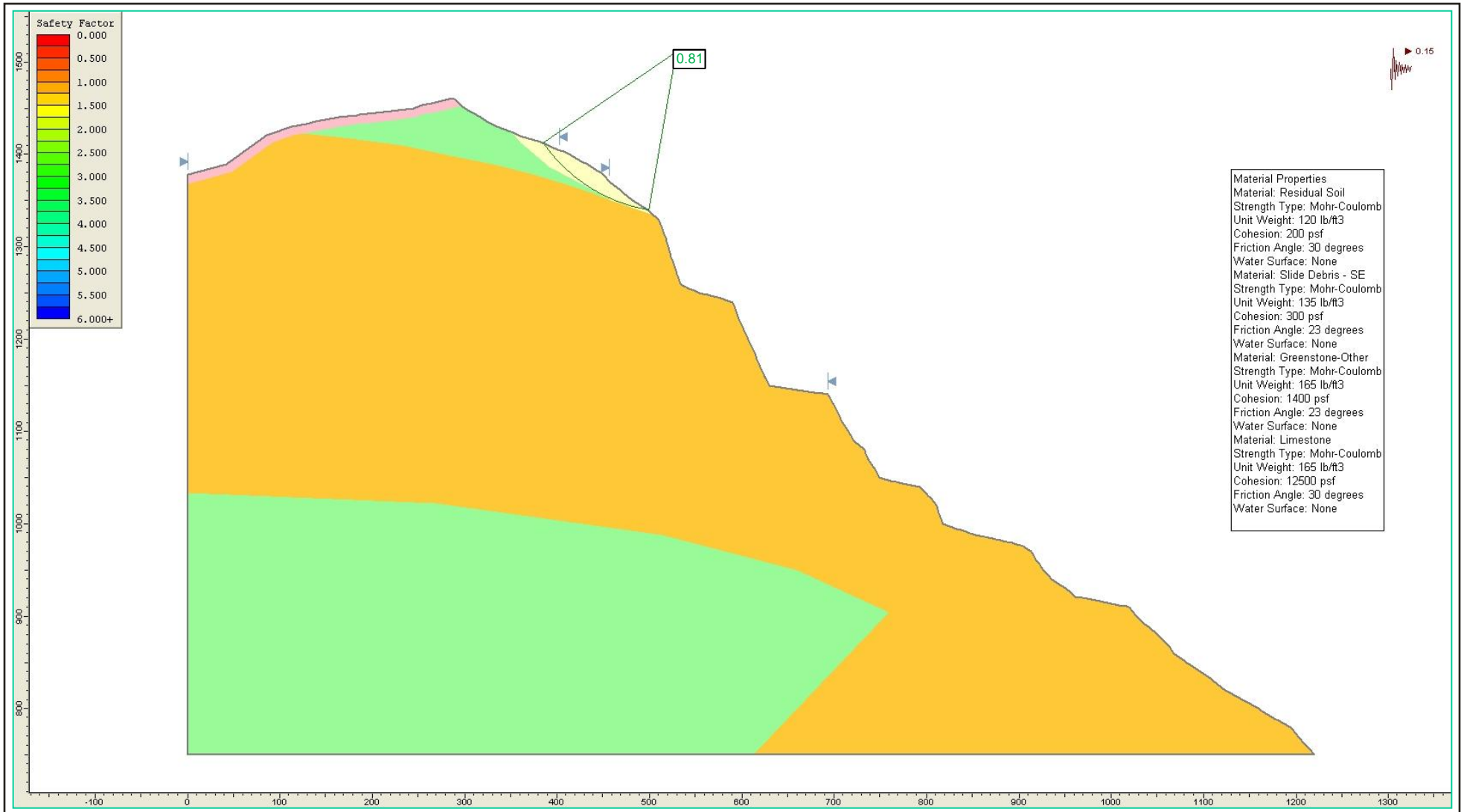


SECTION SE1 – EXISTING
CONDITION: STATIC
FAILURE MODE: CIRCULAR
MIN. FOS = 1.05

Golder Associates		EXISTING CONDITION SCENIC-EASEMENT SLIDE LEHIGH SOUTHWEST CEMENT COMPANY, CA	
Drawn: AJS	App'd: KGH	Date: JULY, 2011	Figure: 6A-2

Project No.: 063-7109 Revision No.: 2

PROJECT NO. 063-7109904 DRAWN: AJS REVIEWED BY: KGH DATE: 07-07-11 FILE LOCATION:

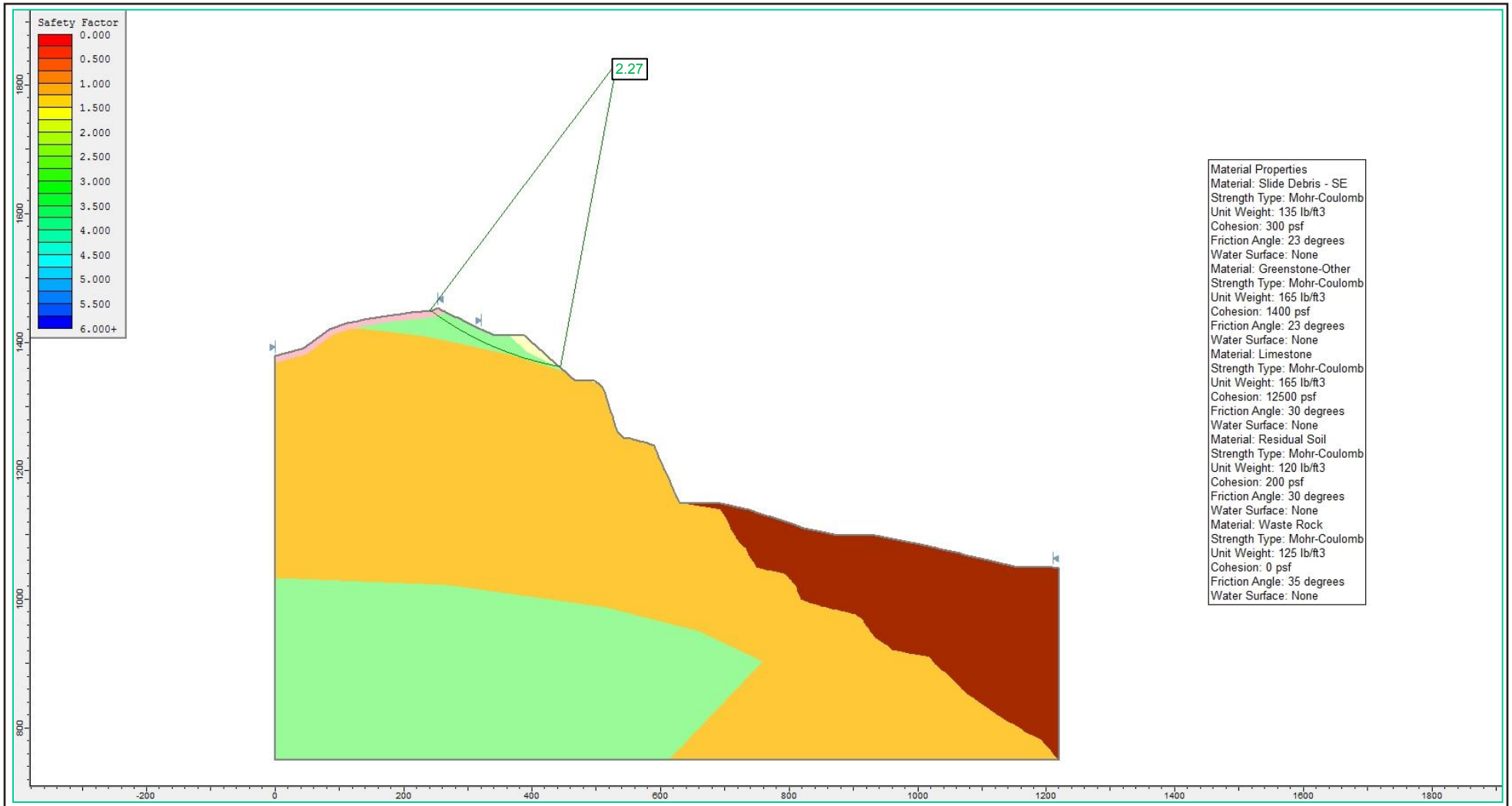


SECTION SE1 – EXISTING
CONDITION: PSEUDO-STATIC (WITH K = 0.15)
FAILURE MODE: CIRCULAR
MIN. FOS = 0.81

Golder Associates		EXISTING CONDITION SCENIC-EASEMENT SLIDE LEHIGH SOUTHWEST CEMENT COMPANY, CA	
Drawn: AJS	App'd: KGH	Date: JULY, 2011	Figure: 6A-3

Project No.: 063-7109 Revision No.: 2

PROJECT NO. 063-7109904 DRAWN: AJS REVIEWED BY: KGH DATE: 07-07-11 FILE LOCATION:

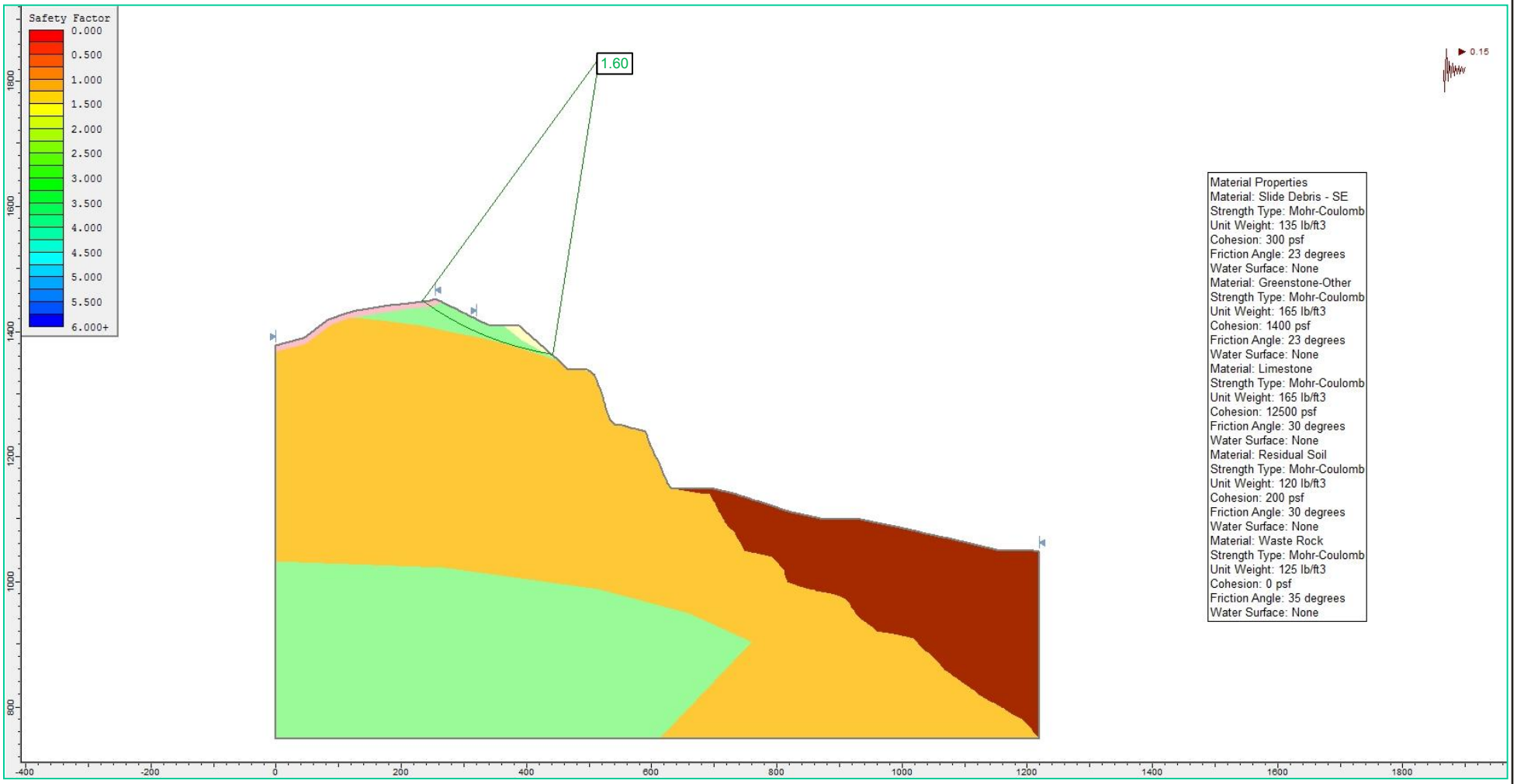


SECTION SE1 – ULTIMATE RECLAMATION
CONDITION: STATIC
FAILURE MODE: CIRCULAR
MIN. FOS = 2.27

Golder Associates		PROPOSED GRADING SCENIC-EASEMENT SLIDE LEHIGH SOUTHWEST CEMENT COMPANY, CA	
Drawn: AJS	App'd: KGH	Date: JULY, 2011	Figure: 6A-4

Project No.: 063-7109 Revision No.: 2

PROJECT NO. 063-7109904 DRAWN: AJS REVIEWED BY: KGH DATE: 07-07-11 FILE LOCATION:



SECTION SE1 – ULTIMATE RECLAMATION
CONDITION: PSEUDO-STATIC (K=0.15)
FAILURE MODE: CIRCULAR
MIN. FOS = 1.60

Golder Associates		PROPOSED GRADING SCENIC-EASEMENT SLIDE LEHIGH SOUTHWEST CEMENT COMPANY, CA	
Drawn: AJS	App'd: KGH	Date: JULY, 2011	Figure: 6A-5

Project No.: 063-7109 Revision No.: 2

Summary of Dynamic Deformation Analysis - Scenic Easement

Selected Notations			
M_w =	Moment magnitude	k_y =	Yield acceleration
a_{brk} =	Peak Horizontal Acceleration at the bedrock	U =	Dynamic deformation along critical slide surface
a_{max} =	Peak Horizontal Acceleration at the crest of slope		

Earthquake Characterization		
M_w	a_{brk} g	a_{max} (Reference 1) g
7.1	0.60	0.60

Deformation Calculation (Reference 2)							
SITE	Section	Failure Description	k_y g	k_y/a_{max}	Slope Deformation, U (in) (Bray and Travasarou)		
					84% Exc.	16% Exc.	50% Exc.
Scenic Easement	SE1	Existing	0.03	0.05	31	118	60

References:

1. Seed, H. B. and Idriss, I. M. (1982), Ground Motions and Soil Liquefaction During Earthquakes Monograph No. 5, Earthquake Engineering Research Institute, Berkeley, California.
2. Bray, J. D. and Travasarou, T. (2007), Simplified Procedure for Estimating Earthquake-Induced Deviatoric Slope Displacements Journal of the Geotechnical and Geoenvironmental Engineering, ASCE, Vol. 133, No. 4, pp. 381-392.

Note: This spreadsheet is only intended to estimate seismic deformation under the above shown earthquake events and sections, assuming the failure mass is a Newmark rigid sliding block.

APPENDIX 7.A

Mid-Pen – Test Pit Logs

TEST PIT LOG

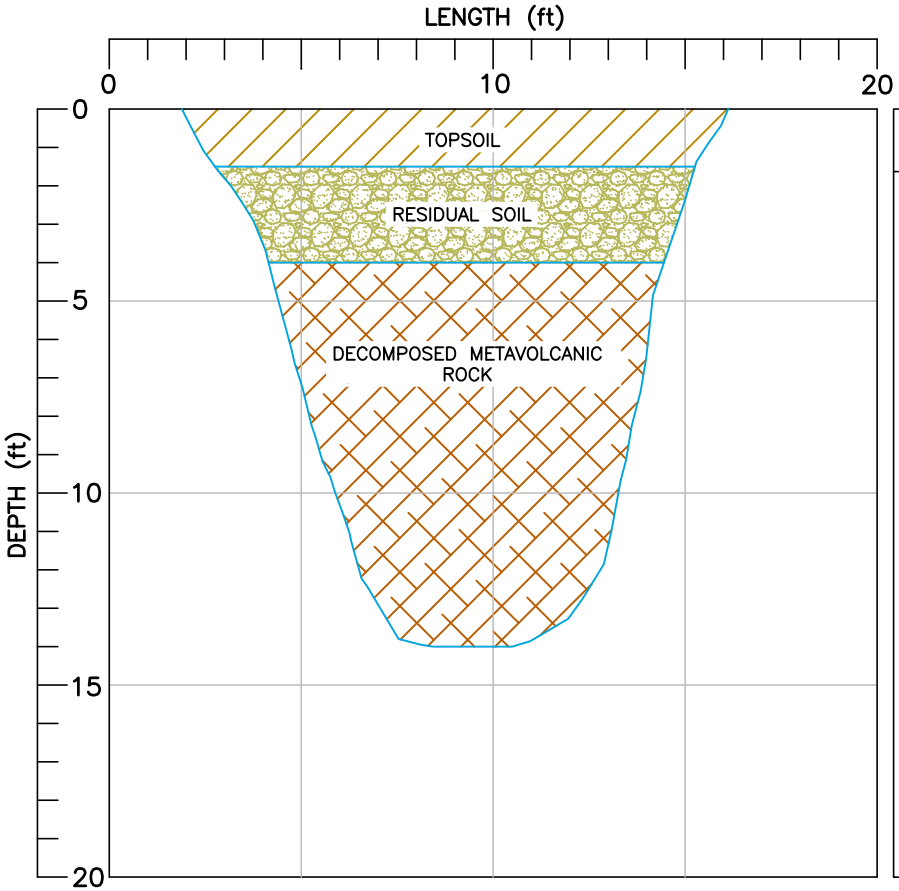
No. TP–MP–1

TEMP 50°F WEATHER SUNNY ENGINEER RHONDA KNUPP OPERATOR

EQUIPMENT SMALL CAT TRACK EXCAVATOR CONTRACTOR LEHIGHHANSON PERMANENTE DATE 01/15/09

COORDINATES N 1944491 E 6095091 ELEV. 1485 DATUM UTM JOB 063–7109.100

LOCATION PERMANENTE PIT 1



LITHOLOGIC DESCRIPTIONS AND EXCAVATION NOTES

0–1.5' TOPSOIL: SOFT, DARK BROWNISH–BLACK CLAY, SOME SAND, TRACE GRAVEL, DAMP. SAND AND GRAVEL ANGULAR. ABUNDANT ROOTS.

1.5'–4' RESIDUAL SOIL TO COMPLETELY WEATHERED ROCK: DENSE TO VERY DENSE, MOTTLED TAN–BROWN GRAVEL, AND SAND, TRACE CLAY, DAMP. GRAVEL AND SAND ARE ANGULAR METAVOLCANIC ROCK FRAGMENTS WITH MnO ON MANY SURFACES. THESE WILL BREAK DOWN TO CLAY, BECAUSE CLAY IS SMEARED ON THE SIDES OF THE PIT WHERE THE BUCKET HAS RUBBED AGAINST THE WALLS. SAMPLE AT 3.5'.

4'–14' DECOMPOSED METAVOLCANIC ROCK: DENSE TO VERY DENSE, MOTTLED TAN–BROWN GRAVEL, AND SAND, LITTLE CLAY. PROBABLY SAME AS OVERLYING MATERIAL, JUST BROKEN DOWN MORE BY BUCKET AS DIGGING BECOMES MORE DIFFICULT. SAMPLE AT 10'.

EXCAVATOR REFUSAL AT 14'. SAME MATERIAL AS ABOVE, BUT ROCK FRAGMENTS ARE BIGGER – MANY ARE COBBLE–SIZED. MAY BE MORE CLAY IN THIS – "SOME" INSTEAD OF "LITTLE". SAMPLE AT 14'.

PHOTOGRAPHIC LOG

SAMPLES

NO.	DEPTH (ft)
1	3.4
2	10
3	14
4*	UNKNOWN

SPECIAL NOTES

LAB TEST RESULTS**

SIEVE SIZE	% PASSING
3/4"	--
#4	--
#200	--

LL=XX; PL=XX: PI=XX

MC=XX%

*CHUNK SAMPLE COLLECTED FROM SPOILS PILE
**LAB TEST RESULTS PROVIDED IN APPENDIX B.

Friday, May 21, 2010 – 11:52am FILE: S:\HansonPermanente\Pit 1 North East Walls\Mid Pen Regrade – 2009 files\RLK Site Visit 1–15–09\Test Pits\TEST PIT LOG.dwg TAB NAME \MP–1
THIS DRAWING HAS BEEN PREPARED BY GOLDER ASSOCIATES INC. FOR USE BY THE CLIENT NAMED IN THE TITLE BLOCK SOLELY IN RESPECT OF THE CONSTRUCTION OPERATION AND MAINTENANCE OF THE FACILITY NAMED IN THE TITLE BLOCK. GOLDER ASSOCIATES INC. SHALL NOT BE LIABLE FOR THE USE OF THIS DRAWING ON ANY OTHER FACILITY OR FOR ANY OTHER PURPOSES.

TEST PIT LOG

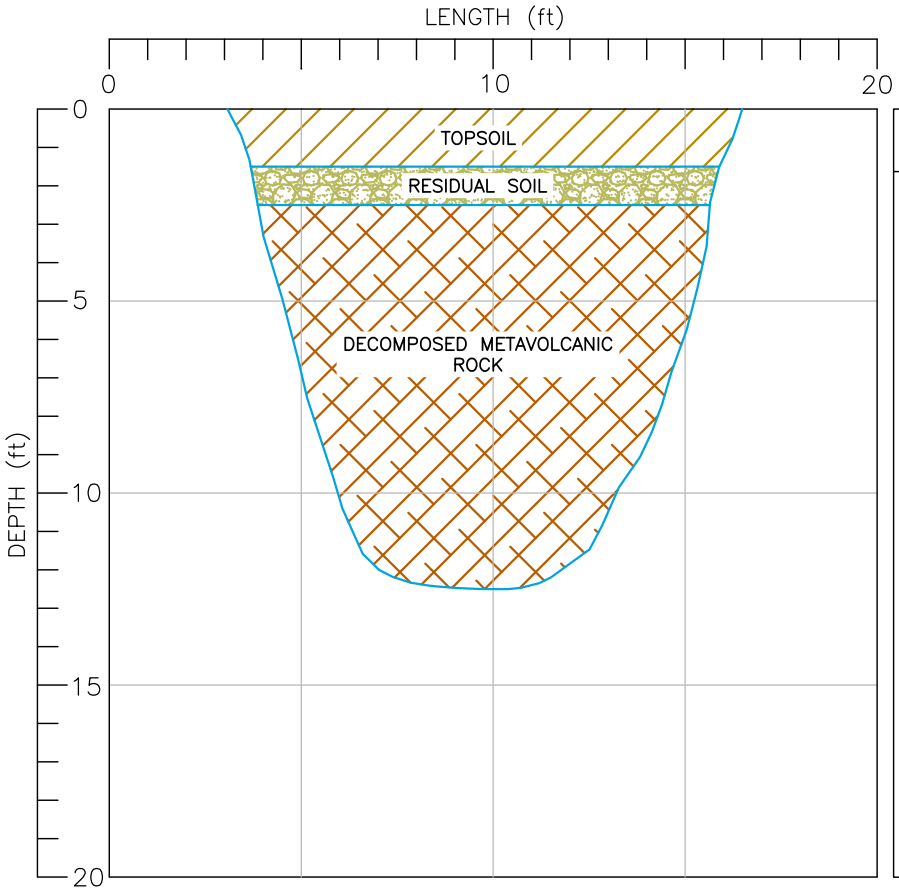
No. TP–MP–2

TEMP 50°F WEATHER SUNNY ENGINEER RHONDA KNUPP OPERATOR

EQUIPMENT SMALL CAT TRACK EXCAVATOR CONTRACTOR LEHIGHHANSON PERMANENTE DATE 01/15/09

COORDINATES N 1944454 E 6095101 ELEV. 1485 DATUM UTM JOB 063–7109.100

LOCATION PERMANENTE PIT 1



LITHOLOGIC DESCRIPTIONS AND EXCAVATION NOTES	
0–1.5'	TOPSOIL: SOFT, DARK BROWNISH–BLACK CLAY, SOME SAND, TRACE GRAVEL, DAMP. SAND AND GRAVEL ANGULAR. ABUNDANT ROOTS.
1.5'–2.5'	RESIDUAL SOIL TO COMPLETELY WEATHERED ROCK: DENSE TO VERY DENSE, MOTTLED TAN–BROWN GRAVEL, AND SAND, TRACE CLAY, DAMP. GRAVEL AND SAND ARE ANGULAR METAVOLCANIC ROCK FRAGMENTS WITH MnO ON MANY SURFACES.
2.5'–12.5'	DECOMPOSED METAVOLCANIC ROCK: DENSE TO VERY DENSE, MOTTLED TAN–BROWN GRAVEL, AND SAND, LITTLE CLAY. GRAVEL AND SAND ARE ANGULAR MV ROCK FRAGMENTS AND PROBABLY SMALLER FRAGMENTS WILL BREAK DOWN TO CLAY, AS DESCRIBED IN PREVIOUS PIT. ABUNDANT MnO ON FRAGMENT SURFACES. SAMPLE AT 10'.

EXCAVATOR REFUSAL AT 12.5 FT. SAMPLE AT 12.5 FT.; MATERIALS LOOK THE SAME AS SAMPLE AT 10'.

PHOTOGRAPHIC LOG

SAMPLES

NO.	DEPTH (ft)
5	10
6	12.5

SPECIAL NOTES

LAB TEST RESULTS*

SIEVE SIZE	% PASSING
3/4"	--
#4	--
#200	--
LL=XX; PL=XX: PI=XX	
MC=XX%	

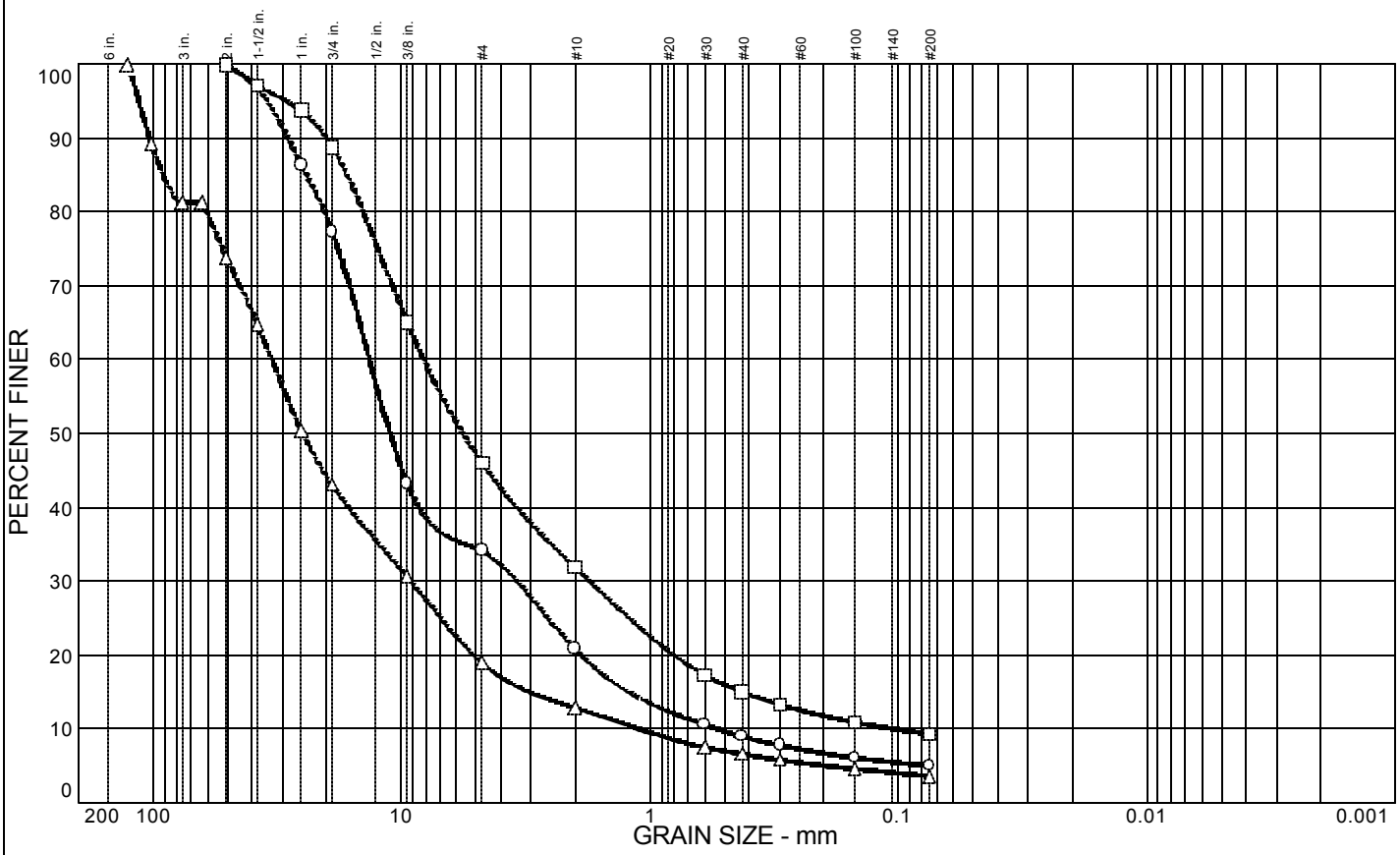
*LAB TEST RESULTS PROVIDED IN APPENDIX B.

Friday, May 21, 2010 – 11:52am FILE: S:\HansonPermanente\Pit 1 North East Walls\Mid Pen Regrade – 2009 files\RLK Site Visit 1–15–09\Test Pits\TEST PIT LOG.dwg TAB NAME \MP–2
THIS DRAWING HAS BEEN PREPARED BY GOLDER ASSOCIATES INC. FOR USE BY THE CLIENT NAMED IN THE TITLE BLOCK SOLELY IN RESPECT OF THE CONSTRUCTION OPERATION AND MAINTENANCE OF THE FACILITY NAMED IN THE TITLE BLOCK. GOLDER ASSOCIATES INC. SHALL NOT BE LIABLE FOR THE USE OF THIS DRAWING ON ANY OTHER FACILITY OR FOR ANY OTHER PURPOSES.

APPENDIX 7.B

Mid-Pen – Lab Test Results

Particle Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○		65.9	29.1	5.0					
□		54.0	36.7	9.3					
△	18.8	62.2	15.4	3.6					

SIEVE inches size	PERCENT FINER ○	PERCENT FINER □	PERCENT FINER △
5			100.0
4			89.2
3			81.2
2.5			81.2
2	100.0	100.0	73.9
1.5"	96.9	97.1	64.8
1"	86.4	93.8	50.4
3/4"	77.3	88.8	43.1
3/8"	43.2	65.1	30.7
GRAIN SIZE			
D_{60}	13.5	8.17	33.3
D_{30}	3.43	1.75	9.15
D_{10}	0.531	0.104	1.10
COEFFICIENTS			
C_c	1.64	3.60	2.28
C_u	25.47	78.56	30.28

SIEVE number size	PERCENT FINER ○	PERCENT FINER □	PERCENT FINER △
#4	34.1	46.0	19.0
#10	20.8	31.9	12.9
#30	10.6	17.3	7.5
#40	9.0	15.0	6.6
#50	7.8	13.3	5.8
#100	6.1	10.9	4.6
#200	5.0	9.3	3.6

SOIL DESCRIPTION

○ Brown Well-Graded GRAVEL w/ Silt & Sand

□ Brown Poorly Graded GRAVEL w/ Silt & Sand

△ Gray Well-Graded GRAVEL w/ Sand

REMARKS:

○

□

△

○ Source: TP-MP-1 Elev./Depth: 3.5'

□ Source: TP-MP-1 Elev./Depth: 10'

△ Source: TP-MP-1 Elev./Depth: 14'

COOPER TESTING LABORATORY

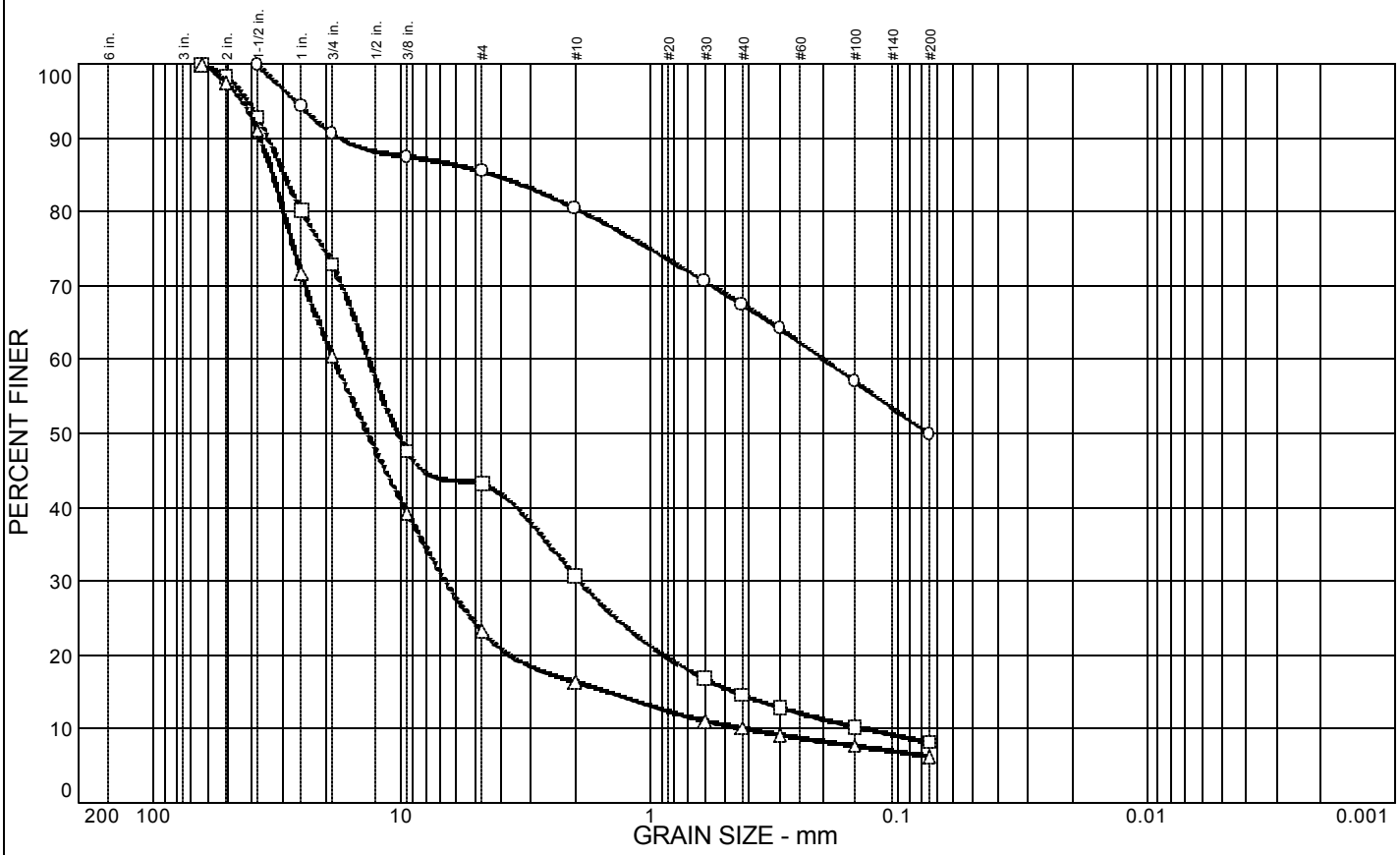
Client: Golder Associates

Project: Hanson - 063-7109.100

Project No.: 287-038

Figure

Particle Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○		14.5	35.6	49.9		SC		25	46
□		56.8	35.0	8.2					
△		76.8	16.9	6.3					

SIEVE inches size	PERCENT FINER ○	□	△
2.5		100.0	100.0
2		98.4	97.6
1.5"	100.0	92.9	91.0
1"	94.3	80.2	71.7
3/4"	90.7	72.9	60.6
3/8"	87.5	47.6	39.3
GRAIN SIZE			
D_{60}	0.198	13.6	18.7
D_{30}		1.92	6.67
D_{10}		0.137	0.409
COEFFICIENTS			
C_c		1.98	5.81
C_u		99.27	45.72

SIEVE number size	PERCENT FINER ○	□	△
#4	85.5	43.2	23.2
#10	80.5	30.7	16.4
#30	70.6	16.8	11.1
#40	67.5	14.6	10.1
#50	64.2	12.9	9.2
#100	57.1	10.3	7.7
#200	49.9	8.2	6.3

SOIL DESCRIPTION

○ Dark Reddish Brown Lean Clayey SAND

□ Brown Well-Graded GRAVEL w/ Clay & Sand

△ Brown Poorly Graded GRAVEL w/ Clay & Sand

REMARKS:

○

□

△

○ Source: TP-MP-2 Elev./Depth: 0-0.5'

□ Source: TP-MP-2 Elev./Depth: 10'

△ Source: TP-MP-2 Elev./Depth: 12.5'

COOPER TESTING LABORATORY

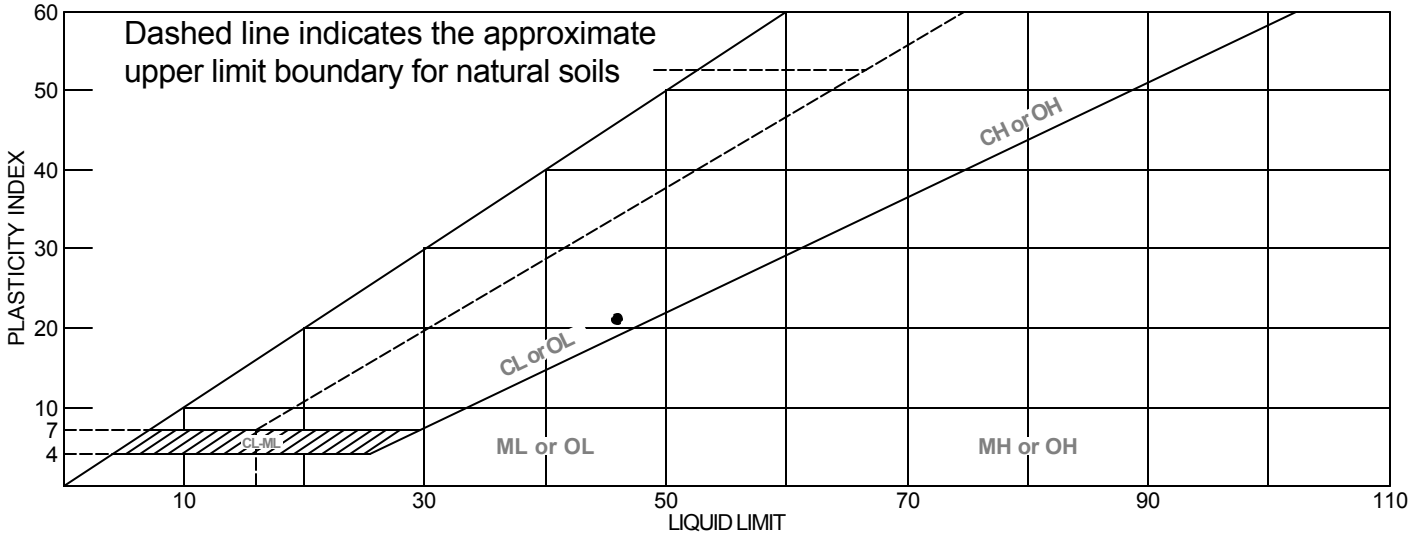
Client: Golder Associates

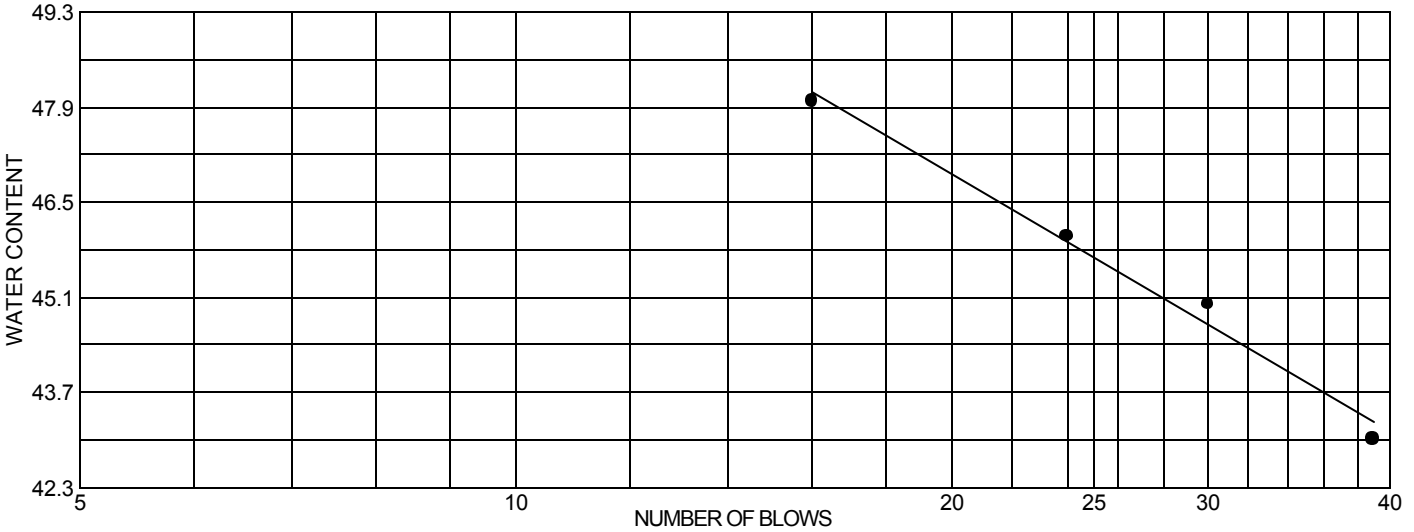
Project: Hanson - 063-7109.100

Project No.: 287-038

Figure

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Dark Reddish Brown Lean Clayey SAND	46	25	21	67.5	49.9	SC

Project No. 287-038 **Client:** Golder Associates

Project: Hanson - 063-7109.100

● **Source:** TP-MP-2 **Elev./Depth:** 0-0.5'

Remarks:

●

LIQUID AND PLASTIC LIMITS TEST REPORT

COOPER TESTING LABORATORY

Figure

Chunk Density
(USACE - Displacement method)

CTL Job No: 287-038 **Project No.:** 063-7109.100
Client: Golder Associates **Date:** 1/26/09
Project Name: Hanson **By:** PJ

Boring: **Sample:** **Depth, ft:**	Franciscan chunk 1	Franciscan chunk 2	Franciscan chunk 3					
Visual Description:	Reddish Brown Weathered Rock	Reddish Brown Weathered Rock	Reddish Brown Weathered Rock					
Actual G_s								
Assumed G_s	2.70	2.70	2.70					
Total Vol cc	231.28	441.70	553.53					
Vol Solids,cc	188.15	355.25	449.75					
Vol Voids,cc	43.13	86.46	103.78					
Moisture, %	5.0	5.9	5.4					
Wet Unit wt, pcf	143.9	143.4	144.2					
Dry Unit wt, pcf	137.1	135.5	136.9					
Saturation, %	58.7	64.9	62.8					
Porosity, %	18.6	19.6	18.7					
Void Ratio	0.229	0.243	0.231					
Series	1	2	3	4	5	6	7	8

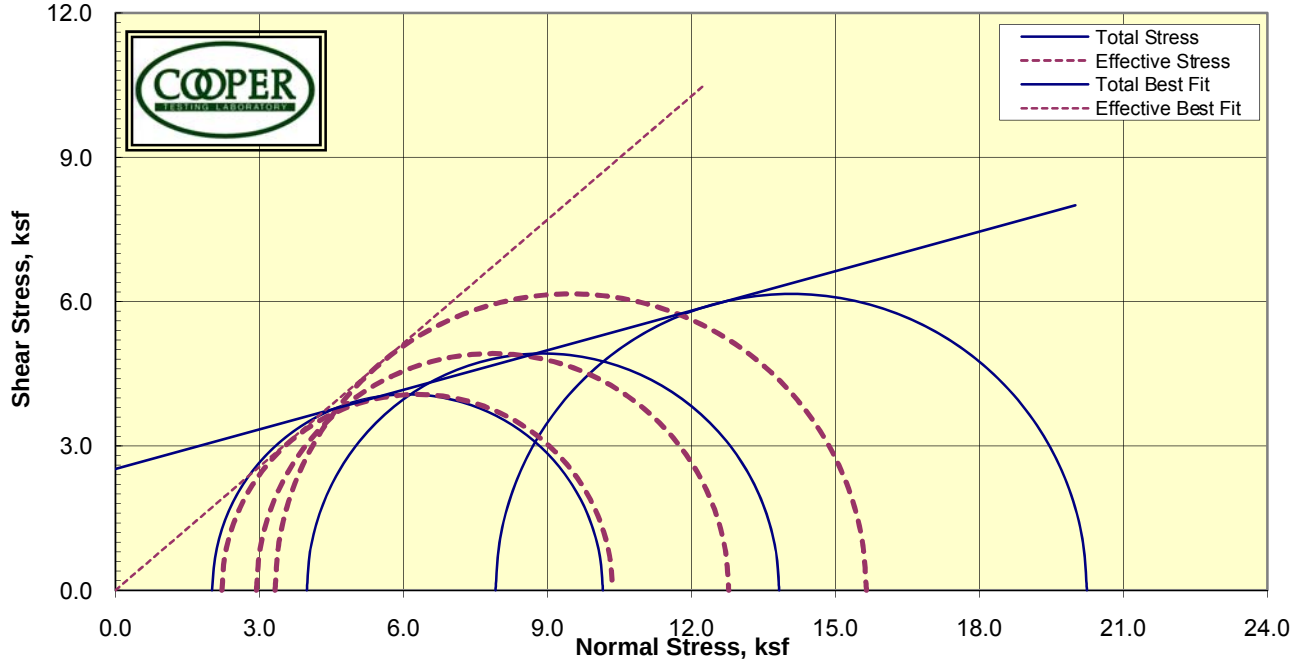
Note: If an assumed specific gravity (Gs) was used then the saturation, porosities, and void ratio should be considered approximate.

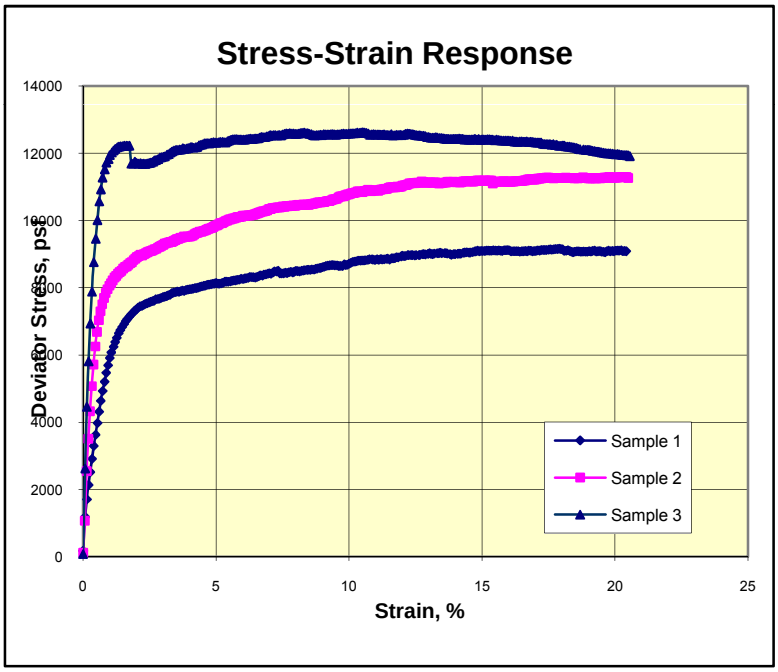
The Zero Air-Voids curves represent the dry density at 100% saturation for each value of specific gravity

COOPER TESTING LABORATORY

Triaxial Consolidated Undrained

(ASTM D4767)

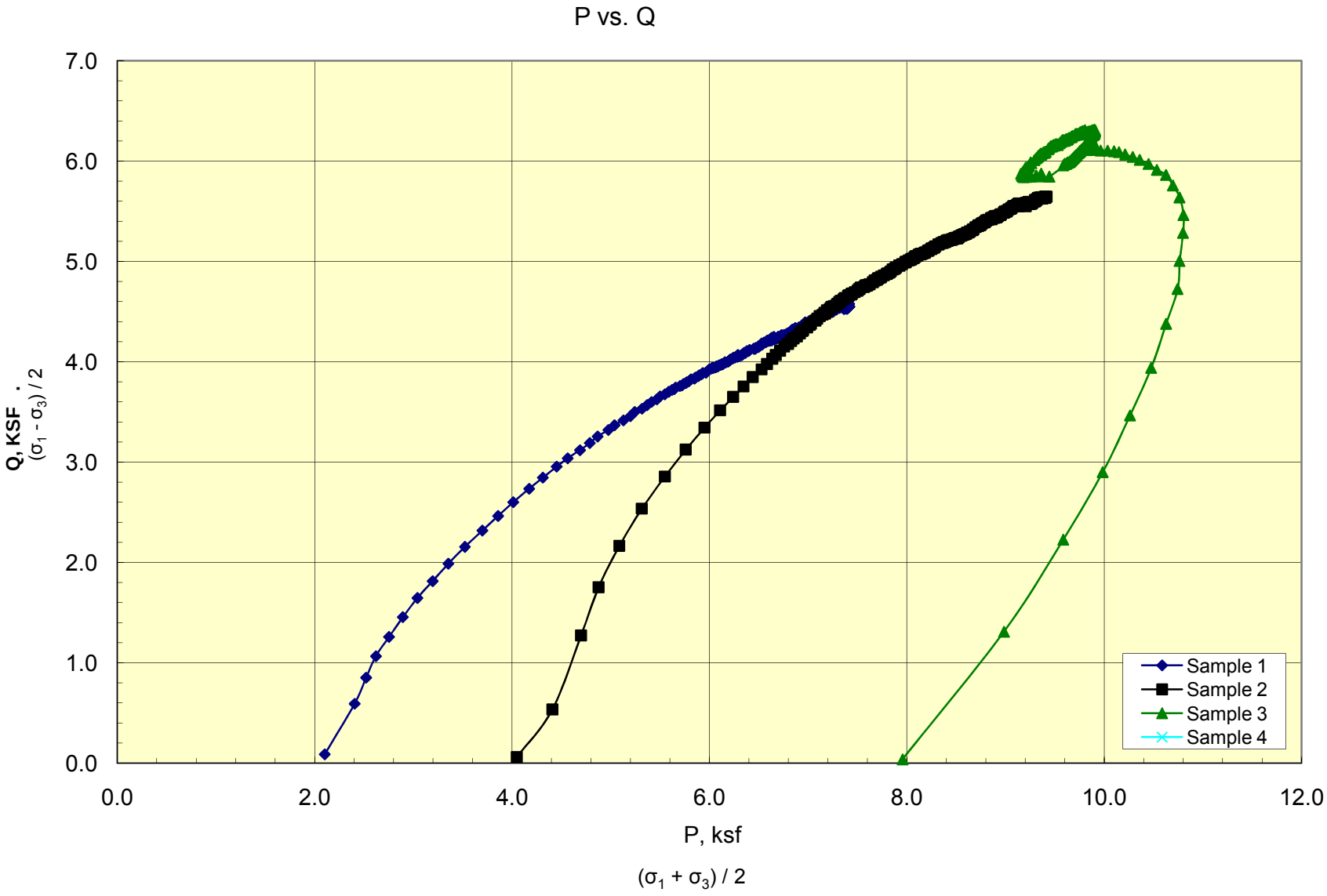


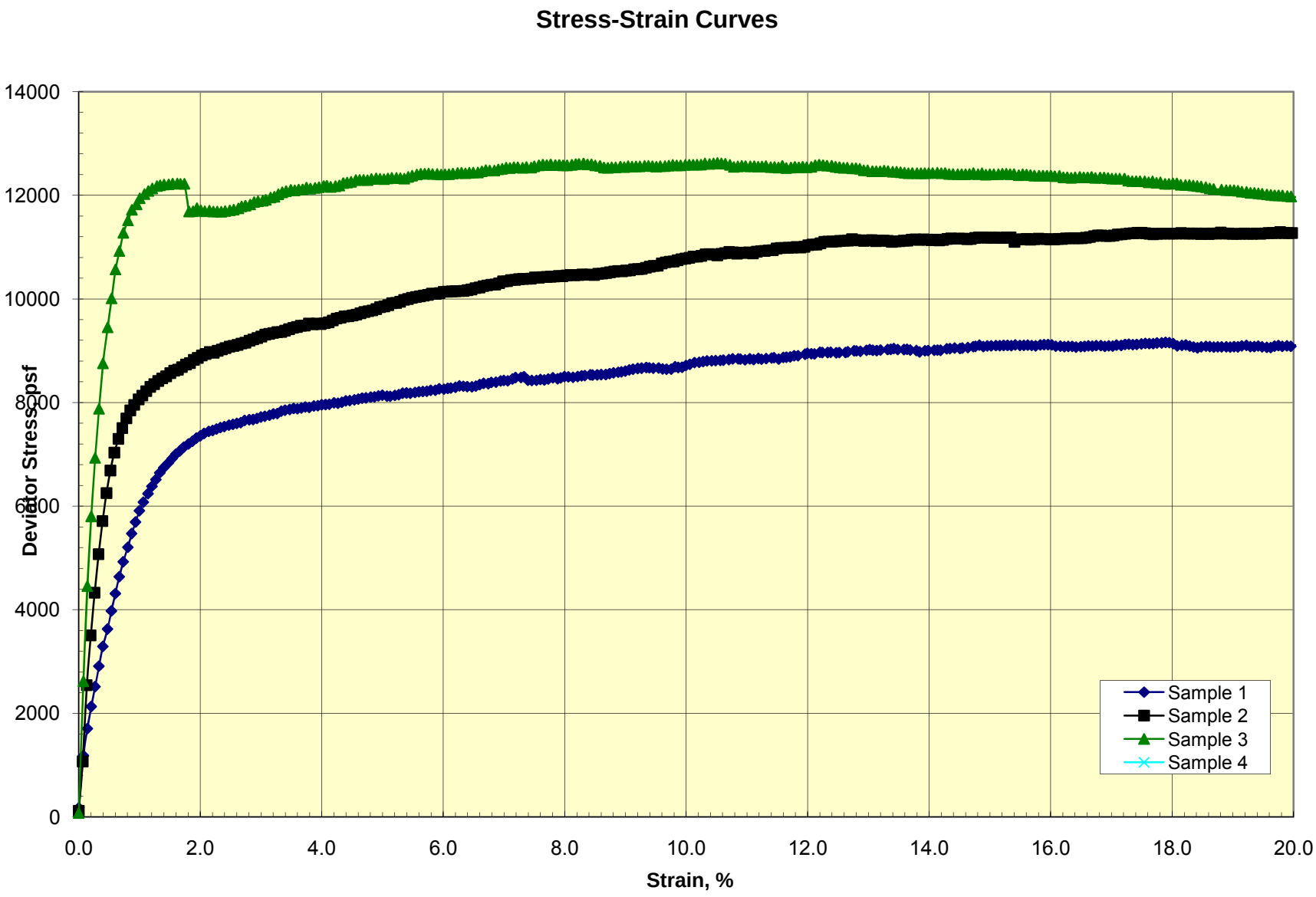


Sample:	1	2	3	4
MC, %	8.4	8.4	8.1	
Dry Dens, pcf	127.8	128.3	128.7	
Sat. %	71.0	72.4	71.1	
Void Ratio	0.319	0.314	0.309	
Diameter in	3.97	3.97	3.97	
Height, in	8.00	8.00	8.00	
	Final			
MC, %	11.8	11.4	11.1	
Dry Dens, pcf	127.8	128.8	129.6	
Sat. %	100.0	100.0	100.0	
Void Ratio	0.319	0.308	0.300	
Diameter, in	4.02	4.02	4.02	
Height, in	7.80	7.77	7.76	
Cell, psi	52.4	66.3	94.1	
BP, psi	38.4	38.6	39.1	
	Effective Stresses At:			
Strain, %	5.0	5.0	5.0	
Deviator ksf	8.140	9.840	12.320	
Excess PP	-0.202	1.051	4.594	
Sigma 1	10.358	12.778	15.646	
Sigma 3	2.218	2.938	3.326	
P, ksf	6.288	7.858	9.486	
Q, ksf	4.070	4.920	6.160	
Stress Ratio	4.671	4.350	4.704	
Rate in/min	0.001	0.001	0.001	
Total C	2.5	ksf		
Total Phi	15.3	Degrees		
Eff. C	0.0	ksf		
Eff. Phi	40.6	Degrees		

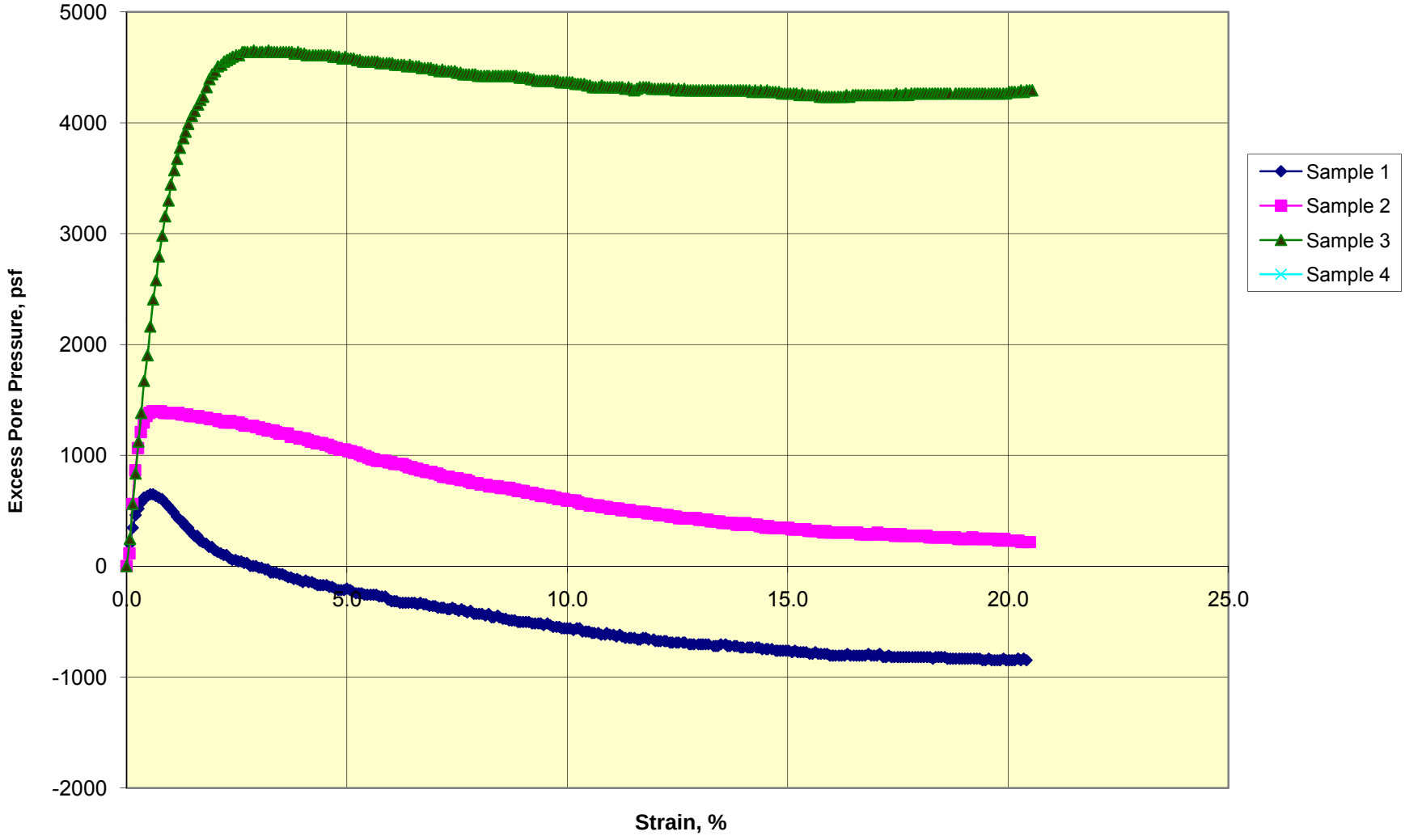
Job No.:	287-038	**Date:**	2/5/2009
Client:	Golder Associates		BY:MD/DC
Project:	Hanson - 063-7109.100		
Sample 1)	TP-MP-1 @ 3.5-14' Reddish Brown Weathered Rock		
Sample 2)	TP-MP-1 @ 3.5-14' Reddish Brown Weathered Rock		
Sample 3)	TP-MP-1 @ 3.5-14' Reddish Brown Weathered Rock		
Sample 4)			

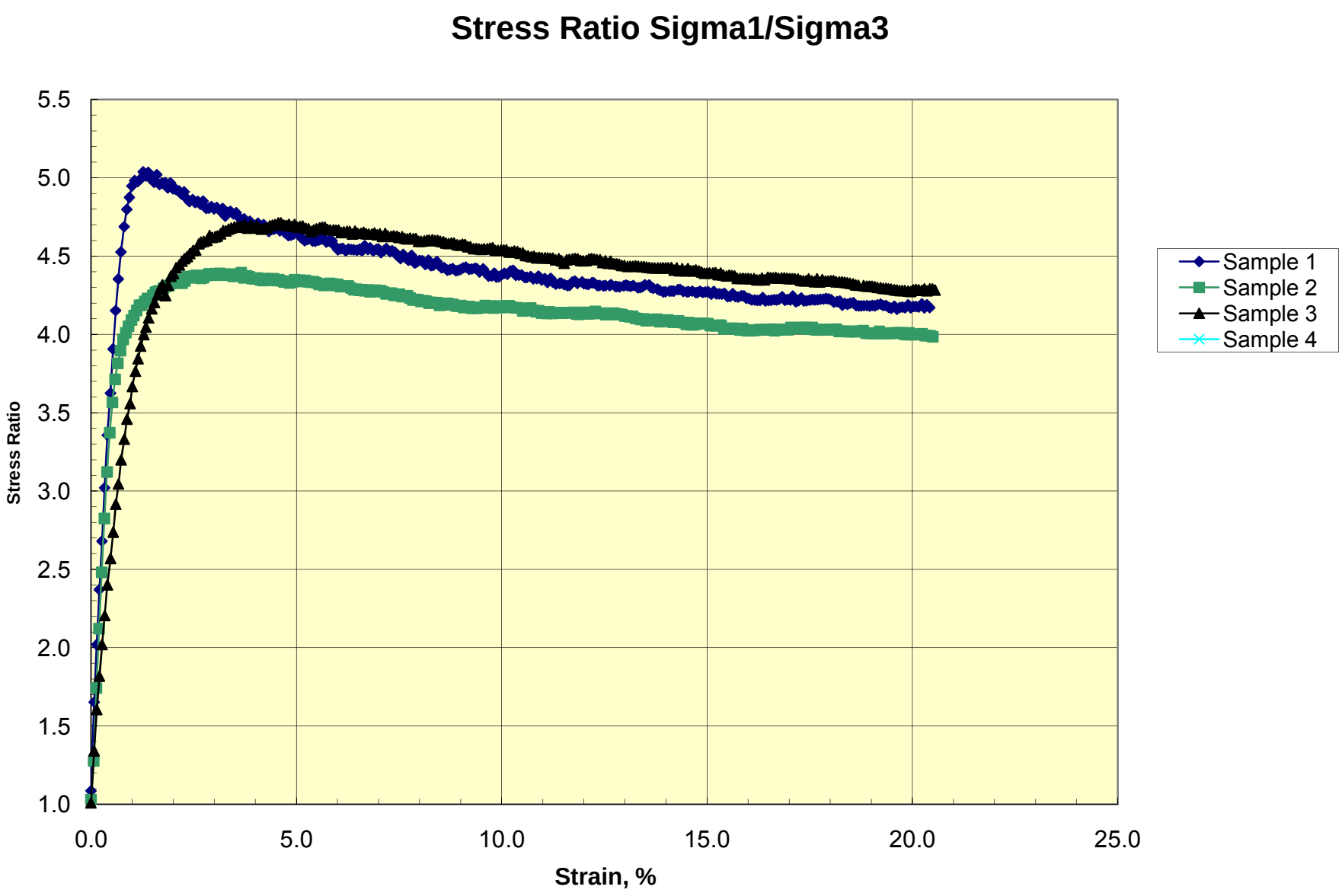
REMARKS: Strengths picked at 5% strain. Remolding target: 100% of 136.5 pcf @ 9.2%. Unable to achieve over 94% of the in-situ density as determined by chunk density testing. Tested -3/4" material.


P vs. Q
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
Q, KSF
(σ1 - σ3) / 2
0.0
2.0
4.0
6.0
8.0
10.0
12.0
P, ksf
(σ1 + σ3) / 2
Sample 1
Sample 2
Sample 3
Sample 4


Stress-Strain Curves
Deviator Stress, psf
Strain, %
0
2000
4000
6000
8000
10000
12000
14000
0.0
2.0
4.0
6.0
8.0
10.0
12.0
14.0
16.0
18.0
20.0
Sample 1
Sample 2
Sample 3
Sample 4

Pore Pressure Response

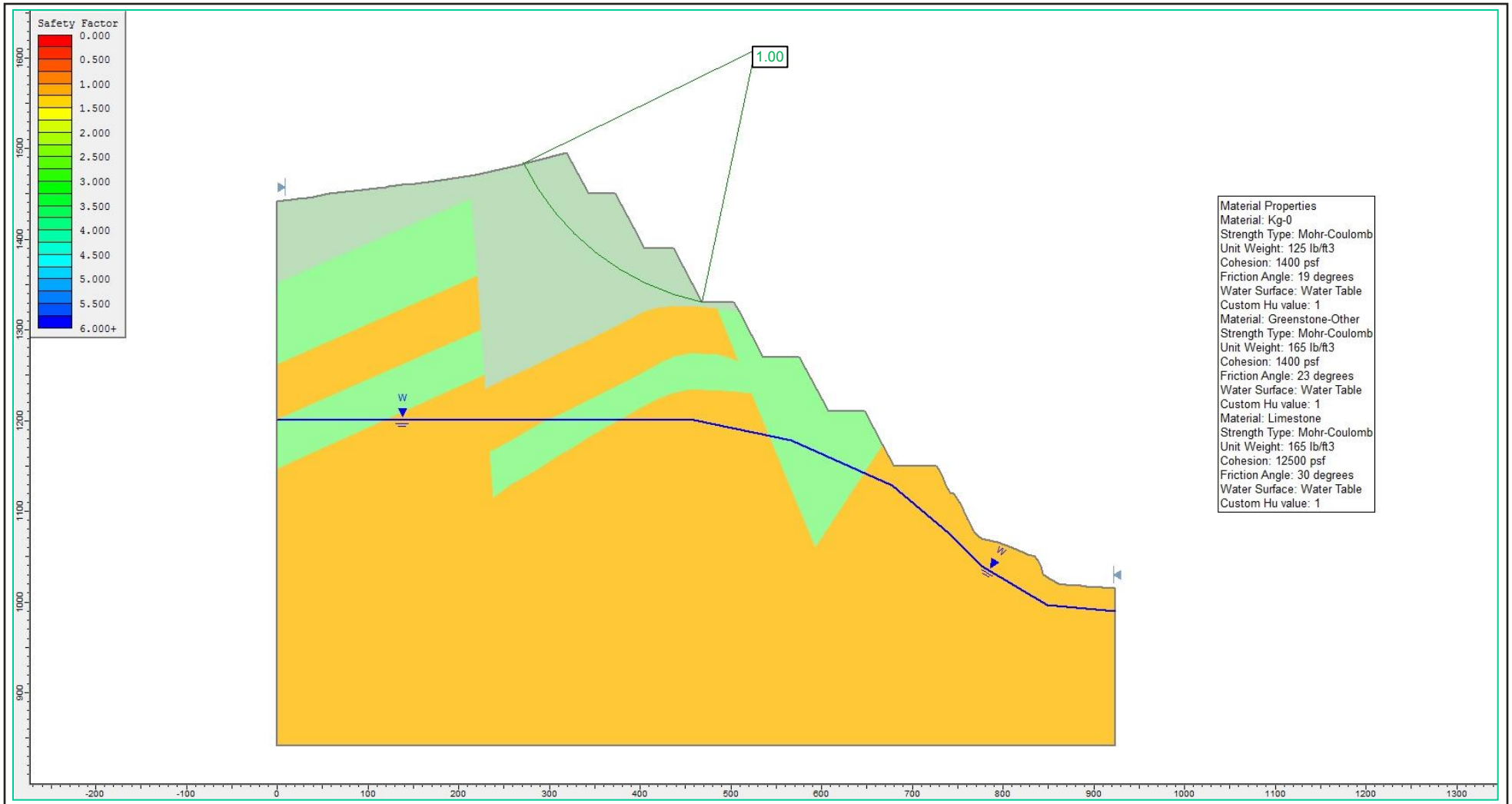



Stress Ratio Sigma1/Sigma3
Stress Ratio
5.5
5.0
4.5
4.0
3.5
3.0
2.5
2.0
1.5
1.0
0.0
5.0
10.0
15.0
20.0
25.0
Strain, %
Sample 1
Sample 2
Sample 3
Sample 4

APPENDIX 7.C

Mid-Pen – Slope Stability Output

PROJECT NO. 063-7109904 DRAWN: AJS REVIEWED BY: KGH DATE: 07-06-11 FILE LOCATION:

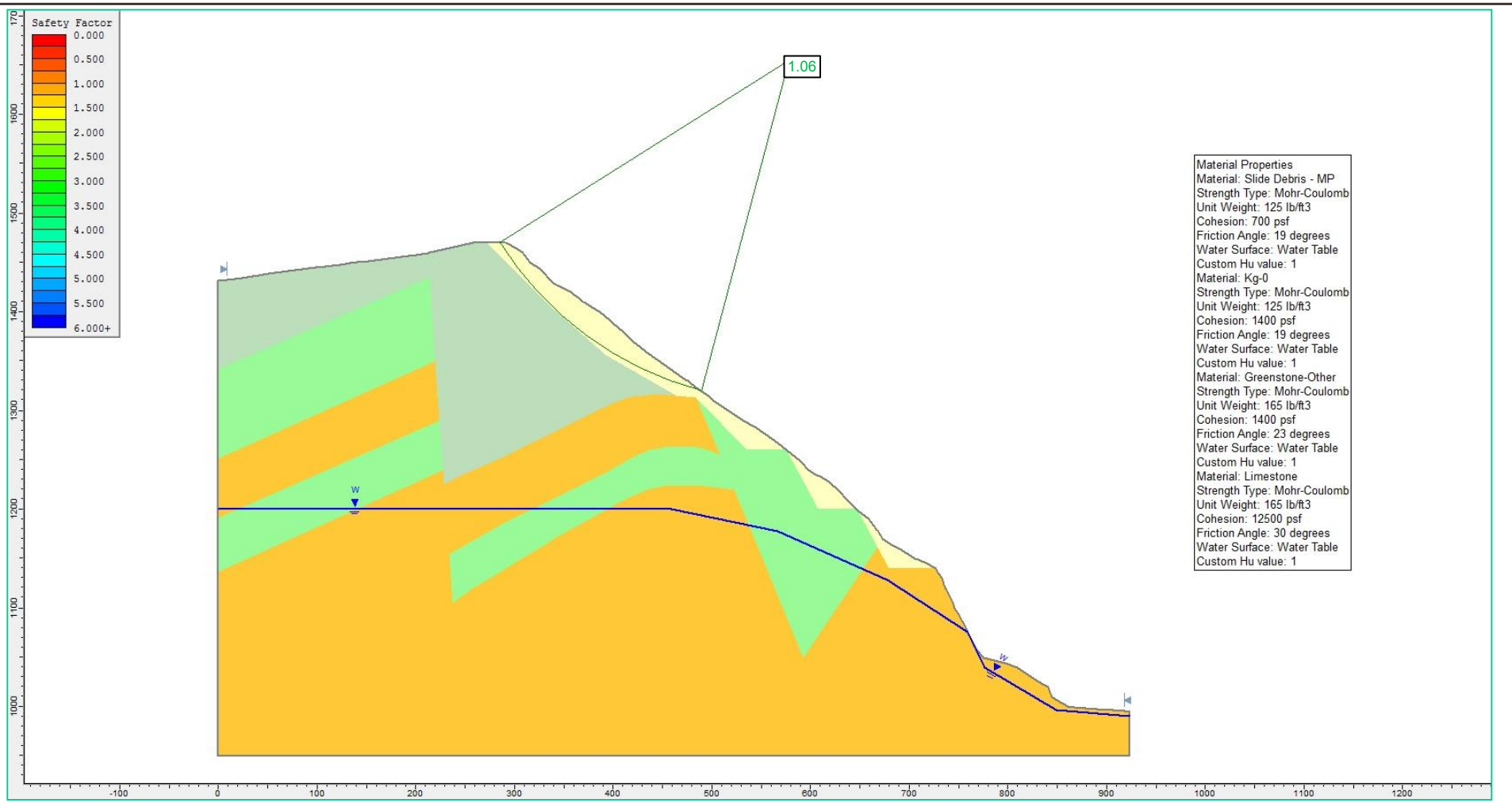


<u>SECTION MP1 – PRE-FAILURE</u>
CONDITION: STATIC
FAILURE MODE: CIRCULAR
BACK CALCULATED Kg-0 STRENGTH: c = 1400 psf; ϕ = 19 degrees

Golder Associates		PRE-FAILURE CONDITION MID-PEN SLIDE (SEC MP1) LEHIGH SOUTHWEST CEMENT COMPANY, CA	
Drawn: AJS	App'd: KGH	Date: JULY, 2011	Figure: 7C-1

Project No.: 063-7109 Revision No.: 2

PROJECT NO. 063-7109904 DRAWN: AJS REVIEWED BY: KGH DATE: 07-06-11 FILE LOCATION:

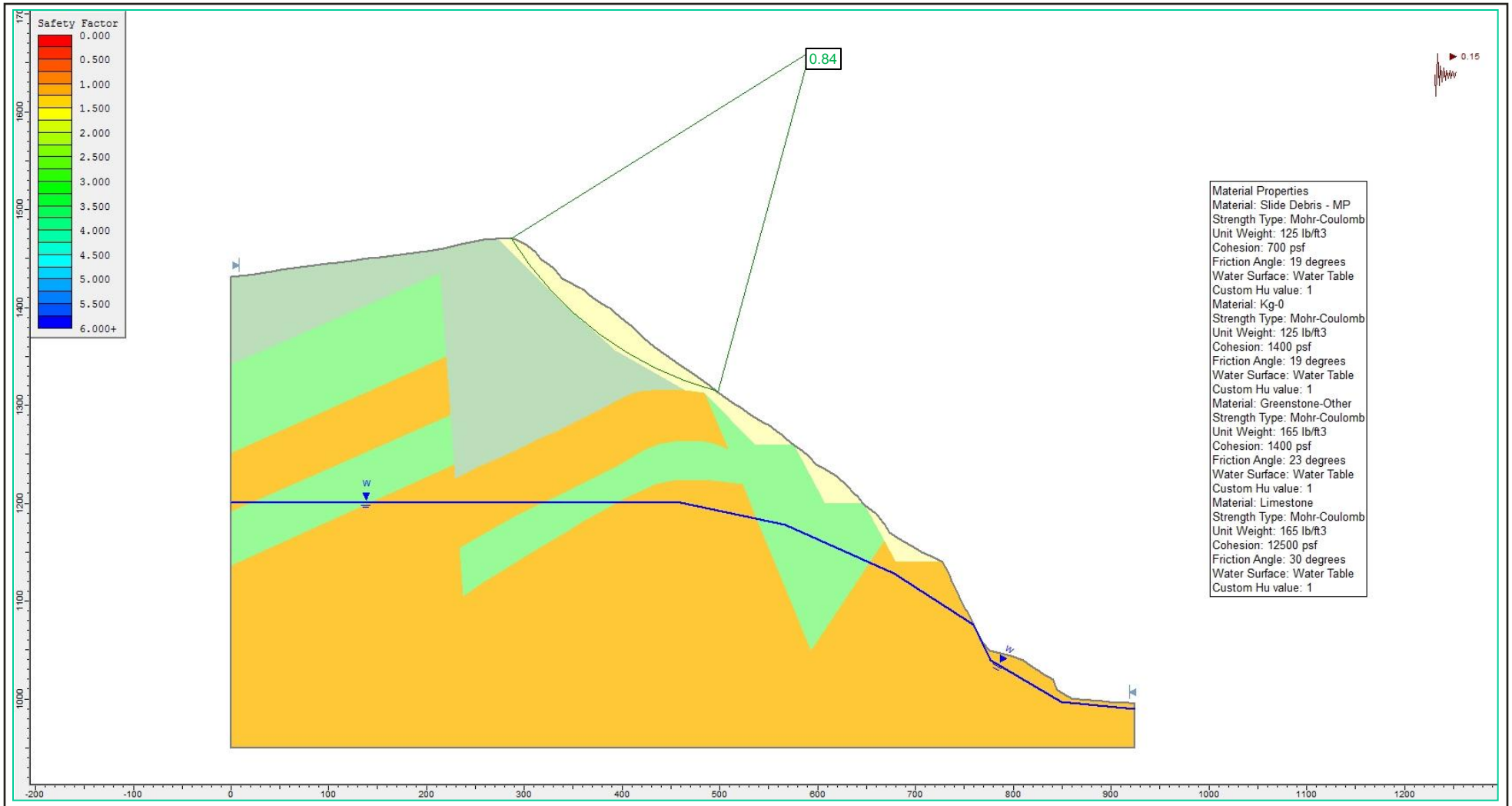


SECTION MP1 – EXISTING
CONDITION: STATIC
FAILURE MODE: CIRCULAR
MIN. FOS = 1.06

Golder Associates		EXISTING CONDITION MID-PEN SLIDE (SEC MP1) LEHIGH SOUTHWEST CEMENT COMPANY, CA	
Drawn: AJS	App'd: KGH	Date: JULY, 2011	Figure: 7C-2

Project No.: 063-7109 Revision No.: 2

PROJECT NO. 063-7109904 DRAWN: AJS REVIEWED BY: KGH DATE: 07-06-11 FILE LOCATION:

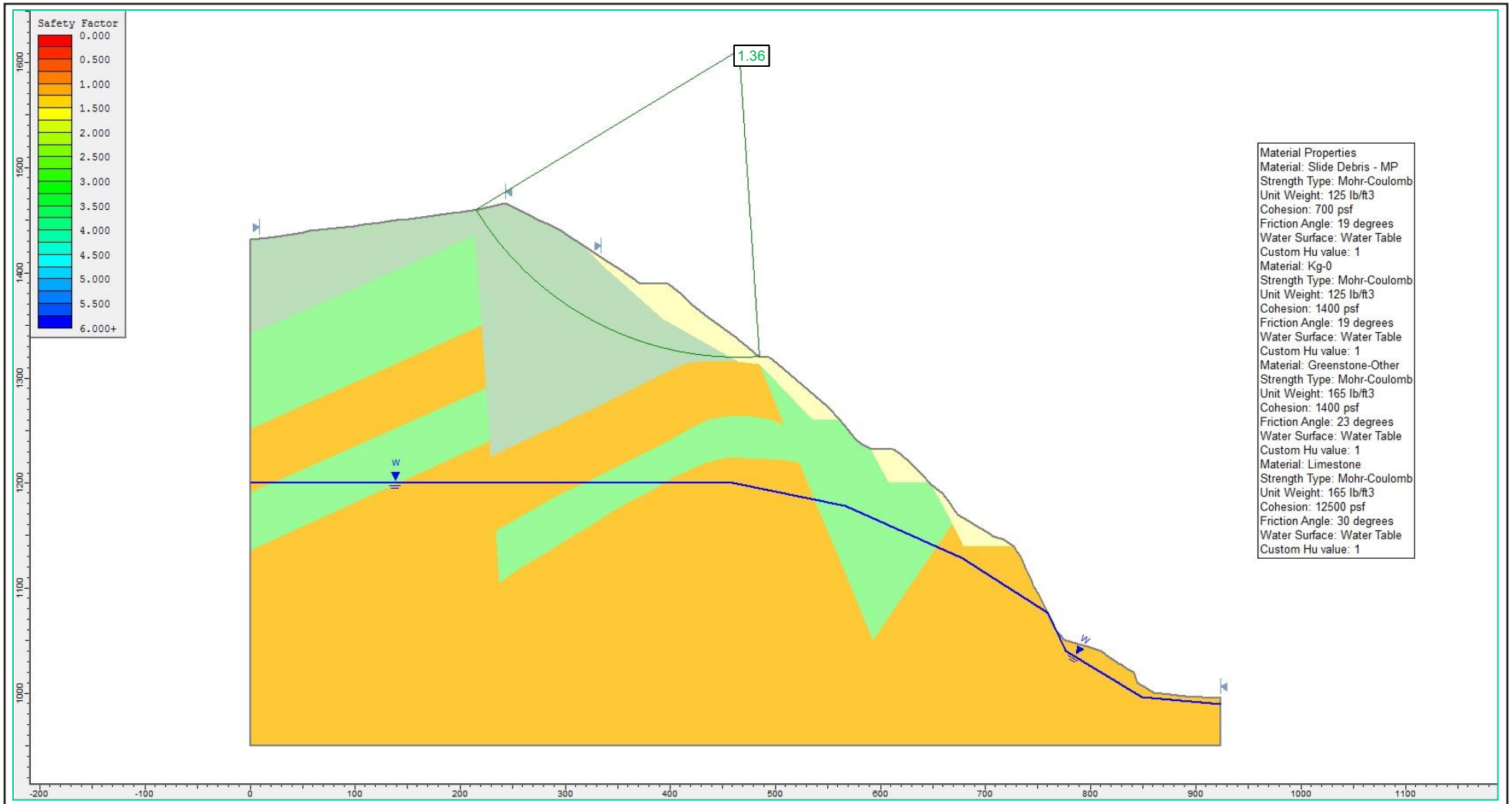


SECTION MP1 – EXISTING
CONDITION: PSEUDO-STATIC (WITH K = 0.15)
FAILURE MODE: CIRCULAR
MIN. FOS = 0.84

Golder Associates		EXISTING CONDITION MID-PEN SLIDE (SEC MP1) LEHIGH SOUTHWEST CEMENT COMPANY, CA	
Drawn: AJS	App'd: KGH	Date: JULY, 2011	Figure: 7C-3

Project No.: 063-7109 Revision No.: 2

PROJECT NO. 063-7109904 DRAWN: AJS REVIEWED BY: KGH DATE: 07-06-11 FILE LOCATION:

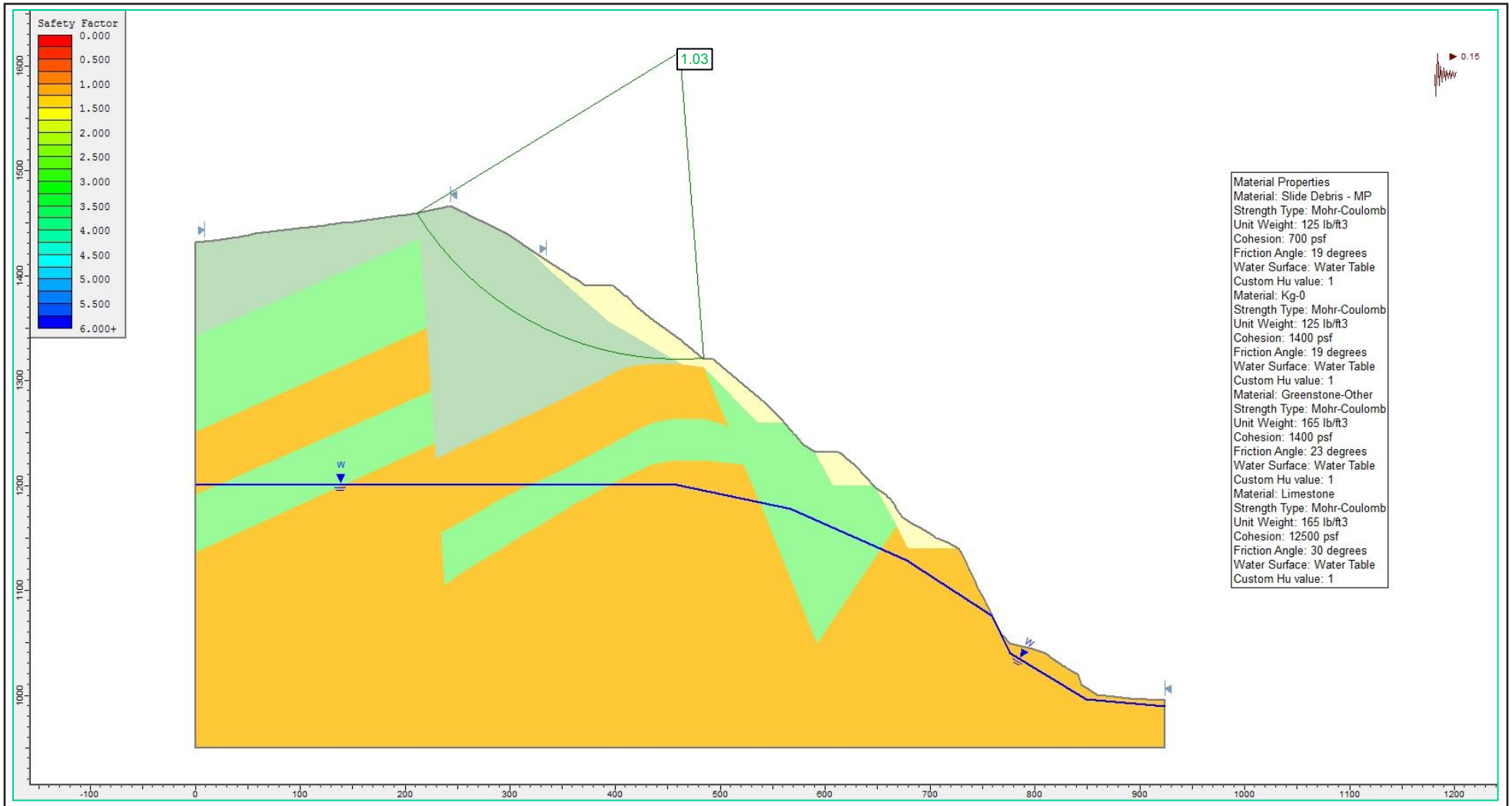


SECTION MP1 – ULTIMATE RECLAMATION
CONDITION: STATIC
FAILURE MODE: CIRCULAR
MIN. FOS = 1.36

Golder Associates		ULTIMATE RECLAMATION MID-PEN SLIDE (SEC MP1) LEHIGH SOUTHWEST CEMENT COMPANY, CA	
Drawn: AJS	App'd: KGH	Date: JULY, 2011	Figure: 7C-6

Project No.: 063-7109 Revision No.: 2

PROJECT NO. 063-7109904 DRAWN: AJS REVIEWED BY: KGH DATE: 07-06-11 FILE LOCATION:

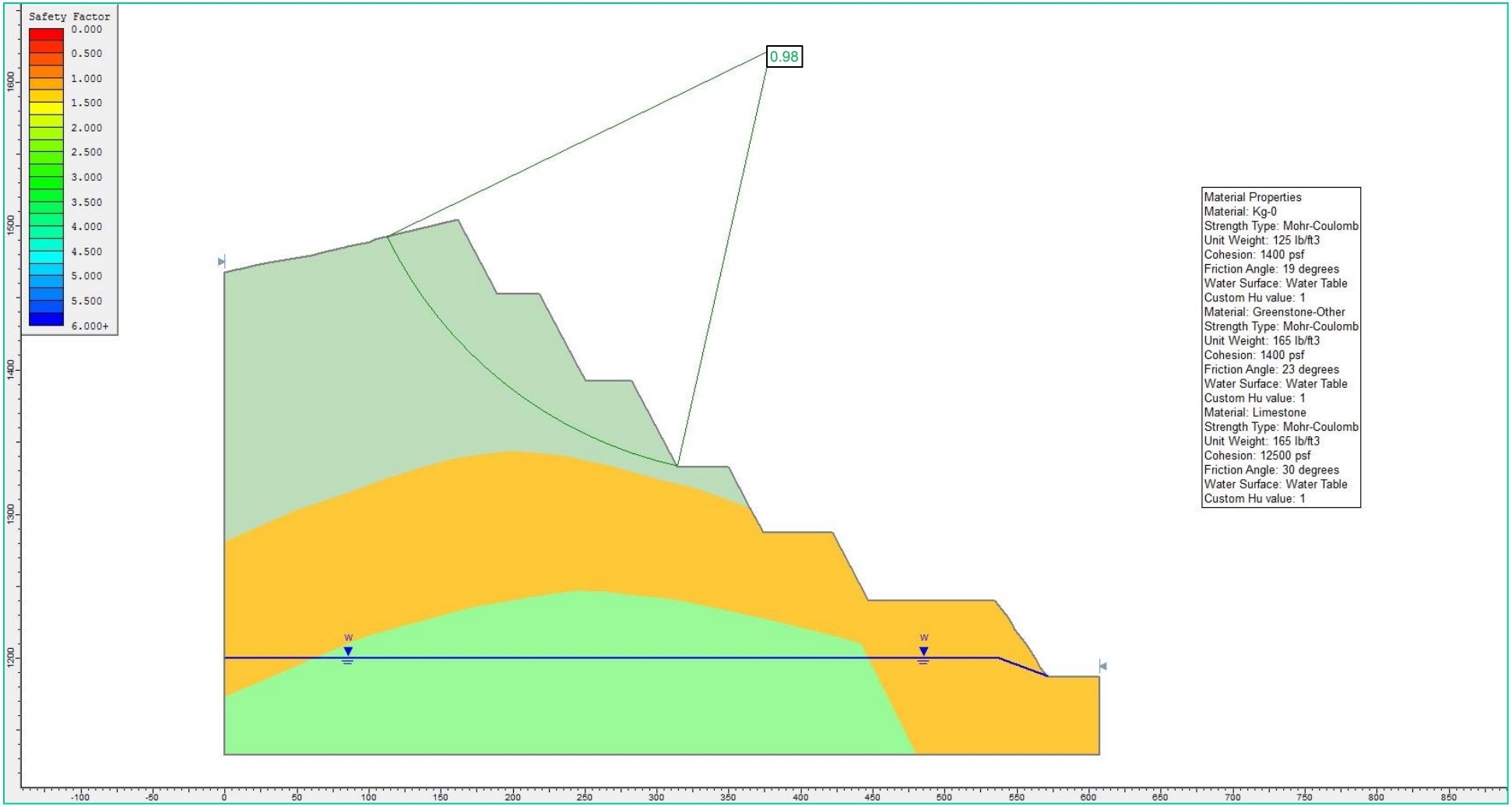


SECTION MP1 – ULTIMATE RECLAMATION
CONDITION: PSEUDO-STATIC (K=0.15)
FAILURE MODE: CIRCULAR
MIN. FOS = 1.03

Golder Associates		ULTIMATE RECLAMATION MID-PEN SLIDE (SEC MP1) LEHIGH SOUTHWEST CEMENT COMPANY, CA	
Drawn: AJS	App'd: KGH	Date: JULY, 2011	Figure: 7C-7

Project No.: 063-7109 Revision No.: 2

PROJECT NO. 063-7109904 DRAWN: AJS REVIEWED BY: KGH DATE: 07-06-11 FILE LOCATION:

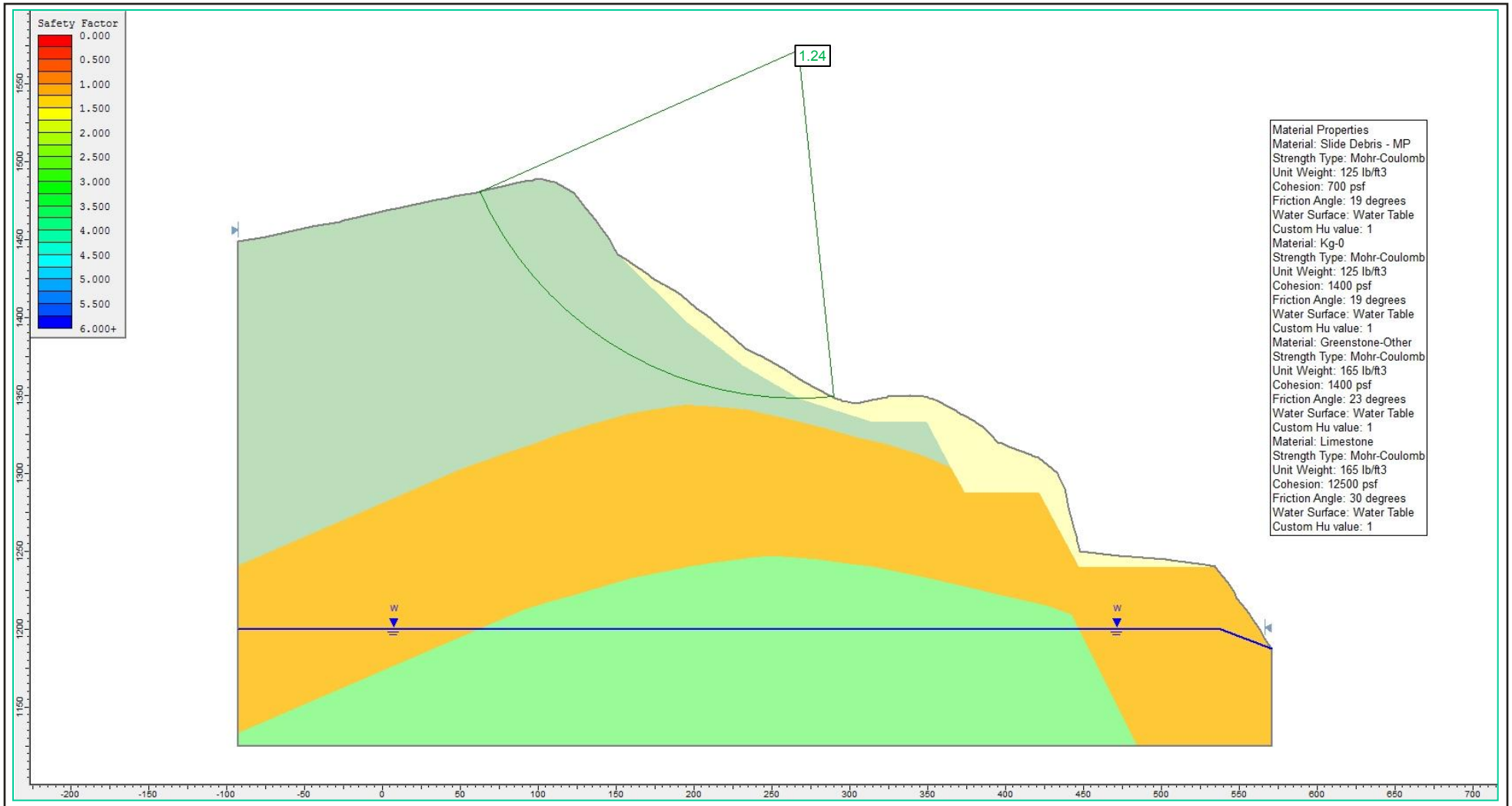


SECTION MP2 – PRE-FAILURE
CONDITION: STATIC
FAILURE MODE: CIRCULAR
BACK CALCULATED Kg-0 STRENGTH: c = 1400 psf; ϕ = 19 degrees

Golder Associates		PRE-FAILURE CONDITION MID-PEN SLIDE (SEC MP2) LEHIGH SOUTHWEST CEMENT COMPANY, CA	
Drawn: AJS	App'd: KGH	Date: JULY, 2011	Figure: 7C-8

Project No.: 063-7109 Revision No.: 2

PROJECT NO. 063-7109904 DRAWN: AJS REVIEWED BY: KGH DATE: 07-06-11 FILE LOCATION:

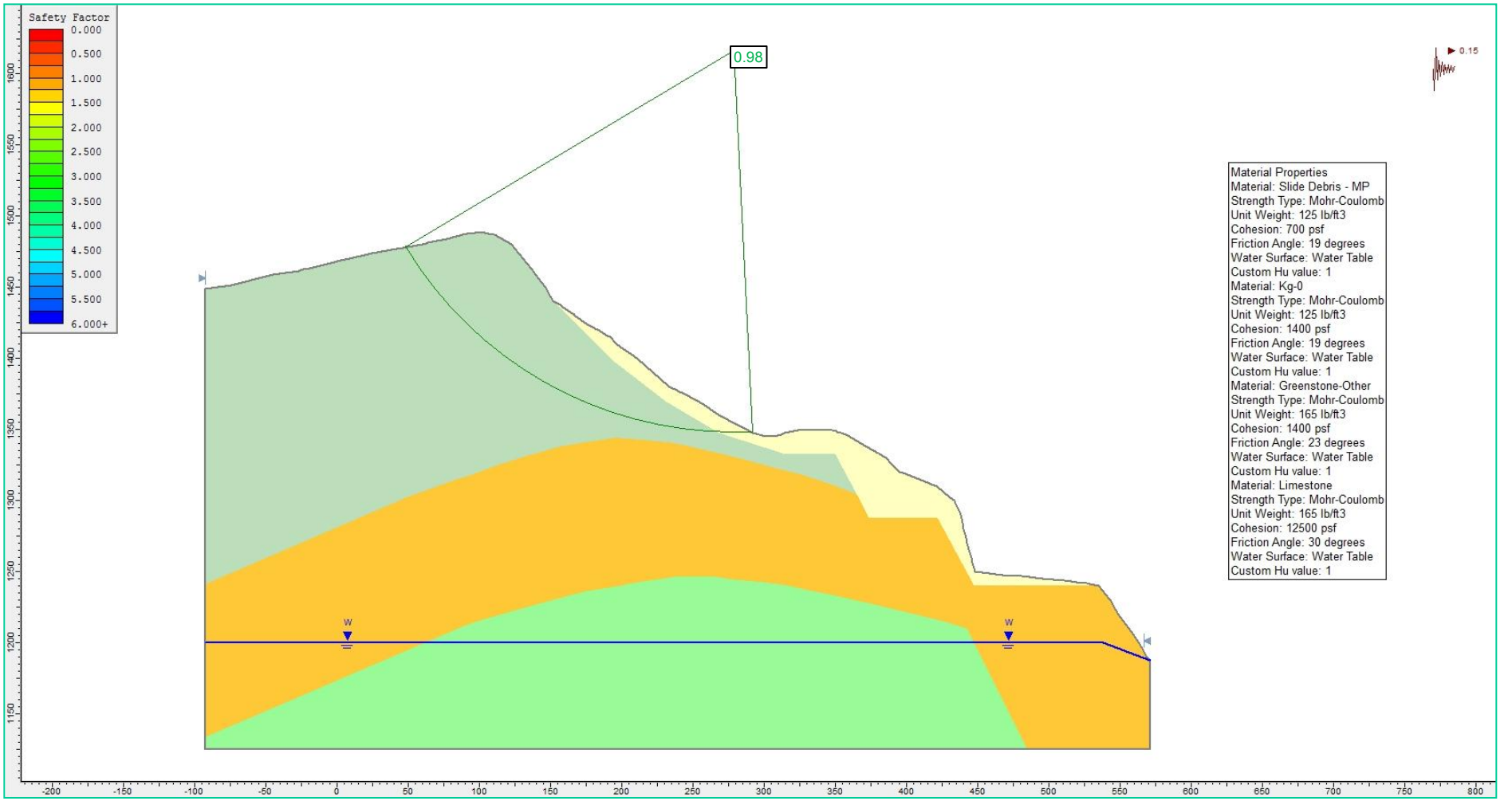


<u>SECTION MP2 – EXISTING</u>
CONDITION: STATIC
FAILURE MODE: CIRCULAR
MIN. FOS = 1.24

Golder Associates		EXISTING CONDITION MID-PEN SLIDE (SEC MP2) LEHIGH SOUTHWEST CEMENT COMPANY, CA	
Drawn: AJS	App'd: KGH	Date: JULY, 2011	Figure: 7C-9

Project No.: 063-7109 Revision No.: 2

PROJECT NO. 063-7109904 DRAWN: AJS REVIEWED BY: KGH DATE: 07-06-11 FILE LOCATION:

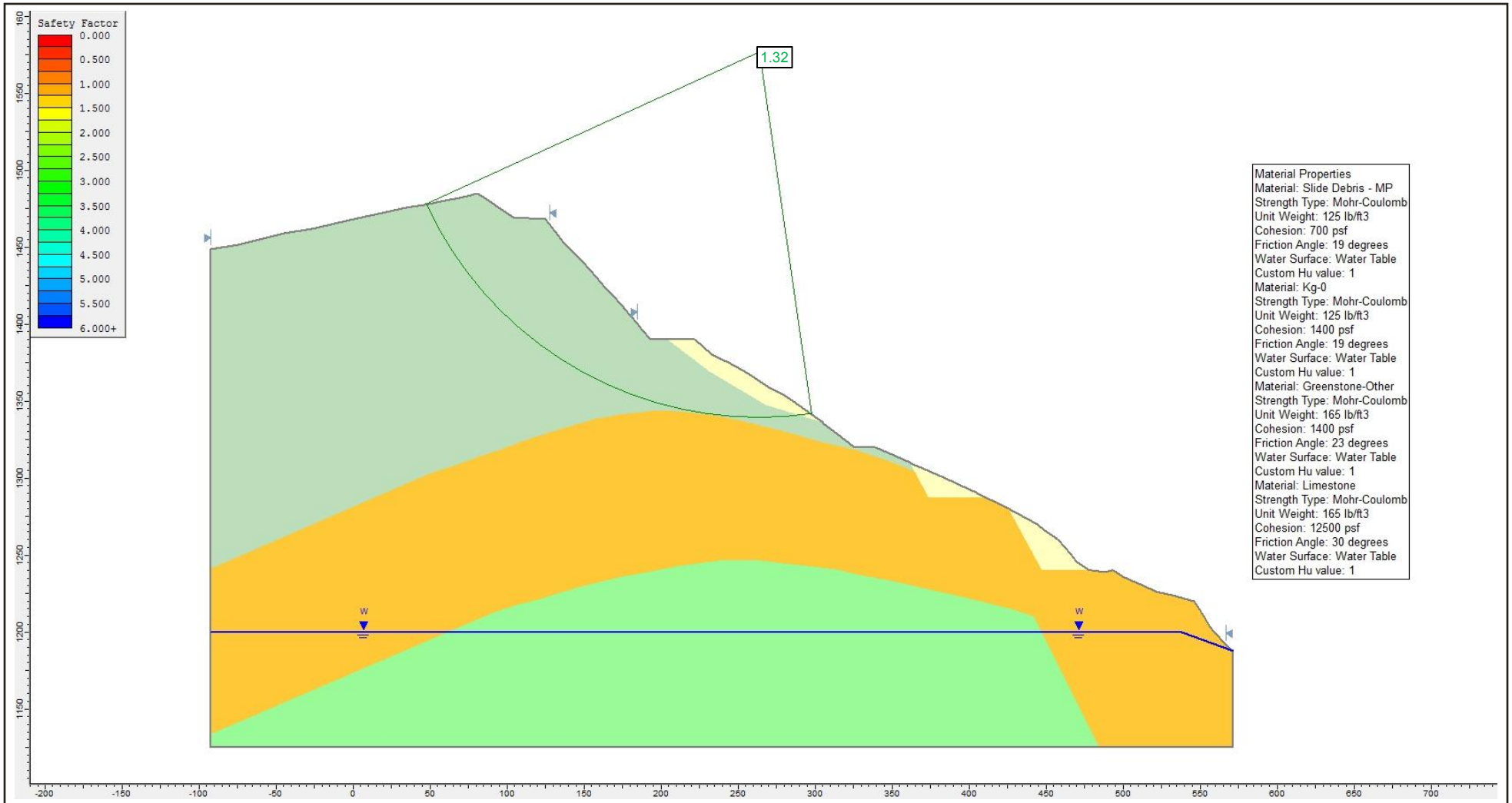


SECTION MP2 – EXISTING
CONDITION: PSEUDO-STATIC (WITH K = 0.15)
FAILURE MODE: CIRCULAR
MIN. FOS = 0.98

Golder Associates		EXISTING CONDITION MID-PEN SLIDE (SEC MP2) LEHIGH SOUTHWEST CEMENT COMPANY, CA	
Drawn: AJS	App'd: KGH	Date: JULY, 2011	Figure: 7C-10

Project No.: 063-7109 Revision No.: 2

PROJECT NO. 063-7109904 DRAWN: AJS REVIEWED BY: KGH DATE: 07-06-11 FILE LOCATION:

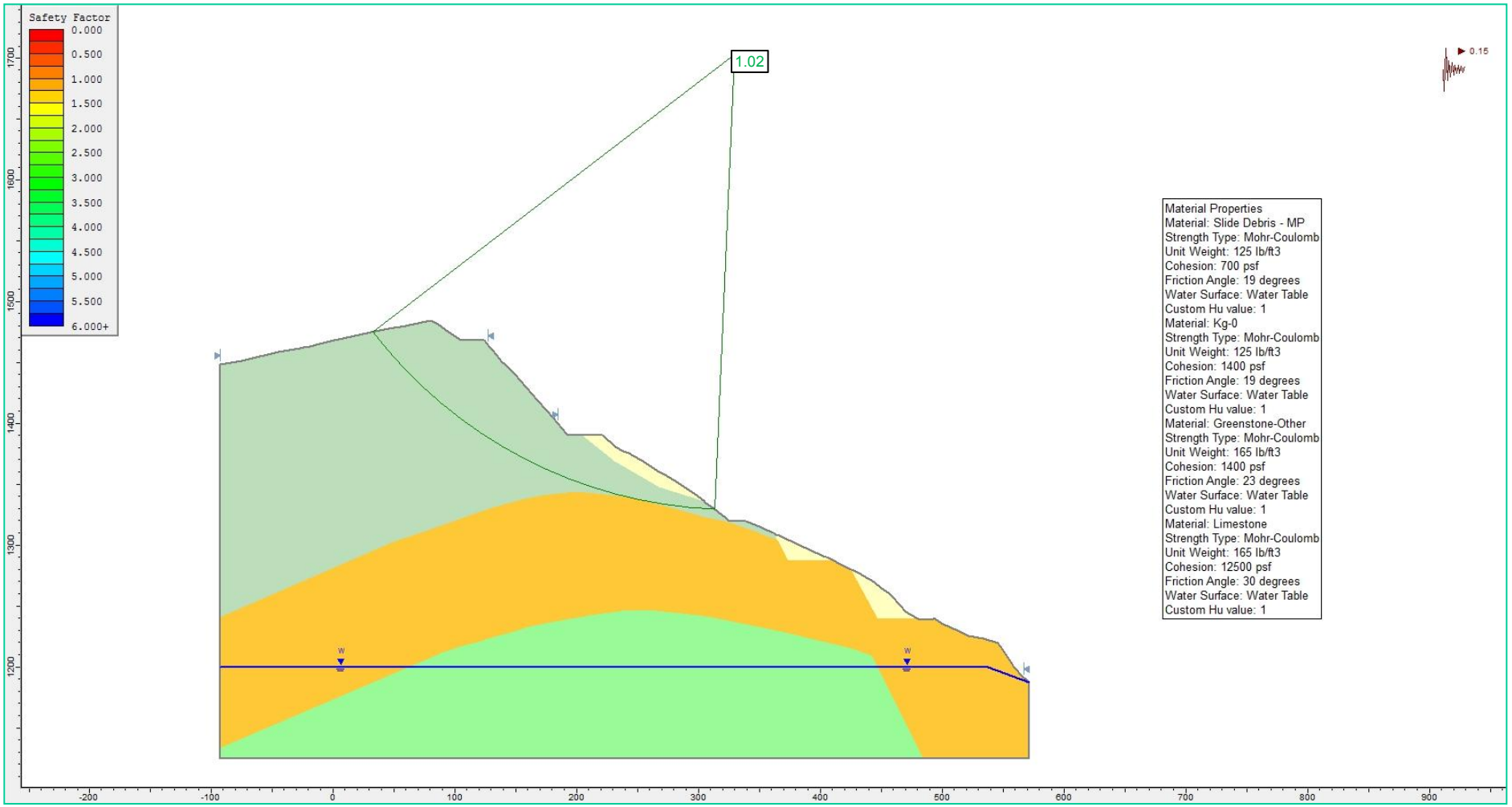


SECTION MP2 – ULTIMATE RECLAMATION
CONDITION: STATIC
FAILURE MODE: CIRCULAR
MIN. FOS = 1.32

Golder Associates		ULTIMATE RECLAMATION MID-PEN SLIDE (SEC MP2) LEHIGH SOUTHWEST CEMENT COMPANY, CA	
Drawn: AJS	App'd: KGH	Date: JULY, 2011	Figure: 7C-13

Project No.: 063-7109 Revision No.: 2

PROJECT NO. 063-7109904 DRAWN: AJS REVIEWED BY: KGH DATE: 07-06-11 FILE LOCATION:



SECTION MP2 – ULTIMATE RECLAMATION
CONDITION: PSEUDO-STATIC (K = 0.15)
FAILURE MODE: CIRCULAR
MIN. FOS = 1.02

Golder Associates		ULTIMATE RECLAMATION MID-PEN SLIDE (SEC MP2) LEHIGH SOUTHWEST CEMENT COMPANY, CA	
Drawn: AJS	App'd: KGH	Date: JULY, 2011	Figure: 7C-14

Project No.: 063-7109 Revision No.: 2

Summary of Dynamic Deformation Analysis - Mid Pen

Selected Notations			
M_w =	Moment magnitude	k_y =	Yield acceleration
a_{brk} =	Peak Horizontal Acceleration at the bedrock	U =	Dynamic deformation along critical slide surface
a_{max} =	Peak Horizontal Acceleration at the crest of slope		

Earthquake Characterization		
M_w	a_{brk} g	a_{max} (Reference 1) g
7.1	0.60	0.60

Deformation Calculation (Reference 2)							
SITE	Section	Failure Description	k_y g	k_y/a_{max}	Slope Deformation, U (in) (Bray and Travasarou)		
					84% Exc.	16% Exc.	50% Exc.
Mid-Pen	MP1	Existing	0.04	0.06	25	96	49
	MP1	Regraded	0.17	0.28	3	11	6
	MP2	Existing	0.14	0.23	4	17	9
	MP2	Regraded	0.16	0.27	3	12	6

References:

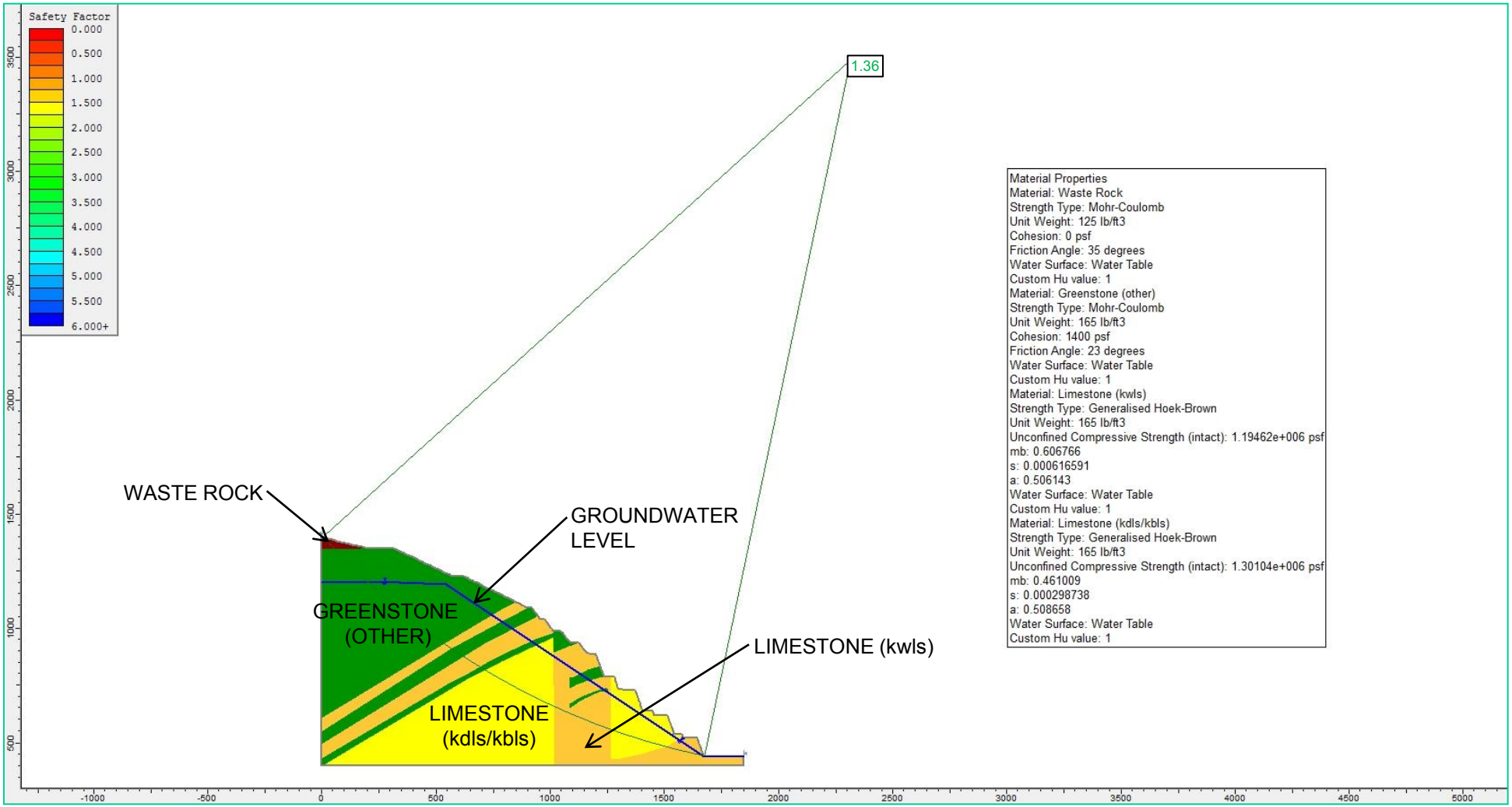
1. Seed, H. B. and Idriss, I. M. (1982), Ground Motions and Soil Liquefaction During Earthquakes Monograph No. 5, Earthquake Engineering Research Institute, Berkeley, California.
2. Bray, J. D. and Travasarou, T. (2007), Simplified Procedure for Estimating Earthquake-Induced Deviatoric Slope Displacements Journal of the Geotechnical and Geoenvironmental Engineering, ASCE, Vol. 133, No. 4, pp. 381-392.

Note: This spreadsheet is only intended to estimate seismic deformation under the above shown earthquake events and sections, assuming potential failure mass is a Newmark rigid sliding block.

APPENDIX 8.A

East Wall – Slope Stability Output

PROJECT NO. 063-7109904 DRAWN: AJS REVIEWED BY: KGH DATE: 07-06-11 FILE LOCATION:



SECTION EW1 – EAST WALL FINAL DESIGN

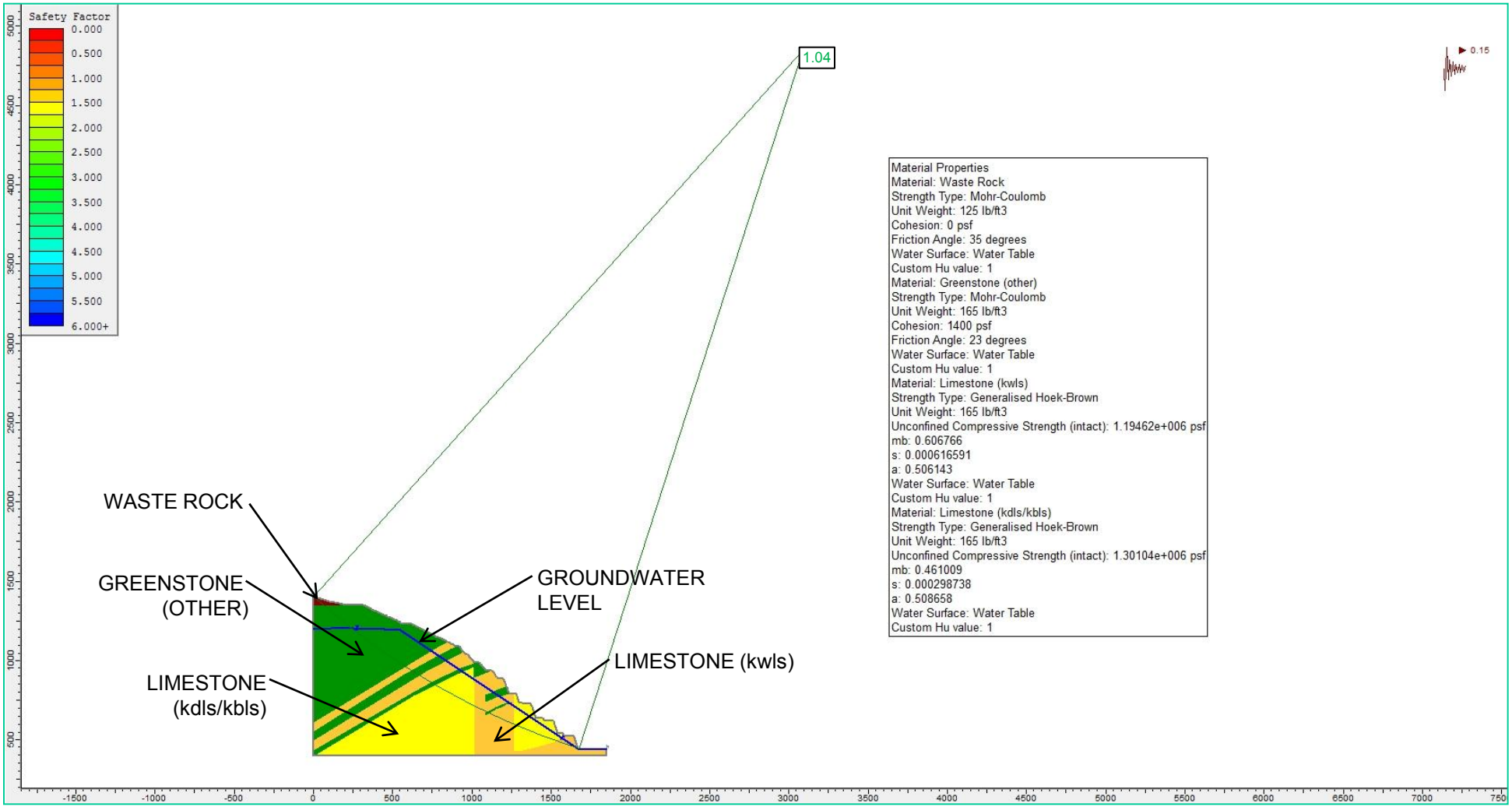
CONDITION: STATIC

FAILURE MODE: CIRCULAR

Golder Associates		FINALSLOPE DESIGN SECTION EW1 – EAST WALL LSCC PERMANENTE, CA	
Drawn: AJS	App'd: KGH	Date: JULY, 2011	Figure: 8A-4

Project No.: 063-7109 Revision No.: 2

PROJECT NO. 063-7109904 DRAWN: AJS REVIEWED BY: KGH DATE: 07-06-11 FILE LOCATION:



SECTION EW1 – EAST WALL FINAL DESIGN

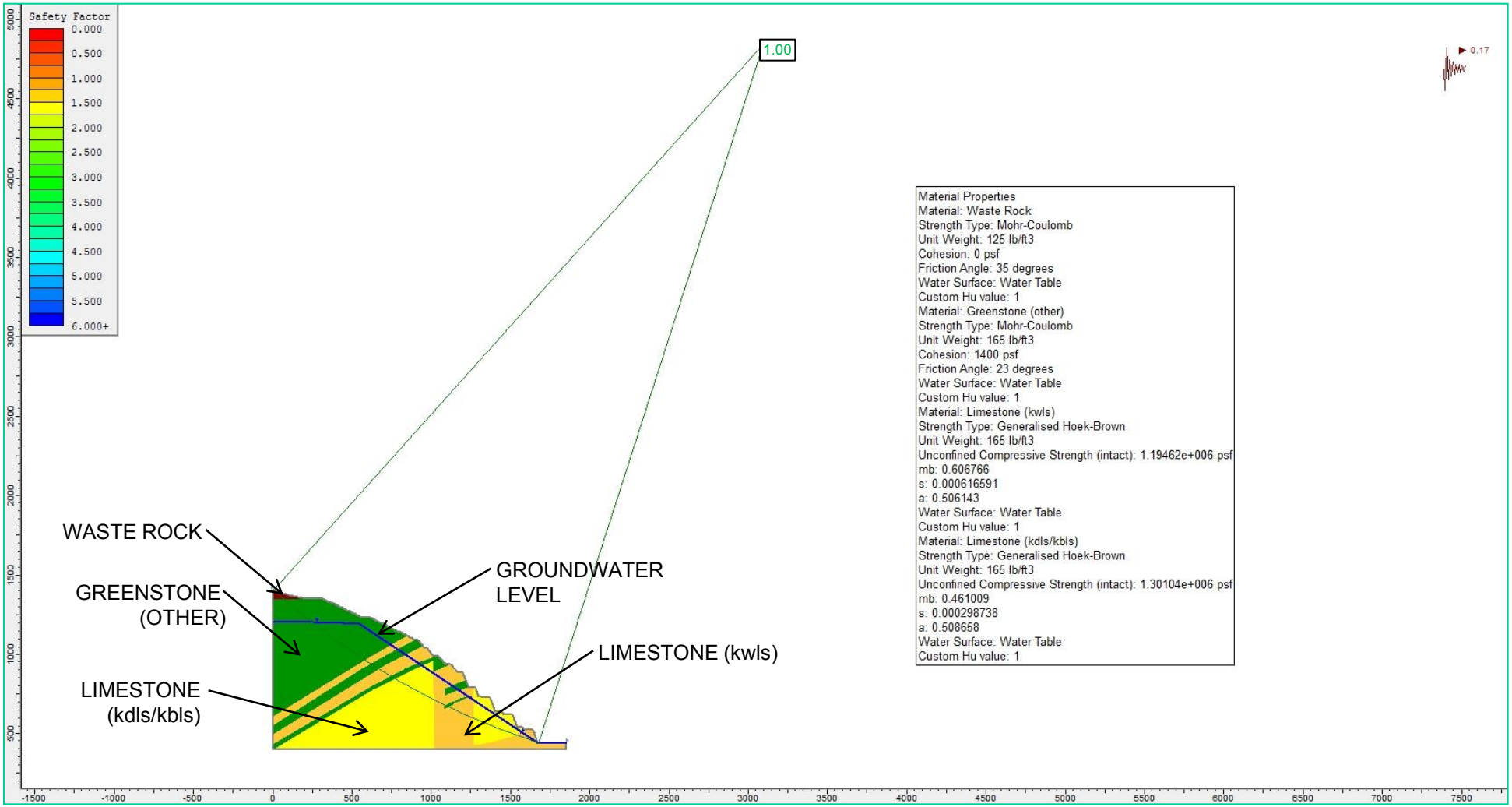
CONDITION: PSEUDO-STATIC (k = 0.15g)

FAILURE MODE: CIRCULAR

Golder Associates		FINALSLOPE DESIGN SECTION EW1 – EAST WALL LSCC PERMANENTE, CA	
Drawn: AJS	App'd: KGH	Date: JULY, 2011	Figure: 8A-5

Project No.: 063-7109 Revision No.: 2

PROJECT NO. 063-7109904 DRAWN: AJS REVIEWED BY: KGH DATE: 07-06-11 FILE LOCATION:



SECTION EW1 – EAST WALL FINAL DESIGN
CONDITION: YIELD ACCELERATION CALCULATION
FAILURE MODE: CIRCULAR

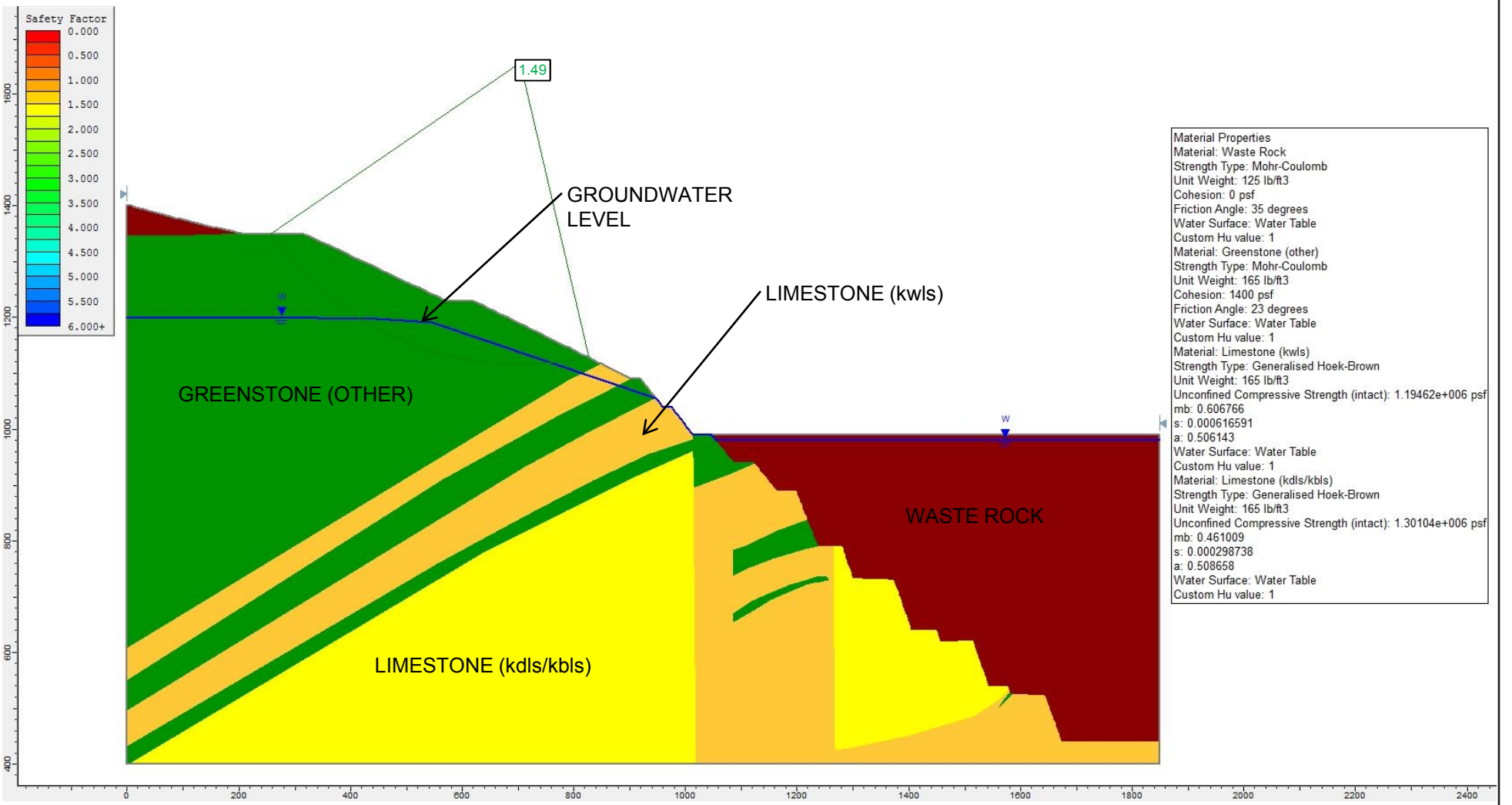
Golder Associates

FINALSLOPE DESIGN
SECTION EW1 – EAST WALL
LSCC PERMANENTE, CA

Drawn: AJS	App'd: KGH	Date: JULY, 2011	Figure: 8A-6

Project No.: 063-7109 Revision No.: 2

PROJECT NO. 063-7109904 DRAWN: AJS REVIEWED BY: KGH DATE: 07-06-11 FILE LOCATION:



SECTION EW1 – EAST WALL FINAL RECLAMATION

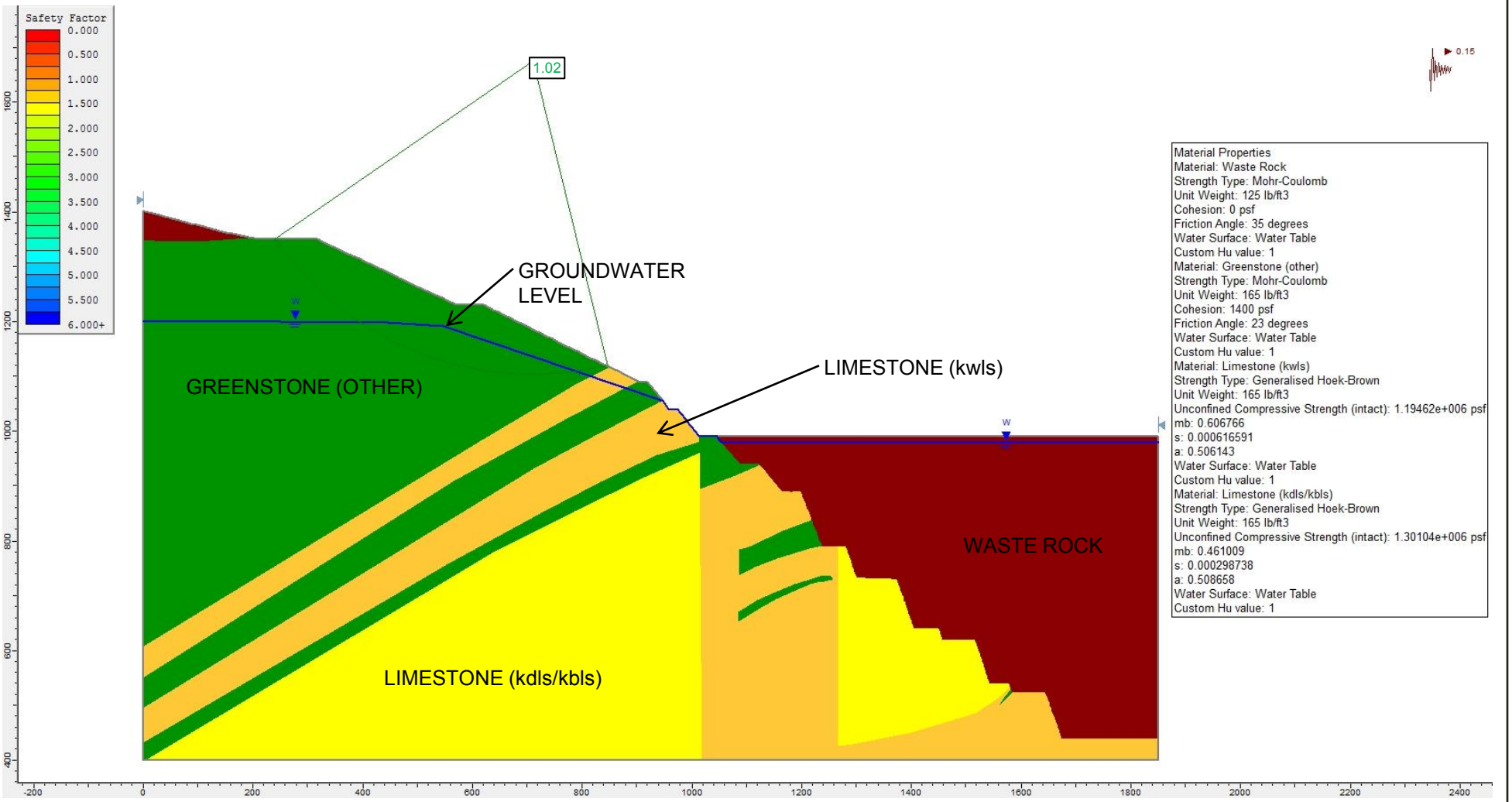
CONDITION: STATIC

FAILURE MODE: CIRCULAR

Golder Associates		FINAL RECLAMATION PLAN SECTION EW1 – EAST WALL LSCC PERMANENTE, CA	
Drawn: AJS	App'd: KGH	Date: JULY, 2011	Figure: 8A-7

Project No.: 063-7109 Revision No.: 2

PROJECT NO. 063-7109904 DRAWN: AJS REVIEWED BY: KGH DATE: 07-06-11 FILE LOCATION:



SECTION EW1 – EAST WALL FINAL RECLAMATION

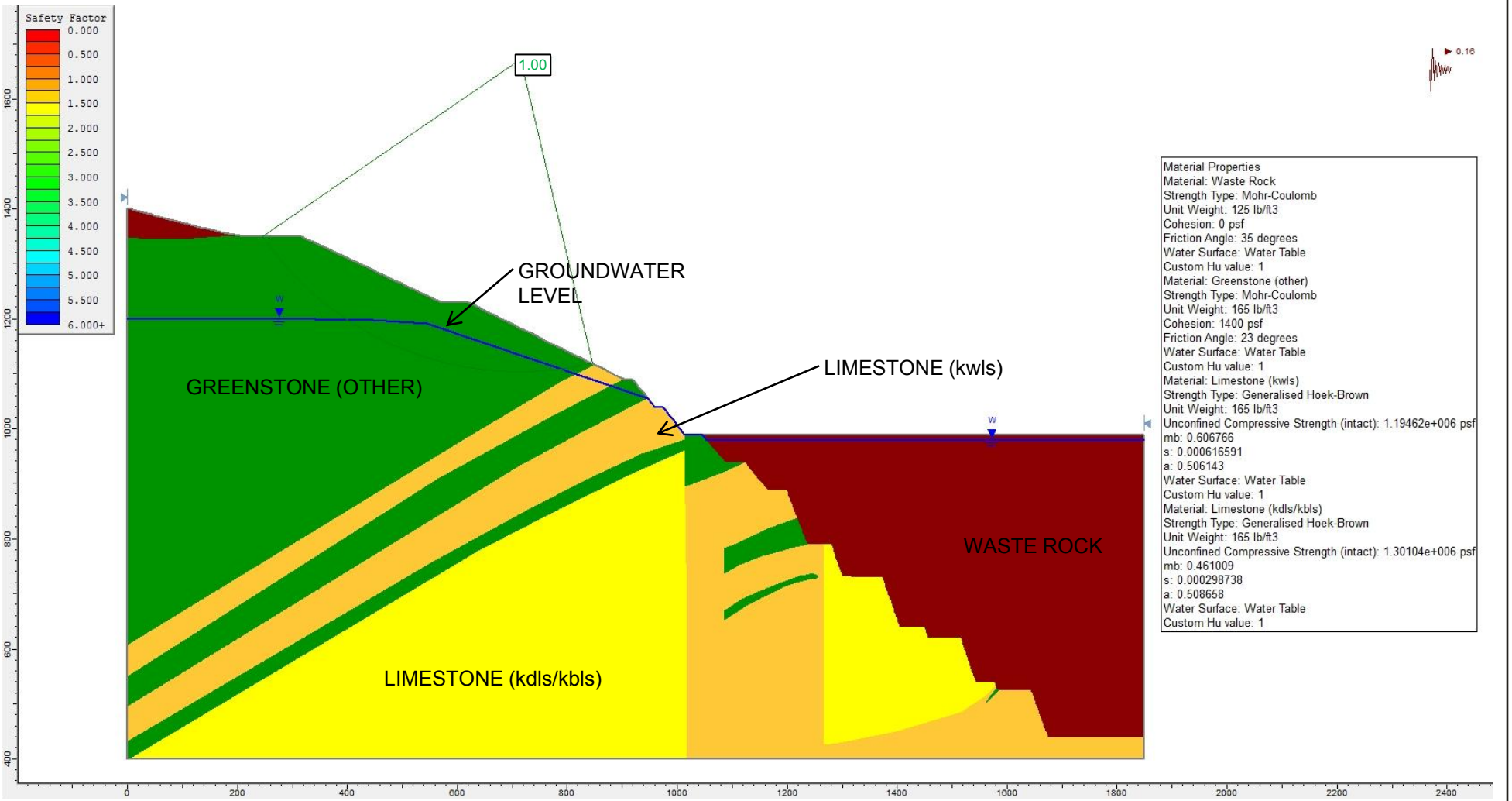
CONDITION: PSEUDO-STATIC (k = 0.15g)

FAILURE MODE: CIRCULAR

Golder Associates		FINAL RECLAMATION PLAN SECTION EW1 – EAST WALL LSCC PERMANENTE, CA	
Drawn: AJS	App'd: KGH	Date: JULY, 2011	Figure: 8A-8

Project No.: 063-7109 Revision No.: 2

PROJECT NO. 063-7109904 DRAWN: AJS REVIEWED BY: KGH DATE: 07-06-11 FILE LOCATION:



SECTION EW1 – EAST WALL FINAL RECLAMATION
CONDITION: YIELD ACCELERATION CALCULATION
FAILURE MODE: CIRCULAR

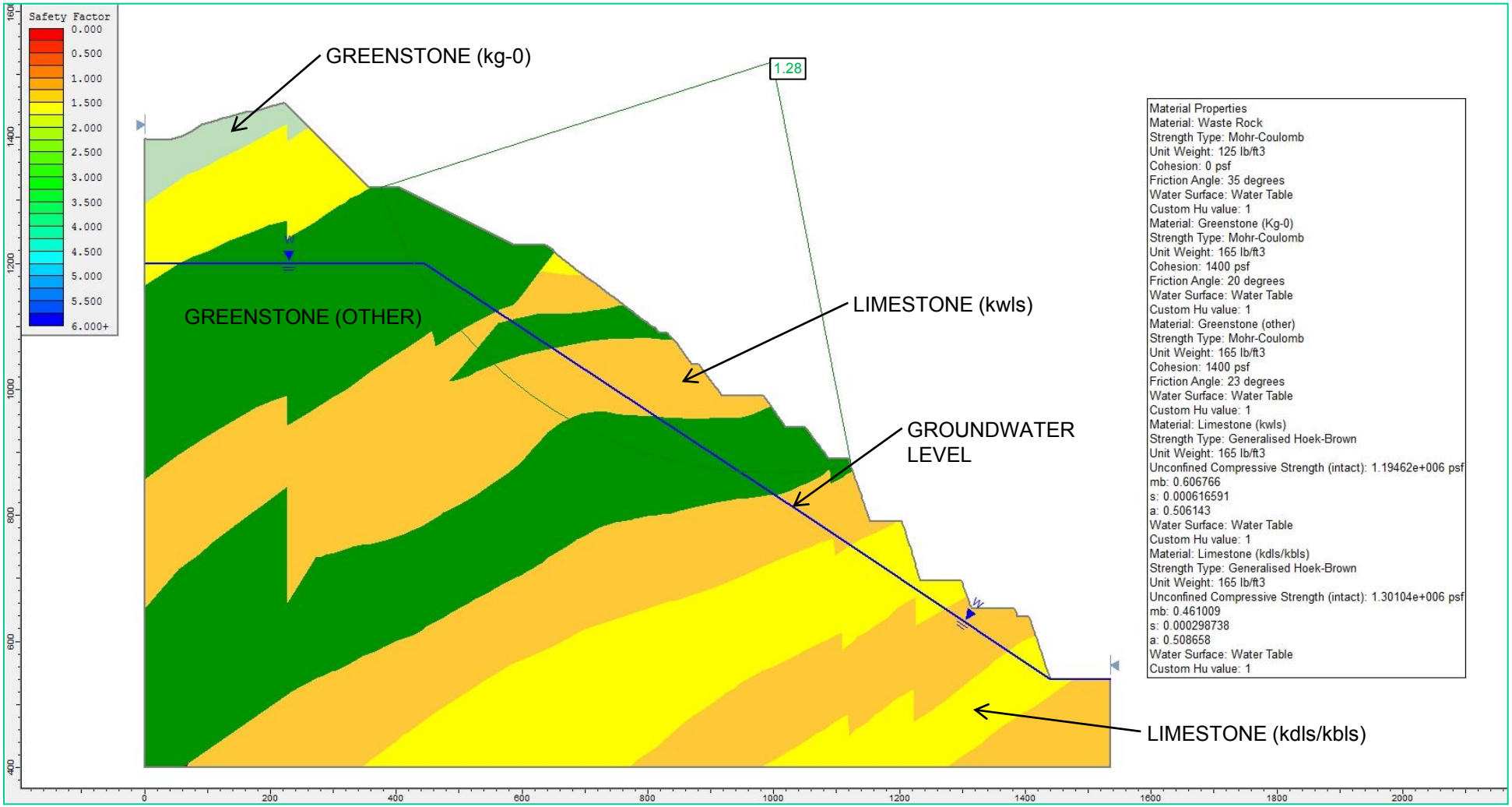
Golder Associates

FINAL RECLAMATION PLAN
SECTION EW1 – EAST WALL
LSCC PERMANENTE, CA

Drawn: AJS	App'd: KGH	Date: JULY, 2011	Figure: 8A-9

Project No.: 063-7109 Revision No.: 2

PROJECT NO. 063-7109904 DRAWN: AJS REVIEWED BY: KGH DATE: 07-06-11 FILE LOCATION:



SECTION EW2 – EAST WALL FINAL DESIGN

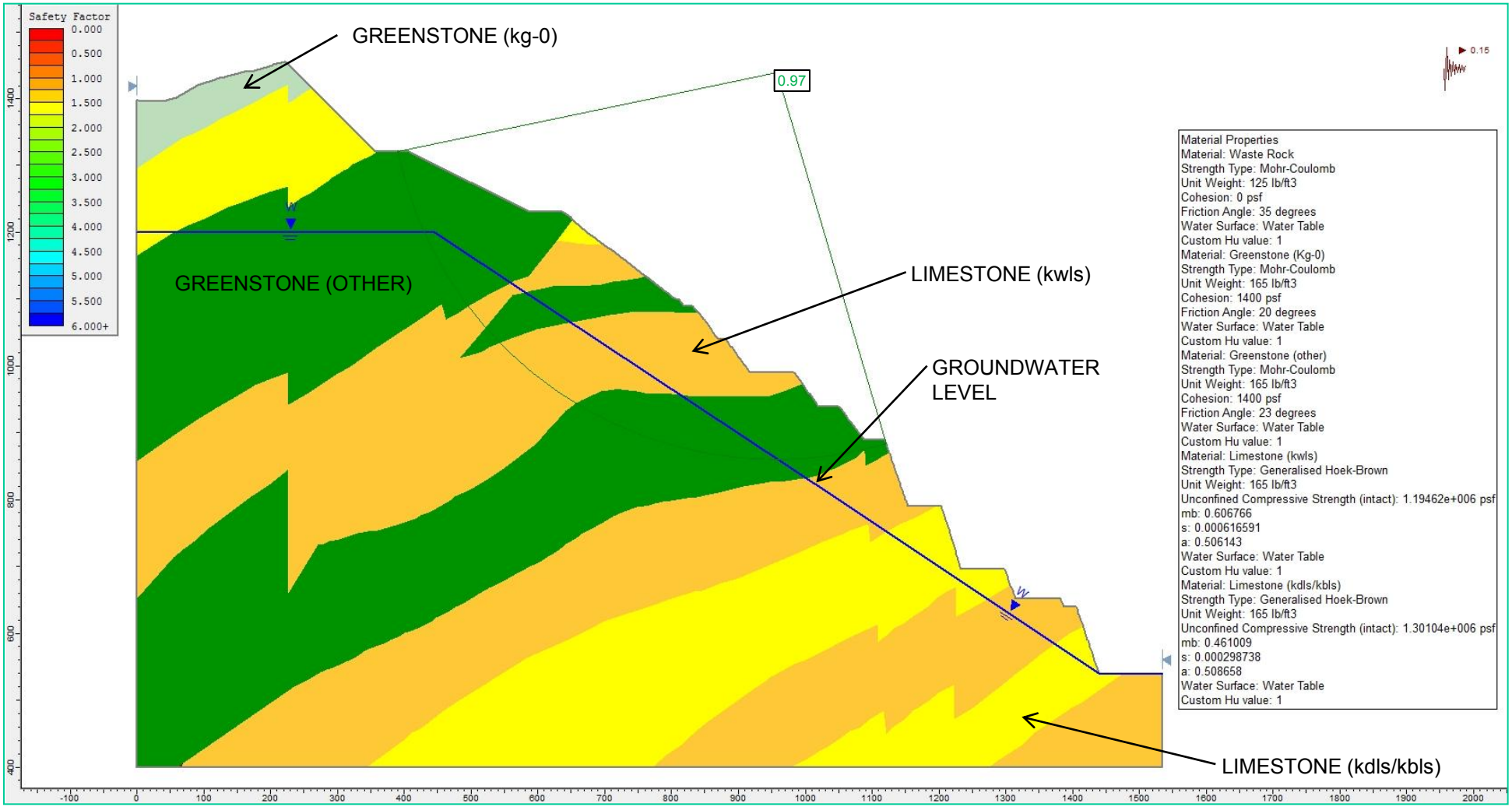
CONDITION: STATIC

FAILURE MODE: CIRCULAR

Golder Associates		FINALSLOPE DESIGN SECTION EW2 – EAST WALL LSCC PERMANENTE, CA	
Drawn: AJS	App'd: KGH	Date: JULY, 2011	Figure: 8A-10

Project No.: 063-7109 Revision No.: 2

PROJECT NO. 063-7109904 DRAWN: AJS REVIEWED BY: KGH DATE: 07-06-11 FILE LOCATION:



SECTION EW2 – EAST WALL FINAL DESIGN

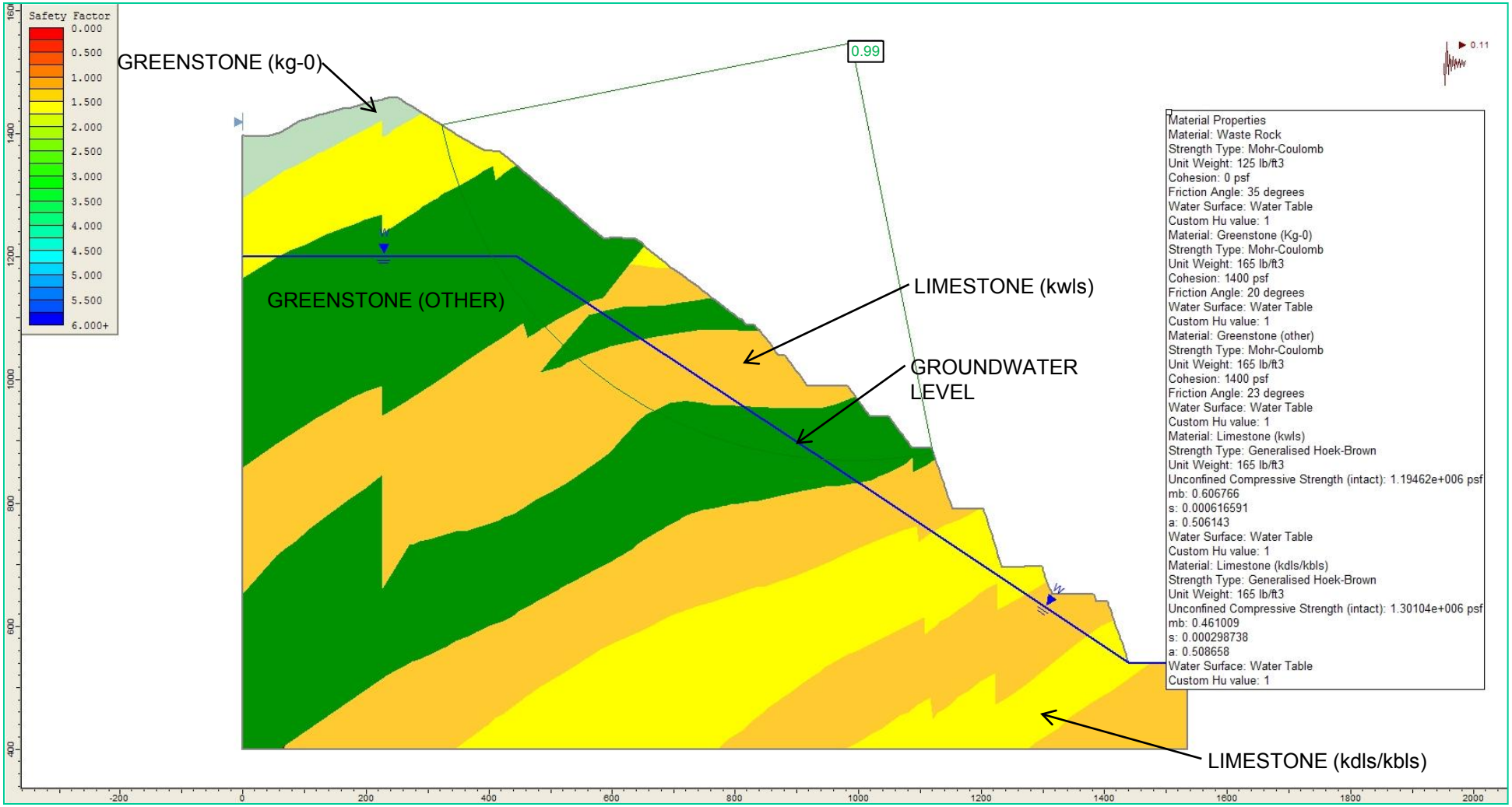
CONDITION: PSEUDO-STATIC (k = 0.15g)

FAILURE MODE: CIRCULAR

Golder Associates		FINALSLOPE DESIGN SECTION EW2 – EAST WALL LSCC PERMANENTE, CA	
Drawn: AJS	App'd: KGH	Date: JULY, 2011	Figure: 8A-11

Project No.: 063-7109 Revision No.: 2

PROJECT NO. 063-7109904 DRAWN: AJS REVIEWED BY: KGH DATE: 07-06-11 FILE LOCATION:



SECTION EW2 – EAST WALL FINAL DESIGN

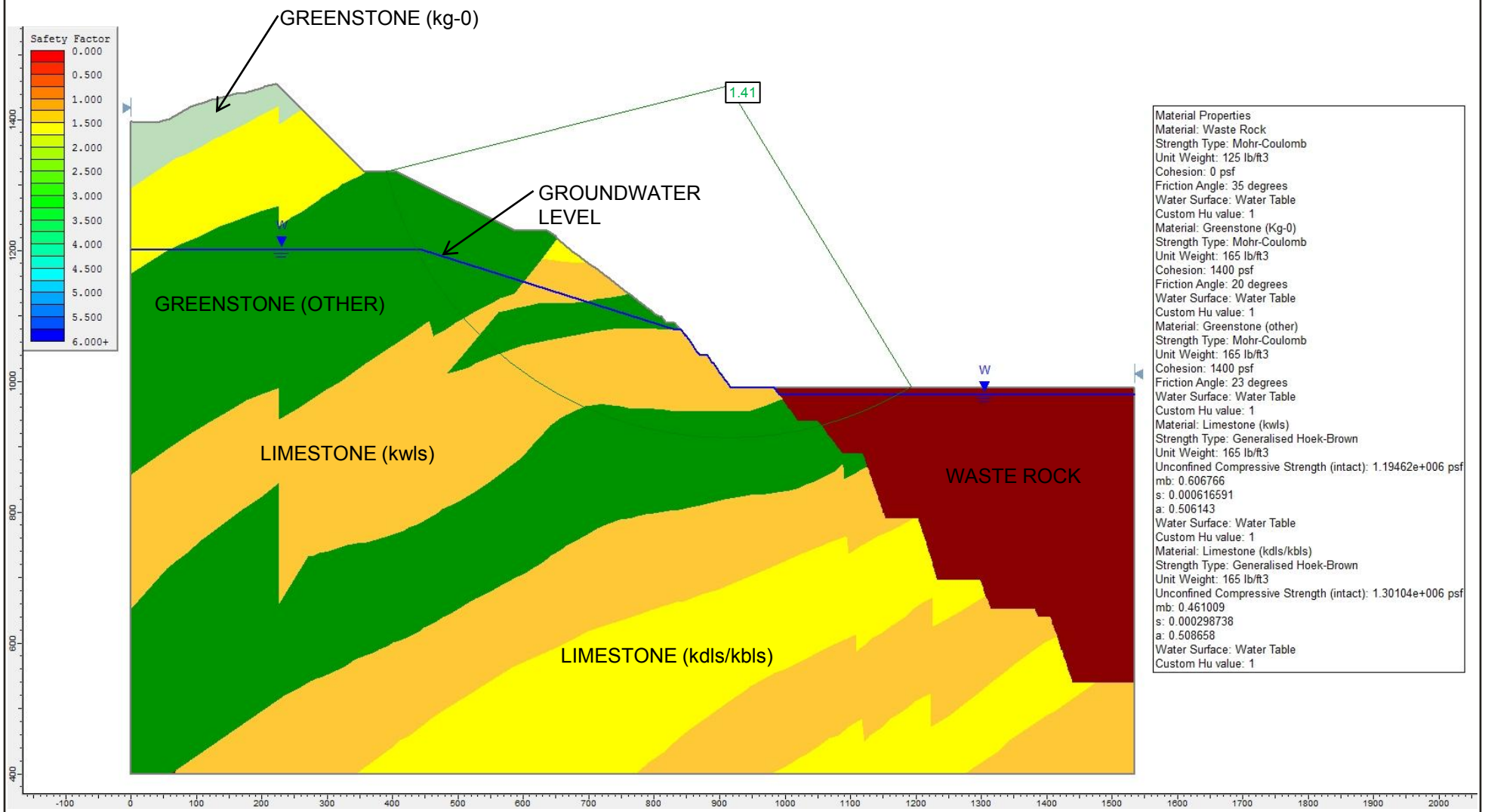
CONDITION: YIELD ACCELERATION CALCULATION

FAILURE MODE: CIRCULAR

Golder Associates		FINALSLOPE DESIGN SECTION EW2 – EAST WALL LSCC PERMANENTE, CA	
Drawn: AJS	App'd: KGH	Date: JULY, 2011	Figure: 8A-12

Project No.: 063-7109 Revision No.: 2

PROJECT NO. 063-7109904 DRAWN: AJS REVIEWED BY: KGH DATE: 07-06-11 FILE LOCATION:



SECTION EW2 – EAST WALL FINAL RECLAMATION

CONDITION: STATIC

FAILURE MODE: CIRCULAR

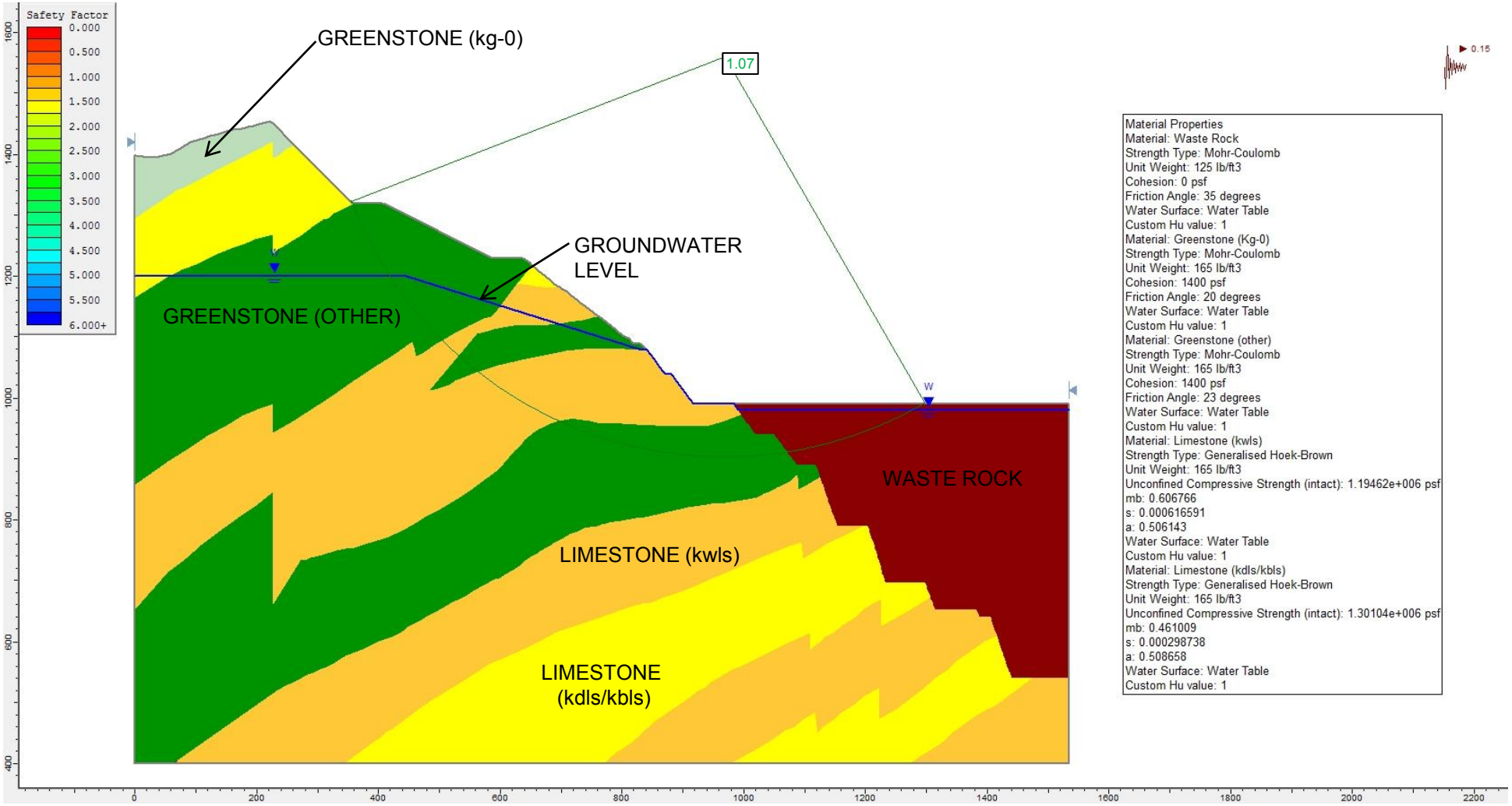
Golder Associates

FINAL RECLAMATION PLAN
SECTION EW2 – EAST WALL
LSCC PERMANENTE, CA

Drawn: AJS	App'd: KGH	Date: JULY, 2011	Figure: 8A-13

Project No.: 063-7109 Revision No.: 2

PROJECT NO. 063-7109904 DRAWN: AJS REVIEWED BY: KGH DATE: 07-06-11 FILE LOCATION:



SECTION EW2 – EAST WALL FINAL RECLAMATION

CONDITION: PSEUDO-STATIC (k = 0.15g)

FAILURE MODE: CIRCULAR

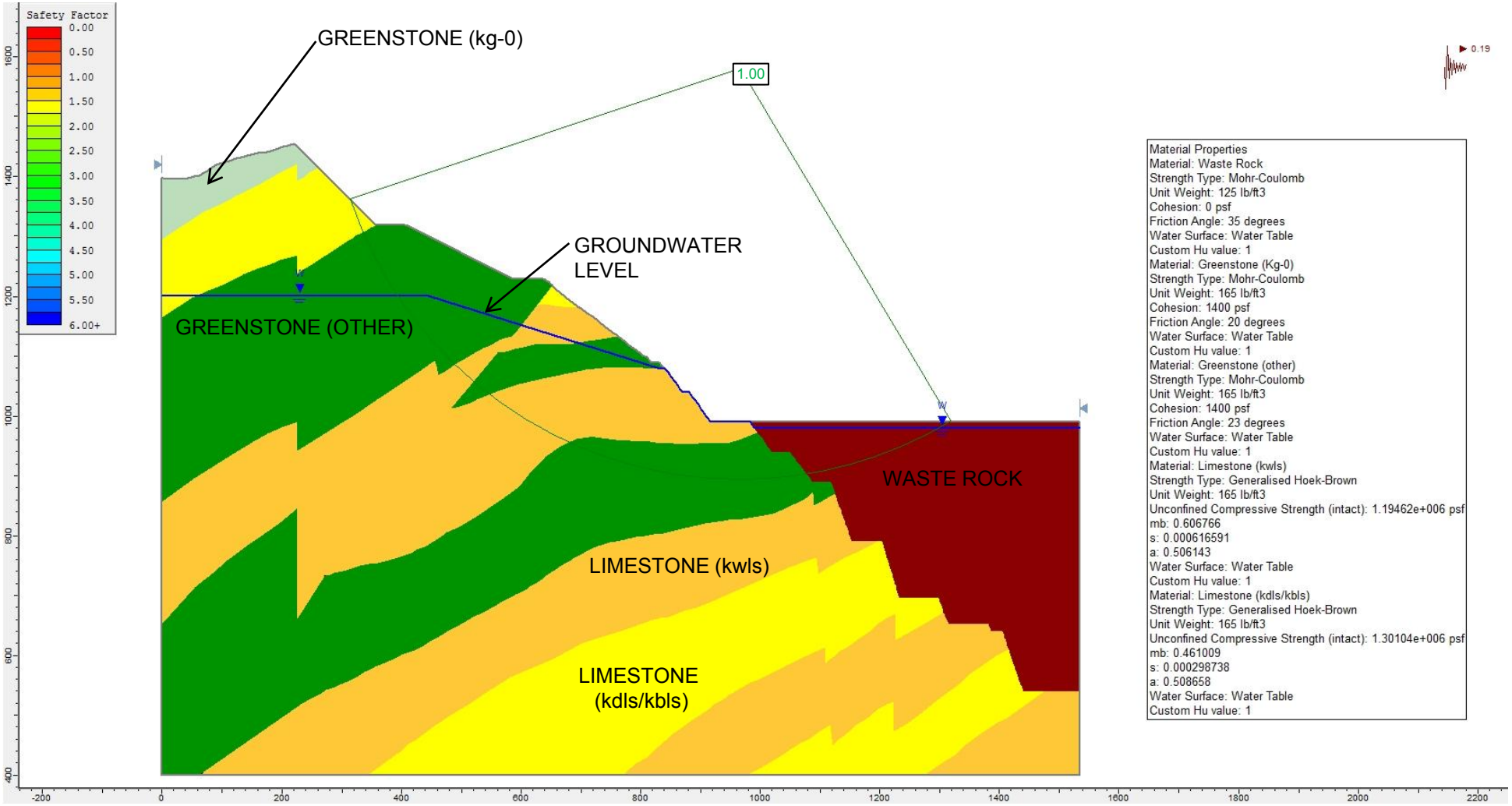
Golder Associates

FINAL RECLAMATION PLAN
SECTION EW2 – EAST WALL
LSCC PERMANENTE, CA

Drawn: AJS	App'd: KGH	Date: JULY, 2011	Figure: 8A-14

Project No.: 063-7109 Revision No.: 2

PROJECT NO. 063-7109904 DRAWN: AJS REVIEWED BY: KGH DATE: 07-06-11 FILE LOCATION:



SECTION EW2 – EAST WALL FINAL RECLAMATION
CONDITION: YIELD ACCELERATION CALCULATION
FAILURE MODE: CIRCULAR

Golder Associates

FINAL RECLAMATION PLAN
SECTION EW2 – EAST WALL
LSCC PERMANENTE, CA

Drawn: AJS	App'd: KGH	Date: JULY, 2011	Figure: 8A-15

Project No.: 063-7109 Revision No.: 2

Summary of Dynamic Deformation Analysis - East Wall

Selected Notations			
M_w =	Moment magnitude	k_y =	Yield acceleration
a_{brk} =	Peak Horizontal Acceleration at the bedrock	U =	Dynamic deformation along critical slide surface
a_{max} =	Peak Horizontal Acceleration at the crest of slope		

Earthquake Characterization		
M_w	a_{brk} g	a_{max} (Reference 1) g
7.1	0.60	0.60

Deformation Calculation (Reference 2)							
SITE	Section	Failure Description	k_y g	k_y/a_{max}	Slope Deformation, U (in) (Bray and Travasarou)		
					84% Exc.	16% Exc.	50% Exc.
East Wall	EW1	Phase 1 Design	0.17	0.28	3	11	6
	EW1	Reclaimed	0.16	0.27	3	13	6
	EW2	Phase 1 Design	0.11	0.18	6	24	12
	EW2	Reclaimed	0.19	0.32	2	9	5

References:

1. Seed, H. B. and Idriss, I. M. (1982), Ground Motions and Soil Liquefaction During Earthquakes Monograph No. 5, Earthquake Engineering Research Institute, Berkeley, California.
2. Bray, J. D. and Travasarou, T. (2007), Simplified Procedure for Estimating Earthquake-Induced Deviatoric Slope Displacements Journal of the Geotechnical and Geoenvironmental Engineering, ASCE, Vol. 133, No. 4, pp. 381-392.

Note: This spreadsheet is only intended to estimate seismic deformation under the above shown earthquake events and sections, assuming potential failure mass is a Newmark rigid sliding block.

APPENDIX 9.A

Geotech Core Logs 2008 Drilling

PERMANENTE QUARRY RMR SYSTEM - RECORD OF GEOTECHNICAL PARAMETERS

Project No.	063-7109.100			**Drilling Method**	HQ3	From 10.0 To 473	**Sheet**	1 of 19	
Borehole #	GT1-1-08	**Azimuth**	NA				**Logged by**	IT/ALH/SW	
Elevation	1058	**Inclination**	-90 (Vertical)				**Drill Rig**	Ruen	
N 106.3	E -5449	**Ref. Point**							

Core Dia: Depth	ROCK TYPE	RUN	Run Data: Recovery & Other Basic Information: From (ft.)	To (ft.)	Recovery (ft.)	Bedding Dominant (Y/N)	RQD (ft.)	Natural Fracture Count	JCR: Average	Minimum	Strength Index: Strength Index	Weathering Index	Detailed Discontinuity Data: Depth (ft.)	Type	Count	α	Shape	Roughness	Infill	Thickness (mm)	JRC	JCR	Rubble/Gouge: Gouge: From	To	Type	Broken Core: From	To	ADDITIONAL TESTING OR COMMENTS, SAMPLES COLLECTED
	Metabasalt	1	10.0	13.0	2.5	N	2.1	0	25		R3	W4																Extensive Ca filling
	Metabasalt	2	13.0	16.0	3.0	N	2.7	0	25		R3	W4																
	Metabasalt	3	16.0	21.0	4.6	N	4.5	0	25		R2	W4																Sample 20.1' to 20.6'; soft, gougy
	Metabasalt	4	21.0	23.0	2.0	N	2.0	0	25		R2	W4																
	Metabasalt	5	23.0	28.0	5.0	N	5.0	1	0	0	R2	W4	23.8	F	1	30	P	R	Cl	15	8.0	0						
	Metabasalt	6	28.0	33.0	5.0	N	5.0	0	25		R2	W4																
	Metabasalt	7	33.0	38.0	5.0	N	5.0	1	20	20	R2 W4		34.7	J	1	60	P	R	Cl	C	14.0	20						
	Metabasalt	8	38.0	43.0	5.0	N	4.8	3	15		R2	W4														39.5	39.7	Sample 41.4' to 41.9'
	Metabasalt	9	43.0	48.0	4.9	N	4.7	3	12	12	R2	W4	44.1	J	1	20	P	VR	Cl	2	16.0	12						
																										45.2	45.4	Gc broken core
	Metabasalt with 0.8 feet of limestone at top of run	10	48.0	53.0	4.7	N	4.3	6	6	6	R3	W4	48.8	F	1	60	ST	VR	Cl	1	18.0	6						Stepped, slicked fault
																										48.2	48.5	Milled gravelly gouge
	Metabasalt	11	53.0	58.0	4.5	N	3.7	10	12	12	R4	W4	55.5	J	1	30	p	VR	Cl	1	16.0	12						
																							56.4	58.0	Sc			Milled greenstone gouge
	Greenstone	12	58.0	63.0	5.0	N	3.7	8	12	12	R3	W4														58.3	58.8	Rubbley pieces
													59.6	J	1	40	P	VR	Cl	1	16.0	12						Sample 61.9' to 62.6'
																										62.6	63.0	
	Greenstone	13	63.0	64.5	1.1	N	0.9	8	12		R2	W4											64.3	64.5	Sc			
	Greenstone	14	64.5	67.0	2.7	N	1.9	15	12		R2	W4											64.5	65.4	Sc			Milled gouge; str: S4
	Metabasalt	15	67.0	72.0	4.8	N	3.3	20	0	0	R2	W4	69.4	F	1	50	P	VR	Cl	40	18.0	0						
																							70.1	71.3	Sc			Gouge with thin sections of more solid core
	Limestone	16	72.0	77.0	4.8	N	4.8	0	25		R3	W3																Top 1.6' cemented breccia
		17	77.0	79.7	2.7	N	2.7	0	25		R3	W3																Extensive Ca infilling
	gouge	17	79.7	82.0	2.3	N	0.0	25	0		S4	W3																Gouge
	Limestone	18	82.0	87.0	4.7	N	3.1	20	12		R0.5	W3											82.0	83.2	Sc			
																							86.4	87.0	Sc			
	gouge	19	87.0	92.0	4.5	N	0.0	50	6		S4	W3																Entire run milled clayey gouge
	Greywacke	20	92.0	96.5	4.0	N	1.3	35	12		R0.5	W3											92.0	92.9	Gc			Clay gouge with solid pieces suspended
																							93.8	94.5	Gc			
	gouge	21	96.5	101.5	4.9	N	0.0	50	0		S4	W3																Entire run milled gouge
	Fault Breccia	22	101.5	105.5	3.7	N	0.0	50	0		R0	W3																
	Greenstone	23	105.5	110.5	5.0	N	5.0	2	12	12	R3	W3	108	J	1	20	P	R	Cl	3	14.0	12						
													109.9	J	1	50	P	R	Cl	2	12.0	12						

Core Dia: Depth	ROCK TYPE	RUN	Run Data: Recovery & Other Basic Information: From (ft.)	To (ft.)	Recovery (ft.)	Bedding Dominant (Y/N)	RQD (ft.)	Natural Fracture Count	JCR: Average	Minimum	Strength Index: Strength Index	Weathering Index	Detailed Discontinuity Data: Depth (ft.)	Type	Count	α	Shape	Roughness	Infill	Thickness (mm)	JRC	JCR	Rubble/Gouge: Gouge: From	To	Type	Broken Core: From	To	ADDITIONAL TESTING OR COMMENTS, SAMPLES COLLECTED
	Greenstone	24	110.5	113.0	2.3	N	2.3	0	15																			
	Greywacke	25	113.0	118.0	5.0	N	0.0	50	4		R1	W4																Entire run soft, friable, gougy rock
	Graywacke	26	118.0	123.0	4.2	N	3.4	20	12	12	R2	W4											118.0	118.4	Sc			
													122.5	J	3	30	P	S	Cl	1	6.0	12						
																							122.5	123.0	Sc			
	Greywacke with calcite veins	27	123.0	128.0	4.5	N	0.0	2	0	0	R1	W4	126	F	1	11	C	S	G		2.0	0	123.0	127.0	Sc			mostly gougy rock
													127.3	F	1	59	P	S	G		2.0	0	127.0	127.4	Sc			
	Greywacke with calcite veins	28	128.0	133.0	4.4	N	1.5	6	14	14	R2	W3	129.7	J	1	43	P	VR	Cl/Ca	1	16.0	14						
													130.2	J	1	70	P	R	Cl/Ca	0.5	14.0	14						
													131.3	J	3	49	P	R	Cl/Ca	0.5	14.0	14						
													132.5	J	1	43	I	VR	Ox/Ca	<0.5	17.0	15						
	Greywacke/Greenstone	29	133.0	138.0	4.7	N	2.2	5	12	0	R2	W3	133.8	J	1	50	P	R	Ox	<0.5	15.0	18						
													134.3	J	1	76	P	VR	Ox	<0.5	18.0	22						
													135	F	1	55	P	S	G		2.0	0	134.7	135.2	Sc			Greywacke/greenstone contact at 134.75 feet
													136.7	F	1	30	P	S	G		2.0	0	136.5	136.9	Sc			
													137.5	J	1	66	P	VR			16.0	18						
	Greenstone	30	138.0	143.0	2.6	N	1.2	13	12	0	R2	W3	140.6	J	1	64	C	SR			6.0	16						
													141.5	J	1	83	P	VR			16.0	20						>10 fractures/foot 141.7' to 142.6'
													141.6	F	1	39	P	S	G		2.0	0	142.6	143.0				Fault at 141.5' - greywacke/greenstone contact
	Greenstone	31	143.0	146.5	3.1	N	1.7	3	5	0	R2	W3	144	J	1	76	U	R	Cl	<0.5	14.0	15						
													144.7	F	1	36	P	S	G		2.0	0	144.3	144.9	Bx/Cl			
													146	F	1	43	P	S	G		2.0	0	143.6	145.9	Bx/Cl			
	Greenstone/Limestone	32	146.0	151.5	5.0	N	2.5	3	11	0	R2.5	W3	148.5	F	1	67	P	S	G		2.0	0	146.5	148.6	Sc			Greenstone/Limestone contact at 148.5 feet
													149.5	J	1	50	P	VR	Ca/Ox	<0.5	18.0	20						
													151.2	J	1	8	P	R			14.0	12						
	Limestone with chert and calcite veins,	33	151.5	156.5	5.0	N	4.1	7	11	6	R3	W2	152.9	J	1	62	P	R			12.0	16						
	some greywacke												153.5	J	1	68	P	R			12.0	16						Limestone/greenstone contact at 153.5 feet
													154.4	J	1	58	P	SR	Ca/Cl	20	4.0	6						
													155	J	1	54	P	R	Ca/Cl	0.5	8.0	12						
													155.5	J	3	66	P	SR	Ca/Cl	1	4.0	6						
	Limestone	34	156.5	159.5	2.8	N	2.8	3	14	14	R3	W3	157.3	J	1	55	P	VR	Ox	<0.5	16.0	14						
													158.3	J	1	70	P	VR	Ox	<0.5	16.0	14						
													158.8	J	1	81	P	VR	Ox	<0.5	16.0	14						
	Limestone with chert, calcite veins	35	159.5	163.0	3.4	N	2.6	5	20	14	R2	W2	160	J	1	82	P	VR	Ca/Bx	1	14.0	20						
													160.3	J	1	70	P	VR	Bx	1	18.0	22						
													161	J	1	61	P	SR	Ca	<0.5	6.0	14						
													161.9	J	1	59	P	VR	Ca	<0.5	18.0	22						

Core Dia: Depth	ROCK TYPE	RUN	Run Data: Recovery & Other Basic Information: From (ft.)	To (ft.)	Recovery (ft.)	Bedding Dominant (Y/N)	RQD (ft.)	Natural Fracture Count	JCR: Average	Minimum	Strength Index: Strength Index	Weathering Index	Detailed Discontinuity Data: Depth (ft.)	Type	Count	α	Shape	Roughness	Infill	Thickness (mm)	JRC	JCR	Rubble/Gouge: Gouge: From	To	Type	Broken Core: From	To	ADDITIONAL TESTING OR COMMENTS, SAMPLES COLLECTED
													162.6	J	1	80	P	VR	Ca	<0.5	18.0	22						
	Limestone	36	163.0	168.0	4.7	N	2.5	3	7	6	R2	W2	165	F	1	57	P	R	G		14.0	6	163.0	165.0	Bx/Cl			
													165.9	J	1	81	P	R	Cl/Bx	1	14.0	10						
													167.2	J	1	33	P	SR	Cl/Bx	10	6.0	6						
	Graywacke/Limestone	37	168.0	173.0	5.0	N	4.2	3	15	10	R2	W3	170.5	J	1	35	P	SR	Bx	2	8.0	10						Fracture along calcite vein
													172.2	J	1	43	P	R	Bx	1	12.0	14						
													172.6	J	1	50	P	VR	Ca	<0.5	18.0	20						
	Limestone/Graywacke	38	173.0	178.0	5.0	N	4.0	6	17	14	R2	W2	174.1	J	1	38	P	VR	Ca	<0.5	18.0	20						Limestone/greywacke contact at 176.7 feet
													175.2	J	3	80	P	VR	Ca/Bx	0.5	18.0	20						
													176.7	F	1	55	U	R	Cl	0.5	12.0	14						
													177.5	J	1	81	P	R	Ca/Bx	0.5	13.0	15						
	Limestone	39	178.0	183.0	5.0	N	5.0	2	20	20	R2	W2	178.4	J	1	70	P	VR	Cl	<0.5	19.0	20						
													181.9	J	1	78	P	R	Ca/Bx	<0.5	16.0	20						
	Limestone	40	183.0	188.0	5.0	N	4.6	5	17	14	R2	W2	184.6	J	1	88	P	VR			19.0	22						
													185.2	J	1	83	P	R	Cl	1	10.0	18						
													185.8	J	1	34	P	SR			8.0	14						
													187	J	1	84	P	R			12.0	16						
													187.3	J	1	63	P	R			12.0	16						
	Limestone	41	188.0	193.0	5.0	N	4.4	3	13	6	R2	W2	189.9	J	1	50.0	P	R			12.0	16						
													191.2	F	1	77.0	ST	R	G		14.0	6	191.2	193.5	Sc			
													191.9	J	1	54.0	P	VR	Bx	2	16.0	17						
	Limestone w/calcite veins, some	42	193.0	198.0	5.0	N	4.1	5	5	0	R2	W3	194.6	F	1	58	P	SR	Cl	10	4.0	0						
	chert												195.7	F	1	58	P	S	Cl	30	2.0	0						
													196	J	1	80	P	VR	Bx	1	16.0	14						
													196.8	J	1	84	P	VR	Bx	2	18.0	12						
													197.6	F	1	61	P	SR	Bx	30	10.0	0						
	Limestone	43	198.0	203.0	5.0	N	5.0	6	20	17	R2	W2	199.5	J	2	70	P	VR			14.0	18						
													200.1	J	1	79	P	R			12.0	17						
													200.8	J	1	60	P	VR	Cl	<0.5	20.0	23						
													201.7	J	2	48	P	VR	Cl	<0.5	17.0	20						
	Limestone	44	203.0	208.0	5.0	N	4.2	7	20	19	R2	W2	203.7	J	1	77	P	VR	Ca	1	17.0	20						
													204.5	J	2	64	P	VR	Ca	<0.5	15.0	19						
													205.8	J	1	73	P	VR	Ca	<0.5	18.0	20						
													206.1	J	1	36	P	VR	Ca	<0.5	17.0	20						
													206.6	J	1	75	P	VR	Ca	<0.5	17.0	20						
													207.7	J	1	47	C	R	Ca	<0.5	13.0	21						
	limestone/brecciated limestone	45	208.0	213.0	5.0	N	5.0	6	14	4	R2	W2	208.5	J	1	74	P	VR			16.0	18						Brecciated limestone

			Run Data																				Rubble/Gouge					
			Recovery & Other Basic Information						JCR		Strength Index		Detailed Discontinuity Data										Gouge			Broken Core		
Core Dia: Depth	ROCK TYPE	RUN	From (ft.)	To (ft.)	Recovery (ft.)	Bedding Dominant (Y/N)	RQD (ft.)	Natural Fracture Count	Average	Minimum	Strength Index	Weathering Index	Depth (ft.)	Type	Count	α	Shape	Roughness	Infill	Thickness (mm)	JRC	JCR	From	To	Type	From	To	ADDITIONAL TESTING OR COMMENTS, SAMPLES COLLECTED
													209.3	J	1	76	P	R			12.0	16						
													210.2	J	1	48	P	SR	Cl	<0.5	4.0	12						
													211.2	J	1	86	P	VR			16.0	18						
													211.8	F	1	40	ST	S	Cl	<0.5	2.0	4						
													212.8	J	1	56	P	R	Cl	0.5	10.0	13						
	Limestone	46	213.0	218.0	5.0	N	5.0	5	18	10	R2	W2	214	J	1	85	P	SR	Ca	15	8.0	10						
													214.9	J	1	84	P	VR	Cl	<0.5	19.0	21						
													215.8	J	1	73	P	VR	Cl	<0.5	16.0	20						
													216.5	J	1	55	P	VR	Cl	<0.5	16.0	20						
													217.1	J	1	86	P	VR			17.0	20						
	limestone	47	218.0	223.0	5.0	N	5.0	0	25		R2	W2																Extensive Ca veining/infill
	Limestone breccia, Ca cemented	48	223.0	228.0	5.0	N	5.0	1	20	20	R2	W2	224.4	J	1	20	P	R	Cl	1	8.0	20						Extensive Ca veining throughout
	Limestone	49	228.0	233.0	5.0	N	5.0	0	25		R3	W2																Breccia in upper 0.4 feet, Ca cemented - unbrecciated limestone below
	Limestone	50	233.0	237.5	4.1	N	2.1	10	20	20	R3	W2	237.2	J	1	70	C	VR	Gc	2	16.0	20						Run moderately fractured though subrounded chert inclusions
	Limestone	51	237.5	242.5	5.0	N	4.7	5	12	12	R3	W2	238.3	J	1	30	P	R	Gc	3	14.0	12						Sample 239.8' to 240.3'
																							241.4	241.6	Gc			
	Limestone	52	242.5	247.6	4.8	N	4.8	1	20	20	R3	W2	245.9	J	1	30	P	VR	Cl	C	16.0	20						
	Limestone	53	247.6	252.9	5.2	N	4.9	4	17																	250.5	250.7	Run brecciated limestone, Ca cemented - frequent void spaces between limestone breccia
	Limestone	54	252.9	258.0	4.9	N	4.9	1	20	20	R3	W2	254.7	J	1	70	P	R	Ca	C	12.0	20						
	Limestone	55	258.0	261.5	3.4	N	1.3	15	12		R3	W2											258.0	260.0	Bx			Cemented fault breccia
	Limestone	56	261.5	262.1	0.6	N	0.6	0	25		R3	W2																
	Greenstone gouge	56	262.1	263.0	1.1	N	0.0	20	2		R1	W4																Solid limestone - Greenstone gouge contact at 262.1 feet
	Gouge	57	263.0	268.0	4.9	N	0.9	50	0	12	S4	W4	263.6	J	1	50	P	R	Cl	2	8.0	12						Breakthrough limestone piece
																							264.8	268.0	Gc			Greenstone gouge with few rounded greywacke pebbles
	greenstone gouge	58	268.0	273.0	5.0	N		50	0		S5	W4																Entire run weak, friable milled rock
	Greenstone gouge	59	273.0	277.0	3.7	N	0.0	40	2		S4	W4																Entire run clay gouge with some greywacke clasts
	Milled greenstone	60	277.0	279.0	0.9	N	0.0	20	2		S4	W4																Milled greenstone with greywacke clasts
	Milled clay	61	279.0	281.0	1.3	N	0.0	20	0		S4	W4																Dark gray clay
	Milled greywacke	62	281.0	283.0	1.8	N	0.0	20	2		S5	W4																Dark gray clay with increasing greywacke pebbles
	Greywacke	63	283.0	286.0	3.0	N	0.0	30	0		S5	W4																Greywacke clasts increasing in size down run in gray clay
	Graywacke	64	286.0	291.0	4.7	N	4.1	15	9	0	R3	W3											286.0	286.9	Milled greenstn.			
													287.3	J	1	70	P	R	Cl	2	8.0	12						
													288.6	J	2	50	P	R	Cl	1	10.0	12						
													289.2	J	1	60	P	R	Cl	5	8.0	0						
													290	J	1	70	P	VR	Cl	2	16.0	12						

			Run Data																			Rubble/Gouge					
			Recovery & Other Basic Information						JCR		Strength Index		Detailed Discontinuity Data											Gouge			Broken Core		
Core Dia: Depth	ROCK TYPE	RUN	From (ft.)	To (ft.)	Recovery (ft.)	Bedding Dominant (Y/N)	RQD (ft.)	Natural Fracture Count	Average	Minimum	Strength Index	Weathering Index	Depth (ft.)	Type	Count	α	Shape	Roughness	Infill	Thickness (mm)	JRC	JCR	From	To	Type	From	To	ADDITIONAL TESTING OR COMMENTS, SAMPLES COLLECTED
	Graywacke	65	291.0	293.0	1.7	N	1.7	2	20	20	R3	W3	291.5	J	1	50	P	R	Cl	C	8.0	20						
													291.9	J	1	35	P	R	Cl	C	8.0	20						
	Graywacke	66	293.0	297.0	4.6	N	4.6	3	12	12	R3	W3	293.58	J	1	60	P	R	Cl	1	10.0	12						Possible run length error
													295.1	J	1	50	P	R	Cl	1	14.0	12						
													296.2	J	1	75	P	R	Cl	1	10.0	12						Limestone contact at 295.8 feet
	Limestone	67	297.0	302.0	4.7	N	3.3	10	12	12	R2	W3											297.6	297.8	Sc			Milled greenstone
													298	J	2	60	P	R	Cl	1	10.0	12						Sample 297' to 297.6'
													300.7	J	1	75	P	R	Cl	2	12.0	12						
													300.9	J	2	75	P	R	Cl	3	14.0	12						
	Limestone	68	302.0	306.0	3.6	N	3.3	8	16	12	R2	W3	303.6	J	2	60	P	R	Cl	C	8.0	20						Run highly fractured - large chert nodules decrease rock strengtl due to brittle nature
													304	J	1	45	P	R	Cl	1	10.0	12						
	Limestone	69	306.0	308.0	1.9	N	1.2	1	12	12	R2	W3	307.4	J	1	50	P	VR	Gc	2	18.0	12						
	Limestone	70	308.0	313.0	5.0	N	4.5	6	12	12	R2	W3	308.6	J	1	50	P	R	Cl	2	8.0	12						Significant chert nodules
																										309.5	310.0	Shattered chert clasts
													310.6	J	1	50	C	S	Ca	2	6.0	12						
	Limestone with Ca veins	71	313.0	318.0	4.7	N	3.5	12	18	3	R3	W1	313.2	F	1	62	C	SR	Sc	5	4.0	3						Ca veins
													313.4	V	1	40	ST	SR	Ca	2	8.0	22						Point load test
													314.5	J	1	45	U	S			2.0	18						
													315	V	1	60	ST	SR	Ca	1.5	8.0	22						
													315.5	V	1	60	P	R	Ca	1.5	8.0	23						
													315.9	S	1	65	P	SR/K	Ca	0.5	6.0	15						
													317.2	V	1	25	P	SR	Ca	0.5	5.0	22						
													317.5	V	1	25	P	SR	Ca	0.5	5.0	22				317.0	318.0	
	Highly fractured limestone with	72	318.0	322.0	4.0	N	0.0	30	19	2	R3	W2	318.2	J	1	30	P	VR			10.0	23						Highly fractured limestone with calcite veins and chert nodules Estimated 10% is chert, Str: R4
	veins and chert nodules												318.4	J	4	65	P	R			10.0	22						
													318.6	J	1	25	U	SR			12.0	23						
													319.2	J	2	45	IR	SR			6.0	23						
													319.5	J	2	60	IR	SR			8.0	22						
													319.6	J	2	35	P	VR			10.0	20						
													320.2	J	2	30	U	SR			8.0	20						
													320.7	J	2	24	P	SR			8.0	20						
													321.2	F	1	25	P	SR	Bx	150	6.0	2	321.2	322.0	Bx/Sc			
	highly fractured limestone with	73	322.0	324.0	1.4	20.0	0.0	6	24	24	R3	W2	322.2	V	2	35	C	VR	Ca	3	14.0	25						Estimated 20% is chert, Str: R4
	chert nodules												322.6	J	1	40	P	VR			12.0	24						
													322.9	J	1	41	ST	VR			12.0	24						
	highly fractured Limestone with	74	324.0	327.0	2.8	N	0.4	35	17	11	R3	W2	324.2	J	3	25	P	R	Ca	1	9.0	24						Highly fractured limestone; chert nodules up to 3" thick (~20%)
	Chert nodules (20%)												324.8	J	1	27	U	SR	Ca	0.2	4.0	16						>10 fractures/foot 324' - 326'

			Run Data																			Rubble/Gouge					
			Recovery & Other Basic Information						JCR		Strength Index		Detailed Discontinuity Data									Gouge			Broken Core		
Core Dia: Depth	ROCK TYPE	RUN	From (ft.)	To (ft.)	Recovery (ft.)	Bedding Dominant (Y/N)	RQD (ft.)	Natural Fracture Count	Average	Minimum	Strength Index	Weathering Index	Depth (ft.)	Type	Count	α	Shape	Roughness	Infill	Thickness (mm)	JRC	JCR	From	To	Type	From	To	ADDITIONAL TESTING OR COMMENTS, SAMPLES COLLECTED
													325	J	2	35	C	SR			4.0	16						
													325.5	J	2	48	P	SR			4.0	16						
													325.2	J	1	24	P	SR			4.0	16						
													326.5	J	1	47	P	SR	Sc	1	5.0	11						
	Brecciated Limestone (fault breccia)	75	327.0	330.5	3.4	N	0.0	100	11	2	R3	W3	327.6	J	2	50	P	R			10.0	20						Brecciated limestone (fault breccia); ~10% chert nodules
	w/chert nodules (10%)												327.7	J	3	40	P	R			10.0	20				327.0	327.5	>10 fractures/foot entire run
													328.4	F	1	45	P	R	Bx		12.0	2	328.4	328.6	Bx			R3 chert clasts, very little gouge; clasts fit together, most aroun 0.1 to 2 cm in diameter, very angular, and smooth sided
													328.6	F	1				Bx		6.0	2	328.6	330.5	Sx/Sp			Core breaks down to gravel with sand
	Brecciated Limestone (fault breccia)	76	330.5	331.0	0.5	N	0.0	50	2	2	R3	W3	330.5	F	1		IR					2	330.5	331.0	Bx/Sp	330.5	331.0	>10 fractures/foot; entire run R3 clasts
		77	331.0	332.0	0.8	N	0.0	50	2	2	R3	W3	331	F	1		IR					2	331.0	332.0	Bx			>10 fractures/foot entire run
	faulted Limestone	78	332.0	333.0	1.5	N	0.5	3	5	2	R3	W3	332	F	1	40	IR		Bx	30		2	332.0	332.2	Bx			Faulted limestone
													332.8	F	1	55	P	VR	Bx	20		2	332.8	332.9	Bx			
													332.9	J	1	47	C	SR			6.0	12						
	Brecciated Limestone	79	333.0	336.0	3.0	N	0.0	50	18	8	R3	W2	333	J	50	5-60	P	SR	Sc	C	4.0	15						Brecciated limestone; >10 fractures/foot entire run
													333.9	J	1	45	P	VR			14.0	20						Core breaks down to GS (UCS) gravel with sand 2.5-0.1 inches ir diameter
	Limestone (10% chert)	80	336.0	340.0	4.0	N	0.5	39	13	0	R2	W2	336	J	30	0-80	P/IR	SR			6.0	0						Heavily fractured; ~10% chert
													336.4	J	1	20	P	VR			10.0	15						>10 fractures/foot 336' to 337.3'
													337.1	V	1	65	P	R			8.0	15						Most joints JCR ~8, R3
													337.4	J	1	35	P	R			10.0	20						
													337.6	J	1	75	P	S	Sc	C	3.0	10						
													338	J	1	40	IR	VR			4.0	20						
													338.4	J	2	40	P	R	Sc	1	8.0	12						
													339	J	1	35	C	R	Gp	2	10.0	10						
													339.2	J	1	35	P	S	Sc	C	4.0	12				339.6	340.0	>10 fractures/foot 339.6' to 340'
	Limestone	81	340.0	342.5	2.4	N	0.0	30	17	15	R3	W3	341	J	2	39	C	SR			18.0	17						Fault breccia; ~20% chert
													341.2	J	2	42	P	SR			6.0	15						>10 fractures/foot entire run; most joints JCR ~15, only major joints logged
													342	J	1	65	P	R			8.0	18						
													342.1	J	1	30	P	R			10.0	18						
													342.3	J	1	55	P	SR			6.0	18						
	Brecciated limestone	82	342.5	347.0	4.3	N	0.9	40	11	9	R2	W3	342.5	J	20							12						Brecciated limestone; >10 fractures/foot 342.5' to 343.6'
													343.8	J	9	65	P	SR			4.0	12						Joint set spaced 2-6" entire run
													345.5	J	1	42	P	SR	Sc	0.5	6.0	10						>10 fractures/foot 344.3' to 345.7'
													346	J	1	33	P	SR	Sc	0.5	4.0	9						
	Brecciated limestone/fault breccia	83	347.0	348.5	1.5	N	0.0	15	2	2	R2	W3	347.6	F	1					80		2	347.6	348.0	Bx/Sc			>10 fractures/foot entire run; joints average JCR 13
	Limestone and chert	84	348.5	350.0	1.5	N	0.9	4	11	8	R3	W2	349	J	3	30	P	R	Sp	6	10.0	8						
													349.6	J	1	44	C	SR			5.0	13						
	Limestone and chert (40%)	85	350.0	351.5	1.5	N	0.8	4	9	2	R3	W2	350.5	F	1	50	P	SR	Bx/Sp	40	6.0	2	350.5	350.6	Bx/Sp			~40% chert; heavily veined with calcite

			Run Data																				Rubble/Gouge					
			Recovery & Other Basic Information						JCR		Strength Index		Detailed Discontinuity Data										Gouge			Broken Core		
Core Dia: Depth	ROCK TYPE	RUN	From (ft.)	To (ft.)	Recovery (ft.)	Bedding Dominant (Y/N)	RQD (ft.)	Natural Fracture Count	Average	Minimum	Strength Index	Weathering Index	Depth (ft.)	Type	Count	α	Shape	Roughness	Infill	Thickness (mm)	JRC	JCR	From	To	Type	From	To	ADDITIONAL TESTING OR COMMENTS, SAMPLES COLLECTED
													351	J	1	34	C	SR			6.0	16						
	Limestone/chert (30%)	86	351.5	353.0	1.5	N	0.0	2	9	2	R2	W2	352	F	1		IR		Bx/Sc	60	8.0	2	352.0	352.3		351.5	352.0	~30% chert
													352.4	J	1	40	P	SR			7.0	15						
	Limestone and chert(40%)	87	353.0	358.0	5.0	N	2.9	13	15	10	R3	W2	355	J	2	25	P	SR			6.0	18						~40% chert; calcite veins
	with Ca veins												355.4	J	1	20	P	VR			11.0	18						
													355.8	J	7	20	U	VR			10.0	15						>10 fractures/foot 355.8' to 356.1'
													356.5	J	1	24	P	VR	Sc	3	12.0	10						
													357.4	J	2	50	C	SR			6.0	14						
	highly fractured Limestone	88	358.0	363.0	4.8	N	0.7	36	12	8	R2	W3	358.4	J	1	68	C	R			10.0	18						Highly fractured; ~20% chert
	and chert(20%)												358.9	J	1	30	P	SR			7.0	17						
													359.8	J	2	42	C	SR	Cl	C	7.0	12						
													360.2	J	3	58	U	SR			8.0	12						
													360.7	J	2	55	P	SR	Cl	C	5.0	12						
													361	J	3	45	P	SR	Cl	C	5.0	12						
													361.6									8				361.6	363.0	>10 fractures/foot 361.6' to 363'; some breccia present but hard to distinguish between weak broken core and fault (Bx)
													362.5	J	1	28	P	SR	Sc	1.5	6.0	8						
	Limestone and Chert	89	363.0	367.0	3.4	N	0.0	12	13	2	R3	W2		J	3							15				363.0	364.5	
													364.7	F	1	65	P	R	G	65	5.0	2	364.6	364.9	Bx/Sc			
													365.3	F	1	60	P	SR	Bx	15	6.0	5						Point load
													365.5	J	1	60	U	R			10.0	20						
													365.7	J	1	50	U	SR			6.0	20						
													366.3	J	1	41	P	R			4.0	11						
															3							15				366.6	367.0	
	Limestone and chert (15%)	90	367.0	372.0	4.2	N	1.4	15	12	6	R3	W2	368	J	1	51	P	S	Cl	0.5	3.0	10						~15% chert; extensive calcite veins
													368.4	J	1	40	C	K	Cl	C	3.0	6						All joints roughly parallel to each other
													368.7	J	1	51	P	R			10.0	18						Chert in 3 areas ~2" thick; Srt:R4
													369.2	J	1	42	U	R	Sc	0.5	8.0	15						
													369.5	J	3	42	P	R	Sc	0.5	8.0	12						
													370.5	J	1	45	P	R	Sc	3	8.0	10						Point load
													371.2	J	4	40	P	SR			9.0	13						
	Limestone	91	372.0	373.0	1.0	N	0.0	6	20	20	R3	W2	372.1	J	1	60	C	R			6.0	20						
													372.9	J	3	50	P	SR			5.0	20						
	Limestone	92	373.0	374.0	1.0	N	0.0	3	19	19	R3	W2	373.2	J	1	50	C	R			10.0	20						
													373.4	J	1	50	C	R			8.0	19						Point load
													373.7	J	1	37	P	SR	Cl	C	7.0	19						
	Limestone with chert nodules	93	374.0	379.0	5.0	N	1.9	20	14	11	R3	W2	374.8	J	1	28	P	SR	Cl	C	7.0	14						~10% chert nodules; lower end R3
													375.6	J	1	35	ST	SR			8.0	14						Healed fractured (~8)

			Run Data																			Rubble/Gouge					
			Recovery & Other Basic Information						JCR		Strength Index		Detailed Discontinuity Data											Gouge			Broken Core		
Core Dia: Depth	ROCK TYPE	RUN	From (ft.)	To (ft.)	Recovery (ft.)	Bedding Dominant (Y/N)	RQD (ft.)	Natural Fracture Count	Average	Minimum	Strength Index	Weathering Index	Depth (ft.)	Type	Count	α	Shape	Roughness	Infill	Thickness (mm)	JRC	JCR	From	To	Type	From	To	ADDITIONAL TESTING OR COMMENTS, SAMPLES COLLECTED
													375.9	J	1	55	IR	SR			6.0	15						
													376.1	J	1	70	U	R			8.0	15						
													376.4	J	2	23	U	SR			7.0	14						
													377.3	J	2	75	P	SR	Sc	1	6.0	11						
													377.6	J	1	60	P	SR	Sc	0.5	5.0	12						
													378	J	1	40	P	SR	Cl	C	6.0	15						
													378.3	J	2	85	IR	R	Sc	0.5	10.0	12						
													378.5	J	1	35	ST	R			8.0	15						
													378.7	J	1	45	C	SR	Cl	C	6.0	12						
	Limestone and chert (~5%)	94	379.0	383.0	4.4	N	1.7	18	13	10	R3	W2	379.5	J	1	35	P	SR	Ca	C	6.0	15						~5% chert; over recovery not accounted for
													380	J	1	25	P	R			8.0	18						
													380.5	J	2	30	P	R			10.0	12						R2 section 380.5' to 380.7'; spun core
													381	J	1	24	ST	SR			6.0	12						R2 section 380.7' to 380.9'
													381.5	J	2	30	P	R	Sc	1	8.0	10						
													382	J	2	45	P	SR			6.0	12						
													382.5	J	1	50	P	SR			8.0	14						
													382.8	J	2	58	ST	R			10.0	12				382.8	383.0	
	Limestone and chert nodules	95	383.0	387.0	4.0	N	2.4	15	15	10	R3	W2	383.2	J	1	60	P	SR			6.0	18						~20% chert nodules
													383.7	J	1	42	ST	R			10.0	19						
													384.5	J	1	35	P	SR	Sc	1	7.0	12						
													385	J	1	54	P	SR	Sc	2	9.0	10						Healed joint set (5) parallel to 385 joint; spaced 2-1" apart from 385' to 385.7'
													385.7	J	2	35	ST	SR			8.0	14						
													386	J	2	54	P	S			3.0	12						
													386.4	J	2	50	P	R			10.0	17				386.0	386.2	Many healed joints (~20) in run; break if handled
	Limestone	96	387.0	387.5	0.35	N	0.35	0	25		R3	W2																2 healed joints (52 degrees)
	Limestone and chert	97	387.5	391.0	3.5	N	0.9	10	18	14	R3	W2	387.2	J	1	30	P	SR			8.0	20						~25% chert
													388.7	J	1	50	P	SR			6.0	19						
													389.5	J	1	55	P	R			14.0	20						
													389.9	J	1	50	P	SR			13.0	18						
													390	J	1	42	P	R	Cl	C	10.0	18						
													390.4	J	2	34	P	SR	Sc	C	7.0	14						
													390.7	J	1	52	P	SR			7.0	17						
	Limestone and chert	98	391.0	393.0	1.5	Y	0.0	7	13	6	R3	W2	391.6	J	1	32	P	SR			6.0	19				391.0	392.0	~20% chert
													392.3	B	2	45	P	S	Cl	0.5	3.0	8						
													392.4	J	1	25	P	R			9.0	19						
													392.7	B	1	60	P	S	Cl	2	3.0	6				392.7	393.0	
	Limestone and chert	99	393.0	398.0	5.0	Y	2.3	26	11	6	R3	W2	393.8	B	2	40	P	S	Cl	C	1.0	6						~20% chert; Str: R4

			Run Data																				Rubble/Gouge					
			Recovery & Other Basic Information						JCR		Strength Index		Detailed Discontinuity Data										Gouge			Broken Core		
Core Dia: Depth	ROCK TYPE	RUN	From (ft.)	To (ft.)	Recovery (ft.)	Bedding Dominant (Y/N)	RQD (ft.)	Natural Fracture Count	Average	Minimum	Strength Index	Weathering Index	Depth (ft.)	Type	Count	α	Shape	Roughness	Infill	Thickness (mm)	JRC	JCR	From	To	Type	From	To	ADDITIONAL TESTING OR COMMENTS, SAMPLES COLLECTED
	chert str:R4												394.1	J	2	38	P	R	Sc	0.5	9.0	15						>10 fractures/foot 394.1' to 394.5'
													394.5	J	1	20	C	R	Sc	1	8.0	11						
													394.8	J	1	40	P	R			8.0	18						
													395.4	B	3	13	P	SR	Sc	0.5	7.0	12						>10 fractures/foot 395.2' to 395.4'
													395.9	B	2	42	P	S	CH	1	3.0	6						
													396.2	B	1	39	P	S	CH	3	3.0	5						
													397.2	J	1	25	P	R			8.0	18						Point load
	Limestone and chert	100	398.0	401.0	2.5	N	1.2	10	10	0	R3	W2	399.1	J	1	25	P	SR			6.0	18						~20% chert; Str: R4
	chert str:R4												399.4	J	1	27	P	SR	Sc	1	6.0	13						Healed fractures along bedding (51 degrees)
													400.2	F	1	47	P	S	G	20	3.0	0	400.1	400.2	CH/Sc	400.0	401.0	Fault is likely along bedding; point load
	Limestone (20%)	101	401.0	403.0	1.8	N	0.0	20	17	14	R3	W2	401.8	J	1	55	P	SR	CH	C	5.0	14				401.0	401.5	~20 % chert
													402	V	1	58	C	SR			6.0	18				402.0	402.6	
													402.7	J	1	58	C	SR			5.0	20						
	Limestone and chert	102	403.0	408.0	5.0	N	0.5	40	12	8	R3	W2	403.5	J	1	51	P	R			7.0	20						
													404.9	Bc					Bx/ Sp	30						404.8	404.9	Fault?; Bx 2" thick
													404.3	J	1	48	C	R			10.0	18						
													404.7	J	1	42	P	SR			8.0	17						Highly fractured rock; many non-continuous joints
													404.9	J	2	55	P	R	Sp	1	9.0	11						
													405.3	J	1	65	C	SR	Sc	1.5	8.0	10						
											R2		405.6	J	1	22	P	SR			8.0	14						Str: R2 from 405.6' to end of run
													405.8	J	1	30	P	R	Sc	1.5	8.0	8						>10 fractures/foot 405.7' to 405.9'
													406.2	B	1	62	P	SR	Sc	1	6.0	8						
													406.7	J	1	30	C	SR	Sc	0.5	6.0	8						Point load
													407	B	1	55	P	SR	Sc	0.5	6.0	8						
	Limestone and chert beds (20%)	103	408.0	413.0	4.8	N	1.9	22	15	12	R3	W2	408.5	J	1	50	C	SR	Sc	0.5	8.0	12				408.0	408.5	~20% chert; many healed joints
													408.9	J	1	15	U	SR			6.0	15						>10 fractures/foot 408' to 409'
													409.1	J	1	50	C	SR			9.0	18						
													409.2	J	1	60	C	SR			5.0	17						
													410	B	3	55	P	SR	Sc	C	6.0	15						
													410.8	J	1	50	C	R	Cl	0.5	10.0	13						
													411.5	J	1	30	C	VR	Sc	0.5	14.0	17						
													411.9	J	1	42	P	R	Sc	0.5	8.0	12						
	Limestone with chert beds	104	413.0	418.0	5.0	N	1.6	35	10	6	R3	W2	413	J	30							~15						>10 fractures/foot 413' to 416'
													414.8	B	1	50	P	S	Cl	0.5	3.0	10						
													417	B	1	50	P	S	Cl	2	3.0	6						
													417.7	B	1	51	P	S	Cl	1.5	3.0	7						
	Brecciated limestone and chert (altered)	105	418.0	423.0	4.9	N	0.0	15	12	10	R2	W3	419	J	1	50	U	SR	Carb	2	8.0	10						Carbon infilled joints; Carb = carbon

			Run Data																			Rubble/Gouge					
			Recovery & Other Basic Information						JCR		Strength Index		Detailed Discontinuity Data											Gouge			Broken Core		
Core Dia: Depth	ROCK TYPE	RUN	From (ft.)	To (ft.)	Recovery (ft.)	Bedding Dominant (Y/N)	RQD (ft.)	Natural Fracture Count	Average	Minimum	Strength Index	Weathering Index	Depth (ft.)	Type	Count	α	Shape	Roughness	Infill	Thickness (mm)	JRC	JCR	From	To	Type	From	To	ADDITIONAL TESTING OR COMMENTS, SAMPLES COLLECTED
													419.2	J	1	35	U	R	Carb	1	8.0	11						
													419.7	J	1	40	P	R	Carb	1	10.0	12						Extensive fluid alteration
													420.3	J	2	50	P	SR	Carb	2	7.0	10						
													421	J	2	60	C	SR	Carb	1	6.0	11						
													421.5	B	1	70	P	S	Carb	1	4.0	18						
													422	B	1	70	P	VR	Carb	0.5	12.0	12						Sample 422.5' to 423'
	Limestone (altered)	106	423.0	428.0	5.0	N	2.1	16	14	11	R3	W3	423.7	J	1	60	P	SR	Cl	C	6.0	17						
													424	J	1	68	C	R	Cl	C	8.0	17						Lower end R3
													424.6	B	2	58	P	SR	Carb	C	6.0	15						
													424.9	V	1	45	P	S	Carb	3	4.0	12						Point load
													425.3	J	1	58	P	SR	Carb	C	8.0	15						
													426.2	J	1	50	P	S	Carb	0.5	4.0	12						Breaks easily along carbon filled joints
													426.7	J	7	58	P	S	Carb	1	4.0	11						
	altered limestone (bedded)	107	428.0	433.0	5.0	Y	2.9	12	10	10	R3	W3	428.5	B	10	60	P	S	Carb	0.5	4.0	10				428.0	429.0	Joint set along bedding every 4-6" entire run; Point load - breaks along bedding
	altered bedded limestone	108	433.0	438.0	5.0	Y	4.2	9	14	8	R3	W3	433.5	J	1	35	P	SR	Cl	C	8.0	17						Alteration along bedding
													434.2	J	1	35	P	SR			5.0	12						
													434.4	B	1	68	P	SR	Carb	0.5	7.0	15						
													435	B	1	70	P	R			12.0	19						
													435.8	B	1	68	ST	SR	Carb	0.5	5.0	18						
													436.4	B	1	50	P	S	Carb	1.5	3.0	8						Point load at 436'
													436.8	B	1	55	C	R	Carb	1	7.0	12						Sample at 434.4' to 435'
													437.3	J	1	50	C	R			10.0	19						
													437.8	J	1	60	P	S	Carb	0.5	3.0	10						
	Limestone	109	438.0	443.0	4.9	N	3.3	8	18	11	R3	W2	439.2	J	1	35	P	R	Carb	C	8.0	18						
													441.5	J	1	60	P	VR			14.0	20						
													443.5	J	1	60	P	SR	Carb	1.5	6.0	17						
													443.9	J	1	60	ST	R	Carb	1.5	8.0	19						Point load
											R2		442.2	J	1	44	P	SR	Carb	1.5	5.0	17						442.2' to 443' str: R2
	Limestone	110	443.0	448.0	5.0	N	3.7	11	17	12	R3	W2	443.3	J	1	55	P	VR	Carb	C	14.0	18						
													444	J	1	43	P	VR	Carb	C	16.0	20						
													444.3	J	1	60	ST	R			10.0	19						
													444.7	J	4	48	P	R			8.0	14						
													445.8	J	1	36	C	R			10.0	17				446.3	446.7	
													447	J	1	65	IR	SR	Carb	1	6.0	12						
	Limestone	111	448.0	453.0	5.0	N	2.5	12	16	10	R3	W2	448.2	J	1	60	IR	R	Carb	1	8.0	14				448.4	448.6	
													449.2	J	1	30	V	VR	Carb	1	12.0	16						Point load
													450	J	1	70	C	VR	Carb	1	10.0	14						2 distinct joint sets

			Run Data																			Rubble/Gouge					
			Recovery & Other Basic Information						JCR		Strength Index		Detailed Discontinuity Data									Gouge			Broken Core		
Core Dia: Depth	ROCK TYPE	RUN	From (ft.)	To (ft.)	Recovery (ft.)	Bedding Dominant (Y/N)	RQD (ft.)	Natural Fracture Count	Average	Minimum	Strength Index	Weathering Index	Depth (ft.)	Type	Count	α	Shape	Roughness	Infill	Thickness (mm)	JRC	JCR	From	To	Type	From	To	ADDITIONAL TESTING OR COMMENTS, SAMPLES COLLECTED
													450.2	J	1	55	P	VR			10.0	18						
													450.6	J	1	30	P	R			10.0	18						
													451	J	1	67	C	SR	Carb	0.5	8.0	15						
													451.5	J	1	25	P	R			9.0	18						
													451.9	J	2	50	P	SR			8.0	18						
													452.3	J	1	65	C	S	Carb/H	1	4.0	10				452.5	453.0	
	Limestone with chert (30%)	112	453.0	458.0	5.0	N	3.9	7	12	10	R3	W2	453.6	J	1	30	P	SR	Graph	C	5.0	10						Graphite joint infill
	Qtz veins(?) no fizz												454.4	J	2	65	P	SR	Carb	1	6.0	12						~30 % chert; quartz and calcite veins
	+ Ca veins												455.7	J	2	60	P	R	Carb	0.5	8.0	14						
													456.5	J	1	75	P	SR	Carb	0.5	7.0	14						
													457.5	J	1	70	C	SR	Carb	C	6.0	12						
	Limestone altered by veins and fluid	113	458.0	463.0	5.2	N	4.0	15	17	13	R3	W2	459.4	J	1	25	P	VR			14.0	16						Limestone altered by veins and fluid
													460.2	J	3	55	P	R	Carb	0.5	8.0	14						Intense veins and stylolites
													460.7	J	1	38	P	R	Carb	C	10.0	17						
													461.4	J	1	40	V	R			12.0	21						
													462	J	1	30	P	R			14.0	21						Point load
													462.4	J	3	55	P	R	Carb	1	10.0	13						
	Limestone/Greenstone	114	463.0	468.0	4.8	Y	3.9	5	16	10	R3	W2	463.4	C		25												Limestone 463' to 463.4'
													464.6	C		65												Greenstone 463.4' to 464.6'
													465.5	J	2	25	P	R			9.0	22						Limestone 464.6' to end of run
													466	J	1	54	P	R	Carb	0.5	8.0	15						Intense veins and stylolites
													467.2	B	1	65	ST	S	Carb	C	3.0	10						Weakness planes along bedding (467' to 468')
	Limestone	115	468.0	473.0	5.0	N	2.9	12	17	13	R3	W2	468.4	J	2	45	P	R	Carb	C	5.0	18						
													469.3	J	1	30	P	SR	Carb	C	8.0	19						
													469.6	J	1	50	P	SR	Carb	1	8.0	15						
													470.2	J	1	20	P	R			10.0	20						Point load
													470.9	J	3	80	P	SR	Carb	1	6.0	13						Spaced ~6" the rest of run
													471.9	V	2	25	P	SR	Carb	C	8.0	14						

PERMANENTE QUARRY RMR SYSTEM - RECORD OF GEOTECHNICAL PARAMETERS

Project No.	063-7109.100			Drilling Method		From 10.0	To 476.5	Sheet	1 of 25
Borehole #	GT1-2-08	Azimuth	000	HQ3				Logged by	AH, IT
Elevation	1054	Inclination	-60					Drill Rig	Ruen
N 47.8	E -5082	Ref. Point							

Core Dia: Depth	ROCK TYPE	RUN	Run Data: Recovery & Other Basic Information: From (ft.)	To (ft.)	Recovery (ft.)	Bedding Dominant (Y/N)	RQD (ft.)	Natural Fracture Count	JCR: Average	Minimum	Strength Index: Strength Index	Weathering Index	Detailed Discontinuity Data: Depth (ft.)	Type	Count	α	Shape	Roughness	Infill	Thickness (mm)	JRC	JCR	Rubble/Gouge: Gouge: From	To	Type	Broken Core: From	To	ADDITIONAL TESTING OR COMMENTS, SAMPLES COLLECTED
	Graywacke with Ca veins	1	10.0	13.0	3.0	N	0.5	9	13	6	R5	W2	11	J	1	57	P	SR	Cl	0.5	8.0	16						
													14.4	J	1	68	P	R	Cl	0.5	14.0	20						
													14.6	J	1	22	ST	SR	Cl	0.5	8.0	12						slickensided surface
													12.1	J	1	69	P	VR	Cl	0.5	16.0	22						
													12.3	J	1	39	P	SR	Cl	1	4.0	7						
													12.6	J	2	44	P	R	Cl	1	8.0	12						
													12.7	J	1	58	U	SR	Cl	0.5	10.0	16						
													12.8	J	1	55	P	S	Cl	1	2.0	6						
	Graywacke with Ca veins	2	13.0	18.0	5.0	N	0.8	32	14	6	R5	W2	13	J	20	27	P	R			8.0	12						<10 FRACTURES/FT 13-14.5 FEET
													14.5	J	2	38	P	R			8.0	12						
													15.2	J	1	31	P	SR			8.0	12						
													15.8	J	2	50	P	SR			10.0	6						SLICKENSIDED SURFACE
													16.4	J	1	57	U	R			10.0	16						
													16.8	J	3	49	P	VR			14.0	20						
													17.2	J	1	8	P	R			12.0	22						
													17.5	J	1	76	P	R			14.0	23						
													17.9	J	1	60	ST	SR	Cl	1.5	2.0	12						
	Graywacke with Ca veins	3	18.0	21.5	3.3	N	0.5	12	14	6	R5	W2	18.4	J	1	54	P	VR			14.0	20						
													18.5	J	1	12	U	R	Ca	2	12.0	12						
													18.7	J	1	72	P	R	Cl	0.5	10.0	6						Slickensided surfaces
													19.3	J	1	63	P	R			10.0	10						
													19.4	J	1	35	P	VR			16.0	20						
													19.5	J	1	58	P	R	Cl	2	9.0	10						
													19.6	F	1	73	P	R	Cl	250	6.0	8	19.8	19.9	Gc			
													20.3	J	2	33	P	R	Cl	2	10.0	12						
													20.5	J	1	18	C	VR	Cl	1	14.0	22						
													21.1	J	2	45	P	VR	Cl	5	14.0	22						
	Graywacke with Ca veins	4	21.5	25.5	3.4	N	0.5	10	16	0	R5	W2	22.1	J	2	61	P	R	G	150	8.0	11	21.3	21.4	Bx			
													22.8	J	1	24	P	VR	Ca		14.0	18						
													23.1	J	1	47	P	R			12.0	17						
													23.3	J	1	24	P	VR			16.0	20						
													23.4	J	1	51	P	R	Cl	0.5	10.0	14						
													23.5	J	1	51	C	R	SC	0.5	10.0	16						
													23.7	F	1	45	P	SR	Cl	400	6.0	0	23.7	23.9	Sc			
													24	J	1	74	P	R		0.5	10.0	14						
													24.4	J	1	62	P	SR			6.0	10						

			Run Data										Rubble/Gouge														
			Recovery & Other Basic Information						JCR		Strength Index		Detailed Discontinuity Data										Gouge			Broken Core		
Core Dia: Depth	ROCK TYPE	RUN	From (ft.)	To (ft.)	Recovery (ft.)	Bedding Dominant (Y/N)	RQD (ft.)	Natural Fracture Count	Average	Minimum	Strength Index	Weathering Index	Depth (ft.)	Type	Count	α	Shape	Roughness	Infill	Thickness (mm)	JRC	JCR	From	To	Type	From	To	ADDITIONAL TESTING OR COMMENTS, SAMPLES COLLECTED
	Graywacke with Ca veins	5	25.5	30.5	5.0	N	2.9	19	19	6	R5	W2	27.2	J	14	53	P	R			14.0	18						<10 fractures per foot 26.3 to 27.3
													27.7	J	1	78	P	VR			18.0	23						
													28.3	J	1	60	P	R	Ca	0.5	9.0	16						
													28.9	J	1	20	ST	R			8.0	15						
													29	J	1	60	P	R	Bx	3	10.0	6						
													29.4	J	1	70	I	R			11.0	24						
	Graywacke with Ca veins	6	30.5	33.0	2.7	N	1.3	5	17	14	R5	W2	31.5	J	2	25	P	VR	Ca	0.5	16.0	20						
													32	J	1	62	P	SR			6.0	16						
													32.2	J	2	46	P	R	Cl	0.5	12.0	18						
	Graywacke with Ca veins	7	33.0	37.0	3.0	N	0.0	33	16	13	R5	W2	34	J	1	60	P	R			10.0	13						
													34.4	J	1	68	P	R			11.0	14						
													34.6	J	1	42	V	R			12.0	20						Some Chlorite alteration
																							34.7	37.0	Gc			Highly sheared zone
	Graywacke with Ca veins	8	37.0	39.0	2.0	N	0.0	8	17	0	R3	W2	37.3	J	1	49	P	VR	Cl	<.5	16.0	20						
													37.3	J	1	61	P	SR	Cl	0.5	2.0	7						
													37.4	J	1	36	P	VR			14.0	18						
													37.6	J	1	43	P	VR			18.0	22						
													37.8	F	1	69	P	S	G	300	6.0	0	37.8	37.9	Bx/Cl			
													38.2	J	1	70	P	VR	Ca	<.5	12.0	16						
													38.4	J	1	41	P	VR	Ca	<.5	16.0	20						
													38.5	J	1	5	P	VR	Cl	<.5	12.0	18						<10 fractures/ft 39-39.5
	Graywacke with Ca veins	9	39.0	43.0	4.0	N	1.6	14	13	7	R4	W2	39	J	7	78	P	SR	SR	Cl	4.0	7						<10 fractures/ft 39-39.5
													39.8	J	1	89	P	SR	SR	Cl	4.0	8						
													40.2	J	1	43	U	R	R		18.0	23						
													40.8	J	3	46	P	VR	VR	Cl	17.0	20						
													41.3	J	2	50	P	R	R	Ca	16.0	14						
	Graywacke with Ca veins	10	43.0	48.0	5.0	N	1.7	14	13	12	R4	W2	43.8	J	1	10	U	R			16.0	16						
													44.4	J	4	55	P	R			9.0	12						
													45	J	1	40	P	R			10.0	12						
													45.9	J	1	48	P	R			9.0	12						
													46.3	J	1	36	P	VR			13.0	14						
													47.4	J	6	50	P	R	Ca	<.5	10.0	14						
	Graywacke with Ca veins	11	48.0	53.0	5.0	N	3.1	12	14	12	R4	W2	48.5	J	3	55	P	VR			12.0	14						
													49.5	J	3	46	P	VR	Cl	0.5	10.0	12						
													50.9	J	1	77	P	R			10.0	13						
													51	J	2	28	P	R	Cl	<.5	8.0	12						
													51.6	J	1	54	P	VR	Cl	<.5	12.0	14						
													52	J	1	34	P	VR	Ca	0.5	16.0	18						
													52.9	J	1	59	P	R			14.0	17						
	Graywacke with Ca veins	12	53.0	57.0	4.0	N	2.7	9	16	0	R3	W1	53.8	J	1	62	P	VR	Ca	2	14.0	22						

			Run Data																				Rubble/Gouge					
			Recovery & Other Basic Information						JCR		Strength Index		Detailed Discontinuity Data										Gouge			Broken Core		
Core Dia: Depth	ROCK TYPE	RUN	From (ft.)	To (ft.)	Recovery (ft.)	Bedding Dominant (Y/N)	RQD (ft.)	Natural Fracture Count	Average	Minimum	Strength Index	Weathering Index	Depth (ft.)	Type	Count	α	Shape	Roughness	Infill	Thickness (mm)	JRC	JCR	From	To	Type	From	To	ADDITIONAL TESTING OR COMMENTS, SAMPLES COLLECTED
													54.4	J	1	15	P	VR	Ca	<.5	13.0	22						
													55	J	3	43	P	VR	Cl	<.5	14.0	22						
													55.8	F	1	55	P	R	G	10	8.0	0	55.8	55.9	Ca/Cl			
													56.3	J	1	60	C	R	Cl	<.5	10.0	20						
													56.5	J	1	35	P	S	Cl	<.5	2.0	10						
													56.8	J	1	27	P	S	Cl	<.5	2.0	10						
	Graywacke with Ca veins	13	57.0	62.0	5.0	N	3.8	6	21	19	R3	W1	58	J	1	43	P	VR	Ca	<.5	14.0	22						
													58.6	J	1	64	P	R	Ca	<.5	10.0	20						
													59.7	J	1	78	P	R	Ca	<.5	10.0	20						
													61.3	J	2	18	P	R	Cl	<.5	10.0	19						
													61.8	J	1	67	P	VR	Ca	<.5	14.0	22						
	Graywacke with Ca veins	14	62.0	67.0	5.0	N	0.0	29	11	0	R3	W2	63	J	1	52	U	R	Ca	<.5	14.0	20						
													63.4	J	1	55	ST	R			10.0	22						
																										63.9	65.7	
													65.9	F	1	38	P	SR	G	590	8.0	0	65.7	68.0	BX/CL			
													66.3	F	1	92	P	SR	BX/G	380	8.0	0						
	Graywacke with Ca veins	15	67.0	70.0	1.7	N	0.0	2	12	2	R1	W4	68.6	J	1	57	I	R			10.0	21						
													68.9	J	1	59	P	SR	Cl	5	6.0	2						
																							69.1	70.0	SC/CHL			Chlorite altered gouge
	Graywacke gouge	16	70.0	73.0	2.2	N	0.0	50	0	0	S4	W3											70.0	73.0	SC			entire run gouge, highly fractured
	Graywacke	17	73.0	75.5	1.8	N	0.0	30	0	0	R1.5	W3	74.2	J	2	29	P	SR	BX	100	8.0	0						
																							74.5	75.5	BX/CL			
	Graywacke	18	75.5	76.0	0.4	N	0.0	15	12		R2	W2														75.5	76.0	entire run broken core
	Graywacke	19	76.0	78.0	0.5	N	0.0	15	12		R2	W2														76.0	78.0	entire run broken core
	Graywacke	20	78.0	79.0	1.0	N	0.0	15	12		R2	W2														78.0	79.0	entire run broken core
	Graywacke	21	79.0	79.5	0.4	N	0.0	15	12		R2	W2														79.0	79.5	entire run broken core
	Graywacke with Ca veins	22	79.5	80.0	0.5	N	0.0	2	18	18	R3	W2	79.6	J	2	66	P	SR			6.0	18						
	Graywacke with Ca veins	23	80.0	83.0	2.8	N	0.0	14	6	0	R2.5	W2											80.0	81.4	GC			>10 fractures/ft
																							81.4	82.2	bx			
													82.6	J	1	50	P	VR	Cl	0.5	10.0	12						
													82.8	F	1	25	P	S	Cl/BX	600	4.0	0						
																							82.7	83.0	Bx/Cl			
	Graywacke with Ca veins	24	83.0	85.5	1.2	N	0.0	10	0	0	R2	W3	86.5	F	1	10	P	S	Cl/G	400	2.0	0	84.0	84.7	Bx/Cl			
													86.9	F	1	28	P	SR	Cl/G	200	6.0	0						
	Graywacke with Ca veins	25	85.5	86.0	0.5	N	0.0	8	12		R2	W3														85.5	86.0	entire run broken core

			Run Data																				Rubble/Gouge					
			Recovery & Other Basic Information						JCR		Strength Index		Detailed Discontinuity Data										Gouge			Broken Core		
Core Dia: Depth	ROCK TYPE	RUN	From (ft.)	To (ft.)	Recovery (ft.)	Bedding Dominant (Y/N)	RQD (ft.)	Natural Fracture Count	Average	Minimum	Strength Index	Weathering Index	Depth (ft.)	Type	Count	α	Shape	Roughness	Infill	Thickness (mm)	JRC	JCR	From	To	Type	From	To	ADDITIONAL TESTING OR COMMENTS, SAMPLES COLLECTED
	Graywacke with Ca veins	26	86.0	87.0	0.4	N	0.0	8	12		R2	W3														86.0	87.0	entire run broken core
	Graywacke with Ca veins	27	87.0	87.5	0.3	N	0.0	8	12		R2	W3														87.0	87.5	entire run broken core
	Graywacke with Ca veins	28	87.5	88.0	0.3	N	0.0	8	12		R1	W3														87.5	88.0	entire run broken core
	Graywacke with Ca veins	29	88.0	88.5	0.5	N	0.0	10	12		R1	W2														88.0	88.5	entire run broken core
	Graywacke with Ca veins	30	88.5	89.0	0.4	N	0.0	10	12		R2	W2														88.5	89.0	entire run broken core
	Graywacke with Ca veins	31	89.5	92.5	3.0	N	0.0	16	12		R3	W2	89.7	J	1	40	P	R	Cl	0.5	10.0	14						
													90	J	2	68	P	R	Cl	0.5	10.0	14						
													90.4	J	2	44	P	R	Cl	0.5	6.0	12						
													90.7	J	1	71	C	R			8.0	16						
													91	J	2	49	P	R	Cl	0.5	12.0	14						
													91.1	J	1	64	I	VR	Ca	0.5	14.0	18						
													91.1	J	1	30	P	R	Ca	0.5	8.0	14						
													91.6	J	2	45	P	R	Ca/Cl	0.5	12.0	14						
													91.8	J	1	23	P	VR	Ca/Cl	0.5	14.0	20						
													92.3	J	3	54	P	VR	Cl	1	14.0	18						
	Graywacke with Ca veins	32	92.5	95.5	2.4	N	0.8	6	10	0	R3	W2	93.2	J	2	34	V	R			12.0	20						
													94.1	J	2	51	P	SR	Cl	1	6.0	10						
													94.6	J	1	22	P	R	Cl	0.5	10.0	12						
													95	F	1	59	I	S	G	1200	1.0	0						sample from 93.2 to 93.8
																							95.0	95.5	Bx/Cl			slickensided surface
	Graywacke with Ca veins	33	95.5	100.5	4.4	N	0.7	9	22	20	R3	W2	96.5	J	2	51	P	R			8.0	22						
													97.1	J	1	35	P	R	Cl	0.5	8.0	20						
													97.4	J	2	50	P	VR	Cl	0.5	12.0	22						
													98	J	1	41	P	VR	Cl	0.5	16.0	22						
													99	J	1	34	P	VR			14.0	22						
													99.6	J	2	41	P	VR			14.0	22						
	Graywacke with Ca veins	34	100.5	103.0	2.5	N	0.0	4	12	0	R3	W2	100.7	J	1	63	P	S	Ca	0.5	14.0	20						
																										100.7	101.3	
													101.5	F	1	12	P	S	Cl	8	2.0	0						slickensided surface
													102.2	J	2	52	P	R	Cl	1	10.0	15						
																							102.6	102.9	Bx/Cl			
	Graywacke with Ca veins	35	103.0	106.5	2.4	N	0.0	4	3	0	R3	W2	104.3	F	1	49	P	S	G	250	2.0	0	104.2	104.4	Bx/Cl			slickensided surface
													105	F	1	60	P	SR	G	900	6.0	0	104.7	105.2	Bx/Cl			
													105.8	J	2	65	P	SR	Cl	1	4.0	8						
																							105.8	106.5	Bx			
	Graywacke with Ca veins	36	106.5	109.0	1.7	N	0.0	10	14	4	R3	W2	107.5	J	1	45	C	VR	Cl	1	14.0	4	107.0	107.5	Bx			
													107.8	J	1	77	ST	R	Cl	0.5	10.0	16						
													108	J	1	23	P	VR	Cl	0.5	18.0	18						
													108.3	J	1	26	P	VR	Cl	0.5	18.0	18				108.5	109.0	
	Graywacke with Ca veins	37	109.0	113.0	3.3	N	0.0	27	20	19	R3	W2	110	J	1	15	P	R	Ca	0.5	12.0	20						

			Run Data																				Rubble/Gouge					
			Recovery & Other Basic Information						JCR		Strength Index		Detailed Discontinuity Data										Gouge			Broken Core		
Core Dia: Depth	ROCK TYPE	RUN	From (ft.)	To (ft.)	Recovery (ft.)	Bedding Dominant (Y/N)	RQD (ft.)	Natural Fracture Count	Average	Minimum	Strength Index	Weathering Index	Depth (ft.)	Type	Count	α	Shape	Roughness	Infill	Thickness (mm)	JRC	JCR	From	To	Type	From	To	ADDITIONAL TESTING OR COMMENTS, SAMPLES COLLECTED
													110.9	J	1	58	P	R	Cl	0.5	10.0	19						
																							111.2	113.0	Bx			>10 fractures per foot
	Graywacke with Ca veins	38	113.0	114.0	0.7	N	0.0	8	10	10	R2	W3	113.5	J	8	54	P	R	Cl	0.5	12.0	10						<10 fractures/foot 113 to 114
	Graywacke with Ca veins	39	114.0	117.5	3.5	N	0.8	5	6	0	R2.5	W3	114.4	J	1	72	C	VR	Cl	0.5	14.0	20						
													115.4	F	1	63	P	R	G	1100	10.0	0	115.1	115.6	Bx			slickensided surface
													115.8	J	1	49	P	SR	Cl	0.5	6.0	0						slickensided surface
													116.3	J	1	40	U	R	Cl	0.5	10.0	12						
													116.6	F	1	79	P	R	G	500	10.0	0	116.5	116.7	Bx			
	Graywacke with Ca veins	40	117.5	119.0	1.7	N	0.0	4	17	12	R2	W3	117.5	J	1	46	P	VR			18.0	20						
													117.8	J	1	62	P	VR			18.0	20						
													118.1	J	1	40	P	R			10.0	16						
													118.7	J	1	20	P	SR	Cl	0.5	6.0	12						
																							118.7	119.0	Bx			
	Graywacke with Ca veins	41	119.0	121.5	1.9	N	0.8	10	18	16	R2	W3	120	J	3	55	P	VR			16.0	20						
													120.8	J	4	40	P	VR	Cl	0.5	16.0	18						
													121	J	1	59	P	R	Cl	0.5	8.0	16						
													121.2	J	2	45	P	VR			16.0	20						
	Graywacke with Ca veins	42	121.5	123.0	0.6	N	0.6	1	6	6	R3	W3	122.7	J	1	65	V	S	Cl	1	4.0	6						slickensided surface
	Graywacke with Ca veins	43	123.0	126.5	3.5	N	1.5	4	2	0	R2	W2	124.6	J	1	36	P	S	Cl	1	4.0	0						slickensided surface
													124.1	J	1	20	I	S	Cl	1	4.0	0						slickensided surface
													125.2	J	1	38	I	SR	Cl	0.5	8.0	7						
													125.7	J	1	19	P	S	Cl	0.5	4.0	0						slickensides
	Graywacke with Ca veins	44	126.5	129.5	2.5	N	0.6	3	8	0	R2	W2											126.5	127.2	Cl			
													127.2	F	1	35	P	S	Cl	160	4.0	0						
																										127.4	127.9	
													128	J	1	36	P	SR	Bx	8	6.0	8						
													128.7	J	1	35	P	R	Ca	0.5	11.0	16						
	Graywacke with Ca veins	45	129.5	130.0	0.3	N	0.0	10			R2.5	W2														129.5	130.0	entire run broken core
	Graywacke with Ca veins	46	130.0	132.5	1.3	N	0.0	6	15	14	R3	W2	131.5	J	1	35	P	R	Cl	0.5	10.0	16						
													131.6	J	1	59	P	R	Cl	0.5	10.0	16						
													132.1	J	1	35	P	R	Cl	0.5	8.0	14						
	Graywacke with Ca veins	47	132.5	137.5	4.3	N	1.1	8	14	6	R3	W2	133.8	J	1	71	P	R			10.0	16						
													133.9	J	1	59	P	R			10.0	16						
													135.6	J	1	28	P	R	Ca	0.5	8.0	16						
													136	J	1	32	P	SR	Bx	6	4.0	6						
													136.8	J	2	25	P	R	Cl	1	8.0	12						
	Graywacke with Ca veins	48	137.5	139.0	1.5	N	0.0	8	17	0	R2.5	W3	137.5	J	1	10	P	VR			14.0	20						
													137.8	J	1	46	P	VR	Ca	0.5	16.0	22						
													138.1	J	2	62	P	VR	Ca	0.5	16.0	22						

			Run Data										Detailed Discontinuity Data										Rubble/Gouge					
			Recovery & Other Basic Information						JCR		Strength Index												Gouge			Broken Core		
Core Dia: Depth	ROCK TYPE	RUN	From (ft.)	To (ft.)	Recovery (ft.)	Bedding Dominant (Y/N)	RQD (ft.)	Natural Fracture Count	Average	Minimum	Strength Index	Weathering Index	Depth (ft.)	Type	Count	α	Shape	Roughness	Infill	Thickness (mm)	JRC	JCR	From	To	Type	From	To	ADDITIONAL TESTING OR COMMENTS, SAMPLES COLLECTED
													138.6	F	1	40	P	SR	G	95	4.0	0						
																							138.6	139.0	Bx			
													138.3	J	1	58	P	VR	Ca	0.5	16.0	22						
	Graywacke with Ca veins	49	139.0	143.0	3.6	N	1.2	8	17	0	R2.5	W2	139.8	J	1	43	P	VR	Ca	0.5	18.0	23						
													140.4	J	1	83	P	VR	Ca	0.5	18.0	23						
													140.8	J	1	48	V	R	Cl	0.5	14.0	20						
													141.1	J	1	52	P	SR	Cl	0.5	6.0	16						
													141.3	J	1	60	P	SR	Cl	0.5	5.0	0						slickensides
													141.7	J	1	66	I	R			14.0	20						
													142.3	J	2	68	P	SR	Cl	0.5	6.0	14						
	Greenstone with Ca veins	50	143.0	148.0	5.0	N	1.3	5	7	0	R3	W3	143.5	J	1	44	P	R			14.0	14						
													144	J	2	45	P	R			14.0	14						
													144.3	J	1	17	P	SR	Cl	0.5	4.0	0						slickensides
													145.2	F	1	50	P	SR	G	150	2.0	0						slickensides
																							145.2	146.9	Bx			
																							147.3	147.8	Bx			
	Greenstone with Ca veins	51	148.0	153.0	3.4	N	0.0	50	6		R1	W3											149.5	153.0	Bx			Chlorite alteration
	Greenstone with Ca veins	52	153.0	155.5	2.5	N	2.5	4	12	0	R1	W2	153.4	J	1	71	P	SR	Cl	0.5	8.0	14						
													154.1	J	1	85	P	VR	CW	0.5	18.0	16						
													154.4	J	1	58	P	SR	Chl	0.5	8.0	0						slickensides
													155	J	1	79	U	VR	Chl	0.5	14.0	16						sample 155 to 155.5
	Greenstone with Ca veins	53	155.5	156.5	0.9	N	0.9	0	25	25	R1.5	W2																no fractures
	Highly weathered greenstone, limestone, chert (low grade)	54	156.5	161.5	4.7	N	1.7	6	5	0	R1.5	W2	157.4	J	3	67	P	S	Chl	10	2.0	0						limestone contact at 158.8 ft
																							157.7	158.5	Chl			greenstone highly fractured gouge
													158.8	F	2	61	P	R	Chl	1	10.0	0						contact
													159.5	J	1	43	P	R			10.0	14						chert from 159 to 159.2
	Limestone w/some chert	55	161.5	163.0	1.5	N	1.4	1	20	20	R1	W1	162.7	J	1	78	I	VR	Cl	0.5	16.0	20						
	Limestone with some chert	56	163.0	165.0	2.0	N	1.8	2	19	18	R1	W1	164.2	J	1	30	P	R	Ca	0.5	12.0	18						sample 163.7 to 164.4
													164.9	J	1	60	P	R	Ca	0.5	20.0	20						
	Limestone with some chert	57	165.0	168.5	3.3	N	2.8	4	20	20	R1	W1	166	J	1	40	P	VR	Ca	0.5	16.0	20						
													167	J	1	82	P	VR			18.0	20						
													167.6	J	1	50	P	VR	oxides		18.0	20						
													168.3	J	1	54	P	VR	oxides		20.0	22						
	Limestone with some chert	58	168.5	173.0	4.3	N	2.9	9	21	20	R1	W1	168.7	J	2	43	P	VR	Ca	0.5	16.0	20						
													169.5	J	1	57	P	VR			20.0	22						
													170	J	1	64	P	VR			20.0	22						
													170.4	J	1	81	P	VR	oxides	0.5	18.0	20						
													170.9	J	2	31	P	VR			20.0	22						
													171.9	J	1	65	U	VR	oxides	1	18.0	20						
													172.2	J	1	96	P	R			14.0	20						

			Run Data										Detailed Discontinuity Data										Rubble/Gouge					
			Recovery & Other Basic Information						JCR		Strength Index												Gouge			Broken Core		
Core Dia: Depth	ROCK TYPE	RUN	From (ft.)	To (ft.)	Recovery (ft.)	Bedding Dominant (Y/N)	RQD (ft.)	Natural Fracture Count	Average	Minimum	Strength Index	Weathering Index	Depth (ft.)	Type	Count	α	Shape	Roughness	Infill	Thickness (mm)	JRC	JCR	From	To	Type	From	To	ADDITIONAL TESTING OR COMMENTS, SAMPLES COLLECTED
	Limestone with some chert	59	173.0	176.5	3.3	N	1.3	4	16	12	R1	W1	173.3	J	1	49	P	VR			14.0	20						
													173.9	J	1	70	SR\T	R			10.0	16						
													174.4	J	1	42	P	SR			6.0	12						
																										175.2	175.7	
													175.3	J	1	84	ST	SR			6.0	14						
	Limestone with some chert	60	176.5	181.5	4.5	N	1.2	23	14	14	R1	W1	177	J	1	65	ST	SR			6.0	14						
													177.7	J	17													
													179.5	J	1	75	P	R			8.0	15						
													180.3	J	1	69	P	R	Cl	0.5	8.0	14						
													180.5	J	1	69	P	R	Ca	0.5	10.0	15						
													180.8	J	1	79	P	R	Ca	0.5	10.0	15						sample 179.5 to 180.3
													181.2	J	1	14	C	SR			6.0	14						
	Limestone with some chert	61	181.5	186.5	4.5	N	2.3	5	18	16	R1	W1	182.3	J	1	44	P	R			14.0	20						
													182.9	J	1	28	P	SR			8.0	16						
													183.7	J	1	37	I	VR	Ca	0.5	18.0	22						
													185.3	J	1	74	P	R	Cl	0.5	16.0	18						
													185.7	J	1	57	P	R			14.0	18						
	Limestone w/ 1.5ft of greenstone	62	186.5	191.5	4.7	N	2.0	5	12	0	R1	W2	187.4	J	2	64	I	VR			16.0	22						
													188.4	J	1	55	P	VR	Ca	0.5	18.0	22						
													1890	J	1	72	P	VR			18.0	22						
													189.8	F	1	70	P	S	G	55	2.0	0	189.7	189.9	Chl			
																							191.0	191.3				greenstone contact at 189.8 and 191.3
													191.3	F	1	61	P	S	G	70	2.0	0						
	Limestone w/ some chert and Ca veins	63	191.5	194.0	2.5	N	1.9	4	18	16	R2	W1	191.6	J	1	59	P	R			12.0	18						
													191.8	J	1	62	P	R			10.0	16						
													193.1	J	1	23	P	VR	oxides	0.5	14.0	18						
													193.7	J	1	41	P	VR	oxides	0.5	14.0	18						
	Limestone w/some chert and Ca veins	64	194.0	199.0	4.7	N	1.9	4	15	14	R2	W1	194.4	J	1	57	P	VR			12.0	16						
													195.4	J	1	81	P	VR			12.0	16						
													196	J	1	45	P	R			8.0	14						
													196.6	J	1	69	P	R			9.0	14						
													196.8	J	1	82	P	R			9.0	14						
													197.3	J	1	63	P	VR			13.0	16						
													198.4	J	1	83	P	R			8.0	14						
	Limestone w/some chert and Ca veins	65	199.0	203.0	4.0	N	2.1	5	17	14	R2	W1	199.7	J	1	81	V	VR			14.0	18						From 200.9 to end higher grade limestone, dark grey
													200.4	J	1	60	P	SR			6.0	14						
													200.8	J	1	56	P	VR			14.0	20						
													201.8	J	1	29	P	R			10.0	14						
													202.2	J	1	63	I	VR			16.0	21						
	Limestone w/some chert and Ca veins	66	203.0	208.0	5.0	N	3.6	7	22	20	R2	W1	203.7	J	1	70	P	VR	Ca	0.5	18.0	22						

			Run Data																				Rubble/Gouge					
			Recovery & Other Basic Information						JCR		Strength Index		Detailed Discontinuity Data										Gouge			Broken Core		
Core Dia: Depth	ROCK TYPE	RUN	From (ft.)	To (ft.)	Recovery (ft.)	Bedding Dominant (Y/N)	RQD (ft.)	Natural Fracture Count	Average	Minimum	Strength Index	Weathering Index	Depth (ft.)	Type	Count	α	Shape	Roughness	Infill	Thickness (mm)	JRC	JCR	From	To	Type	From	To	ADDITIONAL TESTING OR COMMENTS, SAMPLES COLLECTED
													204.8	J	1	69	P	VR			20.0	24						
													205.9	J	2	61	P	VR			18.0	22						
													206.5	J	1	63	P	VR			18.0	22						
													207.2	J	1	69	P	VR			17.0	22						
													207.4	J	1	50	P	VR	Cl	0.5	16.0	20						
	Limestone (low grade) w/some chert	67	208.0	213.0	5.0	N	1.8	8	21	20	R2	W1	208.9	J	1	35	V	VR			14.0	22						
													209.6	J	2	36	P	R			12.0	20						
													209.9	J	1	67	P	VR			16.0	22						
													210.3	J	1	61	P	VR	Cl	0.5	16.0	20						
													210.9	J	1	30	P	VR			16.0	22						
													211.3	J	1	79	P	VR			14.0	22						
													211.6	J	1	48	P	VR			16.0	22						
	Limestone/Ca w/chert, qtz	68	213.0	218.0	5.0	N	3.8	8	14	11	R3	W1	213.2	J	1	77	P	R			10.0	14						
													214.4	J	1	68	P	R	Bx	4	10.0	11						
													214.6	J	1	60	P	VR			14.0	16						
													215.1	J	1	70	P	R			12.0	14						
													215.5	J	1	54	P	VR			16.0	16						
													215.9	J	1	73	P	VR			16.0	16						
													216.9	J	1	42	P	R			10.0	12						sample 215.6 to 216.1
													217.5	J	1	70	P	R			10.0	12						
	Limestone/qtz	69	218.0	222.0	3.6	N	1.9	8	15	0	R3	W1	218.8	J	1	72	P	VR			16.0	20						
													219.2	J	2	62	P	R			10.0	14						
													219.7	J	1	41	P	VR			14.0	18						
													220.2	J	1	63	P	VR			14.0	18						
													220.5	J	2	78	P	R			12.0	16						
													221.3	F	1	65	P	SR	G	140	4.0	0						
																							221.4	222.0	Bx/Cl			slickensides
	Greenstone	70	222.0	227.0	5.0	N	3.6	7	5	0	R1	W3	222.7	J	1	63	P	R	Cl	1	10.0	10						
													223.2	F	1	54	P	SR	G	35	5.0	0						
													224.1	F	1	33	P	S	Cl	1	3.0	0						slickensides
													225	J	1	59	P	SR	Cl	10	6.0	4						
													225.5	J	1	55	P	S	Cl	3	2.0	0						slickensides chert 225.8 to 226.3
													225.9	F	1	26	P	SR	G	30	6.0	0						greenstone/chert contact at 226.3 limestone
													226.6	J	1	74	P	VR			16.0	20						
	Limestone (medium grade)	71	227.0	229.5	2.5	N	2.5	1	20	20	R2	W1	229.2	J	1	80	P	VR			16.0	20						
	w/ calcite veins																											
	Limestone (low to med grade)	72	229.5	233.0	2.9	N	2.4	2	16	14	R2	W1	232	J	1	59	U	R			12.0	18						
													232.3	J	1	35	P	R			10.0	14						
	Limestone	73	233.0	238.0	4.9	N	4.9	3	17	12	R4	W2	233.7	J	1	30	C	R	Ca	C	8.0	20						
													235.9	J	1	60	P	R	Ca	C	14.0	20						

			Run Data																				Rubble/Gouge					
			Recovery & Other Basic Information						JCR		Strength Index		Detailed Discontinuity Data										Gouge			Broken Core		
Core Dia: Depth	ROCK TYPE	RUN	From (ft.)	To (ft.)	Recovery (ft.)	Bedding Dominant (Y/N)	RQD (ft.)	Natural Fracture Count	Average	Minimum	Strength Index	Weathering Index	Depth (ft.)	Type	Count	α	Shape	Roughness	Infill	Thickness (mm)	JRC	JCR	From	To	Type	From	To	ADDITIONAL TESTING OR COMMENTS, SAMPLES COLLECTED
													237.5	J	1	25	P	R	Ca	1	8.0	12						
	Limestone w/extensive Ca veins	74	238.0	243.0	4.7	N	4.7	1	12	12	R4	W2	238.3	J	1	70	P	R	Ca	3	14.0	12						
	Limestone with many chert nodules	75	243.0	247.5	3.7	N	2.4	8	12	12	R4	W2														243.0	243.7	
													244.3	J	1	75	P	VR	Ca	1	18.0	12						
													246.4	J	1	70	IR	VR	Ca	1	18.0	12						break through Ca vein
	Limestone	76	247.5	250.5	3.0	N	1.7	8	12	12	R4	W2	249.6	J	1	50	P	VR	Cl	1	16.0	12						
	Limestone	77	250.5	252.5	1.8	N	1.8	2	20	20	R4	W2	251.1	J	1	80	IR	R	Cl	C	12.0	20						
													251.9	J	1	75	P	R	Ca	C	14.0	20						
	Limestone	78	252.5	253.0	0.6	N	0.6	0			R4	W2																
	Limestone	79	253.0	258.0	4.5	N	4.2	3	0	0	R3	W2	254.7	F	1	40	P	R	Cl	40	8.0	0						thick clay gouge zone
	Limestone - some chert	80	258.0	263.0	5.0	N	5.0	0			R4	W2																
	Limestone	81	263.0	268.0	5.0	N	4.5	5	0	0	R3	W2	266.6	F	4	60	P	S	Cl	8	2.0	0						
																							267.4	267.6	Gc			
	Limestone	82	268.0	269.5	1.5	N	0.0	6	20	20	R3	W2	268.3	J	6	60	P	R			10.0	20						series of parallel breaks throughout run
	Limestone	83	269.5	270.0	1.0	N	0.8	0			R3	W2																extra recovery
	Limestone some Ca veins some chert	84	270.0	273.0	2.9	N	2.9	3	16	8	R2	W2	270.8	J	1	69	P	R	CL	1.5	8.0	8						
													271.9	J	1	63	ST	VR	Ca	0.5	14.0	20						
													272.9	J	1	44	P	VR	Ca	0.5	16.0	20						
	Limestone with some chert	85	273.0	278.0	4.8	N	4.3	4	21	20	R2	W2	273.7	J	1	48	P	VR	Ca	0.5	18.0	22						
													274.9	J	1	47	C	VR	Ca	0.5	16.0	22						
													275.9	J	1	73	P	VR	Ca	0.5	19.0	22						
													276.6	J	1	77	P	VR	Ca	0.5	17.0	20						
	Limestone	86	278.0	283.0	4.6	N	4.5	2	18	16	R2	W2	279.6	J	1	43	P	VR	Ca	0.5	18.0	20						
													281	J	1	70	P	R	Ox	0.5	12.0	16						
	Limestone	87	283.0	288.0	5.0	N	4.1	5	8	0	R2	W2	283.1	J	1	74	U	VR	G	0.5	14.0	20						
													283.5	F	1	19	P	S	G	27	2.0	0	283.3	283.7	Cl			Slickensides
													284.6	F	1	68	P	SR	G	3	4.0	2						
													287	J	1	74	U	R	G	0.5	10.0	18						
													288	F	1	18	P	S	G	1	2.0	0						slickensides
	Limestone	88	288.0	293.0	5.0	N	2.1	7	6	0	R1	W4	288.3	F	1	15	P	S	Cl	0.5	2.0	0						slickensides
													288.6	F	1	29	U	S	Cl	0.5	3.0	0						slickensides
													289.2	J	1	61	P	R	Ox	0.5	8.0	14						
													289.6	F	1	53	P	SR	Ox	0.5	6.0	0						slickensides
													290.5	F	1	58	P	SR	G	195	4.0	0	290.5	291.5	Bx			slickensides
													290.8	J	1	62	P	R	Cl	0.5	10.0	12						
													292.4	J	1	54	P	VR	Cl	0.5	14.0	20						
																										293.2	293.6	
	Limestone	89	293.0	298.0	4.7	N	2.8	6	11	0	R2	W3	294	F	1	45	P	SR	Cl	1	6.0	0						slickensides
													294.4	J	1	72	P	R	Cl	0.5	10.0	12						
													295	J	1	74	P	R	Cl	0.5	8.0	12						

			Run Data										Detailed Discontinuity Data										Rubble/Gouge					
			Recovery & Other Basic Information						JCR		Strength Index												Gouge			Broken Core		
Core Dia: Depth	ROCK TYPE	RUN	From (ft.)	To (ft.)	Recovery (ft.)	Bedding Dominant (Y/N)	RQD (ft.)	Natural Fracture Count	Average	Minimum	Strength Index	Weathering Index	Depth (ft.)	Type	Count	α	Shape	Roughness	Infill	Thickness (mm)	JRC	JCR	From	To	Type	From	To	ADDITIONAL TESTING OR COMMENTS, SAMPLES COLLECTED
													295.4	J	1	78	P	R	Cl	0.5	10.0	12						
													296.4	J	1	54	P	VR	Cl	0.5	14.0	16						
													296.8	J	1	70	P	R	Cl	0.5	12.0	14						
	Limestone	90	298.0	303.0	3.9	N	0.8	19	11	0	R3	W3	299.3	J	1	56	U	R	Cl	0.5	10.0	14						brecciated, very brecciated from 301.5
													299.7	J	1	58	P	VR	Cl	0.5	14.0	18						
													300.5	J	1	13	P	S	Cl	0.5	0.0	0						
													301.2	J	1	26	P	R	Cl	0.5	10.0	14						
																										301.5	303.0	more than 10 fractures/foot
	Limestone	91	303.0	305.0	1.6	N	0.0	15			R3	W3														303.0	305.0	
	Limestone	92	305.0	307.0	1.6	N	0.0	6	12	12	R3	W3														305.0	305.4	
													305.8	J	6	29	P	R	Cl	0.5	8.0	12						series of parallel fractures 305.4 to 306.3
																										306.3	307.0	
	Limestone	93	307.0	309.0	1.2	N	0.0	22	16	16	R3	W3	308.3	J	22	16	P	VR	Ox	0.5	14.0	16				307.0	308.1	<10 fractures/ft 307-309
	Limestone	94	309.0	310.0	1.0	N	0.0	1	12	12	R3	W3	309.6	J	1	11	P	SR	Ca	0.5	6.0	12				309.0	309.4	
																										309.7	310.0	
	Limestone	95	310.0	313.0	2.6	N	0.4	17	15	12	R3	W3	310.8	J	1	52	ST	R	Cl	0.5	8.0	17						
													311.3	J	1	55	U	R	Cl	0.5	12.0	17						
													311.4	J	1	52	ST	R	Cl	0.5	8.0	17						
													311.5	J	2	30	P	SR	Cl	0.5	6.0	14						
													311.7	J	2	25	P	SR	Cl	0.5	6.0	14						
																										312.3	313.0	
	Limestone	96	313.0	315.5	2.2	N	0.0	27	15	14	R3	W3	314.1	J	24	33	P	R	Cl	0.5	10.0	16						at 315.1 some chert; entire run >10 fractures/ft
													314.6	J	3	46	P	R	Cl	0.5	8.0	14						
	Limestone w/some Ca veins	97	315.5	318.0	1.6	N	0.0	6	11	10	R3	W3											316.2	316.8	Bx			
													317.1	J	1	43	P	R	Cl	1	12.0	10						
													317.3	J	3	59	P	SR	Ca	4	6.0	10						break along Ca veins
													317.6	J	2	39	U	R	Ca	9	12.0	12						break along Ca veins
	Limestone	98	318.0	320.0	2.0	N	0.0	7	11	8	R3	W2	318.2	J	3	43	P	SR	Cl	0.5	5.0	12						
													318.6	J	1	7	P	R	Ca	0.5	10.0	14						
													318.8	J	1	34	P	R	Bx	43	10.0	8						
													319.2	J	1	65	U	VR	Ca	0.5	14.0	16						
													319.8	J	1	18	P	SR	Ca	1	6.0	8						
	Limestone	99	320.0	323.0	2.5	N	0.0	9	14	12	R3	W2	320.8	J	1	25	U	R	Cl	0.5	12.0	14						
													321.1	J	2	63	P	VR	Ca	0.5	16.0	18						
													321.9	J	1	14	P	R	Cl	0.5	12.0	13						
													322.2	J	2	24	P	R	Ca	0.5	10.0	13						
													322.4	J	3	32	P	SR	Cl	0.5	6.0	12						
	Limestone w/calcite veins	100	323.0	324.0	0.9	N	0.0	10			R3	W3														323.0	324.0	entire run broken core
	Mostly chert w/some limestone	101	324.0	327.0	1.6	N	0.0	3			R3	W3	325.6	J	1	53	P	VR	Cl	0.5	15.0	14						
													326.1	J	1	61	P	SR	Cl	2	4.0	6						

			Run Data										Detailed Discontinuity Data										Rubble/Gouge					
			Recovery & Other Basic Information						JCR		Strength Index												Gouge			Broken Core		
Core Dia: Depth	ROCK TYPE	RUN	From (ft.)	To (ft.)	Recovery (ft.)	Bedding Dominant (Y/N)	RQD (ft.)	Natural Fracture Count	Average	Minimum	Strength Index	Weathering Index	Depth (ft.)	Type	Count	α	Shape	Roughness	Infill	Thickness (mm)	JRC	JCR	From	To	Type	From	To	ADDITIONAL TESTING OR COMMENTS, SAMPLES COLLECTED
													326.3	J	1	34	P	R	Cl	0.5	12.0	13						
													326.7	F	1	35	I	R	G	82	10.0	0	326.7	327.0	Bx			
	Limestone w/some chert and Ca veins	102	327.0	330.0	3.0	N	0.0	17	13	12	R3	W3	327.4	J	2	73	P	R	Cl	0.5	12.0	14						
													327.9	J	2	29	P	R	Cl	0.5	10.0	13						
													328.2	J	1	77	P	R	Cl	0.5	10.0	13						
													328.6	J	2	29	P	SR	Cl	0.5	6.0	12						
													329	J	9	54	P	R	Cl	0.5	10.0	14						
													329.6	J	1	50	P	R	Cl	0.5	11.0	14						
	Limestone	103	330.0	333.0	3.0	N	0.6	4	19	14	R2	W2	330.5	J	1	81	C	VR	Ca	0.5	18.0	20						
													330.9	J	1	70	ST	VR	Ca	0.5	19.0	22						very brecciated
													331.6	J	1	78	P	R	Ox	0.5	11.0	14						
													332.4	J	1	42	P	VR	Ca	0.5	20.0	22						
	Limestone	104	333.0	338.0	5.0	N	2.0	4	15	14	R2	W2											333.4	334.3	Bx			very brecciated
													335.9	J	1	36	U	R	Ox	0.5	10.0	14						
													336.5	J	1	53	P	VR	Cl	0.5	16.0	15						
													337	J	2	42	P	R	Cl	0.5	12.0	15						
	Limestone w/some chert, Ca veins	105	338.0	343.0	5.0	N	0.5	28	18	14	R2	W3	338.5	J	1	49	P	VR	Cl	0.5	18.0	20						
													339.4	J	1	54	P	R	Cl	0.5	13.0	18						
													339.7	J	1	28	P	R	Cl	0.5	16.0	18						
													339.8	J	1	67	P	VR	Cl	0.5	16.0	19						
													340.3	J	4	53	P	R	Cl	0.5	12.0	14						
																							341.4	343.0	Bx			40 fractures/ft
	Limestone w/some chert, Ca veins	106	343.0	348.0	5.0	N	2.2	6	13	6	R2	W3	343.4	J	1	50	P	VR	Cl	0.5	16.0	20						
													345.3	J	1	52	P	VR	Cl	0.5	15.0	19						
													346.3	F	1	64	P	R	Bx	20	14.0	6						
													346.7	J	1	53	P	SR	Cl	0.5	8.0	6						
													347.3	J	1	58	P	VR	Cl	0.5	19.0	20						
													347.8	J	1	69	U	R	Cl	0.5	10.0	14						
	Limestone	107	348.0	353.0	5.0	N	2.8	11	7	0	R2	W3	348.7	F	2	61	P	R	Cl	0.5	12.0	0						slickensides (very deep)
													349.1	J	2	71	P	R	Cl	0.5	16.0	16						
													350.1	J	2	75	C	R	Cl	0.5	16.0	16						
													350.9	F	1	55	P	SR	Bx	65	8.0	0						slickensides
													352.4	J	4	37	P	R	Cl	0.5	10.0	14						
	Limestone	108	353.0	357.5	3.8	N	0.0	41	5	0	R2	W3	353.5	J	40	60	P	VR	Cl	0.5	12.0	10						<10 fractures/ft (353.5 to 356.7)
													356.8	F	1	39	P	SR	Bx	115	8.0	0						
																										356.6	357.5	
	Limestone	109	357.5	360.0	2.2	N	0.0	2.7	16	10	R1.5	W3	359	J	27	87	P	VR	Cl	0.5	20.0	23						<10 fractures/ft
	Limestone	110	360.0	363.0	2.6	N	0.0	16	20	20	R1.5	W3	361.5	J	16	84	I	SR	Cl	0.5	6.0	20						<10 fractures/ft 361.5 to 362.7
	Limestone	111	363.0	368.0	5.0	N	3.9	1	0	0	R2	W3	364.7	F	1	44	P	R	Bx	190	14.0	0						
	Limestone	112	368.0	373.0	5.0	N	4.5	1	2	2	R2	W2	371.8	J	1	5	P	S	Cl	0.5	1.0	2						several healed fractures, slickensides

			Run Data										Detailed Discontinuity Data										Rubble/Gouge					
			Recovery & Other Basic Information						JCR		Strength Index												Gouge			Broken Core		
Core Dia: Depth	ROCK TYPE	RUN	From (ft.)	To (ft.)	Recovery (ft.)	Bedding Dominant (Y/N)	RQD (ft.)	Natural Fracture Count	Average	Minimum	Strength Index	Weathering Index	Depth (ft.)	Type	Count	α	Shape	Roughness	Infill	Thickness (mm)	JRC	JCR	From	To	Type	From	To	ADDITIONAL TESTING OR COMMENTS, SAMPLES COLLECTED
	Limestone	113	373.0	378.0	5.0	N	5.0	3	13	0	R2	W2	373.9	J	1	72	C	R	Cl	0.5	12.0	18						
													375	J	1	83	P	SR	Cl	1	6.0	0						slickensides
													376.6	J	1	88	P	VR	Cl	0.5	19.0	22						
	Limestone	114	378.0	383.0	4.8	N	4.4	3	20	20	R2	W2	378.2	J	1	40	U	R	Cl	1	12.0	20						
																							380.5	380.7	Gc			
	Limestone	115	383.0	388.0	5.0	N	2.8	8	16	12	R2	W2	383.7	J	1	45	I	VR	Cl	1	16.0	20						
													375.7	J	1	75	I	VR	Cl	2	16.0	12						
																										386.5	388.0	intact but highly fractured - drill induced?
	Limestone	116	388.0	393.0	4.8	N	3.7	5	20	20	R2	W2	388.7	J	1	10	P	S	Cl	1	6.0	20						
																							388.7	389.1	Gc			thick clayey gouge, preserving original structures str:S4
																							390.4	390.7	Cl			thick gouge str: S4
													391.6	J	1	10	P	S	Cl	3	6.0	12						
													392.3	J	1	25	P	S	Cl	C	6.0	20						
	Limestone	117	393.0	398.0	5.0	N	4.5	1	12	12	R2	W2	394.3	J	1	10	P	R	Cl	1	10.0	12						
	Limestone	118	398.0	403.0	4.3	N	3.4	3	16	12	R2	W2														398.0	398.6	highly broken
													399.7	J	1	40	P	R	Cl	1	8.0	20						
													400.1	J	1	50	P	R	Ca	1	8.0	12						break along Ca vein
	Limestone	119	403.0	406.0	2.7	N	0.0	10	17	12	R2	W2	404	J	1	40	P	R	Ca	C	8.0	20						
													404.8	J	1	50	P	R	Ca	C	10.0	20						
													405.4	J	1	20	P	R	Ca	1	12.0	12						
	Limestone	120	406.0	408.0	2.0	N	1.7	2			R2	W2																highly broken core, few Ca veins
	Limestone	121	408.0	412.0	3.7	N	1.3	7	17	12	R2	W2	408.5	V	1	70	P	R	Ca	3	10.0	12						
													410	J	1	40	P	S	Ca	C	6.0	20						
													410.1	J	1	40	P	R	Ca	1	8.0	20						
													410.7	J	1	40	P	R	Cl	2	10.0	12						
	Limestone	122	412.0	417.0	5.0	N	4.3	5	10	6	R2	W2	412.5	V	1	70	P	S	Ca	4	6.0	6						
													414.3	J	1	40	P	R	Cl	1	12.0	12						
													415.6	J	1	40	P	R	Cl	1	8.0	12						
													416.2	J	1	40	P	S	Cl	1	6.0	12						
	Limestone	123	417.0	420.5	3.2	N	2.2	4	12	12	R2	W2	418.1	J	1	35	P	R	Cl	1	10.0	12						
													419.7	J	1	30	P	R	Cl	1	8.0	12						
	Limestone	124	420.5	423.0	2.0	N	0.4	4	20	20	R2	W2	421.4	J	2	45	P	R	Cl	C	14.0	20						
	Limestone	125	423.0	428.0	4.4	N	3.3	5	17	12	R2	W2	423.3	J	1	50	P	R			12.0	20						many non-continuous fractures in core, clay filled
													423.7	J	3	60	P	R	Cl	1	8.0	20						
													424.5	J	1	35	P	R	Cl	1	8.0	12						
													425	J	1	40	P	R	Cl	2	12.0	12						
	Limestone	126	428.0	430.0	2.0	N	1.5	2	12	12	R2	W2	428.3	J	1	30	P	S	Ca	2	6.0	12						
													429.9	J	1	50	P	R	Ca	1	10.0	12						
	Limestone	127	430.0	433.0	3.0	N	0.6	5	10	0	R2	W2	430.6	J	1	60	P	R	Cl	1	8.0	20						
													431.4	F	1	40	P	R	Gc	15	10.0	0						

			Run Data																				Rubble/Gouge					
			Recovery & Other Basic Information						JCR		Strength Index		Detailed Discontinuity Data										Gouge			Broken Core		
Core Dia: Depth	ROCK TYPE	RUN	From (ft.)	To (ft.)	Recovery (ft.)	Bedding Dominant (Y/N)	RQD (ft.)	Natural Fracture Count	Average	Minimum	Strength Index	Weathering Index	Depth (ft.)	Type	Count	α	Shape	Roughness	Infill	Thickness (mm)	JRC	JCR	From	To	Type	From	To	ADDITIONAL TESTING OR COMMENTS, SAMPLES COLLECTED
																							431.5	432.5	Ca			thick Ca vein
	Limestone	128	433.0	438.0	4.7	N	4.4	6	13	0	R2	W2	434.6	J	1	40	P	S	Ca	2	6.0	12						break along vein
													436	J	1	70	P	R	Ca	8	10.0	0						
													436.5	J	1	25	P	R	Cl	1	8.0	20						
													436.8	J	3	40	P	R	Cl	C	8.0	20						
	Limestone	129	438.0	441.0	2.7	N	1.1	5	14	12	R2	W2	438.8	J	1	40	P	R	Cl	C	8.0	20						
													439.4	J	1	45	P	R	Cl	1	10.0	12						
													439.9	J	1	45	P	R	Cl	1	8.0	12						
	Limestone	130	441.0	443.0	1.6	N	0.5	4	12	12	R2	W2	441.8	J	4	30	P	R	Cl	1	10.0	12						parallel breaks throughout run
	Limestone	131	443.0	445.0	2.0	N	1.6	2	12	12	R3	W2	443.3	J	1	35	P	R	Ca	1	8.0	12						
													444.7	J	1	60	P	R	Ca	1	8.0	12						
	Limestone	132	445.0	448.0	3.0	N	3.0	1	12	12	R3	W2	446.2	J	1	45	P	R	Ca	3	10.0	12						
	Limestone	133	448.0	451.5	3.2	N	3.0	2	12	12	R3	W2	448.3	J	1	20	P	R	Cl	1	14.0	12						
													449.7	J	1	45	P	VR	Cl	1	18.0	12						sample 450.3-451.0
	Limestone	134	451.5	456.5	4.8	N	4.1	2	12	12	R3	W2	455.2	J	1	65	P	R	Ca	1	8.0	12						
	Limestone	135	456.5	461.5	4.9	N	4.5	2	12	12	R3	W2	460.5	J	2	40	P	R	Cl	1	12.0	12						
	Limestone	136	461.5	466.5	5.0	n	4.4	3	14	12	R3	W2	463.5	J	1	40	P	R	Cl	1	8.0	12						
													464.1	J	1	30	P	R	Cl	1	10.0	12						
													465.4	J	1	40	P	R	Cl	C	8.0	20						
	Limestone	137	466.5	471.5	5.0	N	5.0	0			R3	W2																
	Limestone	138	471.5	476.5	5.0	N	4.6	3	12	12	R3	W2	472.8	J	1	30	P	S	Cl	1	4.0	12						
													474	J	1	60	P	R	Cl	1	10.0	12						

PERMANENTE QUARRY RMR SYSTEM - RECORD OF GEOTECHNICAL PARAMETERS

Project No.	063-7109.100			Drilling Method		From 16.5 To 436.5	Sheet	1 of 15	
Borehole #	GT-1-3-08	Azimuth	NA	Core			Logged by	DSF/IT	
Elevation	1061.03	Inclination	-90				Drill Rig	Ruen	
N	51.25 E -4859	Ref. Point							

Core Dia: Depth	ROCK TYPE	RUN	Run Data: Recovery & Other Basic Information: From (ft.)	To (ft.)	Recovery (ft.)	Bedding Dominant (Y/N)	RQD (ft.)	Natural Fracture Count	JCR: Average	Minimum	Strength Index: Strength Index	Weathering Index	Detailed Discontinuity Data: Depth (ft.)	Type	Count	α	Shape	Roughness	Infill	Thickness (mm)	JRC	JCR	Rubble/Gouge: Gouge: From	To	Type	Broken Core: From	To	ADDITIONAL TESTING OR COMMENTS, SAMPLES COLLECTED
	Metabasalt	1	16.5	18.0	1.5	N	0.0				R3	W2														16.5	18.0	
	Metabasalt	2	18.0	22.0	0.5	N	0.0				R3	W2														18.0	22.0	
	Fault gouge	3	22.0	23.0	0.0	N	0.0				R2	W3											22.3	23.0	CL/Chl.	22.0	22.3	
	Fault gouge	4	23.0	25.0	1.5	N	0.0				R2	W3											23.0	24.5	CL/Chl.			
	Greywacke/Metabasalt	5	25.0	27.0	1.0	N	0.0				R3	W2														25.0	26.0	
	Fault gouge	6	27.0	28.5	1.0	N	0.0				R2	W3											27.0	28.0	CL/Chl.			
	Greywacke/Metabasalt	7	28.5	30.5	0.5	N	0.0				R3	W2														28.5	29.0	
	Greywacke	8	30.5	32.0	1.5	N	0.0	5	17	15	R3	W2	31	J	1	59	U	R	CL/Ch	<1	13.0	15						
											R3	W2	31.3	J	1	36	PL	R	CL/Ch	<1	6.0	18						
											R3	W2	31.5	J	1	21	U	R	Chl.	<1	10.0	20						
											R3	W2	31.7	J	3	19	PL	R	Chl.	<1	8.0	17						
	Greywacke/Fault breccia	9	32.0	34.0	2.0	N	0.5	4	12	6	R3	W2/W3	32.9	J	1	18	C	R	Chl.	1	12.0	15						Sample @ 32.3'
											R3	W2/W3	33.1	J	3	20	U	R	CL/Ch	5	14.0	6						
	Graywacke/Fault breccia	10	34.0	36.0	2.0	N	0.0	>10	16	14	R3	W2/W3	34.5	J	4	36.0	P	R	Chl.	<1	9.0	14						
											R3	W2/W3	35.7	J	1	39.0	U	R	Chl.	<1	12.0	18						
	Greywacke	11	36.0	38.5	1.5	N	0.0	4	13	11	R3	W2	36.7	J	2	40	U	R	Chl.	<1	10.0	15				36.0	36.7	Calcite veins
											R3	W2	37.3	J	1	21	P	R	Chl.	<1	8.0	12				38.0	38.5	
											R3	W2	38	J	1	42	P	R	Chl.	<1	8.0	11						
	Graywacke	12	38.5	42.0	3.5	N	0.6	>10	15	12	R3	W2	39	J	2	40	P	R	Chl.	<1	8.0	12						Calcite veins
											R3	W2	39.5	J	1	63	U	R	Chl.	<1	12.0	18						Sample @39.5'
											R3	W2	40.6	J	3	10	ST	R	Chl.	<1	16.0	20						
											R3	W2	40.8	J	1	53	U	R	Chl.	<1	11.0	15						
											R3	W2	41	J	1	24	C	R	Chl.	<1	10.0	12						
											R3	W2	41.5	J	1	36	U	R	Chl.	<1	12.0	15						
	Greywacke/Fault breccia	13	42.0	45.0	2.4	N	0.0	4	11	8	R2	W3											43.2	43.4	bx	42.0	42.4	
											R3	W3	42.9	J	3	57	P	R	CL/Ch	3	12.0	8						
											R3	W2	43.8	J	1	65	ST	R	Chl.	<1	14.0	14						
											R2	W3											44.0	44.4	bx			
	Fault breccia/gouge	14	45.0	47.0	1.7	N	0.0	>10			R2	W3											45.0	46.7	bx			Fault breccia w/ thick infill/gouge
	Greywacke	15	47.0	50.0	2.8	N	0.0	7	12	10	R3	W2	47.7	J	1	55	U	R	Chl.	<1	10.0	18				47.0	47.4	
											R3	W2	48.1	J	1	67	P	R	Chl.	<1	8.0	12						
											R3	W2	48.4	J	3	61	C	R	Chl.	<1	9.0	15						
											R3	W2	48.8	J	1	65	P	R	Chl.	<1	8.0	12						

			Run Data																				Rubble/Gouge					
			Recovery & Other Basic Information						JCR		Strength Index		Detailed Discontinuity Data										Gouge			Broken Core		
Core Dia: Depth	ROCK TYPE	RUN	From (ft.)	To (ft.)	Recovery (ft.)	Bedding Dominant (Y/N)	RQD (ft.)	Natural Fracture Count	Average	Minimum	Strength Index	Weathering Index	Depth (ft.)	Type	Count	α	Shape	Roughness	Infill	Thickness (mm)	JRC	JCR	From	To	Type	From	To	ADDITIONAL TESTING OR COMMENTS, SAMPLES COLLECTED
											R3	W2	49.2	J	1	64	P	R	Chl.	<1	6.0	10						
	Fault breccia/gouge	16	50.0	52.0	2.0	N	0.0	5	8.5	8	R2	W3	50.4	J	4	56	U	R	Chl.	3	12.0	8						
											R3	W2	51.4	J	1	41	U	R	Chl.	2	16.0	9						
											R2	W4														51.6	51.9	
	Graywacke/fault breccia	17	52.0	56.0	3.3	N	0.0	>10	8	8	R3	W2/W3	53	J	5	36	U	R	Chl.	2	10.0	8	52.7	53.0	Chl.			Some greenstone/chlorite gouge
	Greywacke	18	56.0	58.5	2.5	N	0.0	6	9	8	R3	W3														56.0	56.7	
											R3	W3	57	J	3	49	U	R	CL/Ch	3	9.0	8						
											R3	W3	57.5	J	2	75	P	R	Chl.	<1	7.0	10						
											R3	W3	57.9	J	1	17	P	R	Chl.	<1	5.0	9						
	Fault gouge/breccia	19	58.5	63.0	2.3	N	0.0	>10			R2	W3											58.5	60.8	bx			breccia intermixed with gouge
	Fault gouge	20	63.0	64.0	1.0	N	0.0	0															63.0	64.0	CL/Chl.			
	Fault breccia/gouge	21	64.0	65.0	0.8	N	0.0	0			R3	W3											64.3	64.7	bx			
	Greywacke	22	65.0	67.0	2.0	N	0.4	2	13.5	12	R3	W2	65.7	J	1	50	U	R	Chl.	<1	8.0	15						
											R3	W2	66.4	J	1	45	U	R	CL/Ch	2	10.0	12						
	Graywacke	23	67.0	70.0	3.0	N	1.0	8	7	0	R3	W3	67.3	J	1	74	U	R	CL/Ch	1	11.0	10						
											R3	W3	67.6	J	1	50	U	R	CL/Ch	1	12.0	10						
											R3	W3	68	J	2	43	U	R	CL/Ch	4	12.0	7						
											R3	W3	68.4	J	3	70	U	R	CL/Ch	7	10.0	0						
											R3	W3	69	J	1	48	P	SM	Chl.	<1	6.0	7						
	Greywacke/fault gouge/breccia	24	70.0	72.0	1.6	N	0.0	>10			R2	W3											70.1	70.4				
																							71.2	71.5				
	Greywacke	25	72.0	73.0	1.0	N	0.0																			72.0	73.0	
	Graywacke	26	73.0	77.0	4.0	N	1.3	>10	13	11	R3	W3	73.1	J	1	58	P	VR	Chl.	10	15.0							Calcite veins, some brecciation
											R3	W3	74	J	11	45	P	R	Chl.	8	11.0							
	Graywacke	27	77.0	81.5	4.5	N	1.5	>10	6	6	R2/R3	W3	77.4	J	7	61	P	R	Chl.	1-4	10.0	6						
	Graywacke	28	81.5	84.0	2.0	N	0.0	>10															82.4	82.7	CL/Chl.	81.9	83.5	some gouge
	Greenstone/ greywacke	29	84.0	85.0	1.0	N	0.0	3	10	8	R3	W2	84.3	J	1	55	U	R	Chl.	<1	10.0	8						
											R3	W2	84.5	J	1	38	C	VR	Chl.	<1	12.0	15						
											R3	W3	84.8	J	1	56	U	R	Chl.	2	10.0	8						
	Fault gouge	30	85.0	86.5	1.5	N	0.0				R2	W4											85.0	86.5	CL/Chl.			Chlorite gouge
	Fault breccia	31	86.5	90.5	4.0	N	0.0	>10	13	8	R3	W3	87.5	J	1	43	U	R	Chl.	<1	10.0	15				86.5	87.0	Calcite and chlorite clasts
											R3	W4	88	J	8	49	P	R	Chl.	2	8.0	8						
	Greywacke	32	90.5	93.0	2.5	N	0.0	>10	10	13	R3	W3	87.5	J	7	58	U	R	Chl.	1	10.0	13						
											R3	W2	88	J	2	28	U	R	Chl.	<1	12.0	16						
	Greywacke/gouge	33	93.0	97.0	4.0	N	0.0	>10			R2	W3											94.8	95.1	CL/Chl.			Mostly broken core
																							95.6	95.9	CL/Chl.			

			Run Data																				Rubble/Gouge					
			Recovery & Other Basic Information						JCR		Strength Index		Detailed Discontinuity Data										Gouge			Broken Core		
Core Dia: Depth	ROCK TYPE	RUN	From (ft.)	To (ft.)	Recovery (ft.)	Bedding Dominant (Y/N)	RQD (ft.)	Natural Fracture Count	Average	Minimum	Strength Index	Weathering Index	Depth (ft.)	Type	Count	α	Shape	Roughness	Infill	Thickness (mm)	JRC	JCR	From	To	Type	From	To	ADDITIONAL TESTING OR COMMENTS, SAMPLES COLLECTED
																							96.7	97.0	CL/Chl.			
	Graywacke/gouge	34	97.0	100.5	3.0	N	0.0	5	13	13	R3	W3	98	J	3	45	P	R	Chl.	2	10.0	13	97.5	98.0	CL/Chl.	97.0	97.5	
											R3	W3	98.1	J	2	30	U	R	Chl.	2	10.0	13	98.3	98.7	CL/Chl.			
	Greywacke	35	100.5	103.0	2.5	N	0.0	6	19	15	R3	W2	100.7	J	5	53	P	R	Chl.	<1	10.0	15						
											R3	W2	101.3	J	1	38	I	R	Chl.	<1	16.0	22						
	Graywacke	36	103.0	108.0	5.0	N	2.0	>10	12	8	R3	W2	103.4	J	4	50	U	R	Chl.	<1	10.0	15						Calcite veins
											R3	W2	103.7	J	5	54	P	R	Chl.	<1	6.0	8						Sample @ 106.5'
											R3	W2	104.8	J	4	78	P	R	Chl.	<1	10.0	15						
	Graywacke	37	108.0	111.0	2.5	N	0.0	5	13	6	R3	W3	108.5	J	2	55	I	R	CL/Ch	<1	15.0	18	109.0	109.3	CL/Chl.			Some fault breccia
											R3	W3	109.9	J	2	74	P	R	Chl.	<1	10.0	6						
											R3	W3	110.3	J	1	71	U	R	CL/Ch	1	16.0	15						
	Graywacke	38	111.0	113.0	2.0	N	0.8	1	15	15	R3	W2	112	J	1	30	U	R	Chl.	<1	10.0	15						
	Graywacke	39	113.0	118.0	5.0	N	0.0	12	13	10	R3	W2	113.2	J	1	50	U	R	Chl.	<1	12.0	18	113.6	113.9	Bx/Chl.			
											R3	W2	113.4	J	7	55	U	R	CL/Ch	1	10.0	10						
											R3	W2	116.6	J	1	65	P	VR	CL/Ch	1	10.0	13						
											R3	W2	117.3	J	1	40	P	VR	Chl.	<1	8.0	15						
	Graywacke	40	118.0	123.0	5.0	N	1.5	6	15	15	R3	W3	118.2	J	1	60	U	R	Chl.	<1	10.0	15						
											R3	W3	118.6	J	5	75	U	R	Chl.	<1	14.0	15						
	Greywacke/breccia	41	123.0	126.0	3.0	N	0.0	6	8	4	R2	W3	123.6	J	5	65	U	R	Chl.	1	12.0	12						
											R2	W3	124.6	J	1	65	U	R	CL/Ch	5	16.0	4						
	Greywacke	42	126.0	129.0	3.0	N	0.5	2	11	10	R2	W3											126.0	126.9	Bx/Chl.			
											R3	W2	127.3	J	1	42	P	R	Chl.	<1	8.0	12	128.0	128.4	Bx/Chl.			
											R3	W2	127.8	J	1	55	P	R	Chl.	<1	6.0	10						
	Greywacke/breccia	43	129.0	133.0	3.8	N	0.0	3	12	12	R1	W4											129.0	131.7	Bx/Chl.			
											R3	W3	131.7	J	2	34	P	R	Chl.	2	10.0	12						
											R3	W3	132.2	J	1	74	P	VR	Chl.	<1	11.0	12						
	Greywacke	44	133.0	137.5	4.1	N	1.0	9	8	4	R2	W4	133.7	J	2	25	P	R	CL/Ch	1	4.0	4						
											R3	W3	134	J	4	58	U	R	Chl.	<1	12.0	12						
											R3	W3	135.6	J	3	31	P	R	Chl.	<1	10.0	10						
	Fault gouge/breccia	45	137.5	142.5	5.0	N	0.0	10	4	0	R1	W4	138.7	J	6	37.0	U	R	Chl./B	7	8.0	0	137.5	140.2	Bx/Chl.			Multiple clay filled fractures
											R2	W4	140.8	J	2	50.0	P	S	CL/Ch	3	4.0	4						
											R3	W3	141	J	2	16.0	U	R	Chl.	1	10.0	8						
	Greywacke	46	142.5	145.5	2.8	N	0.0	5	10	9	R3	W2	142.7	J	2	68	U	R	Chl.	<1	10.0	12						
											R3	W3	144	J	3	60	U	R	Chl.	2	12.0	9						
	Fault gouge/breccia	47	145.5	147.5	1.8	N	0.0	3	2	2	R3	W3														145.5	146.0	
											R1	W4											146.3	147.3	CL/Chl.			
											R3	W3	146	J	3	47	U	VR	CL/Ch	5	12.0	2						

			Run Data																				Rubble/Gouge					
			Recovery & Other Basic Information						JCR		Strength Index		Detailed Discontinuity Data										Gouge			Broken Core		
Core Dia: Depth	ROCK TYPE	RUN	From (ft.)	To (ft.)	Recovery (ft.)	Bedding Dominant (Y/N)	RQD (ft.)	Natural Fracture Count	Average	Minimum	Strength Index	Weathering Index	Depth (ft.)	Type	Count	α	Shape	Roughness	Infill	Thickness (mm)	JRC	JCR	From	To	Type	From	To	ADDITIONAL TESTING OR COMMENTS, SAMPLES COLLECTED
	Greywacke	48	147.5	149.5	2.0	N	0.0	3	6	4	R3	W3														147.5	148.8	
											R3	W3	148.8	J	2	61	U	R	CL/Ch	5	10.0	4	149.3	149.5	Bx/Chl.			
											R3	W2	149	J	1	36	P	VR	Chl.	<1	12.0	8						
	Greywacke/fault breccia	49	149.5	153.0	3.5	N	0.0	7	14	12	R3	W2																
											R3	W2	149.9	J	5	50	U	R	Chl.	1	14.0	12						
											R3	W2	152	J	2	75	U	R	Chl.	<1	10.0	15						
	Fault breccia	50	153.0	158.0	5.0	N	0.0	5	2	2	R1	W4											153.0	154.5	Chl./Bx			Slickensides; fault
											R2	W4	154.5	J	3	65	U	R	Chl.	2	12.0	2						Fault breccia, greenstone/chlorite melange
											R3	W3	156	J	2	25	U	R	Chl.	2	12.0	2						
	Fault breccia	51	158.0	163.0	5.0	N	2.0	2	5	2	R3	W3	158.8	J	1	54	U	R	Chl.	1	10.0	8	162.4	163.0	Chl./Bx			Slickensides; fault
											R3	W3	160.1	J	1	37	P	SM	Chl.	1	6.0	2						Fault breccia, greenstone/chlorite melange
	Greywacke/fault breccia	52	163.0	168.0	3.4	N	0.0	7	4.5	4	R2	W3/W4	163.5	J	5	58	P	R	Chl.	1	10.0	4	163.0	163.5	Chl./Bx			Slickensides; fault
											R2	W3/W4	164.8	J	2	38	U	R	Chl.	1	12.0	5						Fault breccia, greenstone/chlorite melange
	Fault breccia/graywacke	53	168.0	173.0	5.0	N	0.0	3	10	4	R2	W3	169	J	1	20	U	SM	Chl.	1	10.0	4						Slickensides
											R3	W3	169.8	J	1	58	U	R	Chl.	<1	12.0	14						
											R2	W4	172.7	J	1	51	U	R	Chl./Fe	3	12.0	12						
	Limestone	54	173.0	178.0	5.0	N	1.0	10	14	2	R3	W3	173	J	1	50	U	R	Chl./Fe	3	10.0	2						Limestone contact @173'
											R3	W2	173.2	J	2	61	U	R	Ca	1	12.0	18						Low to medium grade
											R3	W2	174.2	J	2	58	U	R	Ca	1	12.0	18						
											R3	W2	174.5	J	5	67	U	R	Ca/Fe	1	8.0	15						
											R3	W2	175.8	J	1	51	U	R	Ca	1	8.0	15						
	Limestone	55	178.0	183.0	5.0	N	1.5	7	18	15	R3	W2	178.2	J	3	55	U	VR	Ca/Fe	1	13.0	20						Sample @ 180-181'
											R3	W2	179.2	J	1	60	U	R	FeOx	<1	10.0	18						Low to medium grade
											R3	W2	179.8	J	1	60	I	R	Ca/Fe	1	16.0	20						
											R3	W2	181.5	J	1	52	I	R	Ca/Fe	<1	13.0	18						
											R3	W2	182	J	1	36	U	R	Ca/Fe	1	10.0	15						
	Limestone	56	183.0	185.5	2.5	N	1.0	2	18	18	R3	W2	183	J	2	61	U	R	Ca	<1	12.0	18						Low grade
	Limestone	57	185.5	186.0	0.5	N	0.0	1	14	14	R3	W2	185.8	J	1	64	U	R	Ca/Fe	<1	9.0	14						Low grade
	Limestone	58	186.0	188.0	1.5	N	0.6	1	15	15	R3	W2	187.2	J	1	68	U	R	Ca/Fe	<1	10.0	15						Low grade
	Limestone	59	188.0	193.0	4.5	N	1.0	5	14	13	R3	W2	188.9	J	4	43	U	R	Ca/Fe	<1	10.0	15						Low to medium grade
											R3	W2	192	J	1	38	U	R	Ca/Fe	<1	11.0	13						
	Limestone	60	193.0	197.5	4.5	N	0.5	5	15	14	R3	W2	195.4	J	2	41	U	R	Ca/Fe	<1	10.0	15						Low grade
											R3	W2	195.8	J	1	68	U	R	Ca	<1	11.0	14						
											R3	W2	196.3	J	2	73	U	R	Ca/Fe	<1	8.0	15						
	Limestone	61	197.5	201.0	3.5	N	0.5	1	15	15	R3	W2	198	J	1	64	P	R	Ca	<1	8.0	15						
	Limestone	62	201.0	203.0	2.0	N	0.7	1	20	20	R3	W2	202.7	J	1	61	ST	R	Ca	<1	14.0	20						
	Limestone	63	203.0	203.5	0.5	N	0.0	0			R3	W2																

			Run Data																			Rubble/Gouge					
			Recovery & Other Basic Information						JCR		Strength Index		Detailed Discontinuity Data									Gouge			Broken Core		
Core Dia: Depth	ROCK TYPE	RUN	From (ft.)	To (ft.)	Recovery (ft.)	Bedding Dominant (Y/N)	RQD (ft.)	Natural Fracture Count	Average	Minimum	Strength Index	Weathering Index	Depth (ft.)	Type	Count	α	Shape	Roughness	Infill	Thickness (mm)	JRC	JCR	From	To	Type	From	To	ADDITIONAL TESTING OR COMMENTS, SAMPLES COLLECTED
	Limestone	64	203.5	204.0	0.5	N	0.0	1	15	15	R3	W2	203.8	J	1	55	P	R	Ca	<1	8.0	15						
	Limestone	65	204.0	208.0	4.0	N	0.0	6	15	15	R3	W2	205.3	J	4	67	I	R	Ca/Fe	<1	16.0	18						Calcite veins
											R3	W2	206.8	J	1	58	U	R	Ca	<1	14.0	15						
											R3	W2	207.6	J	1	75	U	R	Ca	<1	13.0	15						
	Limestone	66	208.0	209.0	1.0	N	0.0	1	14	14	R3	W2	208.7	J	1	55	P	VR	Ca/Fe	<1	9.0	14						
	Limestone	67	209.0	210.5	1.5	N	0.0	2	15	15	R3	W2	209.8	J	2	72	P	VR	Ca/Fe	<1	10.0	15						
	Limestone	68	210.5	213.0	2.5	N	0.0	5	16	14	R3	W2	211.1	J	4		U	R	Ca	<1	10.0	18						
											R3	W2	212.2	J	1		P	R	Ca	<1	8.0	14						
	Limestone	69	213.0	218.0	5.0	N	1.5	4	15	15	R3	W2	213.9	J	4	70	U	R	Ca/Fe	<1	10.0	15						
	Limestone	70	218.0	222.5	4.5	N	0.5	7	16.5	15	R3	W2	219.3	J	5	67	U	VR	Ca	<1	14.0	18						
											R3	W2	219.9	J	2	65	U	R	Ca	<1	12.0	15						
	Limestone	71	222.5	224.0	1.5	N	0.0	1	15	15	R3	W2	222.9	J	1	66	U	R	Ca	<1	10.0	15						
	Limestone	72	224.0	224.5	0.5	N	0.0	0			R3	W2														224.0	224.5	
	Limestone	73	224.5	226.5	2.0	N	0.0	0			R3	W2														224.5	226.5	Drilling induced fractures
	Limestone	74	226.5	229.0	2.5	N	0.5	4	15	14	R3	W2	227.1	J	4	53	P	R	Ca	<1	9.0	15						
											R3	W2	228.1	J	1	58	U	R	Ca	<1	11.0	18						
	Limestone	75	229.0	229.5	0.5	N	0.0	0																				
	Limestone	77	233.0	234.5	1.5	N	0.0	3	14	12	R3	W2	233.3	J	1	68	P	R	Ca/Fe	<1	8.0	12						
											R3	W2	233.5	J	1	60	P	VR	Ca	<1	10.0	15						
											R3	W2	233.8	J	1	62	P	VR	Ca	<1	11.0	14						
	Limestone	80	240.5	243.0	2.0	N	1.6	1	15	15	R3	W2	242.2	J	1	78	U	R	Ca	<1	10.0	15						High grade with calcite veins
	Limestone	81	243.0	244.5	1.5	N	0.5	2	18	18	R3	W2	243.2	J	1	43	U	R	Ca	<1	12.0	18						
	Limestone	82	244.5	249.5	5.0	N	3.5	2	19	18	R3	W2	247.5	J	1	68	U	R	Ca	<1	12.0	18						Medium grade, calcite veins
											R3	W2	248.8	J	1	57	U	R	Ca	<1	14.0	20						
	Limestone	76	229.5	233.0	3.5	N	1.0	5	16.5	15	R3	W2	330.1	J	4	53	P	R	Ca	<1	9.0	15						
											R3	W2	332.1	J	1	58	U	R	Ca	<1	11.0	18						
	Limestone	78	234.5	235.5	1.0	N	0.7	1	18	18	R3	W2	335.2	J	1	50	U	VR	Ca	<1	12.0	18						
	Limestone	79	235.5	240.5	5.0	N	0.0	6	18	15	R3	W2	335.7	J	2	61	P	R	Ca	<1	10.0	15						
											R3	W2	336.8	J	3	48	U	R	Ca	<1	12.0	18						Bottom 2': a lot of calcite infill/veins
											R3	W2	339	J	1	46	U	R	Ca	<1	13.0	20						Point load test @ 237'
	Limestone	83	249.5	250.0	0.5	N	0.0	0			R3	W2																
	Limestone	84	250.0	253.0	3.0	N	1.5	5	16	15	R3	W2	250.1	J	1	42	ST	R	Ca	<1	14.0	18						
											R3	W2	250.6	J	3	40	U	R	Ca	<1	10.0	15						
											R3	W2	250.8	J	1	65	U	R	Ca	<1	10.0	15						
	Limestone	85	253.0	258.0	5.0	N	2.0	4	16.5	15	R3	W2	256.1	J	2	73	U	R	Ca/Fe	<1	11.0	15						
											R3	W2	257.1	J	2	44	ST	R	Ca	<1	15.0	18						
	Limestone	86	258.0	263.0	5.0	N	3.0	4	16.5	15	R3	W2	259.5	J	3	67	P	R	Ca	<1	9.0	15						

			Run Data																				Rubble/Gouge					
			Recovery & Other Basic Information						JCR		Strength Index		Detailed Discontinuity Data										Gouge			Broken Core		
Core Dia: Depth	ROCK TYPE	RUN	From (ft.)	To (ft.)	Recovery (ft.)	Bedding Dominant (Y/N)	RQD (ft.)	Natural Fracture Count	Average	Minimum	Strength Index	Weathering Index	Depth (ft.)	Type	Count	α	Shape	Roughness	Infill	Thickness (mm)	JRC	JCR	From	To	Type	From	To	ADDITIONAL TESTING OR COMMENTS, SAMPLES COLLECTED
											R3	W2	260	J	1	60	U	R	Ca/Fe	<1	12.0	18						
	Limestone	87	263.0	268.0	5.0	N	2.5	2	16	15	R3	W2	263.4	J	1	68	P	R	Ca	<1	10.0	15						
											R3	W2	267	J	1	46	U	R	Ca	1	12.0	17						
	Limestone	88	268.0	273.0	5.0	N	2.0	8	14	12	R3	W2	268.3	J	5	30	U	R	Ca	<1	10.0	15						High grade to 271'
											R3	W2	270.8	J	1	63	C	R	Ca	3	10.0	12						Low grade from 271' to 273'
											R3	W2	271.5	J	2	38	U	R	Ca	<1	8.0	15						
	Limestone	89	273.0	278.0	5.0	N	0.5	8	15	14	R3	W2	273.2	J	5	66	U	R	Ca	<1	10.0	15						
											R3	W2	273.6	J	1	57	U	R	Ca	<1	10.0	17						
											R3	W2	276.3	J	2	46	U	R	Ca	<1	8.0	14						
	Limestone	90	278.0	283.0	5.0	N	3.5	4	15	14	R3	W2	280	J	2	48	U	R	Ca	<1	10.0	15						
											R3	W2	281.2	J	1	68	P	R	Ca	<1	9.0	14						
											R3	W2	281.7	J	1	43	U	R	Ca	<1	9.0	15						
	Limestone	91	283.0	285.5	2.5	N	1.9	1	17	17	R3	W2	285	J	1	64	U	R	Ca	<1	11.0	17						
	Limestone	92	285.5	290.5	5.0	N	1.0	6	16.5	15	R3	W2	286.3	J	3	52	U	R	Ca/Fe	<1	14.0	18						Medium to high grade
											R3	W2	287.3	J	3	59	P	VR	Ca/Fe	<1	10.0	15						Point load test @ 290'
	Limestone	93	290.5	291.5	1.0	N	0.6	0			R3	W2														290.5	291.0	
	Limestone	94	291.5	292.0	0.5	N	0.0	0			R3	W2														291.5	292.0	
	Limestone	95	292.0	293.0	1.0	N	0.0	0			R3	W2																Calcite veins
	Limestone	96	293.0	298.0	5.0	N	3.3	5	17	16	R3	W2	294	J	3	57	U	R	Ca	<1	11.0	18						High grade with calcite veins
											R3	W2	297.4	J	2	55	P	VR	Ca	<1	10.0	16						
	Limestone	97	298.0	303.0	5.0	N	3.4	3	16	16	R3	W2	300	J	3	41	U	R	Ca/Fe	<1	10.0	16						Medium to high grade
	Limestone	98	303.0	308.0	5.0	N	0.0	1	15	15	R3	W2														303.0	304.0	Medium to high grade
											R3	W2	304.7	J	1	42	U	R	Ca/Fe	<1	10.0	15						
	Limestone	99	308.0	313.0	5.0	N	1.0	1	15	15	R3	W2	310	J	1	40	U	R	Ca/Fe	<1	10.0	15						Intermittent soft chlorite infill with pyrite from 310.5' to 313'
																												Medium to high grade
	Limestone	100	313.0	318.0	5.0	N	2.0	5	16	15	R3	W2	313.3	J	3	65	U	R	Ca/Fe	<1	10.0	15						
											R3	W2	315.5	J	2	48	U	R	Ca/Fe	<1	11.0	17						
	Limestone	101	318.0	323.0	5.0	N	4.0	5	17	15	R3	W2	320	J	1	38	U	R	Ca	<1	10.0	15						
											R3	W2	321.2	J	4	49	U	R	Ca/Fe	<1	12.0	19						
	Limestone	102	323.0	325.5	2.5	N	1.5	0			R3	W2																
	Limestone	103	325.5	326.5	1.0	N	1.0	0			R3	W2																Low grade
	Limestone	104	326.5	328.0	1.5	N	1.2	0			R3	W2																
	Limestone	105	328.0	333.0	4.4	N	1.6	7	18	12	R3	W2	328.6	J	1	50	P	R	Cl	C	14.0	20						
														J	1	40	P	R	Cl	C	10.0	20						
														J	2	60	P	VR	Cl	1	16.0	20						
														J	1	45	P	R	Ca	1	10.0	12						
	Limestone	106	333.0	338.0	5.0	N	2.9	6	10	6	R3	W2	333.7	J	1	55	P	R	Ca	1	10.0	12						

			Run Data																				Rubble/Gouge					
			Recovery & Other Basic Information						JCR		Strength Index		Detailed Discontinuity Data										Gouge			Broken Core		
Core Dia: Depth	ROCK TYPE	RUN	From (ft.)	To (ft.)	Recovery (ft.)	Bedding Dominant (Y/N)	RQD (ft.)	Natural Fracture Count	Average	Minimum	Strength Index	Weathering Index	Depth (ft.)	Type	Count	α	Shape	Roughness	Infill	Thickness (mm)	JRC	JCR	From	To	Type	From	To	ADDITIONAL TESTING OR COMMENTS, SAMPLES COLLECTED
													335.2	V	1	20	P	R	Ca	2	8.0	6						
													336.9	J	1	65	P	R	Ca	1	14.0	12						
	Limestone	107	338.0	339.0	0.9	N	0.9	0			R3	W2																Solid recovery
	Limestone	108	339.0	343.0	4.0	N	2.5	6	14	6	R3	W2	339.3	J	1	50	P	R	CL	2	10.0	6						
													339.8	J	1	60	P	VR	CL	C	16.0	20						
													340.1	J	1	70	P	R	CL	C	14.0	20						
													340.8	J	1	70	P	VR	Ca	1	16.0	12						
													342.6	J	1	50	P	R	Ca	1	14.0	12						
	Limestone	109	343.0	348.0	4.7	N	3.4	4	17	12	R3	W2	343.5	J	1	40	P	R	CL	1	10.0	25						Healed fracture
													344.9	J	2	60	P	R	CL	1	10.0	12						
													345.8	J	1	40	P	R	CL	C	8.0	20						
																										346.9	347.4	
													347.6	J	1	50	P	R	CL	1	10.0	12						
	Limestone	110	348.0	350.0	2.3	N	1.7	2	16	12	R3	W2	348.1	J	1	60	P	R	CL	2	8.0	12						Extra recovery
													349	J	1	40	P	R	CL	C	10.0	20						
	Limestone	111	350.0	353.0	2.8	N	2.8	2	20	20	R3	W2	350.9	J	1	35	ST	R	Ca	1	10.0	20						Re-broken previously healed joint
													351.5	J	1	55	P	R	Ca	1	12.0	20						
	Limestone	112	353.0	358.0	5.0	N	4.6	5			R3	W2														356.1	356.5	Rubble recovered, rest of run solid with no natural fractures
	Limestone/chert	113	358.0	363.0	4.7	N	3.3	0.7	12	12	R4	W2											361.5	261.8	Gc			Large chert nodules in run
													362.3	J	1	30	C	R	CL	2	8.0	12						
	Limestone	114	363.0	367.0	4.0	N	3.0	6	6	6	R3	W2	364.7	J	1	70	IR	R	CL	3	12.0	6						
																										366.7	367.0	broken core with clay infilling
	Limestone	115	367.0	368.5	1.2	N	0.6	0			R3	W2																Core substantially milled, no natural breaks
	Limestone	116	368.5	371.0	2.3	N	2.3	0			R3	W2																Run mechanically broken, no natural fractures
	Limestone	117	371.0	373.0	2.0	N	1.3	0	20	20	R3	W2	371.3	J	1	60	P	S			6.0	20						
																										371.6	371.9	Run mechanically fractured, no natural fractures
	Limestone	118	373.0	378.0	5.0	N	5.0	0			R3	W2																
	Limestone	119	378.0	383.0	5.0	N	5.0	0			R3	W2																
	Limestone	120	383.0	388.0	5.0	N	4.4	6	17	12	R3	W2	384	J	1	70	P	VR	CL	2	16.0	12						
													385.2	V	1	30	P	R	Ca	1	8.0	12						
													386.4	J	1	60	IR	VR	CL	3	18.0	12						
													387.2	J	1	50	IR	VR	CL	2	16.0	12						
													387.5	J	1	50	P	R	CL	1	14.0	20						
	Limestone	121	388.0	393.0	4.7	N	1.7	7	12	6	R3	W2	389.3	J	1	50	P	VR	CL	2	16.0	12						Run highly fractued
													390.1	J	1	60	P	VR	Gc	4	18.0	12						
													391.2	J	1	45	P	VR	Gc	8	16.0	6						
													392	J	1	50	P	R	CL	1	8.0	20						

			Run Data																				Rubble/Gouge					
			Recovery & Other Basic Information						JCR		Strength Index		Detailed Discontinuity Data										Gouge			Broken Core		
Core Dia: Depth	ROCK TYPE	RUN	From (ft.)	To (ft.)	Recovery (ft.)	Bedding Dominant (Y/N)	RQD (ft.)	Natural Fracture Count	Average	Minimum	Strength Index	Weathering Index	Depth (ft.)	Type	Count	α	Shape	Roughness	Infill	Thickness (mm)	JRC	JCR	From	To	Type	From	To	ADDITIONAL TESTING OR COMMENTS, SAMPLES COLLECTED
	Limestone	122	392?	393.0	0.7	N	0.7	0			R3	W2																Where did this recovery come from? No short runs previous
	Limestone	123	393.0	398.0	4.7	N	4.4	2	3	0	R3	W2	395.9	J	1	P	R	CL	3	14	6.0							
													396.9	J	1	P	R	CL	6	10	0.0							
	Limestone	124	398.0	403.0	5.0	N	3.4	6	9	6	R3	W2	399.8	J	1	50	U	R	CL	1	14.0	12						
													400.5	J	1	50	P	VR	Gc	8	18.0	6						
	Limestone	125	403.0	408.0	5.0	N	5.0	0			R3	W2																
	Limestone	126	408.0	413.0	5.0	N	5.0	0			R3	W2																
	Limestone	127	413.0	418.0	4.6	N	4.1	2	16	12	R3	W2	413.4	J	1	50	IR	VR	CL	1	16.0	12						
													414.8	J	1	45	P	R	CL	C	12.0	20						
	Limestone	128	418.0	423.0	4.9	N	3.8	7	13	6	R3	W2														419.2	419.4	
													420.7	J	1	70	P	R	CL	C	10.0	20						Break through chert nodule
													421.5	J	1	30	P	R	Gc	8	8.0	6						
																										422.2	422.3	
	Limestone w/ frequent chert bands	129	423.0	428.0	5.0	Y	3.5	10			R3	W2	423.3	J	1	50	P	R	CL	3	10.0	6						
													424.2	J	1	40	P	R	CL	2	12.0	6						
													427.5	J	1	50	P	R	Ca	3	10.0	12						
	Limestone	130	428.0	432.0	4.0	N	1.8	5	6	6	R3	W2	429.2	J	1	50	P	R	Sc	2	12.0	6						
																										430.1	430.3	
	Limestone	131	432.0	433.0	1.0	N	1.0	0			R3	W2																
	Limestone	132	433.0	435.0	1.3	N	1.1	2	12	12	R3	W2	434.4	J	R	50	P	R	Ca	1	14.0	12						Milled rubble recovered at top of run
	Limestone	133	435.0	436.5	1.5	N	1.5	1	12	12	R3	W2	435.9	J	1	40	P	VR	CL	1	16.0	12						

PERMANENTE QUARRY RMR SYSTEM - RECORD OF GEOTECHNICAL PARAMETERS

Project No.	063-7109.100	Drilling Method	Triple Tube HQ	From	15.0	To	268	Sheet	1 of 8
Borehole #	GT 1-4	Azimuth	NA					Logged by	IT
Elevation	1119	Inclination	-90					Drill Rig	Ruen
N	-213	E	-5155	Ref. Point					

Core Dia: Depth	ROCK TYPE	RUN	Run Data: Recovery & Other Basic Information: From (ft.)	To (ft.)	Recovery (ft.)	Bedding Dominant (Y/N)	RQD (ft.)	Natural Fracture Count	JCR: Average	Minimum	Strength Index: Strength Index	Weathering Index	Detailed Discontinuity Data: Depth (ft.)	Type	Count	α	Shape	Roughness	Infill	Thickness (mm)	JRC	JCR	Rubble/Gouge: Gouge: From	To	Type	Broken Core: From	To	ADDITIONAL TESTING OR COMMENTS, SAMPLES COLLECTED
HQ	MetaBasalt	1	15.0	17.0	1.3	NO	0.0	10	0	0	R3	W4																Pieces of basalt in clay
	MetaBasalt	2	17.0	18.0	0.8	NO	0.0	10	0	0	R3	W4																
	MetaBasalt	3	18.0	20.5	2.2	NO	0.8	2	18	16	R3	W4	18.2	J	1	70	P	VR	CL	2	16.0	16						Solid recovery
													18.8	J	1	40	P	R	CL	C	10.0	20						
	MetaBasalt healed fault zone-fine breccia	4	20.5	23.0	2.5	NO	2.1	3	19	16	R3	W4	21.7	J	1	75	C	R	CL	C	12.0	20						
													22.3	J	1	65	P	R	CL	2	8.0	16						
													22.4	J	1	45	P	R	CL	C	14.0	20						
	MetaBasalt - Ca healed breccia	5	23.0	27.5	2.3	NO	1.5	10	20	20	R3	W4	23.5	J	1	50	P	S	CL	C	6.0	20						Below 24.7 clay supported fragments
	MetaBasalt	6	27.5	30.0	0.0																							no recovery
	MetaBasalt	7	30.0	33.0	1.1	NO	0.6	1	6	6	R2	W4	32.6	J	1	40	P	R	CL	10	8.0	6						Cay below break may be drill related? Clay to end of Run
	MetaBasalt	8	33.0	38.0	4.2	NO	2.0	10	15	12	R2	W4	34.5	J	1	15	P	R	CL	1	8.0	12						Break not quite continuous throughout, truncated on lower end b other break at 34.7
													34.7	J	1	50	P	R	CL	2	10.0	12						
													36	J	1	35	P	R	CL	C	8.0	20						Below 36.9 highly weathered clayey basalt
	Weathered Basalt	9	38.0	43.0	3.8	NO	0.0	50	2	0	S4	W4																Basalt in run highly weathered into clay, Ca veins remain solid i soft matrix
																												Run extensively weathered to clay except places where Ca veinin is so extensive that rock held together
	Weathered Basalt	10	43.0	48.0	4.6	NO	1.1	20	2	0	R2	W4																Some greenstone clasts appearing toward end, greenstone dominant below 47.2
	Fault Breccia	11	48.0	53.0	4.2	NO	0.8	50	12	12	R2	W4	51.3	V	1	30	C	R	CA	1	12.0	12	48.0	49.5	CL			Greenstone clay gouge at top of run S4
	Fault Breccia	12	53.0	54.0	0.5	NO	0.0		12	12	R2	W4																Entire recovery broken up
	Greenstone	13	54.0	57.0	2.3	NO	0.8	10	5	0	R2	W4											56.3	57.0	CL			Fault gouge below 56.3, top of run solid but weak
	Greenstone	14	57.0	59.0	1.5	NO	0.0	10	5	0	R2/S4	W4	58.7	B	3	70	P	S	\	\	6.0	12	57.0	57.8	CL			Greenstone fault gouge, some solid fragments suspended, break along bedding?
	Greenstone	15	59.0	63.0	4.0	NO	3.7	2	12	12	R3	W3	60.5	V	1	30	P	R	CA	1	8.0	12						Core solid but weak, top .3 ft fault gouge
													61.9	V	1	30	P	R	CA	2	12.0	12						
	Fault Breccia	16	63.0	65.0	2.0	NO	0.0	10	6	0	R2	W3																Entire run brecciated, gouge in places
	Fault Breccia	17	65.0	68.5	3.5	NO	0.0	40	0	0	S4	W4											65.0	68.5	GC			Entire run soft clayey gouge, original structures visible but a converted to soft clay
	Greenstone gouge	18	68.5	71.0	1.8	NO	0.0	20	0	0	S4	W4											68.5	71.0	GC			Entire run clayey gouge w/ gravels
	Metabasalt/greenstone	19	71.0	75.0	3.7	NO	0.8	10	12	12	R2	W4	72.6	J	4	60	P	R	CL	1	10.0	12						Breaks through thin greenstone clay bands within metabasalt
													72.9	J	1	20	P	R	CL	1	12.0	12						
													73.3	J	1	30	P	R	CL	2	14.0	12						Breaks along greenstone clay flow bands .
													74	J	1	30	P	R	CL	2	14.0	12						Below 74.3 gouge gc metabasalt
	Metabasalt	20	75.0	80.0	4.9	NO	3.6	10	6	0	R3	W4											75.8	76.4	CL			Solid core except for gouge zones
																							78.2	78.4	GC			
																							78.7	79.6	CL			sample for point load testing 77.4-77.9
	Metabasalt	21	80.0	82.0	1.4	NO	1.3	10	6	0	R2	W4											81.1	82.0	GC			Weak gougy rock

			Run Data																				Rubble/Gouge					
			Recovery & Other Basic Information						JCR		Strength Index		Detailed Discontinuity Data										Gouge			Broken Core		
Core Dia: Depth	ROCK TYPE	RUN	From (ft.)	To (ft.)	Recovery (ft.)	Bedding Dominant (Y/N)	RQD (ft.)	Natural Fracture Count	Average	Minimum	Strength Index	Weathering Index	Depth (ft.)	Type	Count	α	Shape	Roughness	Infill	Thickness (mm)	JRC	JCR	From	To	Type	From	To	ADDITIONAL TESTING OR COMMENTS, SAMPLES COLLECTED
	Greenstone/metabasalt	22	82.0	85.5	3.5	NO	2.1	10	12	6	R2	W4	82.8	J	1	30	P	S	CA	2	12.0							Increasing gouge below 83.8
	MetaBasalt/Greenstone	23	85.5	90.0	4.5	NO	1.8	25	6	0	R1	W4																Entire run very weak, friable, varyingly gougy
	Greenstone/Metabasalt 24		90.0	93.0	3.0	NO	3.0	0	25	25	R3	W3	92.7	C														Solid unbroken run, point load 91.4-91.7
	Metabasalt	25	93.0	97.5	4.3	NO	3.4	8	15	12	R3	W3	93.9	J	1	25	P	R	GRE ENST	1	14.0	12						bottom, of break enters brecciated zone 0.3 ft
													95.2	J	1	20	P	R	CA	2	8.0	12						
													96.5	J	1	50	P	S	CL	C	6.0	20						back into soft greenstone below 96.5
	Greenstone	26	97.5	102.5	5.0	NO	0.0	25	6	0	R2	W4																run composed of solid clasts within clayey matrix usually in thi bands, sample 98.4-98.9
	Metabasalt	27	102.5	107.0	4.2	NO	2.8	5	12	12	R2	W4	104.4	J	1	50	IR	R	CL	1	10.0	12						
													105.6	J	1	30	P	R	CA	1	8.0	12						
	Metabasalt run fractured clayey gouge	28	107.0	110.5	3.4	NO	1.2	10	6	6	R2	W4	1090	J	1	30	P	R	CL	3	14.0	6						Contact between relatively solid section above and clayey gouge below
	Metabasalt	29	110.5	113.0	2.3	NO	1.4	8	6	6	R2	W4	112.1	J	5	40	P	R	GC	2	8.0	6						Sample 110.5-111 break through weak brittle rock ;gougy
	Metabasalt	30	113.0	118.0	4.7	NO	2.4	15	12	12	R2	W4	116	J	1	30	P	R	CA	1	8.0	12						
													117	J	1	30	P	R	CA	1	8.0	12						
	Metabasalt	31	118.0	123.0	4.7	NO	1.9	20	16	12	R2	W4	119.1	J	1	40	P	S	CL	1	6.0	20						preexisting separation, obvious crack but only came apart upon handling
													120.2	J	1	50	P	VR	CA	1	18.0	12				122.0	123.0	entire run brittle but bottom entirely broken
	Metabasalt 32		123.0	128.0	5.0	NO	4.5	5	6	6	R2	W4	127.5	J	1	30	P	S	CL	3	6.0	6	127.5	128.0	cl			
	Metabasalt gouge	33	128.0	132.5	2.8	NO	0.0	25	6	6	S4	W4											128.0	132.5	gc			entire run milled gravely clay
	Metabasalt gouge	34	132.5	136.0	1.0	NO	0.4	10	0	0	S4	W4																
	Fault Breccia	35	136.0	138.0	1.3	NO	0.0	10	12	12	R2	W4	137.6	J	1	40	P	R	CL	C	8.0	12						
	Fault Breccia	36	138.0	140.0	2.0	NO	1.5	3	6	6	R2	W4	138.3	J	1	60	P	R	CL	3	10.0	6						sample 139.4-140
	Metabasalt	37	140.0	142.5	2.3	NO	2.2	1	6	6	R2	W4	141.9	J	1	40	P	VR	CL	2	16.0	6						run appears like welded gouge-soft sed deformation features throughout
	Metabasalt	38	142.5	146.0	3.2	NO	1.6	25	6	0	R1	W4																run solid but rock either friable or tight s6 clay
	Metabasalt	39	146.0	149.0	1.6	NO	0.0	10	12	12	R2	W4	147.9	J	3	45	P	R	CL	1	12.0	12	148.7	149.0	GC			several similarly oriented breaks throughout "solid" upper portion of run
	Metabasalt	40	149.0	150.0	1.0	NO	0.0	10	6	6	R2	W4																run broken up- weak brittle rock
	Greenstone/MetaBasalt	41	150.0	151.5	1.5	NO	0.6	20	20	20	R2	W4	130.7	J	1	50	P	S	\	\	6.0	20	150.5	151.5	GC			milled greenstone gouge becoming increasingly rich toward end of run
	Greenstone/ MetaBasalt	42	151.5	153.0	1.5	NO	0.0	10	6	0	R1	W4																entire run gouge/clay rich fractured/ weak
	Metabasalt	43	153.0	155.0	1.6	NO	0.0	20	6	0	R1	W4																entire run milled gravel/ clay, core barrel holds together in split
	Metabasalt	44	155.0	157.0	1.6	NO	0.0	10	6	6	R2	W4	155.5	J	1	40	P	R	GC	3	10.0	6						break along contact with clayey greenstone bit - one of several gouge areas
	Metabasalt	45	157.0	160.0	3.0	NO	1.4	10	25	25	R1	W4	157.3	J	1	40	P	S	CL	1	6.0	25						run extensively broken due to weakness but no natural break observable, thin clay infill common but not extensive
	Metabasalt	46	160.0	163.0	3.0	NO	0.0	10	25	25	R1	W4																no observable breaks through core, entire run fragmented
	Metabasalt	47	163.0	166.0	3.0	NO	2.0	10	16	16	R1	W4																entire run brittle fragmented
	Metabasalt	48	166.0	169.0	2.8	NO	0.0	10	18	16	R1	W4	167	J	1	10	P	R	CL	0.5	10.0	20						brittle, fragmented
													168.3	J	1	35	P	R	CL	1	8.0	16						
	Metabasalt	49	169.0	171.0	1.8	NO	0.0		20	20	R1	W4	171.2	J	1	45	P	R	CL	0.5	12.0	20						brittle, fragmented
	Metabasalt	50	171.0	174.5	2.5	NO	0.4	20	0	0	R1	W4	173	J	1	60	P	S	CL	40	6.0	0	173.8	174.5	GC			clayey gouge between solid material, entire run highly fractured
	Metabasalt	51	171.0	174.5	2.5	NO	0.4	20	9	6	R1	W4	174.9	J	1	55	P	S	CL	80	6.0	0	175.0	175.8				
													176.2	J	1	67	P	SR	CL	1	8.0	6						

Core Dia: Depth	ROCK TYPE	RUN	Run Data: Recovery & Other Basic Information: From (ft.)	To (ft.)	Recovery (ft.)	Bedding Dominant (Y/N)	RQD (ft.)	Natural Fracture Count	JCR: Average	Minimum	Strength Index: Strength Index	Weathering Index	Detailed Discontinuity Data: Depth (ft.)	Type	Count	α	Shape	Roughness	Infill	Thickness (mm)	JRC	JCR	Rubble/Gouge: Gouge: From	To	Type	Broken Core: From	To	ADDITIONAL TESTING OR COMMENTS, SAMPLES COLLECTED
	Metabasalt	52	178.0	183.0	4.2	NO	0.0	10	0	0	R1	W4	178.5	J	1	65	P	S	CL	10	6.0	0						breaks along clay gouge layers
													179.1	J	2	50	P	R	CL	5	8.0	0						entire run highly fractured
	Fault Breccia	53	183.0	186.0	2.3	NO	0.6	25	0	0	R2	W4											183.6	186.0	Gc			
	Fault Breccia	54	186.0	188.5	2.3	NO	0.0	25	0	0	S4	W4											186.0	188.5	Gc			entire run gouge
	Fault Breccia	55	188.5	192.0	3.3	NO	1.2	25	0	0	S4	W4	190.5	J	1	50	P	VR	CL	4	20.0	6	1885.5	190	GC			
													190.7	J	1	40	P	R	CL	3	8.0	6						complete break through brecciated core
	Fault Breccia	56	192.0	194.0	1.2	NO	0.0	10	6	6	R2	W4	193.6	J	1	60	P	S	CL	2	2.0	6	192.8	194.0	GC			run either shattered rock or milled gouge
	Fault Breccia	57	194.0	199.0	4.1	NO	0.0		13	6	R1	W4	197.9	J	1.0	60	P	S	CL	2	8.0	6						sample 196.6-197.3
													198.8	J	1.0	65	S	SR	CL	1	8.0	20	195.0	196.5	GC			
	Fault Breccia	58	199.0	203.0	4.0	NO	0.5	30	25	25	R1	W4	202.5	C	1	45	P					25						metabasalt gouge/ greenstone contact sample 201.6-202.4
	Fault Breccia	59	203.0	208.0	4.9	NO	0.7	40	25	25	S4	W4	203.7	C	1	30	5					25	203.7	208.0	GC			greenstone/ metabasalt contact- other end of unit at bottom of previous run
																												solid gravely clay containing some large >6" clasts, run falls apar easily
	Greenstone	60	208.0	213.0	5.0	NO	5.0	0	25	12	R1	W4																very soft, easily broken into pieces but removed intact
	Greenstone	61	213.0	218.0	5.0	NO	5.0	0	6	0	R1	W4																
	Greenstone	62	218.0	221.5	3.7	NO	2.8	1	6	6	R2	W4	220.4	J	1	35	P	S	CL	4	6.0	6						harder, mostly intact/ sample 218-218.3
	Greenstone	63	221.5	223.0	1.5	NO	1.5	1	12	12	R2	W2	221.9	j	1	40	P	S	CL	1	6.0	12						
	Greenstone	64	223.0	228.0	4.2	NO	3.9	10	8	6	R1	W4	224.9	J	1	65	P	R	CA	1	14.0	6				224.1	224.6	
													225.1	J	1	50	P	VR	CL	1	16.0	12						highly fractured basalt inclusion, fracture angles average 60 degrees
													227.2	J	1	20	U	R	CA	2	8.0	6						
	Greenstone/ metabasalt	65	228.0	231.0	2.8	NO	0.7	25	12	12	S4	W4	230.1	C	1	60	C	R	CL	1	10.0	12	228.0	230.2				contact between gougy material above and solid graywacke? Below . Sample 230.3-231
	Metabasalt	66	231.0	233.0	1.7	NO	1.2	6	12	12	R2	W3	231.8	J	3	30	P	R	CA	C	12.0	12						multiple fractures, maybe drill induced through brittle rock
	Metabasalt	67	233.0	235.5	2.2	NO	0.4	5	4	0	R2	W3	233.6	J	1	30	P	R	CL	3	10.0	6						entire run brittle, highly fractured
													234.2	J	1	70	P	R	CL	5	8.0	0						
													234.6	J	1	30	P	S	CL	2	6.0	6						
	Metabasalt	68	235.5	239.5	3.9	NO	3.4	4	10	6	R2	W3	236	J	1	35	P	R	CL	1	8.0	12						
													237.1	J	1	40	P	S	CA	C	6.0	12						
													238.1	J	1	40	P	R	CL	2	10.0	6						sample 238.5-239.1 break along edge of thick ca vein
													239.2	J	1	40	P	R	CA	1	10.0	12						
	Metabasalt	69	239.5	240.5	0.7	NO	0.0	2	12	12	R2	W3																broken run
	Metabasalt	70	240.5	243.0	2.0	NO	1.1	3	6	0	R2	W3	241.1	J	1	50	P	S	CL	C	6.0	12						
													241.6	J	1	40	P	R	GC	15	12.0	0						
													243.5	J	1	60	P	S	CL	C	6.0	12						
	MetaBasalt	71	243.0	248.0	4.8	NO	2.1	10	12	12	R2	W3	243.9	J	1	30	P	R	L	C	8.0	12						transition between relatively unbroken core and highly fractured 245.9
													244.7	J	1	55	P	S	GC	2	6.0	12						sample 244-244.7
	Metabasalt	72	248.0	250.0	1.8	NO	0.0	0.7	6	0	R2	W3	248.7	J	1	40	P	R	CA	2	8.0	12						
													249.6	J	1	30	P	S	CL	100	6.0	0						contact between solid rock and clay gouge
	Metabasalt	73	250.0	252.5	2.4	NO	0.0	10	8	6	R2	W3	250.9	J	1	30	P	R	CL		10.0	6						

			Run Data																				Rubble/Gouge					
			Recovery & Other Basic Information						JCR		Strength Index		Detailed Discontinuity Data										Gouge			Broken Core		
Core Dia: Depth	ROCK TYPE	RUN	From (ft.)	To (ft.)	Recovery (ft.)	Bedding Dominant (Y/N)	RQD (ft.)	Natural Fracture Count	Average	Minimum	Strength Index	Weathering Index	Depth (ft.)	Type	Count	α	Shape	Roughness	Infill	Thickness (mm)	JRC	JCR	From	To	Type	From	To	ADDITIONAL TESTING OR COMMENTS, SAMPLES COLLECTED
													251.5	J	1	30	P	R	CA		12.0	6						
													252	J	1	40	P	R	\	\	8.0	12						
	Metabasalt	74	252.5	255.5	3.0	NO	1.9	4	12	12	R2	W4	253.1	J	2	60	P	R	\	\	10.0	12						brittle rock moderately fractured, few Ca veins
													255	J	2	70	P	R	CL	1	10.0	12						
	Metabasalt	75	255.5	260.0	4.3	NO	2.3	15	10	6	R2	W4	255.7	J	1	25	P	R	CA	2	8.0	12						
													257.8	J	1	40	P	R	CL	1	12.0	12						
													258	J	1	40	P	R	CL	2	10.0	6	258.7	260.0	GC			gouge at bottom of run
	Metabasalt	76	260.0	263.0	3.0	NO	0.0	25	6	6	R2	W4											260.0	261.3	GC			gouge with some large solid clasts
																							261.7	262.1	GC			
	Metabasalt	77	263.0	266.0	2.5	NO	1.2	15	6	6	R2	W4	264.7	J	2	40	P	R	CL	2	14.0	6	264.1	264.4				
																							265.2	266.0				
	Metabasalt	78	266.0	268.0	1.7	NO	1.7	25	6	6	R2	W4											267.0	268.0				

APPENDIX 9.B

Point Load 2008 Drilling

Hole Number	Depth	Lithology	Test Type	Gauge Load	Failure Type	Is_{50}
	m		(D or A)	(lbf)	1, 2, 3, 4 or 5	(lbf/in^2)
GT1-1-08	14.0	Metabasalt	D	1210	1	216
GT1-1-08	14.0	Metabasalt	A	1195	4	171
GT1-1-08	15.5	Metabasalt	D	1250	1	231
GT1-1-08	19.0	Metabasalt	D	1800	1	333
GT1-1-08	27.0	Metabasalt	D	2000	1	370
GT1-1-08	32.0	Metabasalt	D	1900	1	351
GT1-1-08	41.0	Metabasalt	D	1400	1	259
GT1-1-08	41.5	Metabasalt	A	2000	4	292
GT1-1-08	42.5	Metabasalt	A	2000	1	448
GT1-1-08	55.0	Metabasalt	D	3600	1	683
GT1-1-08	59.3	Greenstone	D	1205	1	228
GT1-1-08	59.3	Greenstone	A	970	4	170
GT1-1-08	59.5	Greenstone	D	1500	4	277
GT1-1-08	66.5	Metabasalt	D	460	3	85
GT1-1-08	67.4	Metabasalt	D	1270	4	308
GT1-1-08	68.0	Metabasalt	D	1000	1	185
GT1-1-08	69.0	Metabasalt	D	1600	1	296
GT1-1-08	71.0	Limestone	D	3000	4,3	555
GT1-1-08	73.0	Limestone	D	3000	1	555
GT1-1-08	74.0	Limestone	D	4500	4	832
GT1-1-08	77.0	Limestone	D	2800	1	531
GT1-1-08	84.0	Metabasalt	D	400	1	74
GT1-1-08	93.5	Graywacke	D	5400	1	998
GT1-1-08	106.5	Greenstone	D	200	2	37
GT1-1-08	109.0	Greenstone	D	1900	4	351
GT1-1-08	112.0	Greenstone	D	75	2	14
GT1-1-08	130.0	Graywacke	D	850	1	157
GT1-1-08	133.0	Graywacke	D	3500	1	647
GT1-1-08	151.0	Limestone	D	3000	1	1346
GT1-1-08	152.0	Limestone	D	3800	1	1386
GT1-1-08	165.0	Limestone	D	1000	1	412
GT1-1-08	171.5	Limestone	D	1100	1	493
GT1-1-08	178.0	Limestone	D	1200	1	494
GT1-1-08	186.0	Limestone	D	600	1	237
GT1-1-08	190.0	Limestone	D	3500	1	1183
GT1-1-08	198.0	Limestone	D	1250	1	561
GT1-1-08	210.5	Limestone	D	900	1	487
GT1-1-08	219.0	Limestone	D	3200	1	1374
GT1-1-08	228.0	Limestone	D	1100	1	453
GT1-1-08	231.0	Limestone	D	600	1	360
GT1-1-08	242.0	Limestone	D	100	1	38
GT1-1-08	252.5	Limestone	D	2500	1	1289
GT1-1-08	264.0	Limestone	D	1100	1	203
GT1-1-08	294.0	Graywacke	D	1100	4	203
GT1-1-08	299.0	Limestone	D	1150	1	213
GT1-1-08	312.0	Limestone	D	3300	1	1303
GT1-1-08	317.0	Limestone	D	1200	1	233
GT1-1-08	322.0	Chert	L	2000	2	236
GT1-1-08	332.0	Limestone	D	1800	1	350
GT1-1-08	349.5	Chert	D	1000	1	190

Hole Number	Depth	Lithology	Test Type	Gauge Load	Failure Type	Is_{50}
	m		(D or A)	(lbf)	1, 2, 3, 4 or 5	(lbf/in^2)
GT1-1-08	359.0	Limestone	D	1100	2	209
GT1-1-08	368.5	Chert	D	25	2	5
GT1-1-08	373.5	Limestone	D	3800	1	721
GT1-1-08	382.7	Limestone	D	3000	1	584
GT1-1-08	383.0	Limestone	D	3500	1	664
GT1-1-08	398.0	Chert	D	4000	1	758
GT1-1-08	399.0	Chert	D	5000	1	924
GT1-1-08	408.0	Limestone	A	500	2	75
GT1-1-08	422.0	Limestone	D	1000	1	190
GT1-1-08	423.5	Limestone	D	500	2	95
GT1-1-08	432.0	Limestone	D	1500	2	284
GT1-1-08	436.0	Chert	D	2200	1	417
GT1-1-08	442.0	Metabasalt	D	150	2	28
GT1-1-08	446.0	Limestone	D	600	2	114
GT1-1-08	452.0	Limestone	D	1500	2	284
GT1-1-08	462.5	Limestone	D	2000	4	379
GT1-1-08	467.0	Limestone	D	1000	2	190
GT1-1-08	470.0	Limestone	D	4500	1	853
GT1-2-08	16.0	Graywacke	D	4000		740
GT1-2-08	24.0	Graywacke	D	7000	1	1294
GT1-2-08	27.0	Graywacke	D	5500	1	1017
GT1-2-08	30.0	Graywacke	D	7500	1	1387
GT1-2-08	42.0	Graywacke	D	2000	1	370
GT1-2-08	48.5	Graywacke	D	4000	1	740
GT1-2-08	56.0	Graywacke	D	1000	2	185
GT1-2-08	91.0	Graywacke	D	2700	1	499
GT1-2-08	100.0	Graywacke	D	3200	1	656
GT1-2-08	116.0	Graywacke	D	4000	4	740
GT1-2-08	129.0	Graywacke	D	4500	1	832
GT1-2-08	133.0	Graywacke	D	1500	1	277
GT1-2-08	144.0	Graywacke	D	800	1	156
GT1-2-08	154.0	Greenstone	D	100	2	18
GT1-2-08	154.5	Greenstone	D	600	1	111
GT1-2-08	161.0	Limestone	D	2700	1	1211
GT1-2-08	171.0	Limestone	D	2200	1	1081
GT1-2-08	186.0	Limestone	D	1500	1	773
GT1-2-08	195.0	Limestone	D	1300	1	558
GT1-2-08	200.0	Limestone	D	2000	1	859
GT1-2-08	212.0	Limestone	D	750	2	406
GT1-2-08	214.0	Chert	D	300	2	55
GT1-2-08	218.0	Chert	D	500	1	92
GT1-2-08	230.0	Limestone	D	4000	1	740
GT1-2-08	232.5	Limestone	D	4000	1	721
GT1-2-08	237.5	Limestone	D	2000	2	370
GT1-2-08	245.0	Limestone	D	2000	1	897
GT1-2-08	253.5	Limestone	D	2500	1	1121
GT1-2-08	261.5	Limestone	D	1500	2	704
GT1-2-08	268.5	Limestone	D	4500	1	1467
GT1-2-08	275.0	Limestone	D	1000	1	449

Hole Number	Depth	Lithology	Test Type	Gauge Load	Failure Type	Is_{50}
	m		(D or A)	(lbf)	1, 2, 3, 4 or 5	(lbf/in^2)
GT1-2-08	287.0	Limestone	D	2100	1	985
GT1-2-08	292.0	Limestone	D	1400	2	473
GT1-2-08	298.0	Limestone	D	2700	1	948
GT1-2-08	329.0	Limestone	D	1000	3	258
GT1-2-08	336.0	Limestone	D	500	2	258
GT1-2-08	350.0	Limestone	D	700	1	276
GT1-2-08	362.0	Limestone	D	1000	1	395
GT1-2-08	371.0	Limestone	D	1100	1	417
GT1-2-08	376.0	Limestone	D	2200	1	802
GT1-2-08	382.8	Limestone	D	730	1	222
GT1-2-08	394.0	Limestone	D	1800	1	773
GT1-2-08	404.5	Limestone	D	2000	1	676
GT1-2-08	409.6	Limestone	D	2100	1	398
GT1-2-08	413.0	Limestone	D	2500	1	987
GT1-2-08	423.5	Limestone	D	500	2	235
GT1-2-08	429.0	Limestone	D	2000	1	1083
GT1-2-08	440.0	Limestone	D	3000	1	1346
GT1-2-08	446.0	Limestone	D	2200	1	668
GT1-2-08	448.8	Limestone	D	3500	1	664
GT1-2-08	448.8	Limestone	A	1200	4	290
GT1-2-08	461.0	Limestone	D	3500	1	1063
GT1-2-08	471.0	Limestone	D	2200	1	945
GT1-2-08	474.0	Limestone	D	3500	1	1276
GT1-2-08	476.5	Limestone	D	3400	1	645
GT1-2-08	476.5	Limestone	A	1160	1	269
GT1-3-08	40.0	Graywacke	D	2600	1	493
GT1-3-08	49.0	Graywacke	D	2500	1	462
GT1-3-08	69.0	Graywacke	D	6000	1	1138
GT1-3-08	84.5	Graywacke	D	500	2	92
GT1-3-08	89.0	Graywacke	D	1900	3	351
GT1-3-08	104.0	Graywacke	D	4200	1	777
GT1-3-08	121.0	Graywacke	D	4500	1	832
GT1-3-08	137.0	Graywacke	D	1000	2	185
GT1-3-08	142.0	Graywacke	D	5500	1	1017
GT1-3-08	151.0	Graywacke	D	6500	1	1202
GT1-3-08	174.0	Limestone	D	2000	1	983
GT1-3-08	177.0	Limestone	D	3500	1	1642
GT1-3-08	184.0	Limestone	D	2000	1	1031
GT1-3-08	191.0	Limestone	D	3200	1	1264
GT1-3-08	200.0	Limestone	D	2300	1	947
GT1-3-08	205.0	Limestone	D	3000	1	1346
GT1-3-08	217.0	Limestone	D	1500	3	547
GT1-3-08	222.0	Limestone	A	3200	1	782
GT1-3-08	223.5	Limestone	D	2000	1	823
GT1-3-08	229.5	Limestone	D	3000	1	978
GT1-3-08	238.0	Limestone	D	2600	1	1116
GT1-3-08	245.0	Limestone	D	3500	1	1570
GT1-3-08	258.0	Limestone	D	3800	1	1285
GT1-3-08	266.0	Limestone	D	3500	1	1570

Hole Number	Depth	Lithology	Test Type	Gauge Load	Failure Type	Is_{50}
	m		(D or A)	(lbf)	1, 2, 3, 4 or 5	(lbf/in^2)
GT1-3-08	279.0	Limestone	D	3400	1	1290
GT1-3-08	288.0	Limestone	D	900	2	355
GT1-3-08	294.0	Limestone	D	2800	1	1021
GT1-3-08	305.0	Limestone	D	3000	1	1346
GT1-3-08	314.0	Limestone	D	2200	1	802
GT1-3-08	320.0	Limestone	D	2000	1	823
GT1-3-08	323.5	Limestone	D	2200	1	987
GT1-3-08	334.0	Limestone	D	3800	1	1386
GT1-3-08	352.0	Limestone	D	2500	1	987
GT1-3-08	361.0	Limestone	D	2600	1	1220
GT1-3-08	369.0	Limestone	D	1900	1	852
GT1-3-08	382.0	Limestone	D	3500	1	1276
GT1-3-08	390.5	Limestone	D	3000	1	1288
GT1-3-08	398.0	Limestone	D	2200	1	987
GT1-3-08	402.0	Limestone	D	1800	1	1081
GT1-3-08	415.0	Limestone	D	3800	1	1386
GT1-4-08	22.0	Metabasalt	D	550	1	102
GT1-4-08	35.0	Metabasalt	D	450	1	83
GT1-4-08	44.5	Metabasalt	D	300	1	57
GT1-4-08	60.0	Greenstone	D	3500	1	647
GT1-4-08	90.5	Metabasalt	D	800	1	148
GT1-4-08	95.8	Metabasalt	D	3800	1	703
GT1-4-08	105.5	Metabasalt	D	1100	1	203
GT1-4-08	117.0	Metabasalt	D	3000	1	555
GT1-4-08	122.0	Metabasalt	D	4000	2	740
GT1-4-08	137.0	Metabasalt	D	200	2	37
GT1-4-08	159.0	Metabasalt	D	10	2	2
GT1-4-08	183.5	Metabasalt	D	3000	1	569
GT1-4-08	223.5	Greenstone	D	350	3	65
GT1-4-08	236.0	Metabasalt	D	2500	1	462
GT1-4-08	245.5	Metabasalt	D	2000	1	370
GT1-4-08	253.5	Metabasalt	D	400	2	76
GT1-4-08	264.5	Metabasalt	D	420	2	80

APPENDIX 9.C

Lab Results 2008 Drilling

UNCONFINED COMPRESSIVE STRENGTH
ASTM D 7012; Method C (Previously ASTM D 2938)

CLIENT: Golder Associates

JOB NO.: 2003-118

LOCATION:

DATE TESTE[5/5/08 HN

PROJECT: Hanson Permanente

Specimen ID Boring, Depth(ft.), Rock type	Diameter (in.)	Length (in.)	Mass (gms)	Wet Density (pcf)	Failure Load (lb)	Failure Types *	Compressive Strength (psi)
GT1-1-08, 41.4-41.9, Metabasalt	2.397	5.172	1046.40	170.8	20,790	F/S	4,610
GT1-1-08, 61.9-62.6, Greenstone	2.401	5.070	1027.10	170.5	6,965	F/S	1,540
GT1-1-08, 422.5-423.0, Limestone	2.400	5.136	981.10	160.9	7,815	F	1,730
GT1-2-08, 163.7-164.4, Limestone	2.388	5.308	1053.00	168.7	52,159	F	11,650
GT1-4-08, 196.6-197.3, Metabasalt	2.400	4.993	921.10	155.4	384	F/S	80

Notes and Comments: * Failure types S: Shear Failure, M: Matrix Failure, F: Failure due to Fracture/Bedding, V: Void Failure, C: Combination

Data Entered By: HN Date: 05/05/2008
Data Checked By: [illegible] Date: 05/06/08
Filename: GOUCSRC7

ADVANCED TERRA TESTING, INC. ATT

Moisture & Density Determinations
ASTM D 2216 & D 2937

CLIENT: Golder & Associates JOB NO.: 2003-118
LOCATION: Hanzen Permanente Project Site

BORING	GT1-1-08	GT1-1-08	GT1-1-08	GT1-2-08
SAMPLE DEPTH	41.40-41.90'	61.90-62.90'	422.50-423.00'	163.70-164.40'
SAMPLE NO.				
DATE SAMPLED				
DATE TESTED	05-01-08 HN	05-01-08 HN	05-01-08 HN	05-01-08 HN
ROCK DESCRIPTION	Metabasalt	Greenstone	Limestone	Limestone
DENSITY DETERMINATIONS				
Sample Height (IN)	5.172	5.070	5.136	5.308
Sample Diameter (IN)	2.397	2.401	2.400	2.388
Wt of Wet Rock (GMs)	1046.40	1027.10	987.70	1053.00
Sample Volume (CU Ft)	0.01351	0.01328	0.01345	0.01376
WET DENSITY (PCF)	170.8	170.5	161.9	168.7
DRY DENSITY (PCF)	167.7	166.7	161.4	168.7
MOISTURE DETERMINATIONS				
Wt. of Wet Rock & Dish (gms)	179.20	494.41	260.17	776.09
Wt. of Dry Rock & Dish (gms)	176.08	483.71	259.37	775.79
Net Loss of Moisture (gms)	3.12	10.70	0.80	0.30
Wt. of Dish (gms)	6.76	8.29	8.23	6.80
Wt. of Dry Rock (gms)	169.32	475.42	251.14	768.99
Moisture Content (%)	1.8	2.3	0.3	0.0

BORING	GT1-4-08	GT1-1-08	GT1-1-08	GT1-1-08
SAMPLE DEPTH	196.60-197.30'	20.10-20.60'	297.00-297.60'	434.40-435.00'
SAMPLE NO.				
DATE SAMPLED				
DATE TESTED	05-01-08 HN	05-01-08 HN	05-01-08 HN	05-01-08 HN
ROCK DESCRIPTION	Metabasalt	Metabasalt	Limestone	Limestone
DENSITY DETERMINATIONS				
Sample Height (IN)	4.993	5.431	5.119	5.337
Sample Diameter (IN)	2.400	2.394	2.430	2.398
Wt of Wet Rock (GMs)	927.00	1046.20	1045.30	1033.30
Sample Volume (CU Ft)	0.01307	0.01415	0.01374	0.01395
WET DENSITY (PCF)	156.3	163.0	167.7	163.3
DRY DENSITY (PCF)	148.9	154.6	167.4	162.8
MOISTURE DETERMINATIONS				
Wt. of Wet Rock & Dish (gms)	382.49	85.56	348.74	482.16
Wt. of Dry Rock & Dish (gms)	364.51	81.48	348.00	480.62
Net Loss of Moisture (gms)	17.98	4.08	0.74	1.54
Wt. of Dish (gms)	6.73	6.65	8.29	8.34
Wt. of Dry Rock (gms)	357.78	74.83	339.71	472.28
Moisture Content (%)	5.0	5.5	0.2	0.3

Data entered by: SR Date: 05/06/2008
Data checked by: W Date: 05/06/08
FileName: GOMDHANA

ADVANCED TERRA TESTING, INC. ATT

Moisture & Density Determinations
ASTM D 2216 & D 2937

CLIENT: Golder & Associates
LOCATION: Hanzen Permanente Project Site

JOB NO.: 2003-118

BORING	GT7-2-08	GT7-4-08
SAMPLE DEPTH	179.50-180.30'	201.60-202.40'
SAMPLE NO.		
DATE SAMPLED		
DATE TESTED	05-01-08 HN	05-01-08 HN
ROCK DESCRIPTION	Limestone	Metabasalt

DENSITY DETERMINATIONS		
Sample Height (IN)	5.301	5.473
Sample Diameter (IN)	2.398	2.418
Wt of Wet Rock (GMs)	1016.70	977.40
Sample Volume (CU Ft)	0.01385	0.01454
WET DENSITY (PCF)	161.8	148.2
DRY DENSITY (PCF)	161.6	140.0

MOISTURE DETERMINATIONS		
Wt. of Wet Rock & Dish (gms)	402.62	729.99
Wt. of Dry Rock & Dish (gms)	402.29	690.02
Net Loss of Moisture (gms)	0.33	39.97
Wt. of Dish (gms)	8.27	6.63
Wt. of Dry Rock (gms)	394.02	683.39
Moisture Content (%)	0.1	5.8

Data entered by: SR Date: 05/06/2008
Data checked by: D Date: 05/06/08
FileName: GOMDHANB

ADVANCED TERRA TESTING, INC. ATT

UNCONFINED COMPRESSIVE STRENGTH
ASTM D 7012; Method C (Previously ASTM D 2938)

CLIENT: Golder Associates Inc.

JOB NO.: 2003-119

LOCATION: Hanson Permanente Project Site

DATE TESTED: 6/10/08 HN

PROJECT: 063-7109x100

Specimen ID Boring, Depth(ft.), Rock type	Diameter (in.)	Length (in.)	Mass (gms)	Wet Density (pcf)	Failure Load (lb)	Failure Types **	Compressive Strength (psi)
GT1-2-08, 116.7-117.4, Graywacke	2.399	5.765	1131.30	165.4	809	F	180
GT1-2-08, 30.5-31.1, Graywacke	2.390	4.855	958.40	167.6	56,355	F	12,560
GT1-2-08, 59.2-59.7, Graywacke	2.388	4.956	976.70	167.6	20,140	F	4,500

Notes and Comments: * Failure types S: Shear Failure, M: Matrix Failure, F: Failure due to Fracture/Bedding, V: Void Failure, C: Combination

Data Entered By: HN Date: 06/10/2008
Data Checked By: W Date: 06/10/08
Filename: GOUCSRC2

ADVANCED TERRA TESTING, INC. ATT

Moisture & Density Determinations
ASTM D 2216 & D 2937

CLIENT: Golder Associates Inc. JOB NO.: 2003-119
LOCATION: Hanson Permanente, Project # 063-7109x100 Site

BORING	GT1-1-08	GT1-2-08	GT1-2-08	GT1-2-08
SAMPLE DEPTH	116.7-117.4'	30.5-31.1'	59.2-59.7'	25.5-26.4'
SAMPLE NO.				
DATE SAMPLED				
DATE TESTED	06/10/08 HN	06/10/08 HN	06/10/08 HN	06/10/08 HN
ROCK DESCRIPTION	Graywacke	Graywacke	Graywacke	Graywacke
DENSITY DETERMINATIONS				
Sample Height (IN)	5.765	4.855	4.956	5.391
Sample Diameter (IN)	2.399	2.390	2.388	2.389
Wt of Wet Rock (GMs)	1131.30	958.40	976.70	1062.70
Sample Volume (CU Ft)	0.01508	0.01260	0.01285	0.01398
WET DENSITY (PCF)	165.4	167.6	167.6	167.5
DRY DENSITY (PCF)	162.8	167.2	166.6	167.3
MOISTURE DETERMINATIONS				
Wt. of Wet Rock & Dish (gms)	485.78	227.20	229.98	791.45
Wt. of Dry Rock & Dish (gms)	478.41	226.69	228.58	790.22
Net Loss of Moisture (gms)	7.37	0.51	1.40	1.23
Wt. of Dish (gms)	8.21	6.73	6.69	8.26
Wt. of Dry Rock (gms)	470.20	219.96	221.89	781.96
Moisture Content (%)	1.6	0.2	0.6	0.2

BORING	GT1-3-08	GT1-4-08
SAMPLE DEPTH	74.8-75.5'	61.0-61.7'
SAMPLE NO.		
DATE SAMPLED		
DATE TESTED	06/10/08 HN	06/10/08 HN
ROCK DESCRIPTION	Graywacke	Greenstone
DENSITY DETERMINATIONS		
Sample Height (IN)	4.578	4.723
Sample Diameter (IN)	2.401	2.398
Wt of Wet Rock (GMs)	898.10	1027.70
Sample Volume (CU Ft)	0.01200	0.01234
WET DENSITY (PCF)	165.1	183.5
DRY DENSITY (PCF)	164.3	182.7
MOISTURE DETERMINATIONS		
Wt. of Wet Rock & Dish (gms)	550.23	422.87
Wt. of Dry Rock & Dish (gms)	547.59	420.90
Net Loss of Moisture (gms)	2.64	1.97
Wt. of Dish (gms)	8.39	8.29
Wt. of Dry Rock (gms)	539.20	412.61
Moisture Content (%)	0.5	0.5

Data entered by: DPM/HN Date: 06/12/2008
Data checked by: CU Date: 06/13/08
FileName: GOMDHPS

ADVANCED TERRA TESTING, INC. ATT

UNCONFINED COMPRESSIVE STRENGTH
With Stress / Strain Measurements
ASTM D 7012; Method D (Previously ASTM D 3148)

CLIENT: Golder Associates, Inc. JOB NO.: 2003-119

LOCATION: Hanson Permanente, Project #063-7109x100 Site DATE TESTED: 6/11-12/08 HN

Specimen ID			Diameter (in.)	Length (in.)	Mass (gms)	Wet Density (pcf)	Failure Load (lb)	Failure Type **	Compressive Strength (psi)	Young's Modulus (X10^6 psi)	Poisson's Ratio
Boring	Depth (ft.)	Rock type									
GT1-2-08	25.5-26.4	Graywacke	2.389	5.391	1062.70	167.5	56,750	S/F	12,660	6.63	0.108
GT1-3-08	74.8-75.5	Graywacke	2.401	4.578	898.10	165.1	16,750	S/F	*3680	5.13	0.276
GT1-4-08	61.0-61.7	Graywacke	2.398	4.723	1027.70	183.5	36,000	F/S	*7960	8.17	0.231

Notes and Comments:

* Indicates regardless of ASTM D 7012 method D, sample with L/D < 2.0.
was tested and correction factor for short sample was applied to the calculation.

$C=Ca/[0.88+0.24b/h]$

Ca = Failure Load / Surface Area

b = Sample Diameter

h = Sample Length

** Failure Type:

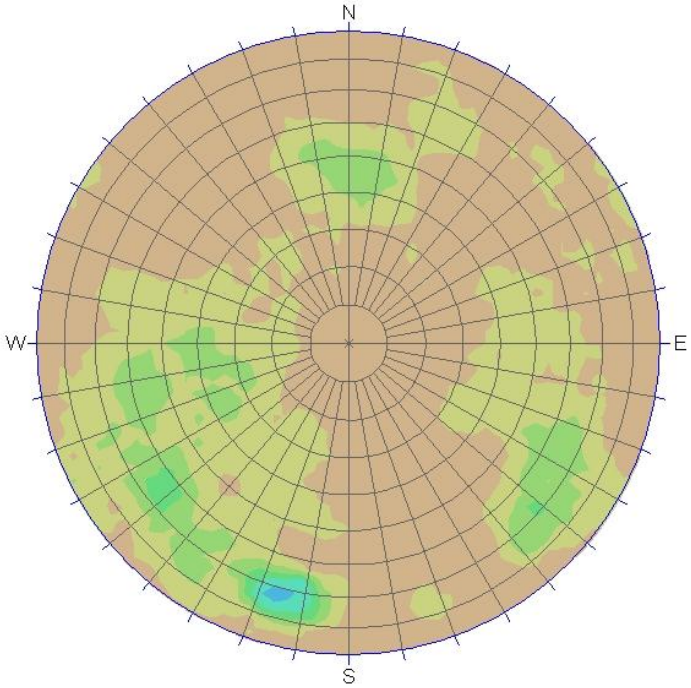
S: Shear Failure, M: Matrix Failure, F/V Fracture, Bedding/Void Collapse, C: Combination

Data Entered By: HN Date: 06/12/2008
Data Checked By: CJ Date: 06/13/08
Filename: GOUCSSR1

ADVANCED TERRA TESTING, INC. ATT

APPENDIX 9.D

Stereonets

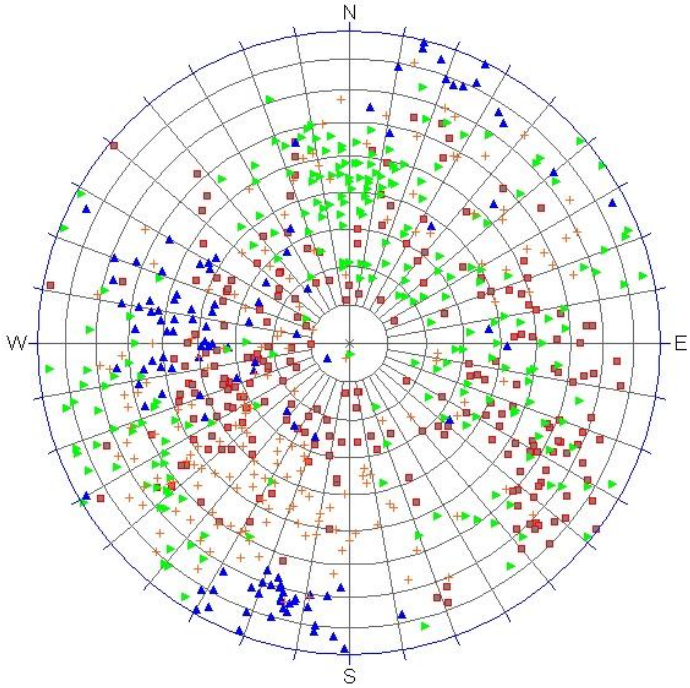


Schmidt
Concentrations
% of total per 1.0 % area

0.00 ~ 1.00 %
1.00 ~ 2.00 %
2.00 ~ 3.00 %
3.00 ~ 4.00 %
4.00 ~ 5.00 %
5.00 ~ 6.00 %
6.00 ~ 7.00 %
7.00 ~ 8.00 %
8.00 ~ 9.00 %
9.00 ~ 10.00 %

Terzaghi Correction
Min. Bias Angle = 15 deg
Max. Conc. = 5.5395%

Equal Area
Lower Hemisphere
756 Poles
756 Entries



DHID

GT1-1-08 [235]
GT1-2-08 [115]
GT1-3-08 [231]
GT1-4-08 [175]

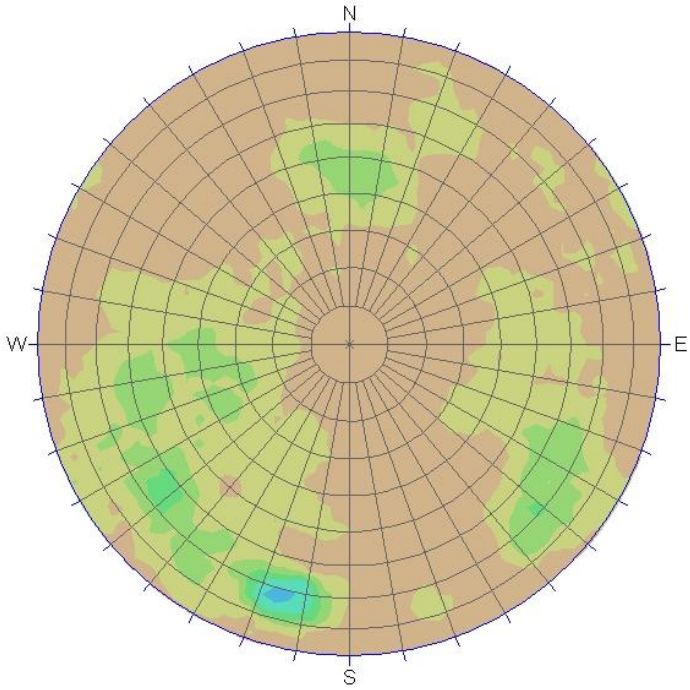
Equal Area
Lower Hemisphere
756 Poles
756 Entries

TITLE

ALL ORIENTED CORE DATA

Golder Associates

PROJECT No.	063-7109		FILE No.	
DESIGN	RLK	02/07/10	SCALE AS SHOWN	REV. 0
CADD	RLK	02/07/10	APPENDIX 9D	
CHECK	GM	02/08/10		
REVIEW	KH	02/08/10		

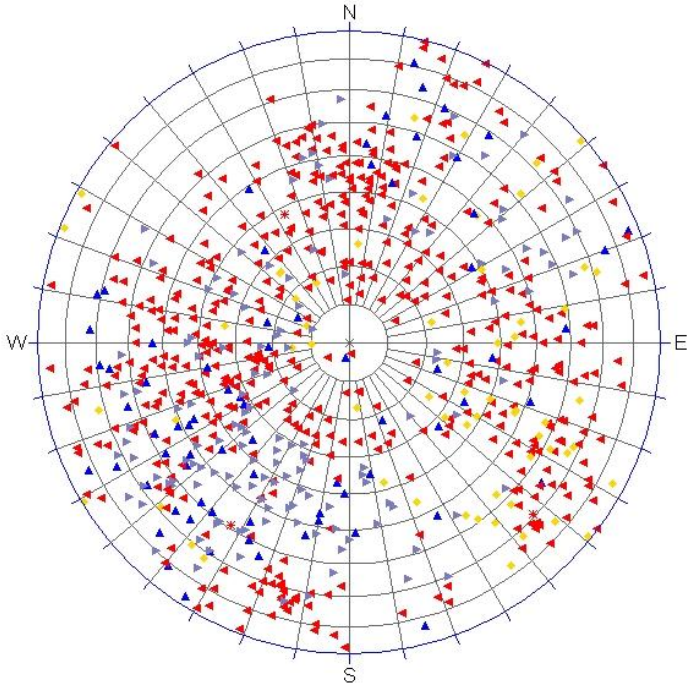


Schmidt
Concentrations
% of total per 1.0 % area

0.00 ~ 1.00 %
1.00 ~ 2.00 %
2.00 ~ 3.00 %
3.00 ~ 4.00 %
4.00 ~ 5.00 %
5.00 ~ 6.00 %
6.00 ~ 7.00 %
7.00 ~ 8.00 %
8.00 ~ 9.00 %
9.00 ~ 10.00 %

Terzaghi Correction
Min. Bias Angle = 15 deg
Max. Conc. = 5.5395%

Equal Area
Lower Hemisphere
756 Poles
756 Entries



LITH

- Dolomitic Limeston [4]
- Fault Breccia [2]
- Fault Breccia (Gra [20]
- Fault Breccia (Gre [35]
- Fault Breccia (Met [16]
- Graywacke [61]
- Greenstone [3]
- Limestone [476]
- Metabasalt [139]

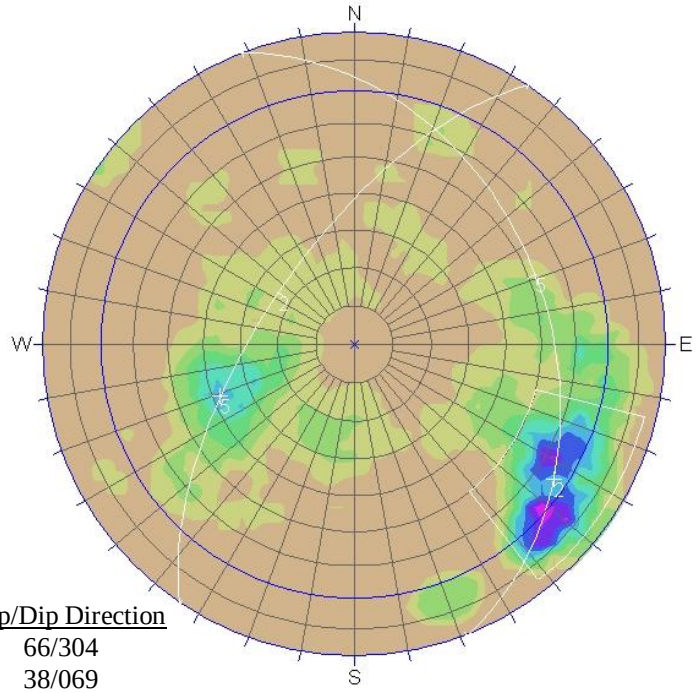
Equal Area
Lower Hemisphere
756 Poles
756 Entries

TITLE

ALL ORIENTED CORE DATA

Golder Associates

PROJECT No.	063-7109		FILE No.	
DESIGN	RLK	02/07/10	SCALE AS SHOWN	REV. 0
CADD	RLK	02/07/10	APPENDIX 9D	
CHECK	GM	02/08/10		
REVIEW	KH	02/08/10		



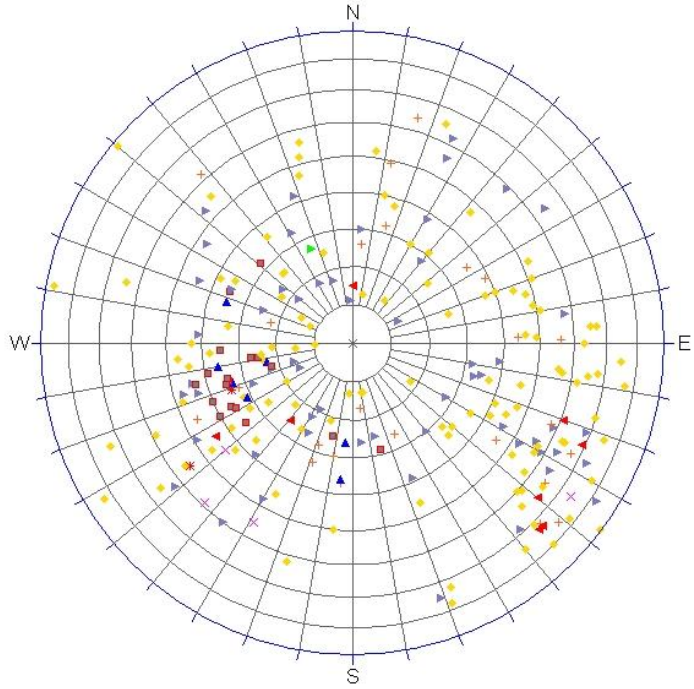
Schmidt
Concentrations
% of total per 1.0 % area

0.00 ~ 1.00 %
1.00 ~ 2.00 %
2.00 ~ 3.00 %
3.00 ~ 4.00 %
4.00 ~ 5.00 %
5.00 ~ 6.00 %
6.00 ~ 7.00 %
7.00 ~ 8.00 %
8.00 ~ 9.00 %
9.00 ~ 10.00 %

Terzaghi Correction
Min. Bias Angle = 15 deg
Max. Conc. = 8.8357%

Equal Area
Lower Hemisphere
235 Poles
235 Entries

Set	Dip/Dip Direction
2	66/304
5	38/069



TYPE

- Bedding [18]
- Bedding Trace [7]
- Contact (Open) [1]
- Fault [24]
- Foliation [4]
- Joint [113]
- Shear [2]
- Vein [8]
- Vein (Intact) [58]

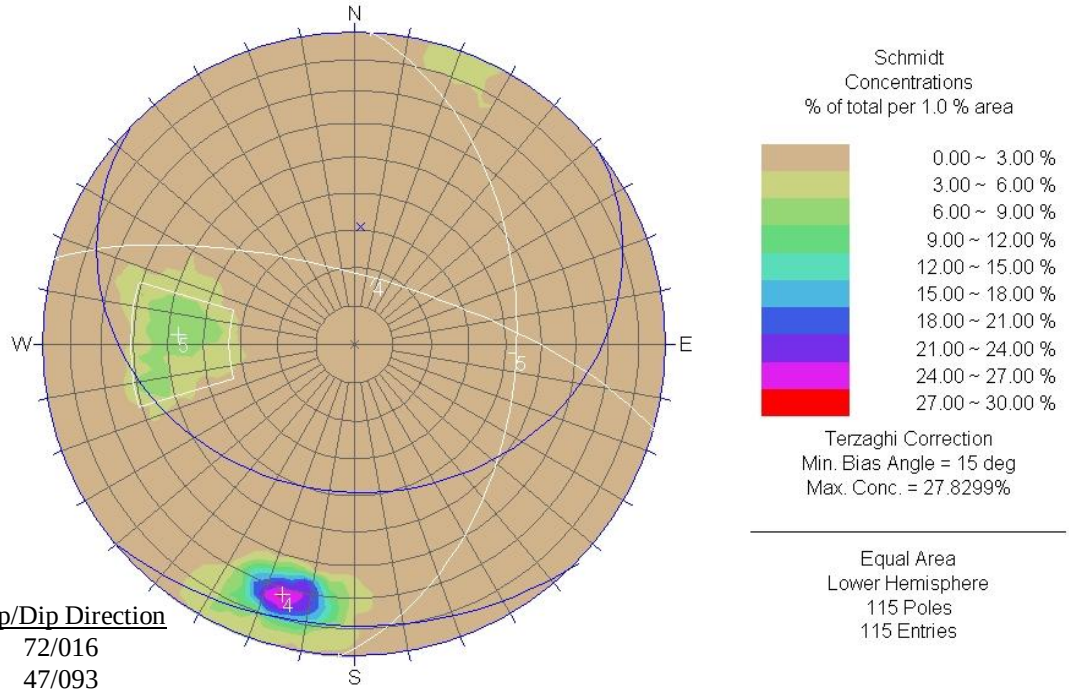
Equal Area
Lower Hemisphere
235 Poles
235 Entries

TITLE

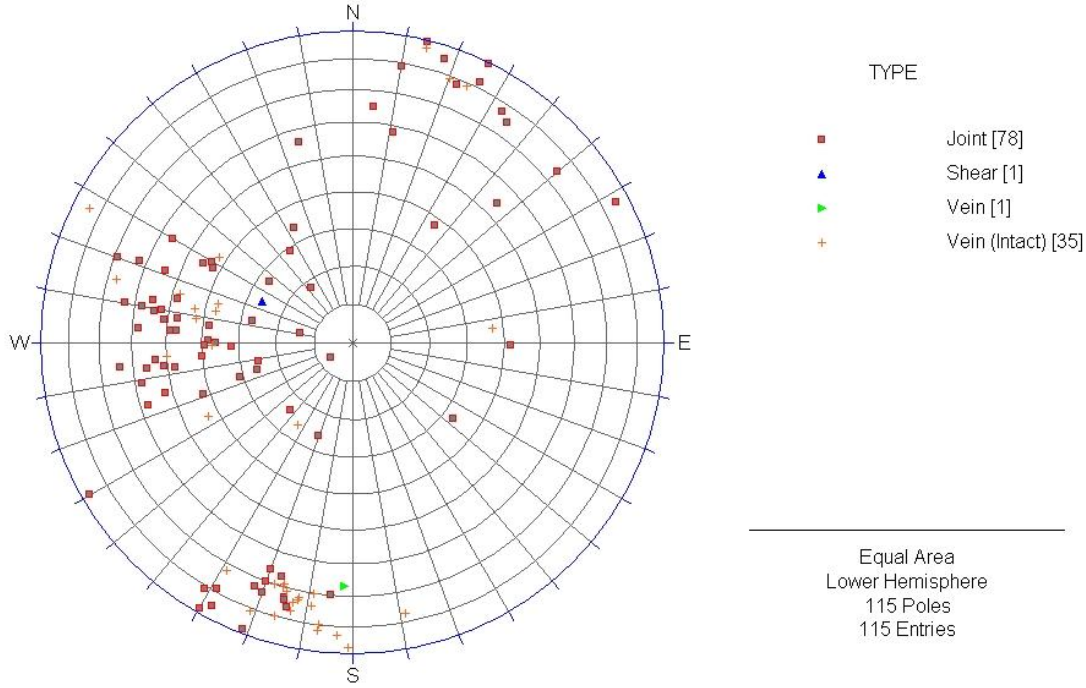
GT1-1-08

Golder Associates

PROJECT No.	063-7109		FILE No.	
DESIGN	RLK	02/07/10	SCALE AS SHOWN	REV. 0
CADD	RLK	02/07/10	APPENDIX 9D	
CHECK	GM	02/08/10		
REVIEW	KH	02/08/10		



Set	Dip/Dip Direction
4	72/016
5	47/093

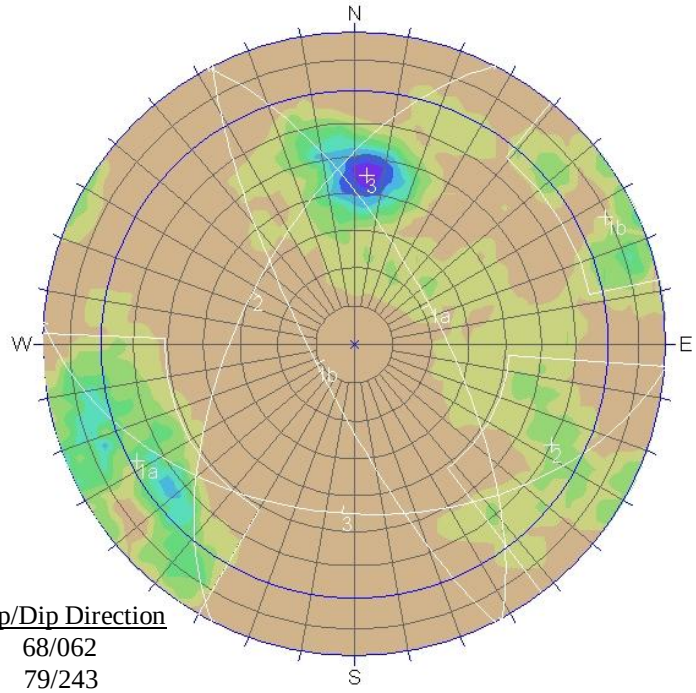


TITLE

GT1-2-08

Golder Associates

PROJECT No.	063-7109		FILE No.	
DESIGN	RLK	02/07/10	SCALE AS SHOWN	REV. 0
CADD	RLK	02/07/10	APPENDIX 9D	
CHECK	GM	02/08/10		
REVIEW	KH	02/08/10		



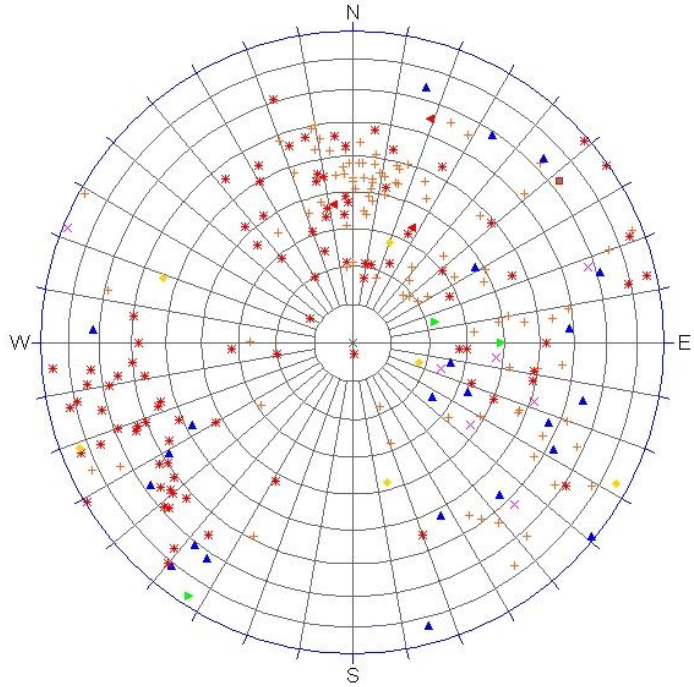
Schmidt
Concentrations
% of total per 1.0 % area

0.00 ~ 1.00 %
1.00 ~ 2.00 %
2.00 ~ 3.00 %
3.00 ~ 4.00 %
4.00 ~ 5.00 %
5.00 ~ 6.00 %
6.00 ~ 7.00 %
7.00 ~ 8.00 %
8.00 ~ 9.00 %
9.00 ~ 10.00 %

Terzaghi Correction
Min. Bias Angle = 15 deg
Max. Conc. = 8.0485%

Equal Area
Lower Hemisphere
231 Poles
231 Entries

Set	Dip/Dip Direction
1a	68/062
1b	79/243
2	60/297
3	45/184



TYPE

Contact (Open) [1]
Fault [23]
Foliation [3]
Joint [96]
Shear [7]
Vein [6]
Vein (Intact) [92]
n/a [3]

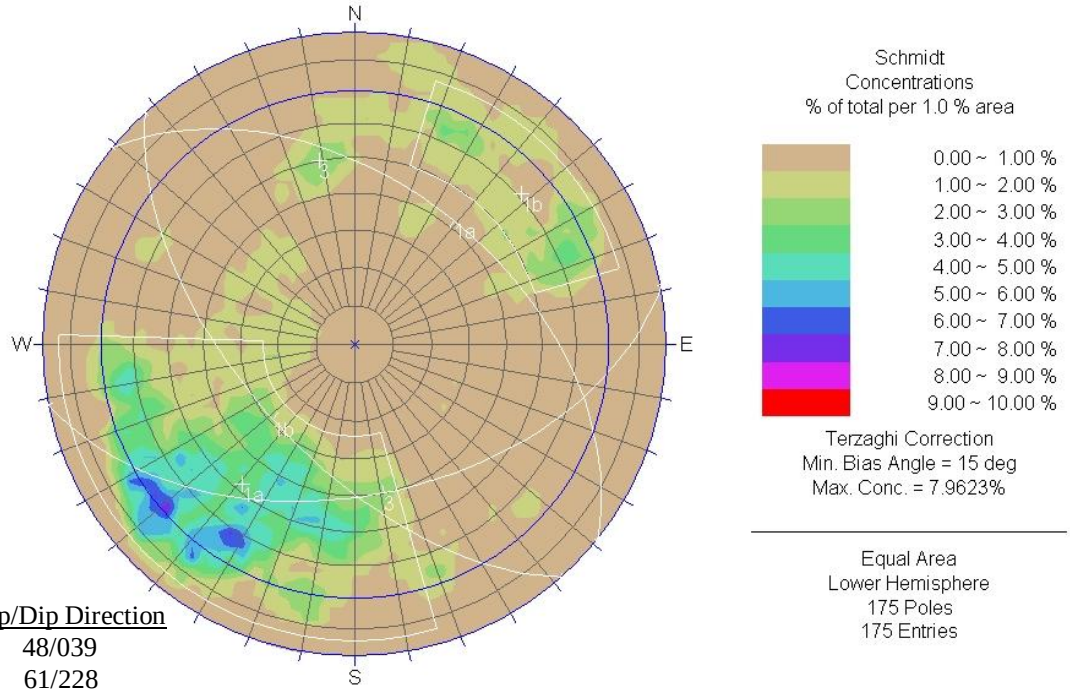
Equal Area
Lower Hemisphere
231 Poles
231 Entries

TITLE

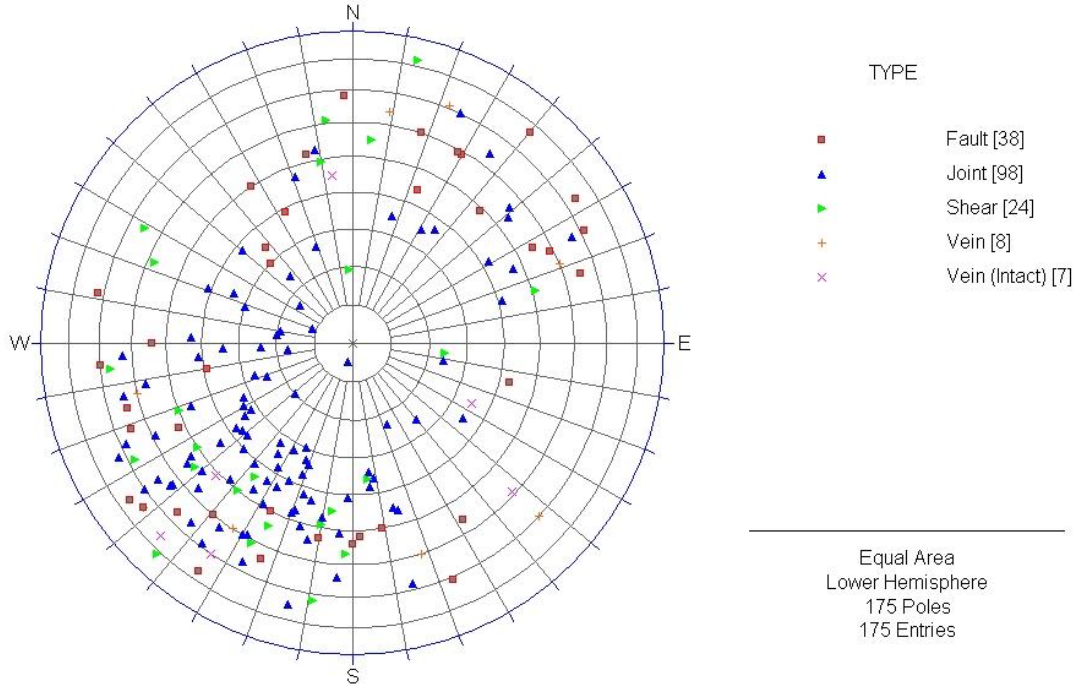
GT1-3-08

Golder Associates

PROJECT No.	063-7109		FILE No.	
DESIGN	RLK	02/07/10	SCALE AS SHOWN	REV. 0
CADD	RLK	02/07/10	APPENDIX 9D	
CHECK	GM	02/08/10		
REVIEW	KH	02/08/10		



Set	Dip/Dip Direction
1a	48/039
1b	61/228
3	50/169

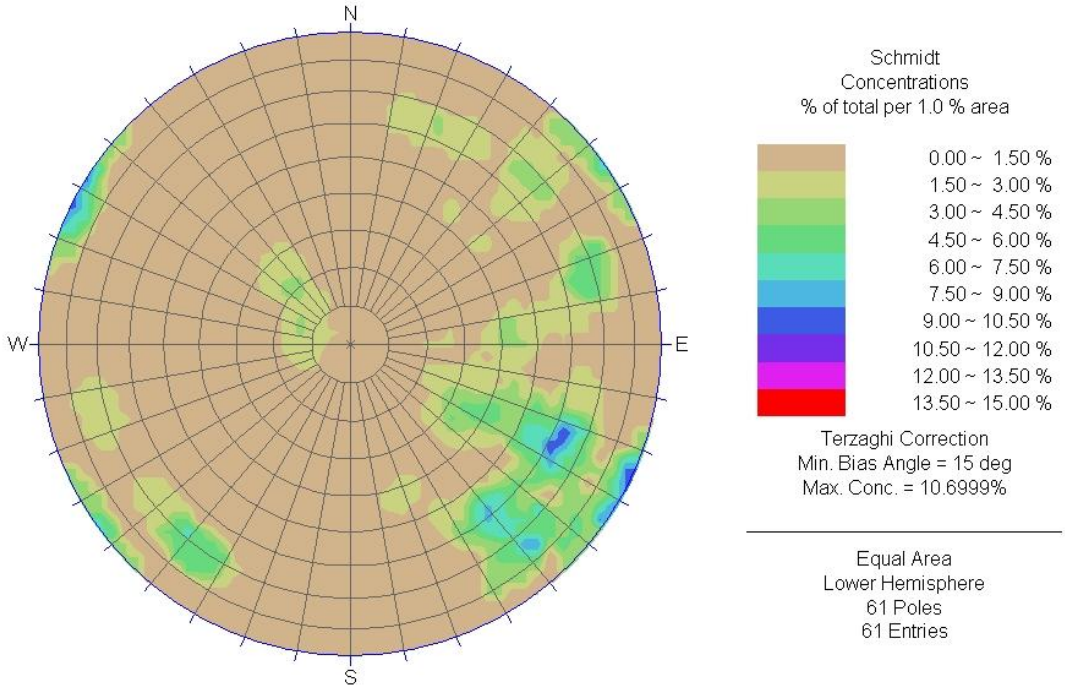


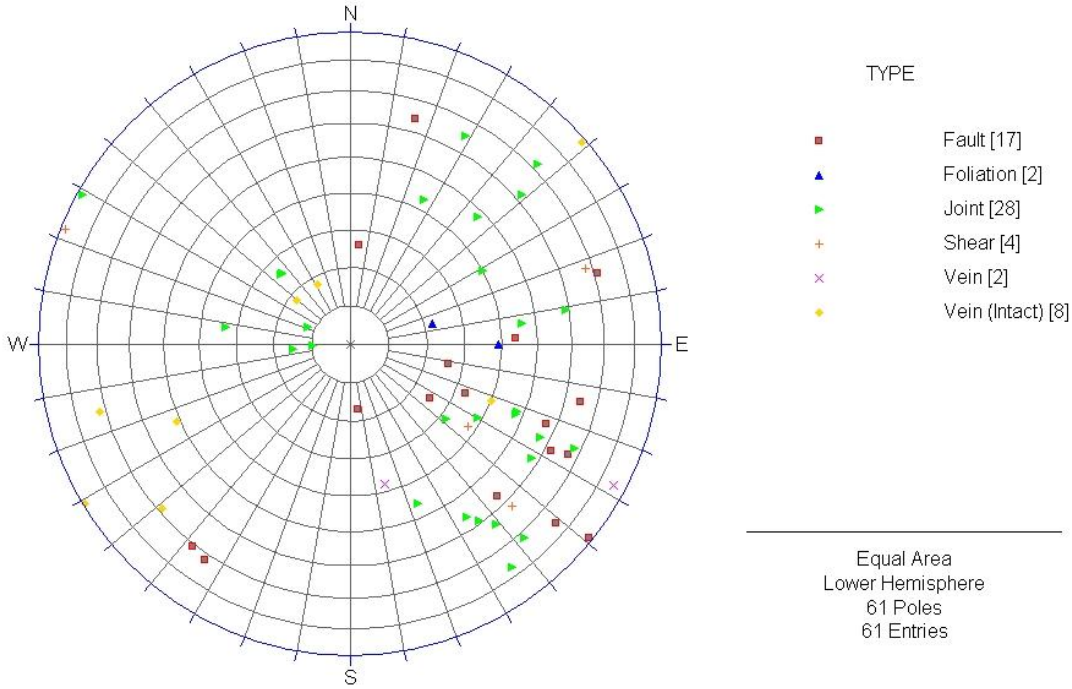
TITLE

GT1-4-08

Golder Associates

PROJECT No.	063-7109		FILE No.
DESIGN	RLK	02/07/10	SCALE AS SHOWN REV. 0
CADD	RLK	02/07/10	APPENDIX 9D
CHECK	GM	02/08/10	
REVIEW	KH	02/08/10	



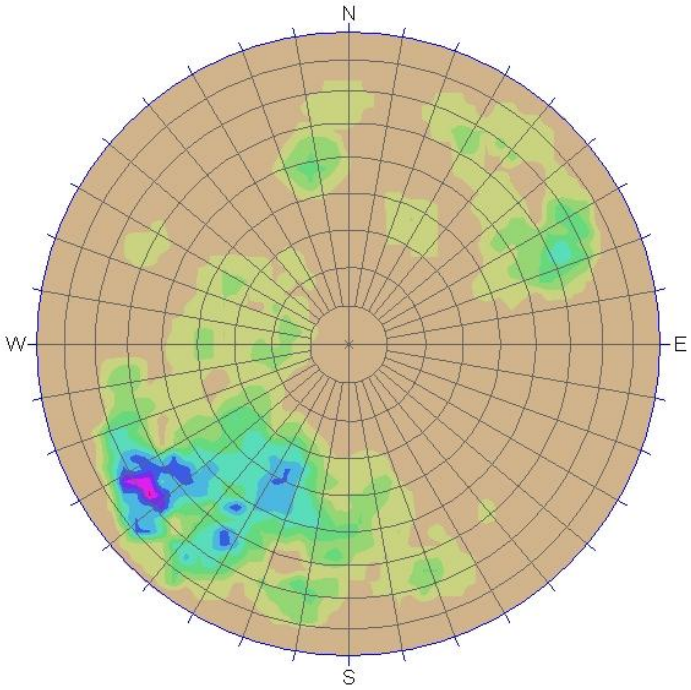


TITLE

GRAYWACKE, ORIENTED CORE DATA

Golder Associates

PROJECT No.	063-7109		FILE No.	
DESIGN	RLK	02/07/10	SCALE AS SHOWN	REV. 0
CADD	RLK	02/07/10	APPENDIX 9D	
CHECK	GM	02/08/10		
REVIEW	KH	02/08/10		

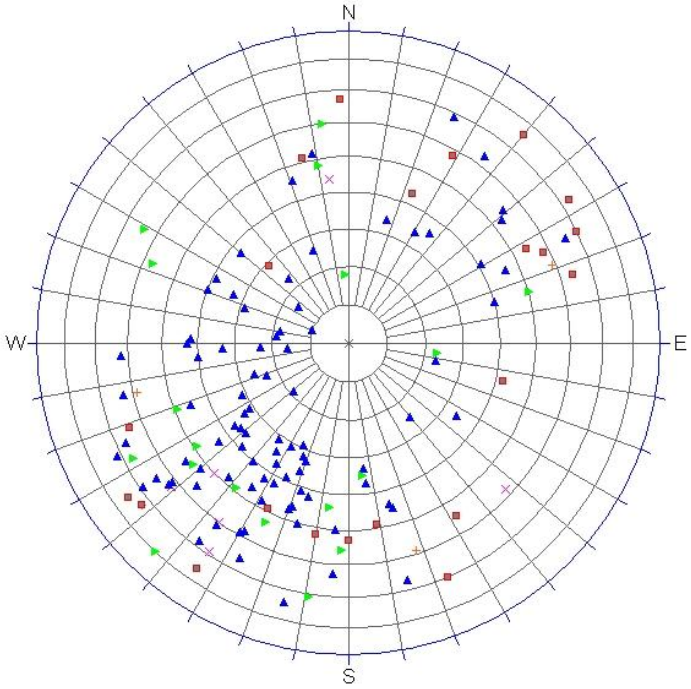


Schmidt
Concentrations
% of total per 1.0 % area

0.00 ~ 1.00 %
1.00 ~ 2.00 %
2.00 ~ 3.00 %
3.00 ~ 4.00 %
4.00 ~ 5.00 %
5.00 ~ 6.00 %
6.00 ~ 7.00 %
7.00 ~ 8.00 %
8.00 ~ 9.00 %
9.00 ~ 10.00 %

Terzaghi Correction
Min. Bias Angle = 15 deg
Max. Conc. = 9.1724%

Equal Area
Lower Hemisphere
139 Poles
139 Entries



TYPE

Fault [22]
Joint [89]
Shear [18]
Vein [4]
Vein (Intact) [6]

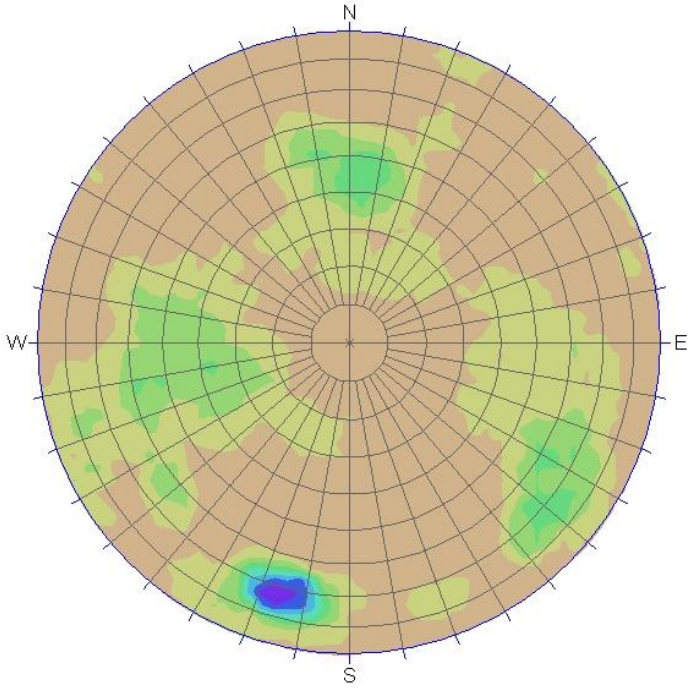
Equal Area
Lower Hemisphere
139 Poles
139 Entries

TITLE

METAVOLCANIC ROCK, ORIENTED CORE DATA

Golder Associates

PROJECT No.		063-7109	FILE No.	
DESIGN	RLK	02/07/10	SCALE AS SHOWN	REV. 0
CADD	RLK	02/07/10	APPENDIX 9D	
CHECK	GM	02/08/10		
REVIEW	KH	02/08/10		

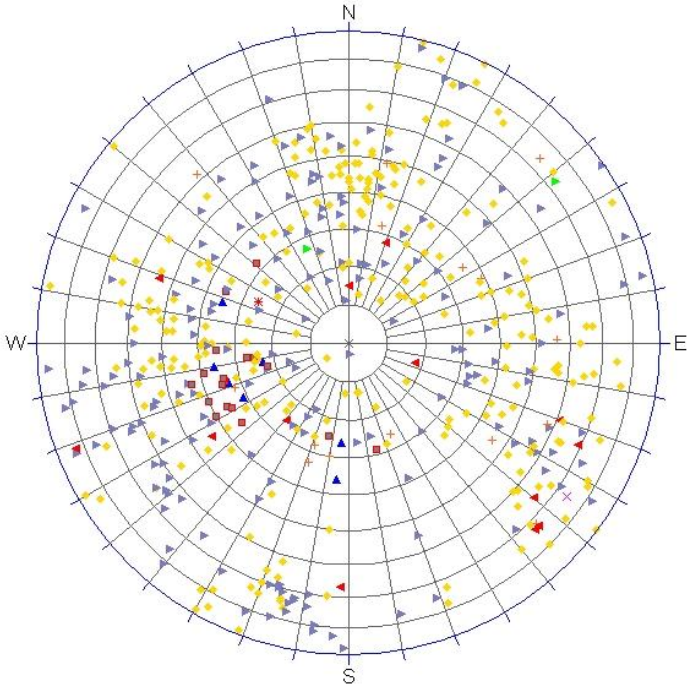


Schmidt
Concentrations
% of total per 1.0 % area

0.00 ~ 1.00 %
1.00 ~ 2.00 %
2.00 ~ 3.00 %
3.00 ~ 4.00 %
4.00 ~ 5.00 %
5.00 ~ 6.00 %
6.00 ~ 7.00 %
7.00 ~ 8.00 %
8.00 ~ 9.00 %
9.00 ~ 10.00 %

Terzaghi Correction
Min. Bias Angle = 15 deg
Max. Conc. = 8.0157%

Equal Area
Lower Hemisphere
480 Poles
480 Entries



TYPE

- Bedding [18]
- Bedding Trace [7]
- Contact (Open) [2]
- Fault [15]
- Foliation [1]
- Joint [248]
- Shear [1]
- Vein [13]
- Vein (Intact) [175]

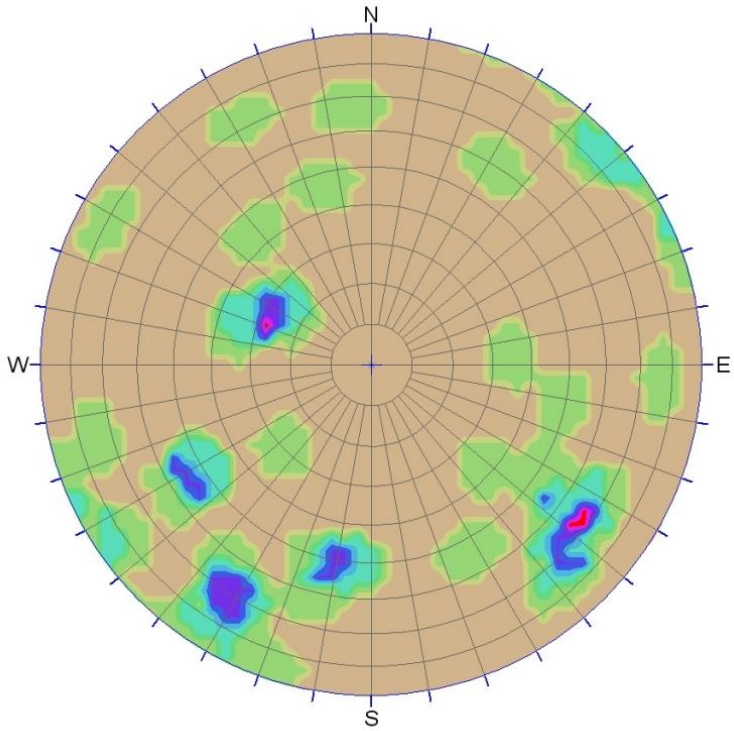
Equal Area
Lower Hemisphere
480 Poles
480 Entries

TITLE

LIMESTONE, ORIENTED CORE DATA

Golder Associates

PROJECT No.	063-7109		FILE No.	
DESIGN	RLK	02/07/10	SCALE AS SHOWN	REV. 0
CADD	RLK	02/07/10	APPENDIX 9D	
CHECK	GM	02/08/10		
REVIEW	KH	02/08/10		

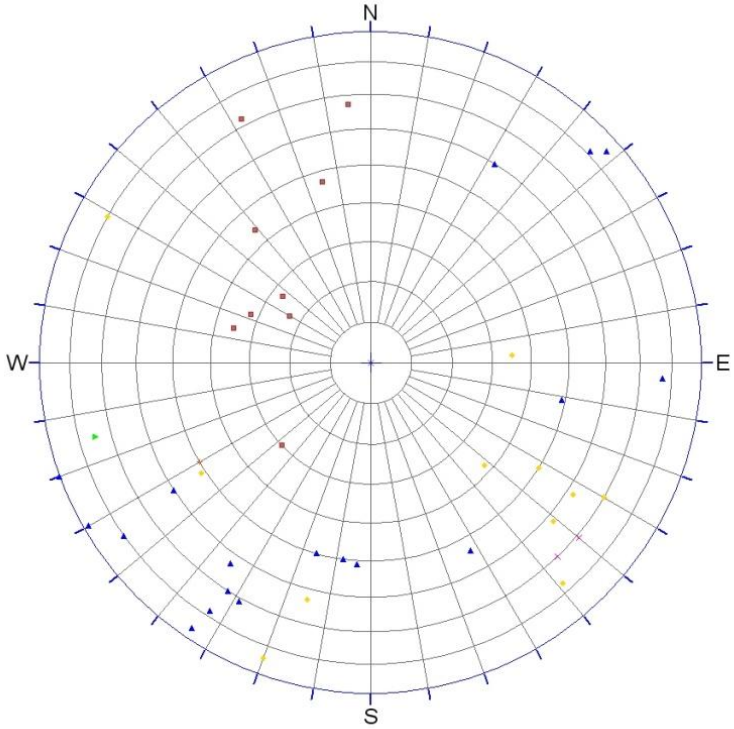


Schmidt
Concentrations
% of total per 1.0 % area

	0.00 ~ 1.00 %
	1.00 ~ 2.00 %
	2.00 ~ 3.00 %
	3.00 ~ 4.00 %
	4.00 ~ 5.00 %
	5.00 ~ 6.00 %
	6.00 ~ 7.00 %
	7.00 ~ 8.00 %
	8.00 ~ 9.00 %
	9.00 ~ 10.00 %

No Bias Correction
Max. Conc. = 9.5238%

Equal Area
Lower Hemisphere
42 Poles
42 Entries



TYPE

- B [9]
- F [18]
- F/C [1]
- F/V [1]
- J [2]
- JS [11]

Equal Area
Lower Hemisphere
42 Poles
42 Entries

TITLE

SOUTH WALL MAPPING

Golder Associates

PROJECT No.	063-7109		FILE No.	
DESIGN	RLK	02/07/10	SCALE AS SHOWN	REV. 0
CADD	RLK	02/07/10	APPENDIX 9D	
CHECK	GM	02/08/10		
REVIEW	KH	02/08/10		

APPENDIX 9.E

Seismic Displacement Calculations

Summary of Dynamic Deformation Analysis - South Wall

Selected Notations			
M_w =	Moment magnitude	k_y =	Yield acceleration
a_{brk} =	Peak Horizontal Acceleration at the bedrock	U =	Dynamic deformation along critical slide surface
a_{max} =	Peak Horizontal Acceleration at the crest of slope		

Earthquake Characterization		
M_w	a_{brk}	a_{max} (Reference 1)
	g	g
7.1	0.60	0.60

Deformation Calculation (Reference 2)							
SITE	Section	Failure Description	k_y	k_y/a_{max}	Slope Deformation, U (in) (Bray and Travasarou)		
			g		84% Exc.	16% Exc.	50% Exc.
South Wall	Section 9A	Reclaimed	0.17	0.28	3	11	6

References:

1. Seed, H. B. and Idriss, I. M. (1982), Ground Motions and Soil Liquefaction During Earthquakes Monograph No. 5, Earthquake Engineering Research Institute, Berkeley, California.
2. Bray, J. D. and Travasarou, T. (2007), Simplified Procedure for Estimating Earthquake-Induced Deviatoric Slope Displacements Journal of the Geotechnical and Geoenvironmental Engineering, ASCE, Vol. 133, No. 4, pp. 381-392.

Note: This spreadsheet is only intended to estimate seismic deformation under the above shown earthquake events and sections, assuming potential failure mass is a Newmark rigid sliding block.

APPENDIX 10.A

WMSA Boring Logs

SUMMARY: BORING NO. WMSA-2

COORDINATES:

DATE DRILLED: 4/26/07 - 4/26/07
DRILLING METHOD: Prosonic (Boart Longyear), Rotosonic
SURFACE CONDITIONS: Grass, some underlying gravel up to 5"

ELEVATION:

DEPTH IN FEET	SAMPLE NO.	RECOVERY	LAB TESTING	SAMPLE TYPE	LAB MOISTURE % OF DRY WEIGHT	DRY DENSITY PCF	LITHOLOGY	DESCRIPTION	SYMBOL	MOISTURE	CONSISTENCY	DEPTH IN FEET
0								SANDY GRAVEL (GP) w/ little low plasticity fines, gray, trace cobbles up to 5" diameter, waste rock--greenstone, dry	GP	dry	medium dense	0
5												5
								GRAVELLY CLAY (CL) w/ some fine to coarse sand (waste rock--greenstone), dark yellowish brown, gravel to 1.5 " diameter, moderate cementation, moist	CL	dry	very dense	
10								SANDY GRAVEL (GP) w/some fines , dark yellowish brown, gravel to 3" diameter, trace cobbles to 5" diameter, waste rock--greenstone, dry	GP			10
15										dry	dense	15
20								GRAVELLY CLAY (CL) w/ some sand, dark yellowish brown, dry, increasing limestone, waste rock	CL			20
25								SANDY GRAVEL (GP) w/ some moderate plasticity fines, very dark grayish brown, gravel to 3" diameter, moderate cementation, waste rock ~60% greenstone, ~40% limestone, dry	GP			25
								SANDY CLAY(CL) to CLAYEY SAND (SC) w/some gravel to 1" diameter, dark yellowish brown, dry, waste rock	CL/SC	dry	very dense	
30								SANDY GRAVEL (GP) w/ some low plasticity fines, very dark gray, gravel to 3" diameter, trace cobbles, waste rock ~90% low to medium grade limestone, ~10% greenstone, dry @33': Increasing greenstone				30
35									GP			35
								@37': ~70% greenstone, ~30% limestone @38': Pale green, ~95% greenstone		dry	medium dense	
40												40

Continued Next Page

A. 2" O.D. SPLIT-SPOON SAMPLER
B. 3" O.D. THIN WALL SAMPLER
C. 3-1/4" O.D. x 2-1/2" LINER
D. 3-1/2" O.D. SPLIT-BARREL SAMPLER
E. 2" I.D. SPLIT-SPOON SAMPLER
X. SAMPLE NOT RECOVERED
A. - ATTERBERG
G. - GRAIN SIZE
C. - CONSOLIDATION
DS - DIRECT SHEAR
T - TRIAXIAL
P - PERMEABILITY
WATER LEVEL - ATD
WATER LEVEL - AD

Golder Associates

Lehigh Permanente Cement Quarry

Job No 063-7109
Engr D.S.F. and P.Y.
Date 7/24/07

Lehigh Permanente Cement Quarry
Cupertino, CA
West Materials Storage Area

SUMMARY: BORING NO. WMSA-2

COORDINATES:

DATE DRILLED: 4/26/07 - 4/26/07
DRILLING METHOD: Prosonic (Boart Longyear), Rotosonic
SURFACE CONDITIONS: Grass, some underlying gravel up to 5"

ELEVATION:

DEPTH IN FEET	SAMPLE NO.	RECOVERY	LAB TESTING	SAMPLE TYPE	LAB MOISTURE % OF DRY WEIGHT	DRY DENSITY PCF	LITHOLOGY	DESCRIPTION	SYMBOL	MOISTURE	CONSISTENCY
40											
								@42': Light reddish brown, increasing gravel to cobbles, ~95% limestone waste rock	GP		
45								GRAVELLY CLAY (CL) w/ some sand, very dark grey, gravel to 1.5" diameter, moderate cementation, waste rock~95% greenstone, very stiff, dry	CL		
								CLAYEY GRAVEL (GC) w/ some sand, brown/greenish gray, gravel to 4" diameter, cementation, waste rock limestone and greenstone, dry		dry	dense
50									GC		
55								CLAYEY GRAVEL (GC) w/ some sand, very dark gray, cementation, mostly limestone waste rock, dry		dry	very dense
60	WMSA-2-8		A, G	Bag	23-26			@62': Light yellowish brown, moderate cementation			
65								@66': Very dark gray	GC		
70								@72': Predominantly greenstone			
75										dry	very dense
80											

Continued Next Page

A. 2" O.D. SPLIT-SPOON SAMPLER
B. 3" O.D. THIN WALL SAMPLER
C. 3-1/4" O.D. x 2-1/2" LINER
D. 3-1/2" O.D. SPLIT-BARREL SAMPLER
E. 2" I.D. SPLIT-SPOON SAMPLER
X. SAMPLE NOT RECOVERED
A. - ATTERBERG
G. - GRAIN SIZE
C. - CONSOLIDATION
DS - DIRECT SHEAR
T - TRIAXIAL
P - PERMEABILITY
WATER LEVEL - ATD
WATER LEVEL - AD

Golder Associates

Lehigh Permanente Cement Quarry

Job No 063-7109
Engr D.S.F. and P.Y.
Date 7/24/07

Lehigh Permanente Cement Quarry
Cupertino, CA
West Materials Storage Area

SUMMARY: BORING NO. WMSA-2

COORDINATES:

DATE DRILLED: 4/26/07 - 4/26/07
DRILLING METHOD: Prosonic (Boart Longyear), Rotosonic
SURFACE CONDITIONS: Grass, some underlying gravel up to 5"

ELEVATION:

DEPTH IN FEET	SAMPLE NO.	RECOVERY	LAB TESTING	SAMPLE TYPE	LAB MOISTURE % OF DRY WEIGHT	DRY DENSITY PCF	LITHOLOGY	DESCRIPTION	SYMBOL	MOISTURE	CONSISTENCY	DEPTH IN FEET
80												80
								@81': Dark yellowish brown, gravel to 6"				
								@83': Increasing gravel				
85									GC			85
										dry	very dense	
90								CLAYEY GRAVEL (GC) w/little sand, weak red, cobbles to 6" diameter, limestone waste rock, very stiff, dry				90
								@94': Very dark greenish gray, greenstone	GC			
95												95
								GRAVELLY CLAY (CL) w/some sand, very dark gray, gravel to 2" diameter, very cemented, limestone and greenstone waste rock, dry		dry	dense	
100												100
									CL			
105												105
										dry	dense	
110								CLAYEY GRAVEL (GC) w/ some sand, dark gray, gravel to 3", limestone waste rock, dry				110
115									GC			115
										dry	dense	
120												120

Continued Next Page

A. 2" O.D. SPLIT-SPOON SAMPLER
B. 3" O.D. THIN WALL SAMPLER
C. 3-1/4" O.D. x 2-1/2" LINER
D. 3-1/2" O.D. SPLIT-BARREL SAMPLER
E. 2" I.D. SPLIT-SPOON SAMPLER
X. SAMPLE NOT RECOVERED
A. - ATTERBERG
G. - GRAIN SIZE
C. - CONSOLIDATION
DS - DIRECT SHEAR
T - TRIAXIAL
P - PERMEABILITY
WATER LEVEL - ATD
WATER LEVEL - AD

Golder Associates

Lehigh Permanente Cement Quarry

Job No 063-7109
Engr D.S.F. and P.Y.
Date 7/24/07

Lehigh Permanente Cement Quarry
Cupertino, CA
West Materials Storage Area

SUMMARY: BORING NO. WMSA-2

COORDINATES:

DATE DRILLED: 4/26/07 - 4/26/07
DRILLING METHOD: Prosonic (Boart Longyear), Rotosonic
SURFACE CONDITIONS: Grass, some underlying gravel up to 5"

ELEVATION:

DEPTH IN FEET	SAMPLE NO.	RECOVERY	LAB TESTING	SAMPLE TYPE	LAB MOISTURE % OF DRY WEIGHT	DRY DENSITY PCF	LITHOLOGY	DESCRIPTION	SYMBOL	MOISTURE	CONSISTENCY
120									GC		
								SANDY GRAVEL (GP) w/ some high plasticity clay (native ground underlying fill), yellowish brown, gravel to 2", very cemented, greenstone, dry	GP		
125	WMSA-2-13		A	Bag	35-39						
								CLAY (CL) w/ some gravel and sand, dark grayish brown, signficant cementation, occasional weathered rock fragments (greenstone), mottled, hard, dry		dry	hard
130	WMSA-2-15		A, G	Bag	30-34				CL		
135											
								CLAYEY GRAVEL (GC) w/ some sand, dark yellowish brown, weathered rock fragments, mottled, greenstone, dry	GC	dry	very dense
140											
								SANDY GRAVEL (GP) w/ some low plasticity clay, dark grayish brown, gravel to 1.5", cemented, limestone and a little greenstone, very dense, dry	GP		
145								GREENSTONE, dark yellowish brown, mottled, fine grained, subangular, medium to highly weathered w/ oxidized rock fragments, RQD = 0, hard, dry		dry	very dense
150									IGNSFG		
155								@155': Dark gray, powder (greenstone) due to drilling			
								Terminate borehole @ 158' bgs No water encountered			
160											

A. 2" O.D. SPLIT-SPOON SAMPLER
B. 3" O.D. THIN WALL SAMPLER
C. 3-1/4" O.D. x 2-1/2" LINER
D. 3-1/2" O.D. SPLIT-BARREL SAMPLER
E. 2" I.D. SPLIT-SPOON SAMPLER
X. SAMPLE NOT RECOVERED
A. - ATTERBERG
G. - GRAIN SIZE
C. - CONSOLIDATION
DS - DIRECT SHEAR
T - TRIAXIAL
P - PERMEABILITY
WATER LEVEL - ATD
WATER LEVEL - AD

Golder Associates

Lehigh Permanente Cement Quarry

Job No 063-7109
Engr D.S.F. and P.Y.
Date 7/24/07

Lehigh Permanente Cement Quarry
Cupertino, CA
West Materials Storage Area

SUMMARY: BORING NO. WMSA-3

COORDINATES:

DATE DRILLED: 4/28/07 - 4/29/07
DRILLING METHOD: Prosonic (Boart Longyear), Rotosonic
SURFACE CONDITIONS: Short grass, fine to coarse gravel to 3" (mostly limestone)

ELEVATION:

DEPTH IN FEET	SAMPLE NO.	RECOVERY	LAB TESTING	SAMPLE TYPE	LAB MOISTURE % OF DRY WEIGHT	DRY DENSITY PCF	LITHOLOGY	DESCRIPTION	SYMBOL	MOISTURE	CONSISTENCY	DEPTH IN FEET
0								SANDY GRAVEL (GP) w/ some low plasticity fines, yellowish brown, gravel to 3", low grade limestone waste rock, dry	GP	dry	medium dense	0
5	WMSA-3-1		A, G	Bag	34-38			@4': Brown				5
								CLAYEY SAND (SC) w/ some gravel, yellowish brown, gravel to 2", mostly limestone w/ some weathered greenstone, cemented waste rock, dry		dry	very dense	
10								@8': Dark yellowish brown, increasing cementation	SC			10
								@12': Very dark grayish brown				
15								SILTY SAND (SM) w/ some gravel, yellowish brown, gravel to 3", mostly limestone waste rock, dry		dry	medium dense	15
20								@19': Very dark grayish brown				20
								@21': White, went through ~7' diameter limestone boulder, mostly powder, trace cobbles 3" to 6" diameter				
25								@27': Very dark grayish brown, greenstone	SM	dry	medium dense	25
								@28': Brown, mostly medium grade limestone				
30								@32': Very dark grayish brown, mostly greenstone				30
								@33': Yellowish brown, mostly limestone				
35	WMSA-3-4		A, G	Bag	32-36							35
								@38': Very pale brown				
40												40

Continued Next Page

A. 2" O.D. SPLIT-SPOON SAMPLER
B. 3" O.D. THIN WALL SAMPLER
C. 3-1/4" O.D. x 2-1/2" LINER
D. 3-1/2" O.D. SPLIT-BARREL SAMPLER
E. 2" I.D. SPLIT-SPOON SAMPLER
X. SAMPLE NOT RECOVERED
A. - ATTERBERG
G. - GRAIN SIZE
C. - CONSOLIDATION
DS - DIRECT SHEAR
T - TRIAXIAL
P - PERMEABILITY
WATER LEVEL - ATD
WATER LEVEL - AD

Golder Associates

Lehigh Permanente Cement Quarry

Job No 063-7109
Engr D.S.F.
Date 7/24/07

Lehigh Permanente Cement Quarry
Cupertino, CA
West Materials Storage Area

SUMMARY: BORING NO. WMSA-3

COORDINATES:

DATE DRILLED: 4/28/07 - 4/29/07
DRILLING METHOD: Prosonic (Boart Longyear), Rotosonic
SURFACE CONDITIONS: Short grass, fine to coarse gravel to 3" (mostly limestone)

ELEVATION:

DEPTH IN FEET	SAMPLE NO.	RECOVERY	LAB TESTING	SAMPLE TYPE	LAB MOISTURE % OF DRY WEIGHT	DRY DENSITY PCF	LITHOLOGY	DESCRIPTION	SYMBOL	MOISTURE	CONSISTENCY	DEPTH IN FEET
40												40
								@42': Increasing fines, limestone, cemented	SM			
45								@45': Very pale brown, ~70% low to medium grade limestone, ~30% greenstone				45
								@47': Yellowish brown				
								SANDY GRAVEL (GP) w/ trace fines, yellowish brown, cobbles to 8" diameter, greenstone waste rock, very dense, cemented, dry	GP	dry	very dense	
50												50
								CLAYEY GRAVEL (GC) w/ some sand, yellowish brown, gravel to 2", greenstone w/ some limestone, cemented, moderately stiff, dry	GC			
55												55
								SANDY GRAVEL (GP) w/ some low plasticity fines, brown, gravel to 3" diameter, greenstone waste rock, cemented, dense, dry				
								@58': Increasing cobbles to 7" diameter, greenstone, harder drilling		dry	dense	
60												60
65												65
								@67': ~80% greenstone, ~20% low grade limestone	GP			
70												70
								@72': Yellowish brown				
75												75
80												80

Continued Next Page

A. 2" O.D. SPLIT-SPOON SAMPLER
B. 3" O.D. THIN WALL SAMPLER
C. 3-1/4" O.D. x 2-1/2" LINER
D. 3-1/2" O.D. SPLIT-BARREL SAMPLER
E. 2" I.D. SPLIT-SPOON SAMPLER
X. SAMPLE NOT RECOVERED
A. - ATTERBERG
G. - GRAIN SIZE
C. - CONSOLIDATION
DS - DIRECT SHEAR
T - TRIAXIAL
P - PERMEABILITY
WATER LEVEL - ATD
WATER LEVEL - AD

Golder Associates

Lehigh Permanente Cement Quarry

Job No 063-7109
Engr D.S.F.
Date 7/24/07

Lehigh Permanente Cement Quarry
Cupertino, CA
West Materials Storage Area

SUMMARY: BORING NO. WMSA-3

COORDINATES:

DATE DRILLED: 4/28/07 - 4/29/07
DRILLING METHOD: Prosonic (Boart Longyear), Rotosonic
SURFACE CONDITIONS: Short grass, fine to coarse gravel to 3" (mostly limestone)

ELEVATION:

DEPTH IN FEET	SAMPLE NO.	RECOVERY	LAB TESTING	SAMPLE TYPE	LAB MOISTURE % OF DRY WEIGHT	DRY DENSITY PCF	LITHOLOGY	DESCRIPTION	SYMBOL	MOISTURE	CONSISTENCY
80									GP		
85								CLAYEY GRAVEL (GC) w/ some sand, dark yellowish brown, gravel to 2", limestone and greenstone, well cemented, mottled, dry	GC		
								SANDY GRAVEL (GP) w/ some low plasticity fines, brown, gravel to 3" diameter, greenstone, cemented, dense, dry	GP	dry	very dense
90								CLAYEY GRAVEL (GC) w/ some sand, dark yellowish brown, gravel to 2", mostly limestone, cemented, dry	GC		
95								SANDY GRAVEL (GP) w/ some low plasticity fines, gravel to 3", mostly greenstone, cemented, dry	GP		
								CLAYEY GRAVEL (GC) w/ some sand, dark yellowish brown, gravel to 2", mostly limestone, cemented, dry Harder drilling	GC	dry	medium dense
100								SANDY GRAVEL (GP) w/ some fines, gravel to 3", low grade limestone, dry @102': Very pale brown, trace chert	GP		
105										moist	very dense
110								GRAVELLY CLAY (CL) w/ little sand (native ground underlying fill), greenish black, colluvium, tree roots, very dense, cemented, moist	CL		
115	WMSA-3-9		A, G	Bag	45-51			LIMESTONE, low to medium grade, yellowish brown, fine grained, sub angular, medium to highly weathered, some oxide staining, dense, moist	LS	moist	very dense
120								GREENSTONE, mottled (green, red, yellow, brown), fine grained, subrounded, highly to completely weathered, medium	IGNSFG	dry	very dense

Continued Next Page

A. 2" O.D. SPLIT-SPOON SAMPLER
B. 3" O.D. THIN WALL SAMPLER
C. 3-1/4" O.D. x 2-1/2" LINER
D. 3-1/2" O.D. SPLIT-BARREL SAMPLER
E. 2" I.D. SPLIT-SPOON SAMPLER
X. SAMPLE NOT RECOVERED
A. - ATTERBERG
G. - GRAIN SIZE
C. - CONSOLIDATION
DS - DIRECT SHEAR
T - TRIAXIAL
P - PERMEABILITY
WATER LEVEL - ATD
WATER LEVEL - AD

Golder Associates

Lehigh Permanente Cement Quarry

Job No 063-7109
Engr D.S.F.
Date 7/24/07

Lehigh Permanente Cement Quarry
Cupertino, CA
West Materials Storage Area

SUMMARY: BORING NO. WMSA-3

COORDINATES:

DATE DRILLED: 4/28/07 - 4/29/07
DRILLING METHOD: Prosonic (Boart Longyear), Rotosonic
SURFACE CONDITIONS: Short grass, fine to coarse gravel to 3" (mostly limestone)

ELEVATION:

DEPTH IN FEET	SAMPLE NO.	RECOVERY	LAB TESTING	SAMPLE TYPE	LAB MOISTURE % OF DRY WEIGHT	DRY DENSITY PCF	LITHOLOGY	DESCRIPTION	SYMBOL	MOISTURE	CONSISTENCY	DEPTH IN FEET
120								hard, loose, RQD = 0, dry	IGNSFG			120
125												125
130												130
								Terminated borehole @ 133' bgs No water encountered				
135												135
140												140
145												145
150												150
155												155
160												160

A. 2" O.D. SPLIT-SPOON SAMPLER
B. 3" O.D. THIN WALL SAMPLER
C. 3-1/4" O.D. x 2-1/2" LINER
D. 3-1/2" O.D. SPLIT-BARREL SAMPLER
E. 2" I.D. SPLIT-SPOON SAMPLER
X. SAMPLE NOT RECOVERED
A. - ATTERBERG
G. - GRAIN SIZE
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WATER LEVEL - ATD
WATER LEVEL - AD

Golder Associates

Lehigh Permanente Cement Quarry

Job No 063-7109
Engr D.S.F.
Date 7/24/07

Lehigh Permanente Cement Quarry
Cupertino, CA
West Materials Storage Area

SUMMARY: BORING NO. WMSA-4

COORDINATES:

DATE DRILLED: 4/24/07 - 4/24/07
DRILLING METHOD: Prosonic (Boart Longyear), Rotosonic
SURFACE CONDITIONS: Sporadic brush, gravel up to 2", dry

ELEVATION:

DEPTH IN FEET	SAMPLE NO.	RECOVERY	LAB TESTING	SAMPLE TYPE	LAB MOISTURE % OF DRY WEIGHT	DRY DENSITY PCF	LITHOLOGY	DESCRIPTION	SYMBOL	MOISTURE	CONSISTENCY	DEPTH IN FEET
0								SANDY GRAVEL (GP) w/ some low plasticity fines, very dark brown, loose, dry, limestone and greenstone waste rock		dry	loose	0
5								@4': Increasing gravel, medium dense	GP	dry	medium dense	5
10												10
								CLAYEY GRAVEL (GC) w/ some sand, gravel to 3" diameter, mostly limestone waste rock, very dark brown, dense, moist to wet		moist to wet	dense	
15												15
20										moist	dense	20
25									GC			25
30										moist to wet	dense	30
35								@36': 2' of GRAVELLY CLAY (CL) w/ some sand, gray, very stiff, significant cementation, dry	CL	dry	very stiff	35
										moist	very dense	
40												40

Continued Next Page

A. 2" O.D. SPLIT-SPOON SAMPLER
B. 3" O.D. THIN WALL SAMPLER
C. 3-1/4" O.D. x 2-1/2" LINER
D. 3-1/2" O.D. SPLIT-BARREL SAMPLER
E. 2" I.D. SPLIT-SPOON SAMPLER
X. SAMPLE NOT RECOVERED
A. - ATTERBERG
G. - GRAIN SIZE
C. - CONSOLIDATION
DS - DIRECT SHEAR
T - TRIAXIAL
P - PERMEABILITY
WATER LEVEL - ATD
WATER LEVEL - AD

Golder Associates

Lehigh Permanente Cement Quarry

Job No 063-7109
Engr D.S.F. and P.Y.
Date 7/24/07

Lehigh Permanente Cement Quarry
Cupertino, CA
West Materials Storage Area

SUMMARY: BORING NO. WMSA-4

COORDINATES:

DATE DRILLED: 4/24/07 - 4/24/07
DRILLING METHOD: Prosonic (Boart Longyear), Rotosonic
SURFACE CONDITIONS: Sporadic brush, gravel up to 2", dry

ELEVATION:

DEPTH IN FEET	SAMPLE NO.	RECOVERY	LAB TESTING	SAMPLE TYPE	LAB MOISTURE % OF DRY WEIGHT	DRY DENSITY PCF	LITHOLOGY	DESCRIPTION	SYMBOL	MOISTURE	CONSISTENCY
40											
									GC		
45											
								@47': 1' of GRAVELLY SAND (SP) w/ little clay, grayish brown, very dense, dry	SP	dry	very dense
									GC	dry to moist	very dense
50											
55								@55': 2' of GRAVELLY SAND (SP) w/ little clay, grayish brown, very dense, dry	SP	dry	dense
	WMSA-4-11		A, G	Bag	22			CLAYEY SAND w/ some gravel (native ground underlying fill), reddish brown, very stiff, moderate cementation, moist	SC	moist	very dense
	WMSA-4-12		A, G	Bag	37-42						
60								GRAVELLY SAND (SP) w/ some fines, grayish brown, dense, dry	SP	dry	dense
65								LIMESTONE, gray, fine grained, subangular to subrounded, some calcite filled fractures, hard, RQD = 0, dense, dry	LS	dry	dense
70										dry	very dense
75											
80								Terminate borehole @ 78' bgs No water encountered			

A. 2" O.D. SPLIT-SPOON SAMPLER
B. 3" O.D. THIN WALL SAMPLER
C. 3-1/4" O.D. x 2-1/2" LINER
D. 3-1/2" O.D. SPLIT-BARREL SAMPLER
E. 2" I.D. SPLIT-SPOON SAMPLER
X. SAMPLE NOT RECOVERED
A. - ATTERBERG
G. - GRAIN SIZE
C. - CONSOLIDATION
DS - DIRECT SHEAR
T - TRIAXIAL
P - PERMEABILITY
WATER LEVEL - ATD
WATER LEVEL - AD

Golder Associates

Lehigh Permanente Cement Quarry

Job No 063-7109
Engr D.S.F. and P.Y.
Date 7/24/07

Lehigh Permanente Cement Quarry
Cupertino, CA
West Materials Storage Area

SUMMARY: BORING NO. WMSA-5

COORDINATES:

DATE DRILLED: 4/24/07 - 4/25/07
DRILLING METHOD: Prosonic (Boart Longyear), Rotosonic
SURFACE CONDITIONS: Greenstone and limestone waste rock up to 5" diameter, dry

ELEVATION:

DEPTH IN FEET	SAMPLE NO.	RECOVERY	LAB TESTING	SAMPLE TYPE	LAB MOISTURE % OF DRY WEIGHT	DRY DENSITY PCF	LITHOLOGY	DESCRIPTION	SYMBOL	MOISTURE	CONSISTENCY
0								SANDY GRAVEL (GP) w/ some fines, cobbles to 6" diameter, low to medium grade limestone waste rock, trace chert, loose, dry	GP	dry	loose
5											
10	WMSA-5-2		A	Bag	35-38			CLAYEY GRAVEL (GC) w/ some sand, yellowish brown, gravel waste rock to 3" diameter, medium dense, moist	GC	moist	medium dense
15								SANDY GRAVEL (GP) w/ trace clay, gravel waste rock to 2" diameter, some iron oxide staining, medium dense, dry	GP	dry	medium dense
20											
25								@24': Dark gray, ~60% low to medium grade limestone, ~40% high grade limestone waste rock		dry	loose
30								SANDY SILT (ML) w/ trace cobbles to 6" diameter, greenish black, greenstone waste rock, loose, dry	ML		
								SANDY GRAVEL (GP) w/ trace clay, brown, gravel to 2.5" diameter, loose, dry	GP	dry	medium dense
								CLAYEY GRAVEL (GP) w/ some sand, dark yellowish brown, trace cobbles to 6" diameter, greenstone waste rock, medium dense, dry	GP	moist	dense
								GRAVELLY CLAY (CL) w/ some sand, dark brown, gravel to 1.5" diameter, low grade limestone waste rock, dense, moist	CL	dry	loose
35								SILTY GRAVEL (GM) w/ some sand, pale brown, gravel to 2" diameter, loose, dry	GM		
								SANDY GRAVEL (GP) w/ some fines, pale prown, gravel to 3", loose, dry	GP		
40											

Continued Next Page

A. 2" O.D. SPLIT-SPOON SAMPLER
B. 3" O.D. THIN WALL SAMPLER
C. 3-1/4" O.D. x 2-1/2" LINER
D. 3-1/2" O.D. SPLIT-BARREL SAMPLER
E. 2" I.D. SPLIT-SPOON SAMPLER
X. SAMPLE NOT RECOVERED
A. - ATTERBERG
G. - GRAIN SIZE
C. - CONSOLIDATION
DS - DIRECT SHEAR
T - TRIAXIAL
P - PERMEABILITY
WATER LEVEL - ATD
WATER LEVEL - AD

Golder Associates

Lehigh Permanente Cement Quarry

Job No 063-7109
Engr D.S.F. and P.Y.
Date 7/24/07

Lehigh Permanente Cement Quarry
Cupertino, CA
West Materials Storage Area

SUMMARY: BORING NO. WMSA-5

COORDINATES:

DATE DRILLED: 4/24/07 - 4/25/07
DRILLING METHOD: Prosonic (Boart Longyear), Rotosonic
SURFACE CONDITIONS: Greenstone and limestone waste rock up to 5" diameter, dry

ELEVATION:

DEPTH IN FEET	SAMPLE NO.	RECOVERY	LAB TESTING	SAMPLE TYPE	LAB MOISTURE % OF DRY WEIGHT	DRY DENSITY PCF	LITHOLOGY	DESCRIPTION	SYMBOL	MOISTURE	CONSISTENCY
40								@40' - 42': Greenish brown, significant cementation			
45								@46': Very pale brown	GP	dry	very dense
50								@50': Yellowish brown		dry	dense
55								GRAVELLY SAND (GP) w/ trace fines, gravel to 1.5", loose dry	GP	dry	loose
	WMSA-5-11		A, G	Bag	25-28			CLAYEY SAND (SC) w/ some gravel (native ground underlying fill), black/green, mottled, greenstone, cementation, very dense, dry	SC	dry	very dense
60											
65											
70								GREENSTONE, some fines, green/pale brown, mottled, to 4" diameter, fine grained, subangular, medium weathered, RQD = 4, hard, dry	IGNSFG	dry	hard
75											
80											

Continued Next Page

A. 2" O.D. SPLIT-SPOON SAMPLER
B. 3" O.D. THIN WALL SAMPLER
C. 3-1/4" O.D. x 2-1/2" LINER
D. 3-1/2" O.D. SPLIT-BARREL SAMPLER
E. 2" I.D. SPLIT-SPOON SAMPLER
X. SAMPLE NOT RECOVERED
A. - ATTERBERG
G. - GRAIN SIZE
C. - CONSOLIDATION
DS - DIRECT SHEAR
T - TRIAXIAL
P - PERMEABILITY
WATER LEVEL - ATD
WATER LEVEL - AD

Golder Associates

Lehigh Permanente Cement Quarry

Job No 063-7109
Engr D.S.F. and P.Y.
Date 7/24/07

Lehigh Permanente Cement Quarry
Cupertino, CA
West Materials Storage Area

SUMMARY: BORING NO. WMSA-5

COORDINATES:

DATE DRILLED: 4/24/07 - 4/25/07
DRILLING METHOD: Prosonic (Boart Longyear), Rotosonic
SURFACE CONDITIONS: Greenstone and limestone waste rock up to 5" diameter, dry

ELEVATION:

DEPTH IN FEET	SAMPLE NO.	RECOVERY	LAB TESTING	SAMPLE TYPE	LAB MOISTURE % OF DRY WEIGHT	DRY DENSITY PCF	LITHOLOGY	DESCRIPTION	SYMBOL	MOISTURE	CONSISTENCY	DEPTH IN FEET
80									IGNSFG			80
85								Terminate borehole @86' bgs No water encountered				85
90												90
95												95
100												100
105												105
110												110
115												115
120												120

A. 2" O.D. SPLIT-SPOON SAMPLER
B. 3" O.D. THIN WALL SAMPLER
C. 3-1/4" O.D. x 2-1/2" LINER
D. 3-1/2" O.D. SPLIT-BARREL SAMPLER
E. 2" I.D. SPLIT-SPOON SAMPLER
X. SAMPLE NOT RECOVERED
A. - ATTERBERG
G. - GRAIN SIZE
C. - CONSOLIDATION
DS - DIRECT SHEAR
T - TRIAXIAL
P - PERMEABILITY
WATER LEVEL - ATD
WATER LEVEL - AD

Golder Associates

Lehigh Permanente Cement Quarry

Job No 063-7109
Engr D.S.F. and P.Y.
Date 7/24/07

Lehigh Permanente Cement Quarry
Cupertino, CA
West Materials Storage Area

SUMMARY: BORING NO. WMSA-6

COORDINATES:

DATE DRILLED: 4/27/07 - 4/27/07
DRILLING METHOD: Prosonic (Boart Longyear), Rotosonic
SURFACE CONDITIONS: Small patches of vegetation, gravel up to 3", trace cobbles

ELEVATION:

DEPTH IN FEET	SAMPLE NO.	RECOVERY	LAB TESTING	SAMPLE TYPE	LAB MOISTURE % OF DRY WEIGHT	DRY DENSITY PCF	LITHOLOGY	DESCRIPTION	SYMBOL	MOISTURE	CONSISTENCY
0								SANDY GRAVEL (GP) w/ little fines, dark yellowish brown, gravel to 3" (mostly greenstone waste rock w/ some limestone), moderately dense	GP	dry	medium dense
5										dry	very dense
10								CLAYEY GRAVEL (GP) w/ some sand, yellowish brown, gravel to 3", trace cobbles, mostly greenstone waste rock, trace chert, well cemented, very dense, dry @12': Very dark gray, highly weathered greenstone waste rock			
15											
20								@18': Yellowish brown, increasing gravel size, some cobbles to 5", mostly limestone waste rock			
25								@23': Very dark gray, mostly greenstone waste rock, increasing sand	GP		
30										dry to moist	dense
35	WMSA-6-4		A, G	Bag	24-27						
40											

Continued Next Page

A. 2" O.D. SPLIT-SPOON SAMPLER
B. 3" O.D. THIN WALL SAMPLER
C. 3-1/4" O.D. x 2-1/2" LINER
D. 3-1/2" O.D. SPLIT-BARREL SAMPLER
E. 2" I.D. SPLIT-SPOON SAMPLER
X. SAMPLE NOT RECOVERED
A. - ATTERBERG
G. - GRAIN SIZE
C. - CONSOLIDATION
DS - DIRECT SHEAR
T - TRIAXIAL
P - PERMEABILITY
WATER LEVEL - ATD
WATER LEVEL - AD

Golder Associates

Lehigh Permanente Cement Quarry

Job No 063-7109
Engr D.S.F.
Date 7/24/07

Lehigh Permanente Cement Quarry
Cupertino, CA
West Materials Storage Area

SUMMARY: BORING NO. WMSA-6

COORDINATES:

DATE DRILLED: 4/27/07 - 4/27/07
DRILLING METHOD: Prosonic (Boart Longyear), Rotosonic
SURFACE CONDITIONS: Small patches of vegetation, gravel up to 3", trace cobbles

ELEVATION:

DEPTH IN FEET	SAMPLE NO.	RECOVERY	LAB TESTING	SAMPLE TYPE	LAB MOISTURE % OF DRY WEIGHT	DRY DENSITY PCF	LITHOLOGY	DESCRIPTION	SYMBOL	MOISTURE	CONSISTENCY
40								@40': Yellowish brown, cobbles to 7", mostly low grade limestone @43: Very dark gray	GP	dry	dense
45											
50								CLAYEY SAND (SC) w/ some gravel (native ground underlying fill), limestone to 3" diameter, mottled (red, yellow, green, brown), subrounded, hard, dense, dry	SC	dry	dense
55	WMSA-6-6		A, G	Wrap	22-25						
60								GREENSTONE, dark green/gray, mottled, fine grained, subangular, hard, RQD = 3, dry	IGNSFG		
65											
70								Terminate borehole @ 68' bgs No water encountered			
75											
80											

A. 2" O.D. SPLIT-SPOON SAMPLER
B. 3" O.D. THIN WALL SAMPLER
C. 3-1/4" O.D. x 2-1/2" LINER
D. 3-1/2" O.D. SPLIT-BARREL SAMPLER
E. 2" I.D. SPLIT-SPOON SAMPLER
X. SAMPLE NOT RECOVERED
A. - ATTERBERG
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WATER LEVEL - ATD
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Golder Associates

Lehigh Permanente Cement Quarry

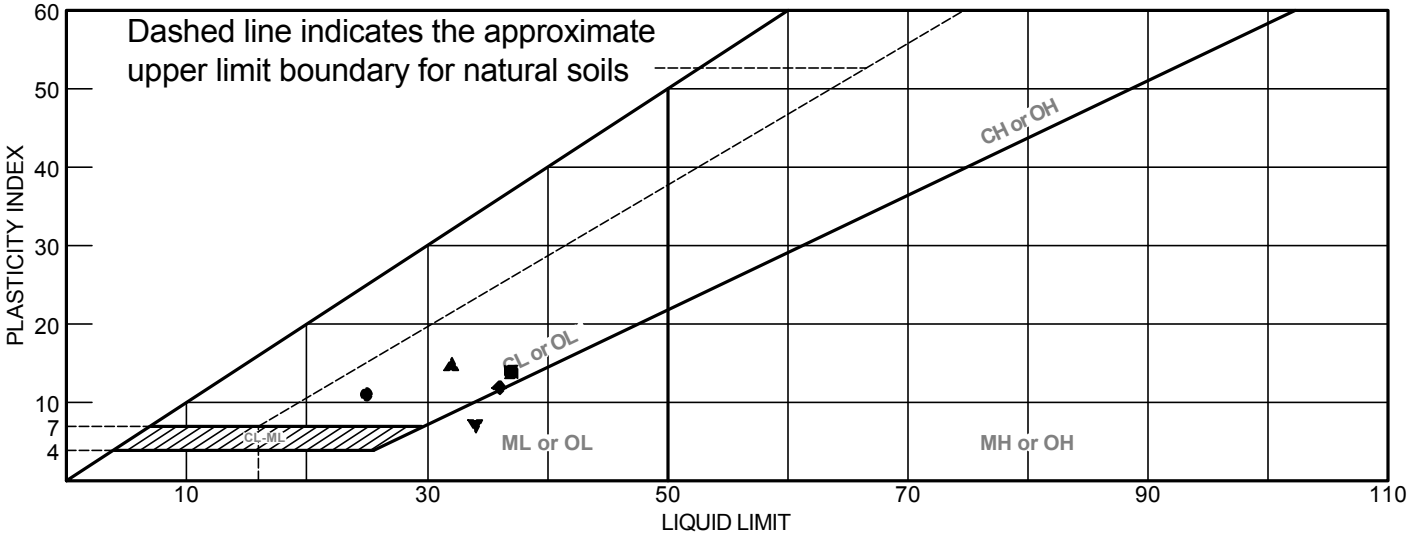
Job No 063-7109
Engr D.S.F.
Date 7/24/07

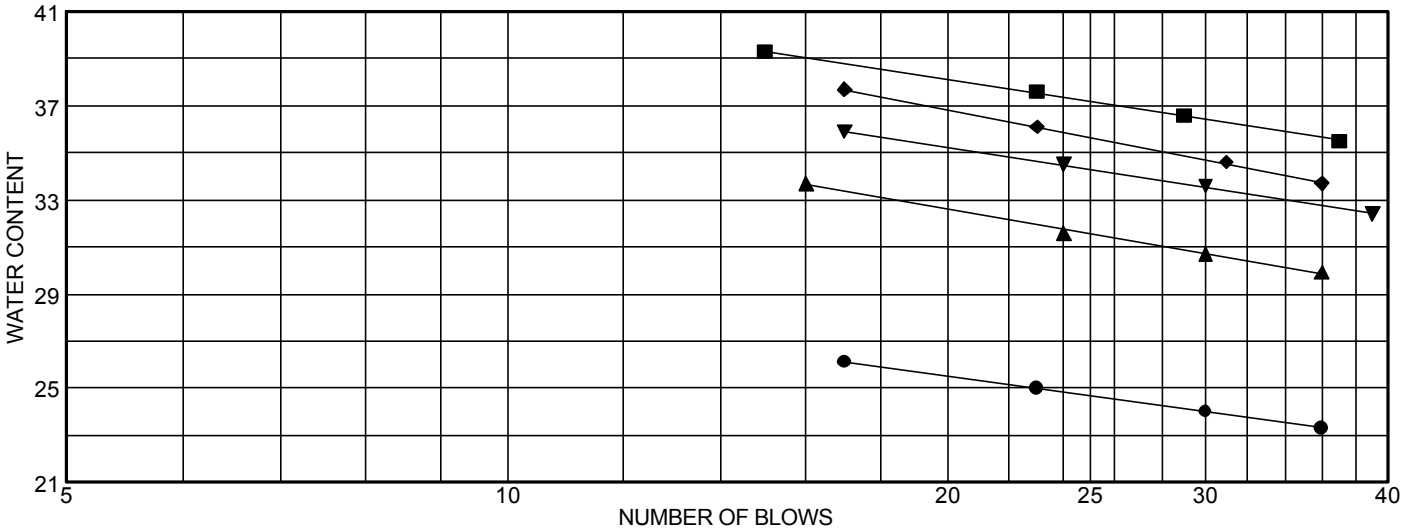
Lehigh Permanente Cement Quarry
Cupertino, CA
West Materials Storage Area

APPENDIX 10.B

WMSA Laboratory Test Results

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Black Lean Clayey GRAVEL w/ Sand	25	14	11			
■	Brown Sandy Lean CLAY w/ Gravel	37	23	14			
▲	Green & Gray Lean CLAY w/ Sand	32	17	15			
◆	Brown Lean Clayey SAND w/ Gravel	36	24	12			
▼	Brown Silty SAND w/ Gravel	34	27	7			

Project No. 287-030 **Client:** Golder Associates

Project: Hanson/ West Materials Storage Area - 003-7109.008

● **Source:** WMSA-2 **Sample No.:** 2-8 **Elev./Depth:** 61'
■ **Source:** WMSA-2 **Sample No.:** 2-13 **Elev./Depth:** 125'
▲ **Source:** WMSA-2 **Sample No.:** 2-15 **Elev./Depth:** 131'
◆ **Source:** WMSA-3 **Sample No.:** 3-1 **Elev./Depth:** 6'
▼ **Source:** WMSA-3 **Sample No.:** 3-4 **Elev./Depth:** 35'

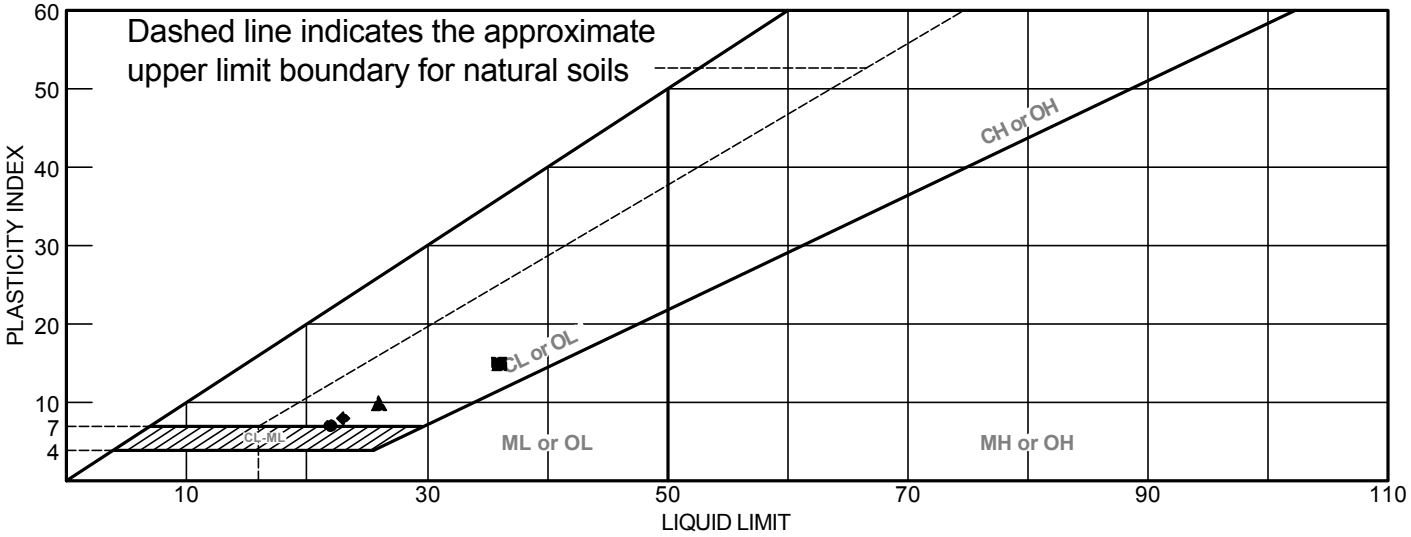
Remarks:
●
■
▲
◆
▼

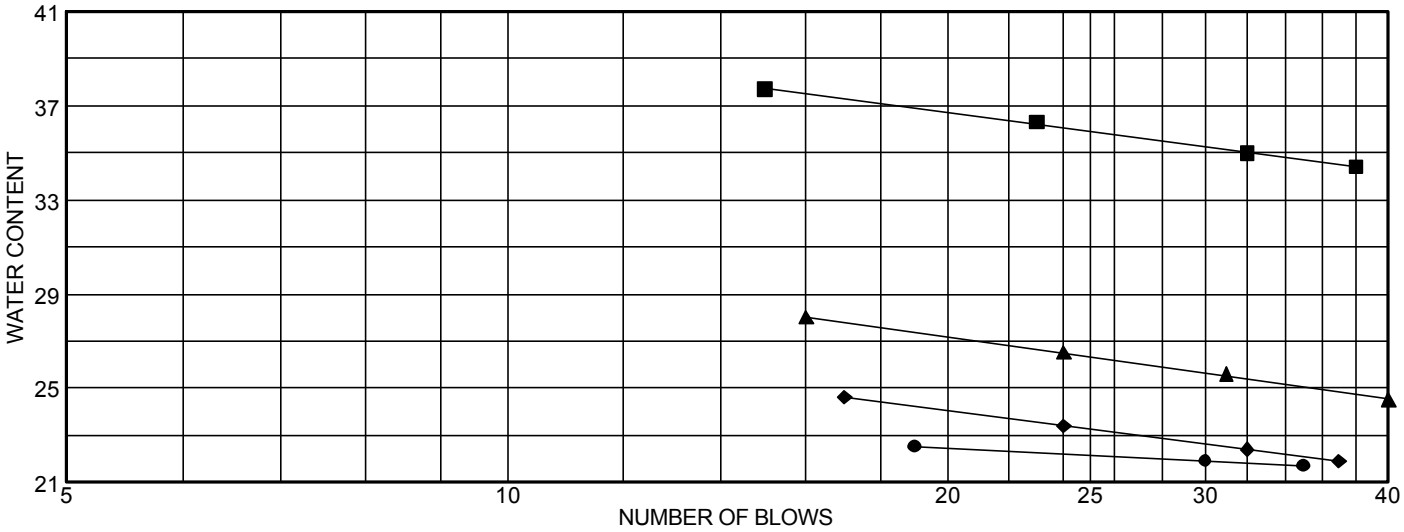
LIQUID AND PLASTIC LIMITS TEST REPORT

COOPER TESTING LABORATORY

Figure

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Brown Silty, Clayey GRAVEL w/ Sand	22	15	7			
■	Brownish Yellow Lean Clayey SAND w/ Gravel	36	21	15			
▲	Black & Green Lean Clayey SAND w/ Gravel	26	16	10			
◆	Black Lean Clayey SAND w/ Gravel	23	15	8			

Project No. 287-030 **Client:** Golder Associates

Project: Hanson/ West Materials Storage Area - 003-7109.008

● **Source:** WMSA-4 **Sample No.:** 4-11 **Elev./Depth:** 58'
■ **Source:** WMSA-5 **Sample No.:** 5-2 **Elev./Depth:** 13'
▲ **Source:** WMSA-5 **Sample No.:** 5-11 **Elev./Depth:** 58'
◆ **Source:** WMSA-6 **Sample No.:** 6-6 **Elev./Depth:** 54'

Remarks:
●
■
▲
◆

LIQUID AND PLASTIC LIMITS TEST REPORT

COOPER TESTING LABORATORY

Figure

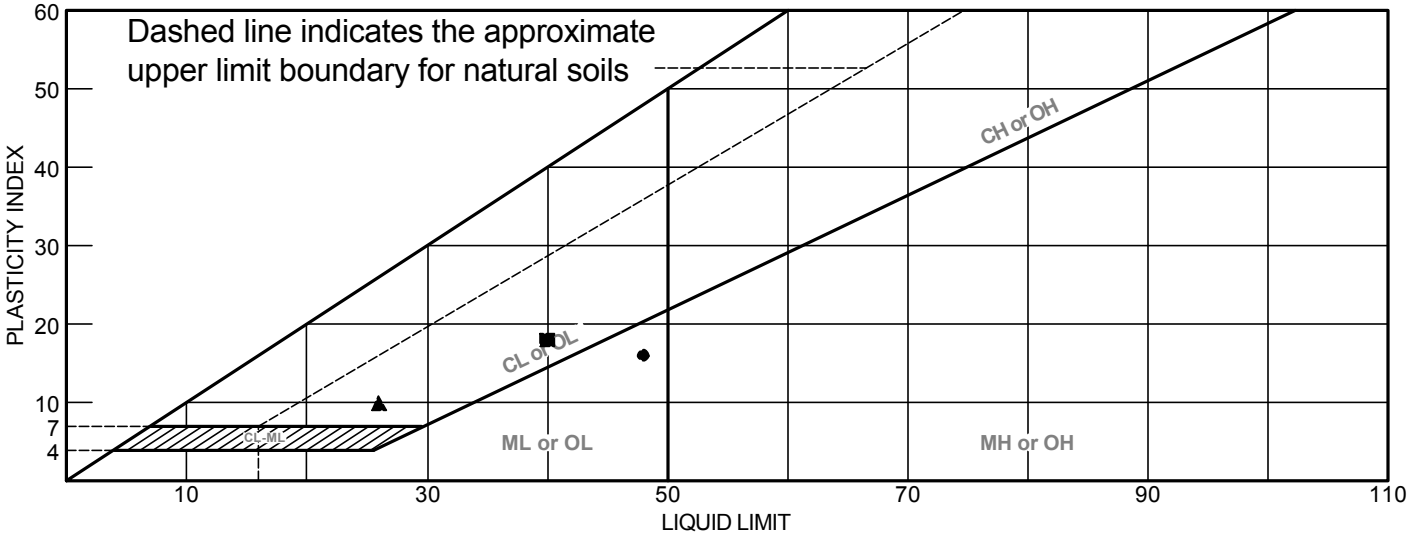
#200 Sieve Wash Analysis
ASTM D 1140

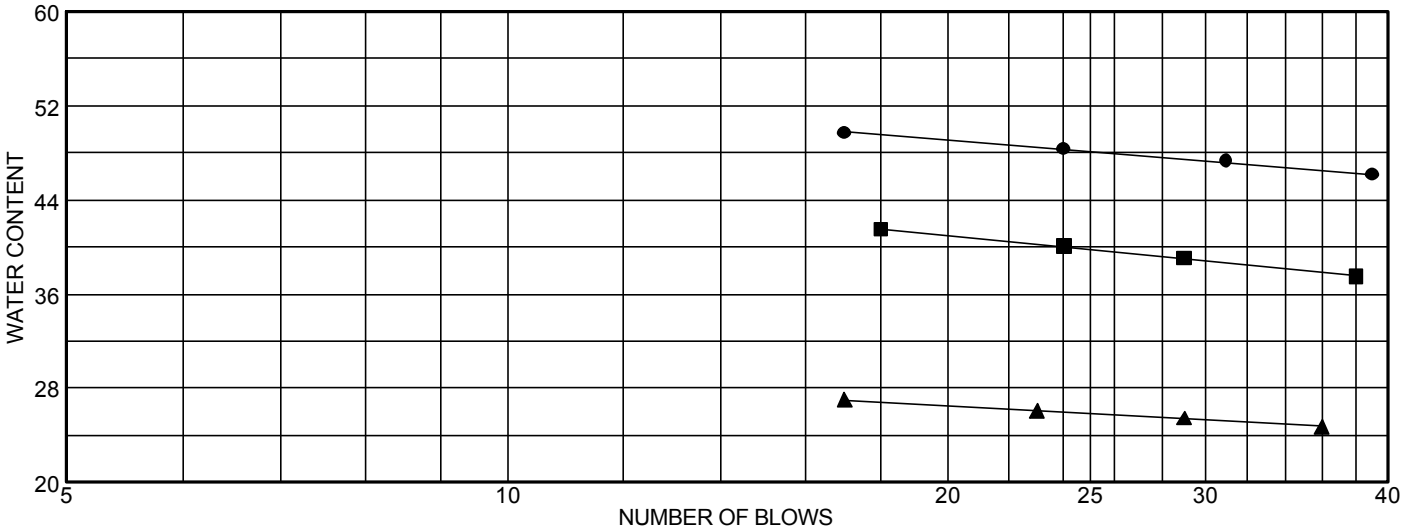
Job No.: 287-030 **Project No.:** 003-7109.008 **Run By:** MD
Client: Golder Associates **Date:** 5/31/2007 **Checked By:** DC
Project: Hanson/West Materials Storage Area

Boring:	WMSA-2	WMSA-2	WMSA-3	WMSA-3	WMSA-4	WMSA-5	WMSA-6	
Sample:	2-8	2-15	3-1	3-4	4-11	5-11	6-6	
Depth, ft.:	61	131	6	35	58	58	54	
Soil Type:	Black Lean Clayey GRAVEL w/ Sand	Green & Gray Lean CLAY w/ Sand	Brown Lean Clayey SAND w/ Gravel	Brown Silty SAND w/ Gravel	Brown Silty,Clayey GRAVEL w/ Sand	Black & Green Lean Clayey SAND w/ Gravel	Black Lean Clayey SAND w/ Gravel	
Wt of Dish & Dry Soil, gm	717.7	945.8	860.4	879.1	907.1	829.0	920.4	
Weight of Dish, gm	84.5	309.8	278.2	82.9	80.2	96.4	174.3	
Weight of Dry Soil, gm	633.2	636.0	582.2	796.2	826.9	732.6	746.1	
Wt. Ret. on #4 Sieve, gm	294.5	75.3	132.6	175.8	318.3	124.4	276.2	
Wt. Ret. on #200 Sieve, gm	533.9	178.4	416.9	612.9	627.6	463.4	603.7	
% Gravel	**46.5**	**11.8**	**22.8**	**22.1**	**38.5**	**17.0**	**37.0**	
% Sand	**37.8**	**16.2**	**48.8**	**54.9**	**37.4**	**46.3**	**43.9**	
% Silt & Clay	**15.7**	**71.9**	**28.4**	**23.0**	**24.1**	**36.7**	**19.1**	

Remarks: As an added benefit to our clients, the gravel fraction may be included in this report. Whether or not it is included is dependent upon both the technician's time available and if there is a significant enough amount of gravel. The gravel is always included in the percent retained on the #200 sieve but may not be weighed separately to determine the percentage, especially if there is only a trace amount, (5% or less).

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Dark Brown Silty GRAVEL w/ Sand	48	32	16			
■	Brownish Yellow Lean Clayey SAND w/ Gravel	40	22	18			
▲	Dark Reddish Gray Lean Clayey GRAVEL w/ Sand	26	16	10			

Project No. 287-032 **Client:** Golder Associates

Project: Hanson/West Materials Storage Area - 063-7109.008

● **Source:** WMSA-3 **Sample No.:** 3-9 **Elev./Depth:** 113'

■ **Source:** WMSA-4 **Sample No.:** 4-12 **Elev./Depth:** 59'

▲ **Source:** WMSA-6 **Sample No.:** 6-4 **Elev./Depth:** 33'

Remarks:

●

■

▲

LIQUID AND PLASTIC LIMITS TEST REPORT

COOPER TESTING LABORATORY

Figure

#200 Sieve Wash Analysis
ASTM D 1140

Job No.:	287-032	**Project No.:** 063-7109.008	**Run By:** MD
Client:	Golder Associates	**Date:** 6/26/2007	**Checked By:** DC
Project:	Hanson/West Materials Storage Area		

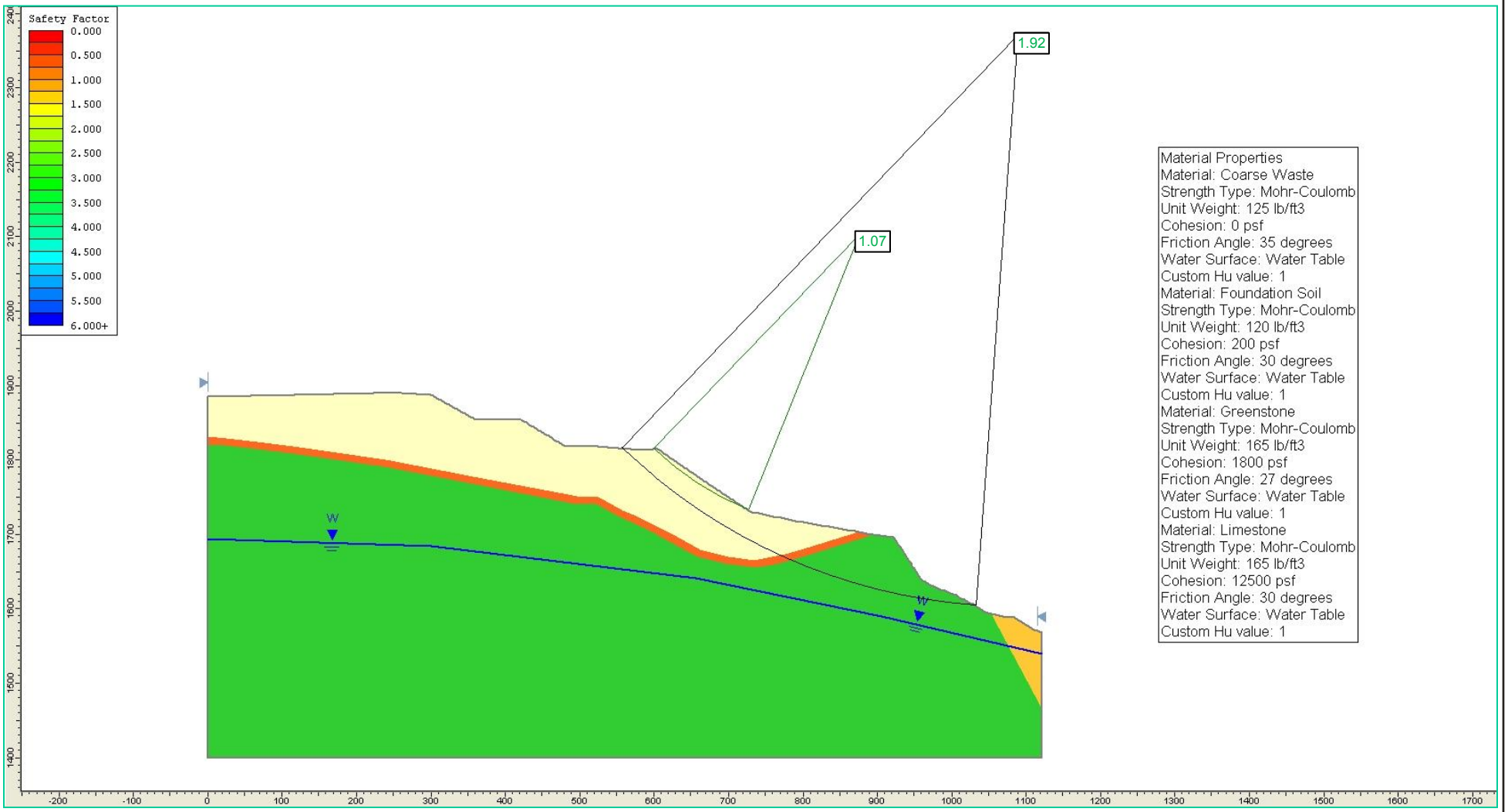
Boring:	WMSA-3	WMSA-4	WMSA-9					
Sample:	3-9	4-12	6-4					
Depth, ft.:	113	59	33					
Soil Type:	Dark Brown Silty GRAVEL w/ Sand	Brownish Yellow Lean Clayey SAND w/ Gravel	Dark Reddish Gray Lean Clayey GRAVEL w/ Sand					
Wt of Dish & Dry Soil, gm	783.0	568.5	750.1					
Weight of Dish, gm	83.7	84.4	82.9					
Weight of Dry Soil, gm	699.3	484.1	667.2					
Wt. Ret. on #4 Sieve, gm	289.7	94.1	300.0					
Wt. Ret. on #200 Sieve, gm	477.1	245.3	543.2					
% Gravel	**41.4**	**19.4**	**45.0**					
% Sand	**26.8**	**31.2**	**36.4**					
% Silt & Clay	**31.8**	**49.3**	**18.6**					

Remarks: As an added benefit to our clients, the gravel fraction may be included in this report. Whether or not it is included is dependent upon both the technician's time available and if there is a significant enough amount of gravel. The gravel is always included in the percent retained on the #200 sieve but may not be weighed separately to determine the percentage, especially if there is only a trace amount, (5% or less).

APPENDIX 10.C

WMSA Slope Stability Output

PROJECT NO. 063-7109904 DRAWN: AJS REVIEWED BY: KGH DATE: 07-07-11 FILE LOCATION:



SECTION W1 – EXISTING EAST SLOPE OF WMSA

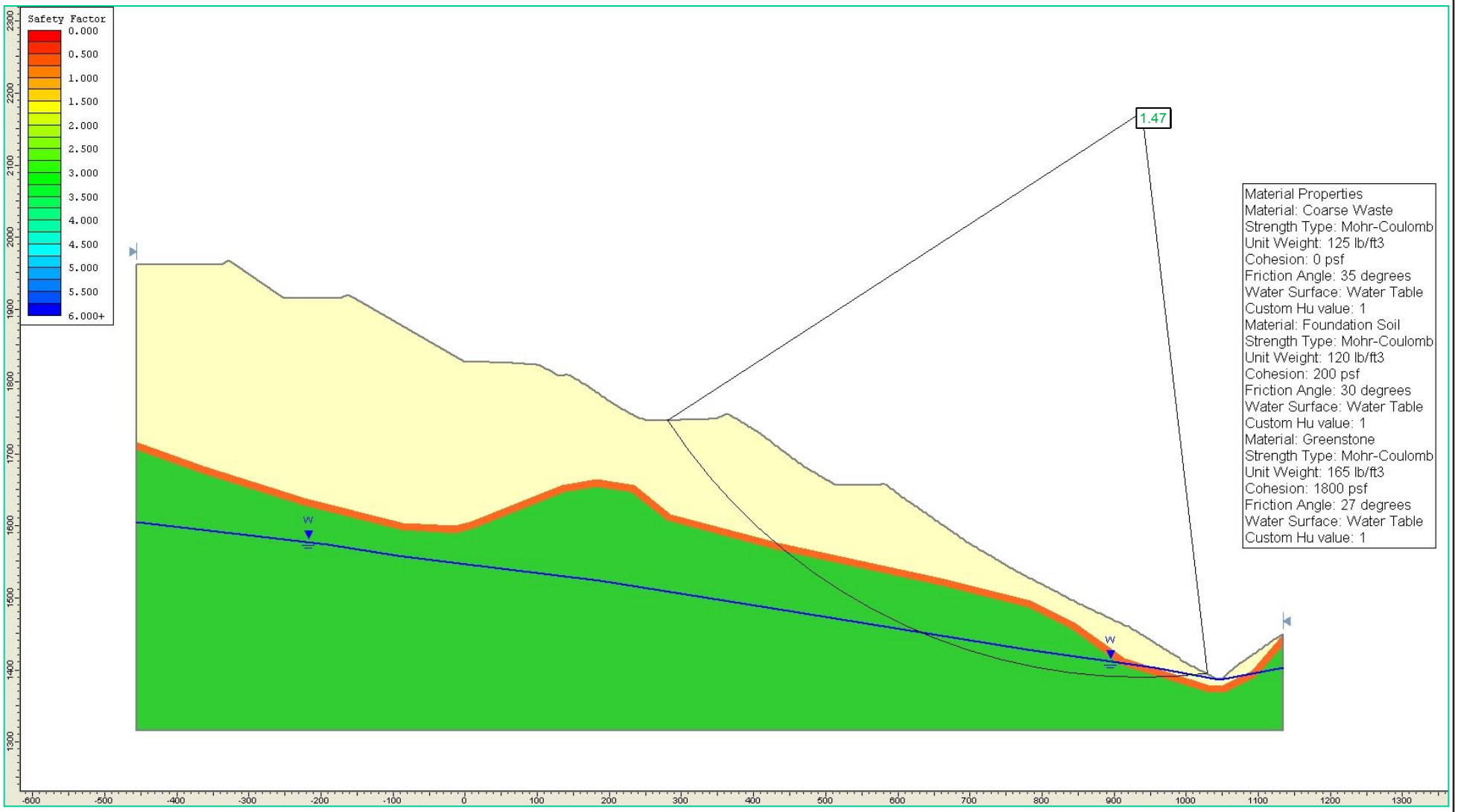
CONDITION: STATIC

FAILURE MODE: CIRCULAR

Golder Associates		EXISTING SLOPE STABILITY SECTION W1 – WMSA LEHIGH SOUTHWEST CEMENT COMPANY, CA	
Drawn: AJS	App'd: KGH	Date: JULY, 2011	Figure: 10C-1

Project No.: 063-7109 Revision No.: 2

PROJECT NO. 063-7109904 DRAWN: AJS REVIEWED BY: KGH DATE: 07-07-11 FILE LOCATION:



SECTION W2 – EXISTING SOUTH SLOPE OF WMSA

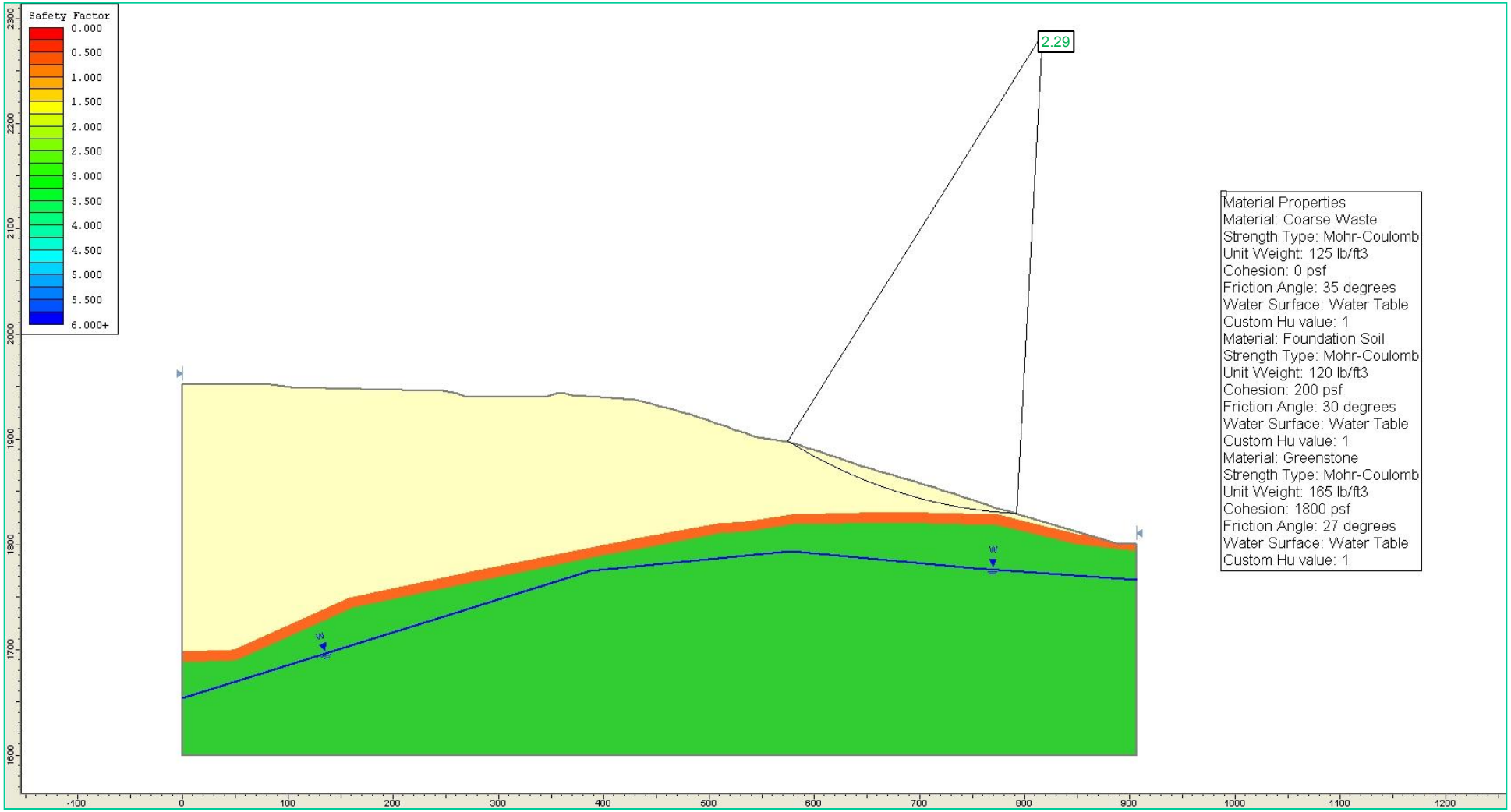
CONDITION: STATIC

FAILURE MODE: CIRCULAR

Golder Associates		EXISTING SLOPE STABILITY SECTION W2 – WMSA LEHIGH SOUTHWEST CEMENT COMPANY, CA	
Drawn: AJS	App'd: KGH	Date: JULY, 2011	Figure: 10C-2

Project No.: 063-7109 Revision No.: 2

PROJECT NO. 063-7109904 DRAWN: AJS REVIEWED BY: KGH DATE: 07-07-11 FILE LOCATION:



SECTION W3 – EXISTING NORTH SLOPE OF WMSA

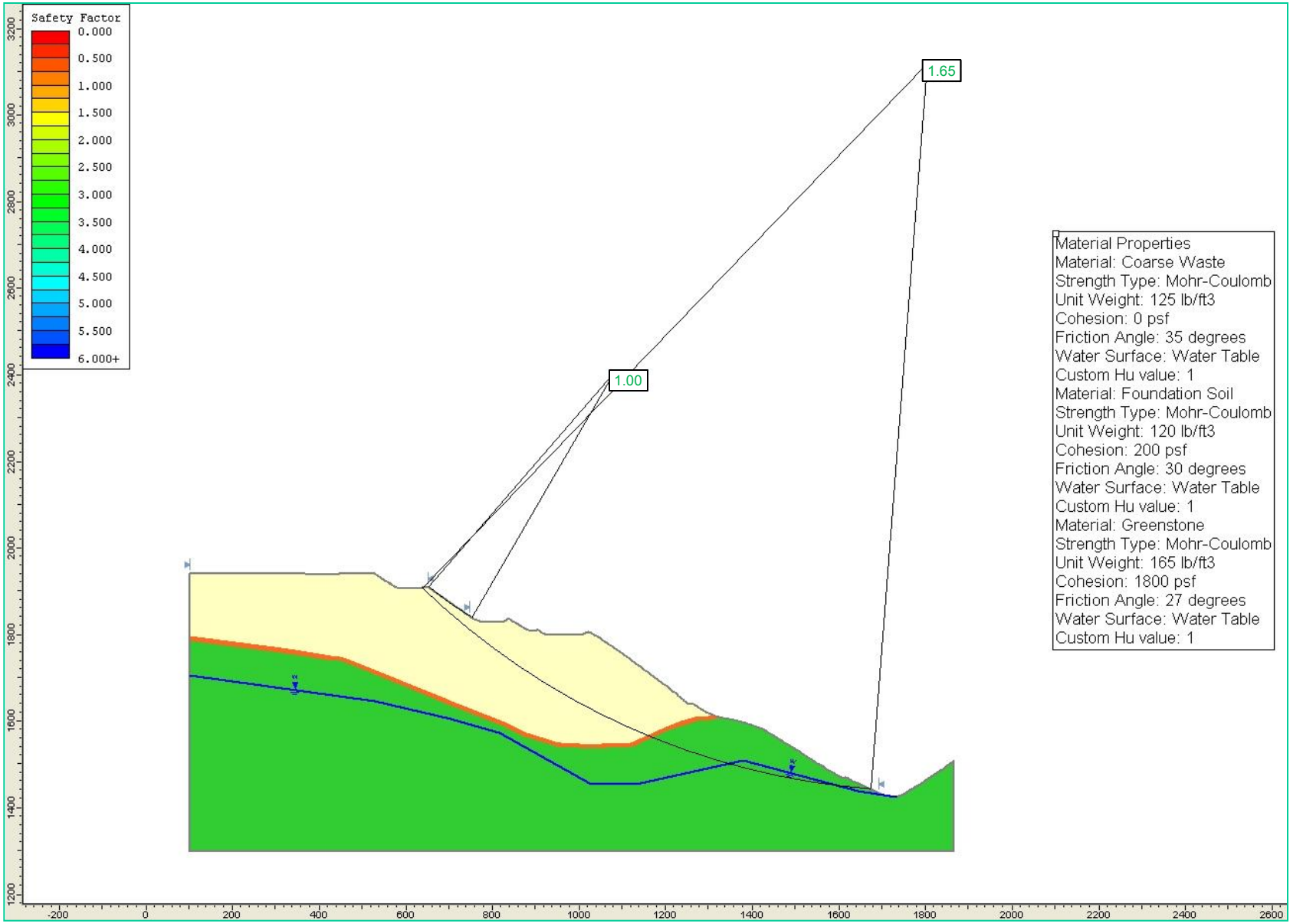
CONDITION: STATIC

FAILURE MODE: CIRCULAR

Golder Associates		EXISTING SLOPE STABILITY SECTION W3 – WMSA LEHIGH SOUTHWEST CEMENT COMPANY, CA	
Drawn: AJS	App'd: KGH	Date: JULY, 2011	Figure: 10C-3

Project No.: 063-7109 Revision No.: 2

PROJECT NO. 063-7109904 DRAWN: AJS REVIEWED BY: KGH DATE: 07-07-11 FILE LOCATION:



BACK ANALYSIS SECTION W4

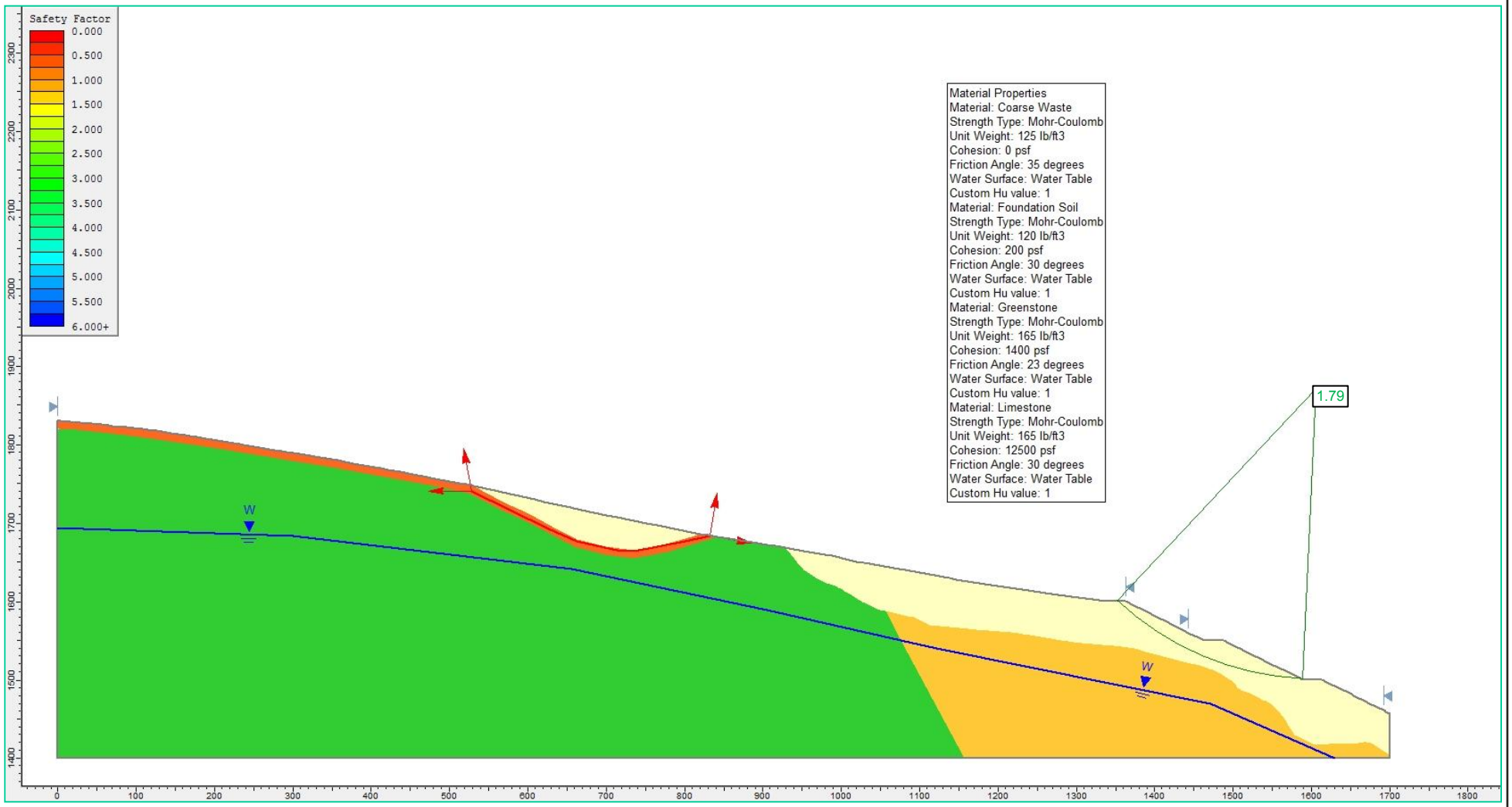
CONDITION: STATIC

FAILURE MODE: CIRCULAR

Golder Associates		BACK ANALYSES OF SECTION W4 – UPPER DUMP LEHIGH SOUTHWEST CEMENT COMPANY, CA	
Drawn: AJS	App'd: KGH	Date: JULY, 2011	Figure: 10C-4

Project No.: 063-7109 Revision No.: 2

PROJECT NO. 063-7109904 DRAWN: AJS REVIEWED BY: KGH DATE: 07-07-11 FILE LOCATION:



SECTION W1 – WMSA FINAL RECLAMATION

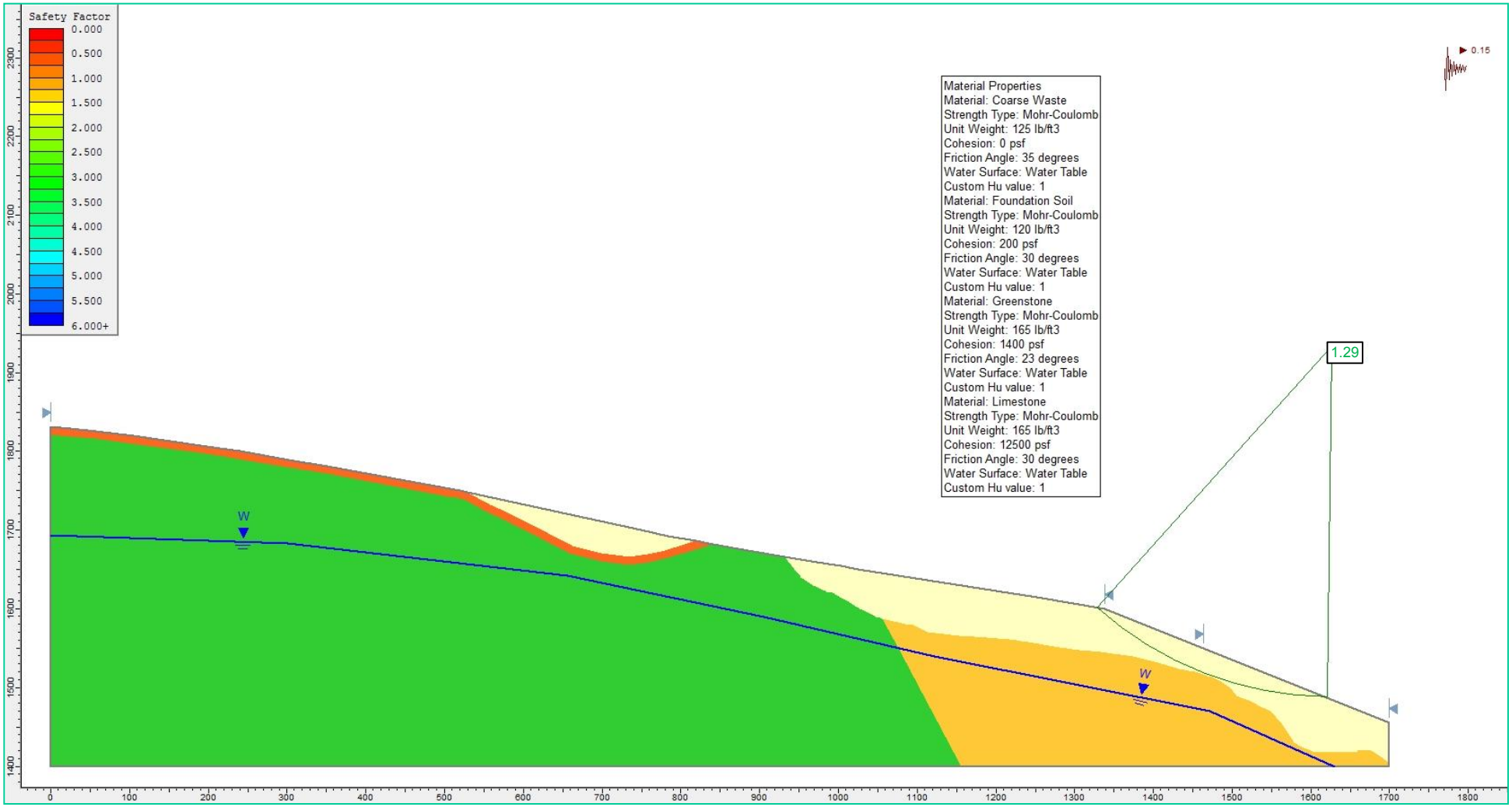
CONDITION: STATIC

FAILURE MODE: CIRCULAR

Golder Associates	STATIC CONDITION PROPOSED SEC W1, WMSA LEHIGH SOUTHWEST CEMENT COMPANY, CA		
Drawn: AJS	App'd: KGH	Date: JULY, 2011	Figure: 10C-5

Project No.: 063-7109 Revision No.: 2

PROJECT NO. 063-7109904 DRAWN: AJS REVIEWED BY: KGH DATE: 07-07-11 FILE LOCATION:



SECTION W1 – WMSA FINAL RECLAMATION

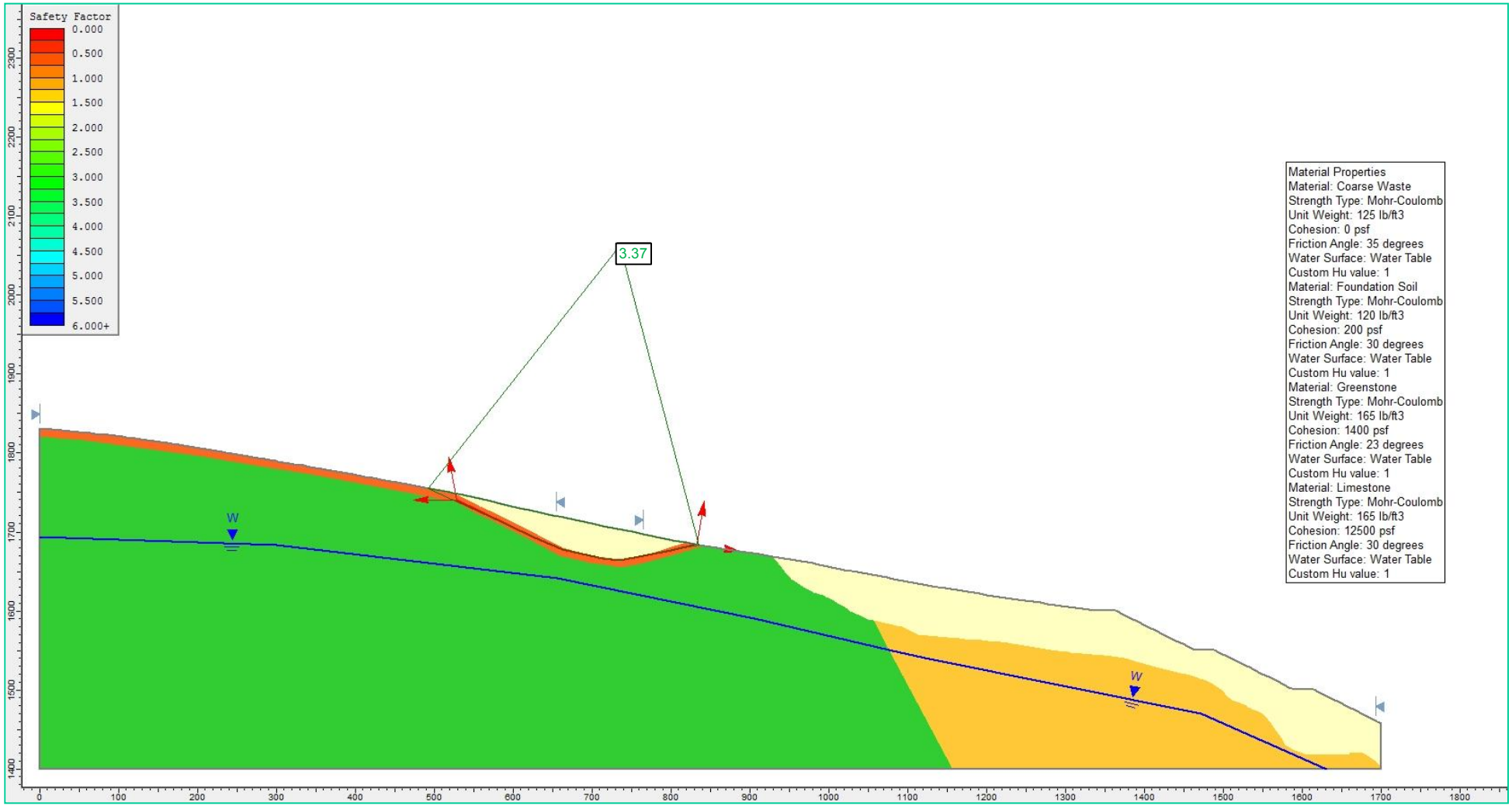
CONDITION: PSEUDO-STATIC (Ks = 0.15)

FAILURE MODE: CIRCULAR

Golder Associates	PSEUDO-STATIC ANALYSES PROPOSED SEC W1, WMSA LEHIGH SOUTHWEST CEMENT COMPANY, CA		
Drawn: AJS	App'd: KGH	Date: JULY, 2011	Figure: 10C-6

Project No.: 063-7109 Revision No.: 2

PROJECT NO. 063-7109904 DRAWN: AJS REVIEWED BY: KGH DATE: 07-07-11 FILE LOCATION:



SECTION W1 – WMSA FINAL RECLAMATION

CONDITION: STATIC

FAILURE MODE: BLOCK

Golder Associates		STATIC CONDITION PROPOSED SEC W1, WMSA LEHIGH SOUTHWEST CEMENT COMPANY, CA	
Drawn: AJS	App'd: KGH	Date: JULY, 2011	Figure: 10C-7

Project No.: 063-7109 Revision No.: 2

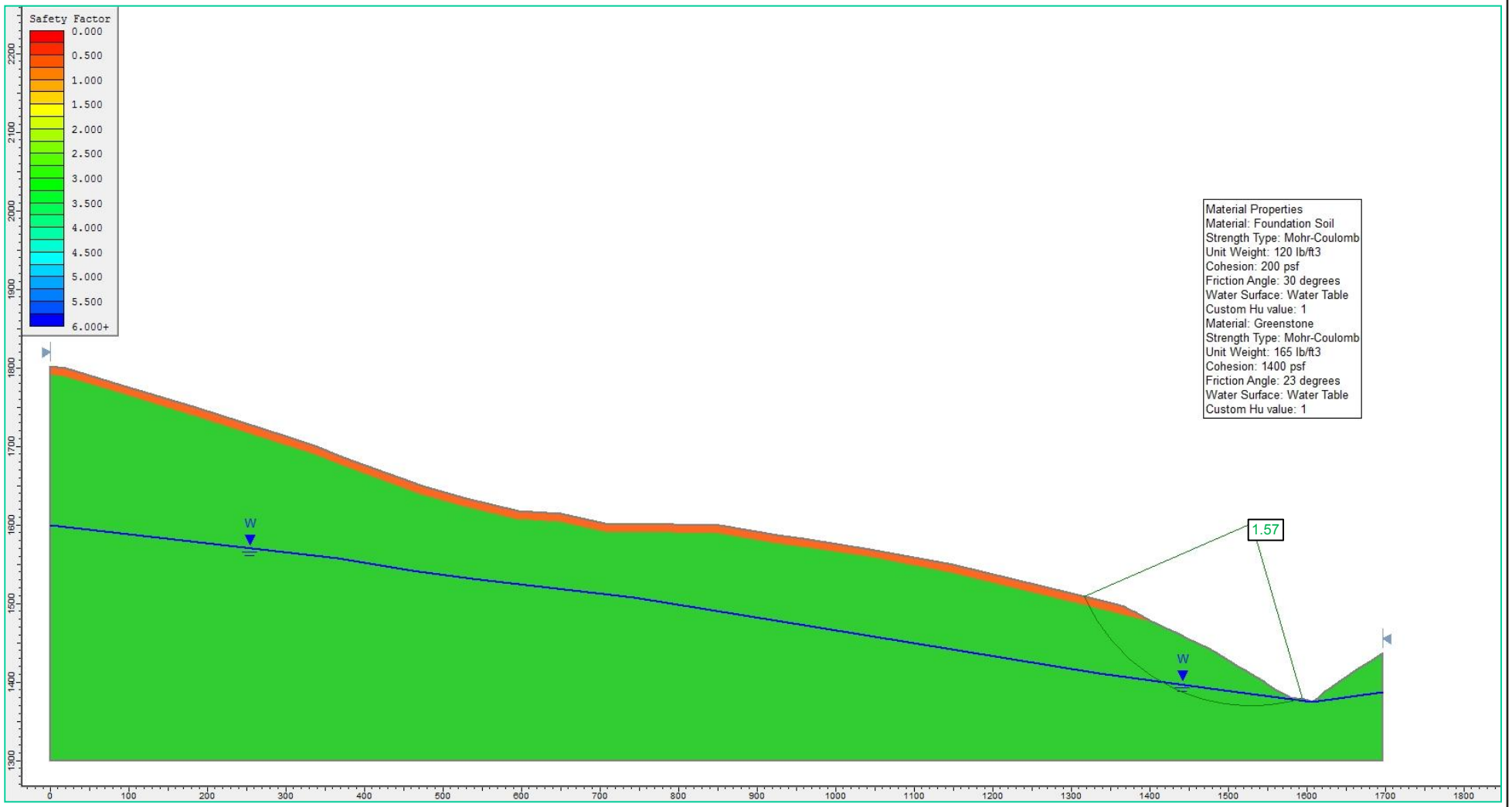
PROJECT NO. 063-7109904 DRAWN: AJS REVIEWED BY: KGH DATE: 07-07-11 FILE LOCATION:

SECTION W1 – WMSA FINAL RECLAMATION
CONDITION: PSEUDO-STATIC (Ks = 0.15)
FAILURE MODE: BLOCK

Golder Associates		PSEUDO-STATIC ANALYSES PROPOSED SEC W1, WMSA LEHIGH SOUTHWEST CEMENT COMPANY, CA	
Drawn: AJS	App'd: KGH	Date: JULY, 2011	Figure: 10C-8

Project No.: 063-7109 Revision No.: 2

PROJECT NO. 063-7109904 DRAWN: AJS REVIEWED BY: KGH DATE: 07-07-11 FILE LOCATION:



SECTION W2 – WMSA FINAL RECLAMATION

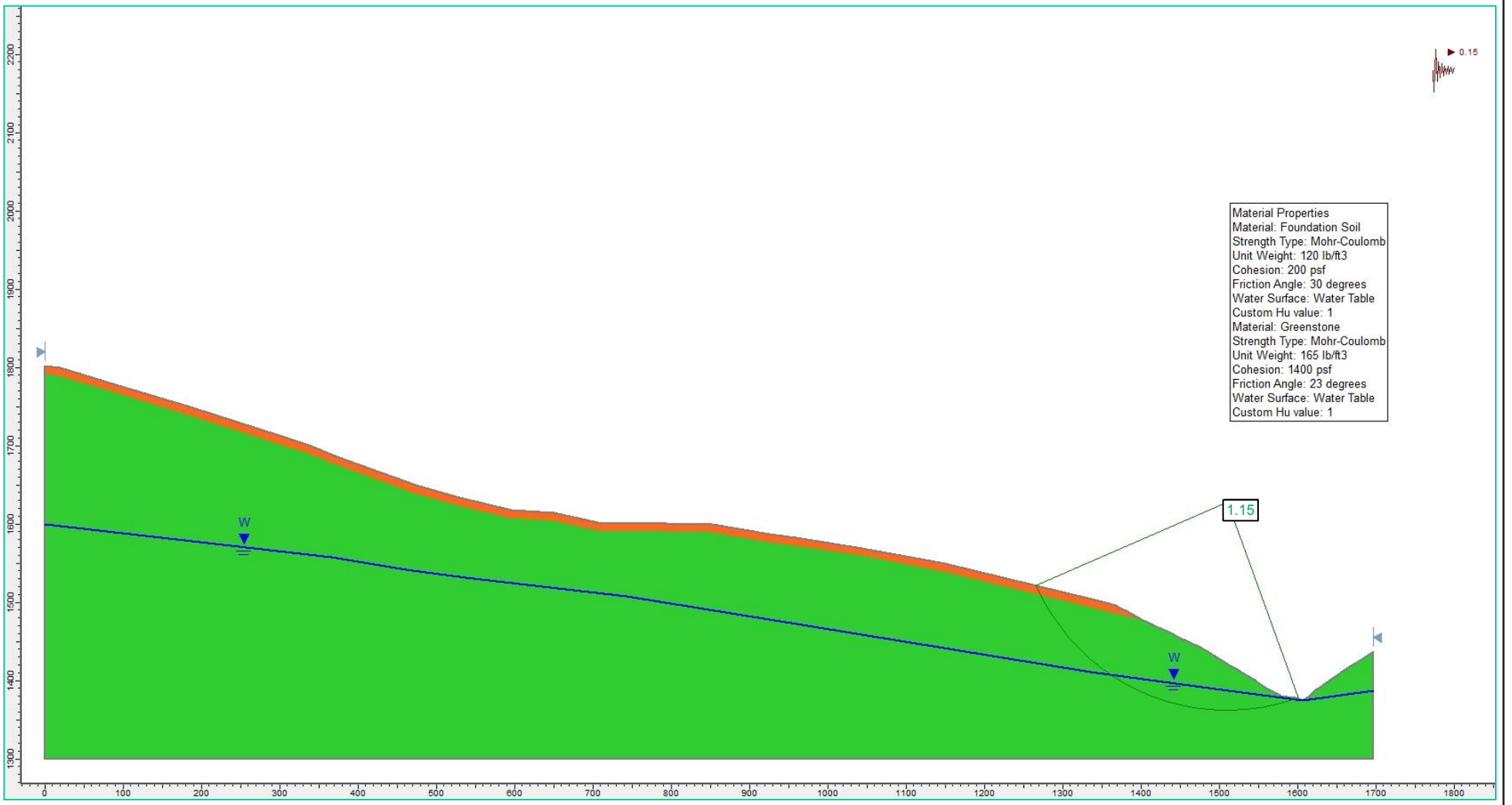
CONDITION: STATIC

FAILURE MODE: CIRCULAR

Golder Associates		STATIC CONDITION PROPOSED SEC W2, WMSA LEHIGH SOUTHWEST CEMENT COMPANY, CA	
Drawn: AJS	App'd: KGH	Date: JULY, 2011	Figure: 10C-9

Project No.: 063-7109 Revision No.: 2

PROJECT NO. 063-7109904 DRAWN: AJS REVIEWED BY: KGH DATE: 07-07-11 FILE LOCATION:



SECTION W2 – WMSA FINAL RECLAMATION

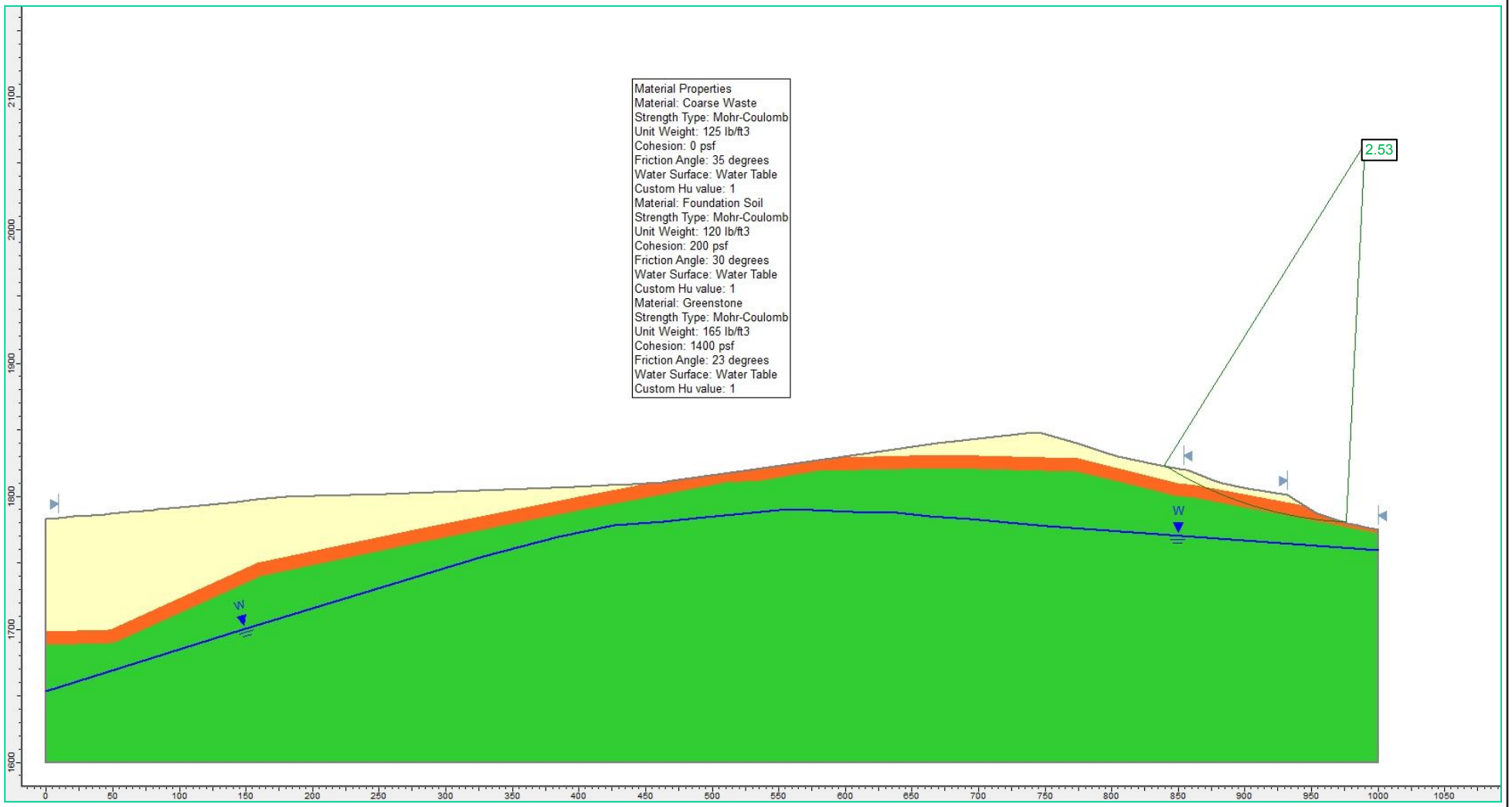
CONDITION: PSEUDO-STATIC (Ks = 0.15)

FAILURE MODE: CIRCULAR

Golder Associates		PSEUDO-STATIC ANALYSES PROPOSED SEC W2, WMSA LEHIGH SOUTHWEST CEMENT COMPANY, CA	
Drawn: AJS	App'd: KGH	Date: JULY, 2011	Figure: 10C-10

Project No.: 063-7109 Revision No.: 2

PROJECT NO. 063-7109904 DRAWN: AJS REVIEWED BY: KGH DATE: 07-07-11 FILE LOCATION:



SECTION W3 – WMSA FINAL RECLAMATION

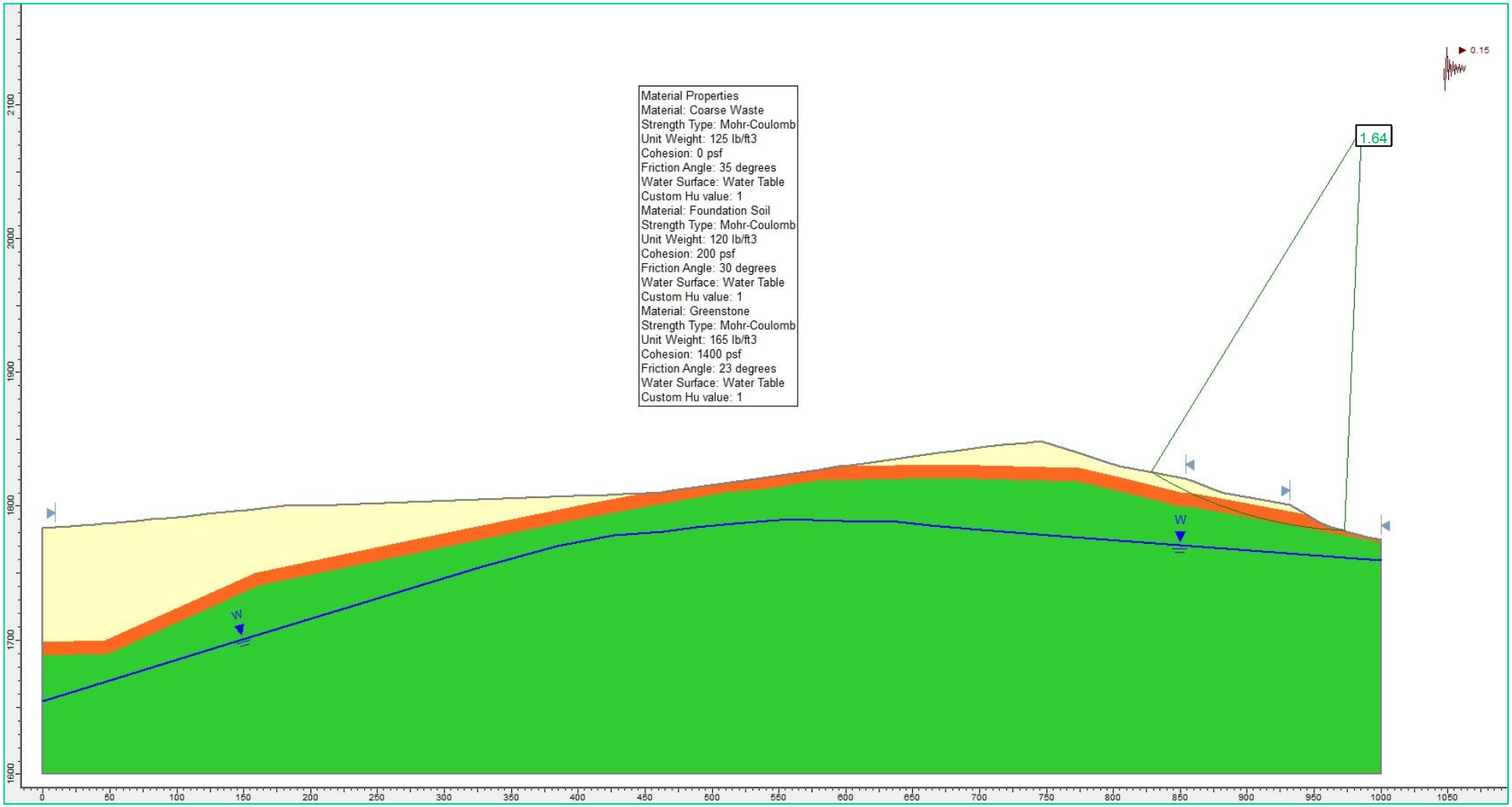
CONDITION: STATIC

FAILURE MODE: CIRCULAR

Golder Associates		STATIC CONDITION PROPOSED SEC W3, WMSA LEHIGH SOUTHWEST CEMENT COMPANY, CA	
Drawn: AJS	App'd: KGH	Date: JULY, 2011	Figure: 10C-11

Project No.: 063-7109 Revision No.: 2

PROJECT NO. 063-7109904 DRAWN: AJS REVIEWED BY: KGH DATE: 07-07-11 FILE LOCATION:



SECTION W3 – WMSA FINAL RECLAMATION

CONDITION: PSEUDO-STATIC (Ks = 0.15)

FAILURE MODE: CIRCULAR

Golder Associates		PSEUDO-STATIC ANALYSES PROPOSED SEC W3, WMSA LEHIGH SOUTHWEST CEMENT COMPANY, CA	
Drawn: AJS	App'd: KGH	Date: JULY, 2011	Figure: 10C-12

Project No.: 063-7109 Revision No.: 2

Summary of Dynamic Deformation Analysis - WMSA

Selected Notations			
M_w =	Moment magnitude	k_y =	Yield acceleration
a_{brk} =	Peak Horizontal Acceleration at the bedrock	U =	Dynamic deformation along critical slide surface
a_{max} =	Peak Horizontal Acceleration at the crest of slope		

Earthquake Characterization		
M_w	a_{brk} g	a_{max} (Reference 1) g
7.1	0.60	0.60

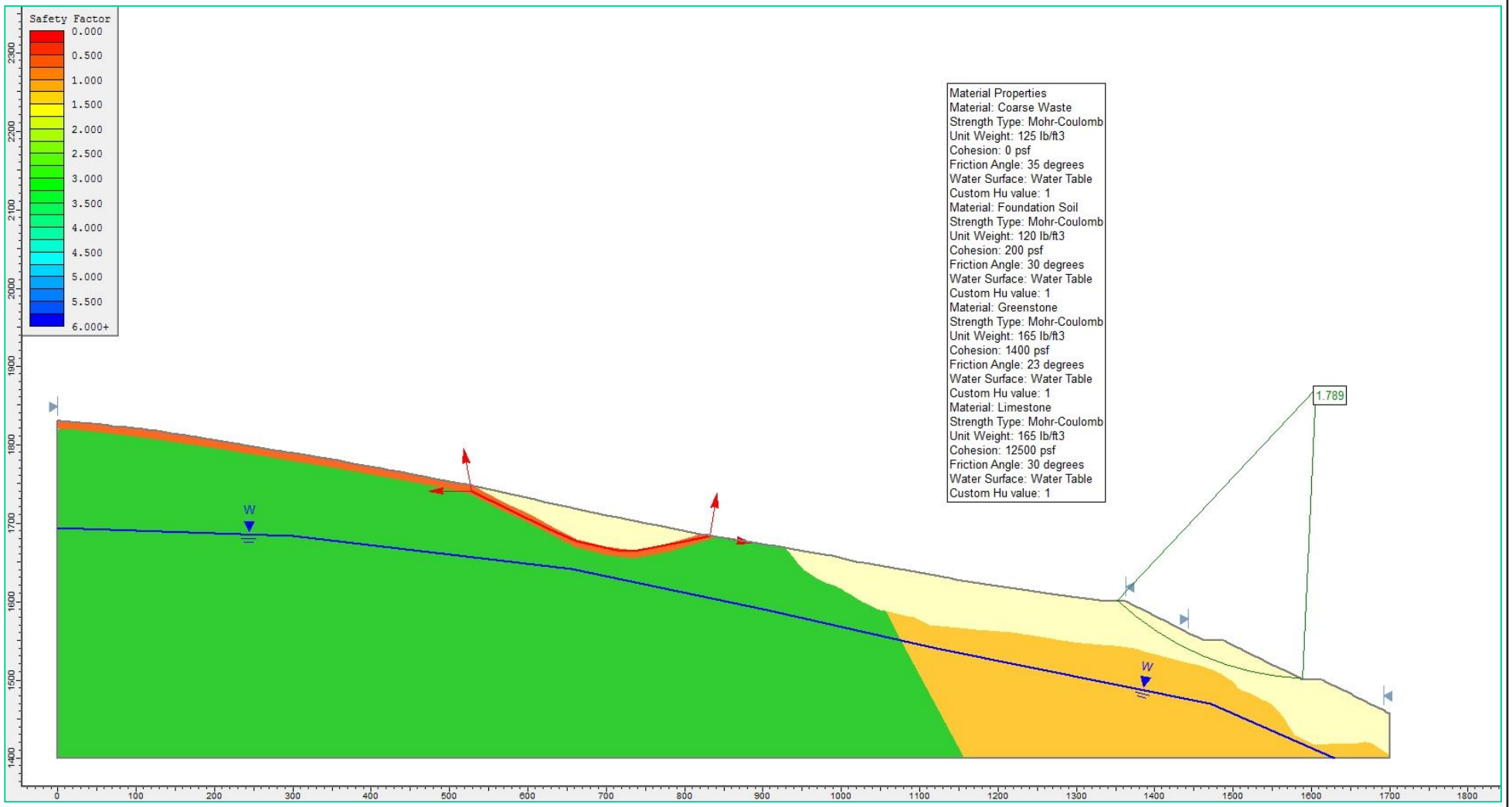
Deformation Calculation (Reference 2)							
SITE	Section	Failure Description	k_y g	k_y/a_{max}	Slope Deformation, U (in) (Bray and Travasarou)		
					84% Exc.	16% Exc.	50% Exc.
WMSA	W2	grading design	0.19	0.32	2	9	5
	W3	grading design	0.32	0.53	1	3	1

References:

1. Seed, H. B. and Idriss, I. M. (1982), Ground Motions and Soil Liquefaction During Earthquakes Monograph No. 5, Earthquake Engineering Research Institute, Berkeley, California.
2. Bray, J. D. and Travasarou, T. (2007), Simplified Procedure for Estimating Earthquake-Induced Deviatoric Slope Displacements Journal of the Geotechnical and Geoenvironmental Engineering, ASCE, Vol. 133, No. 4, pp. 381-392.

Note: This spreadsheet is only intended to estimate seismic deformation under the above shown earthquake events and sections, assuming potential failure mass is a Newmark rigid sliding block.

PROJECT NO. 063-7109904 DRAWN: AJS REVIEWED BY: KGH DATE: 07-07-11 FILE LOCATION:



SECTION W1 – WMSA FINAL RECLAMATION

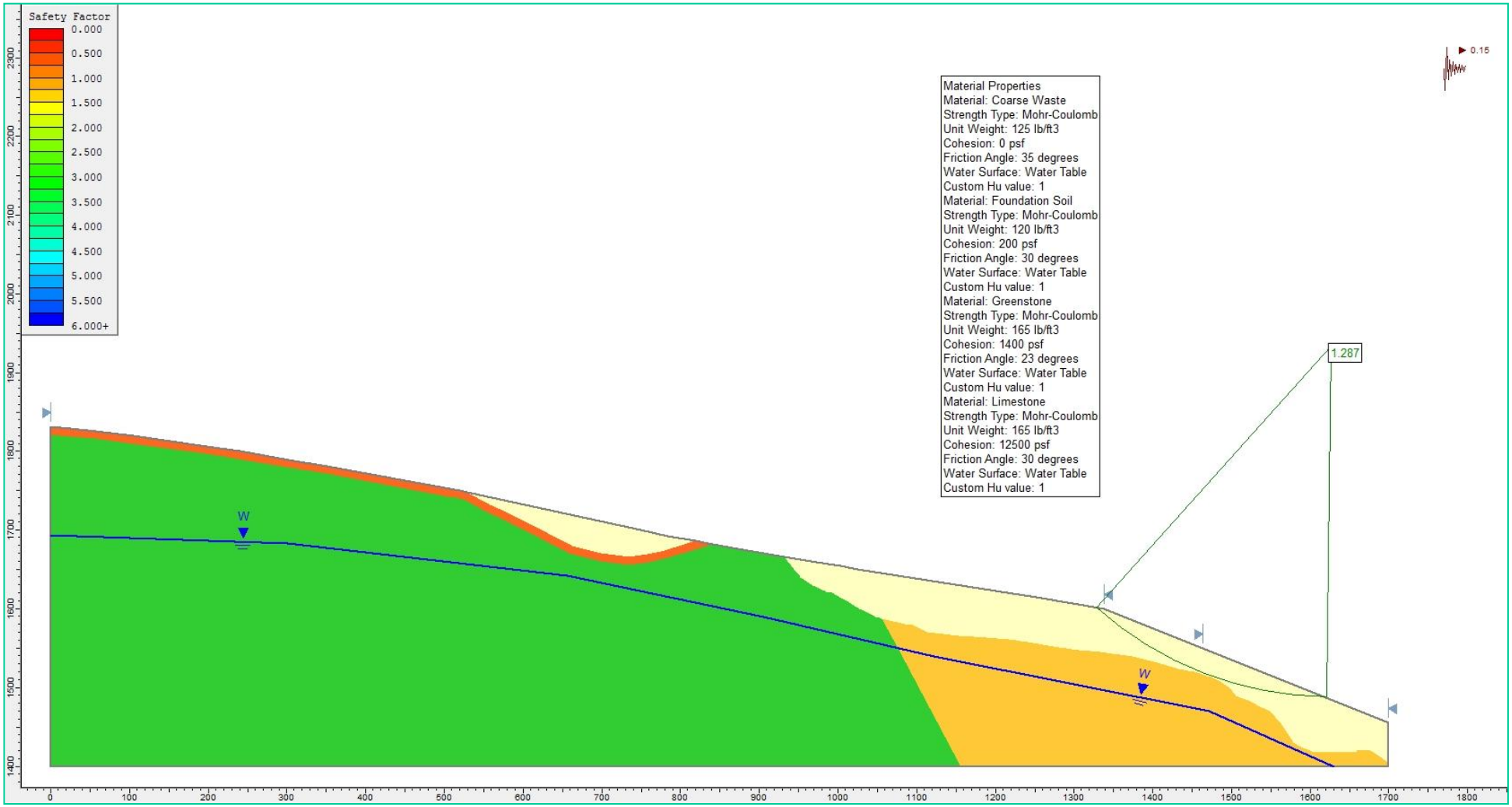
CONDITION: STATIC

FAILURE MODE: CIRCULAR

Golder Associates	STATIC CONDITION PROPOSED SEC W1, WMSA LEHIGH SOUTHWEST CEMENT COMPANY, CA		
Drawn: AJS	App'd: KGH	Date: JULY, 2011	Figure: 10C-14

Project No.: 063-7109 Revision No.: 2

PROJECT NO. 063-7109904 DRAWN: AJS REVIEWED BY: KGH DATE: 07-07-11 FILE LOCATION:



SECTION W1 – WMSA FINAL RECLAMATION

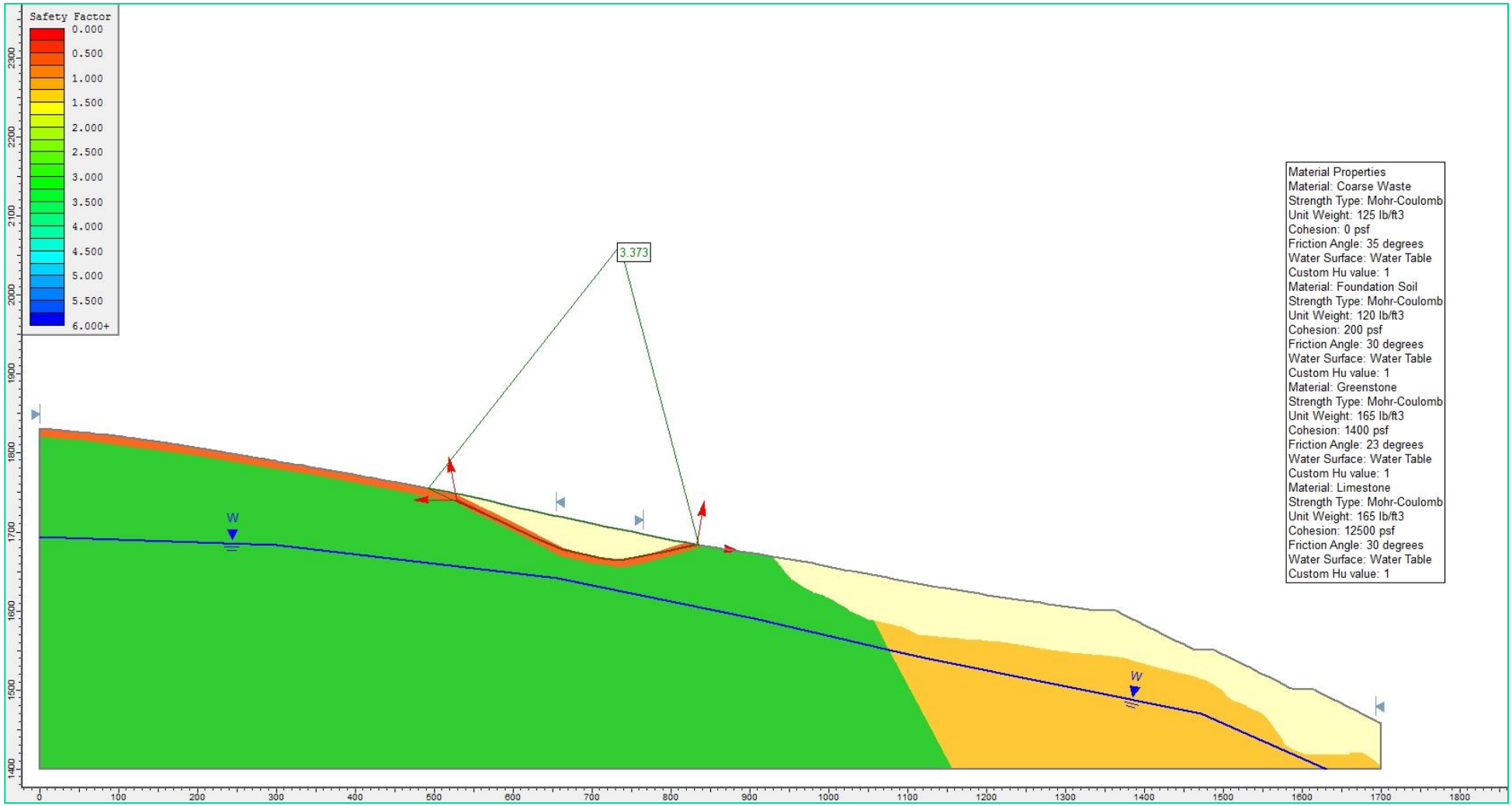
CONDITION: PSEUDO-STATIC (Ks = 0.15)

FAILURE MODE: CIRCULAR

Golder Associates	PSEUDO-STATIC ANALYSES PROPOSED SEC W1, WMSA LEHIGH SOUTHWEST CEMENT COMPANY, CA		
Drawn: AJS	App'd: KGH	Date: JULY, 2011	Figure: 10C-15

Project No.: 063-7109 Revision No.: 2

PROJECT NO. 063-7109904 DRAWN: AJS REVIEWED BY: KGH DATE: 07-07-11 FILE LOCATION:



SECTION W1 – WMSA FINAL RECLAMATION

CONDITION: STATIC

FAILURE MODE: BLOCK

Golder Associates		STATIC CONDITION PROPOSED SEC W1, WMSA LEHIGH SOUTHWEST CEMENT COMPANY, CA	
Drawn: AJS	App'd: KGH	Date: JULY, 2011	Figure: 10C-16

Project No.: 063-7109 Revision No.: 2

PROJECT NO. 063-7109904 DRAWN: AJS REVIEWED BY: KGH DATE: 07-07-11 FILE LOCATION:

SECTION W1 – WMSA FINAL RECLAMATION

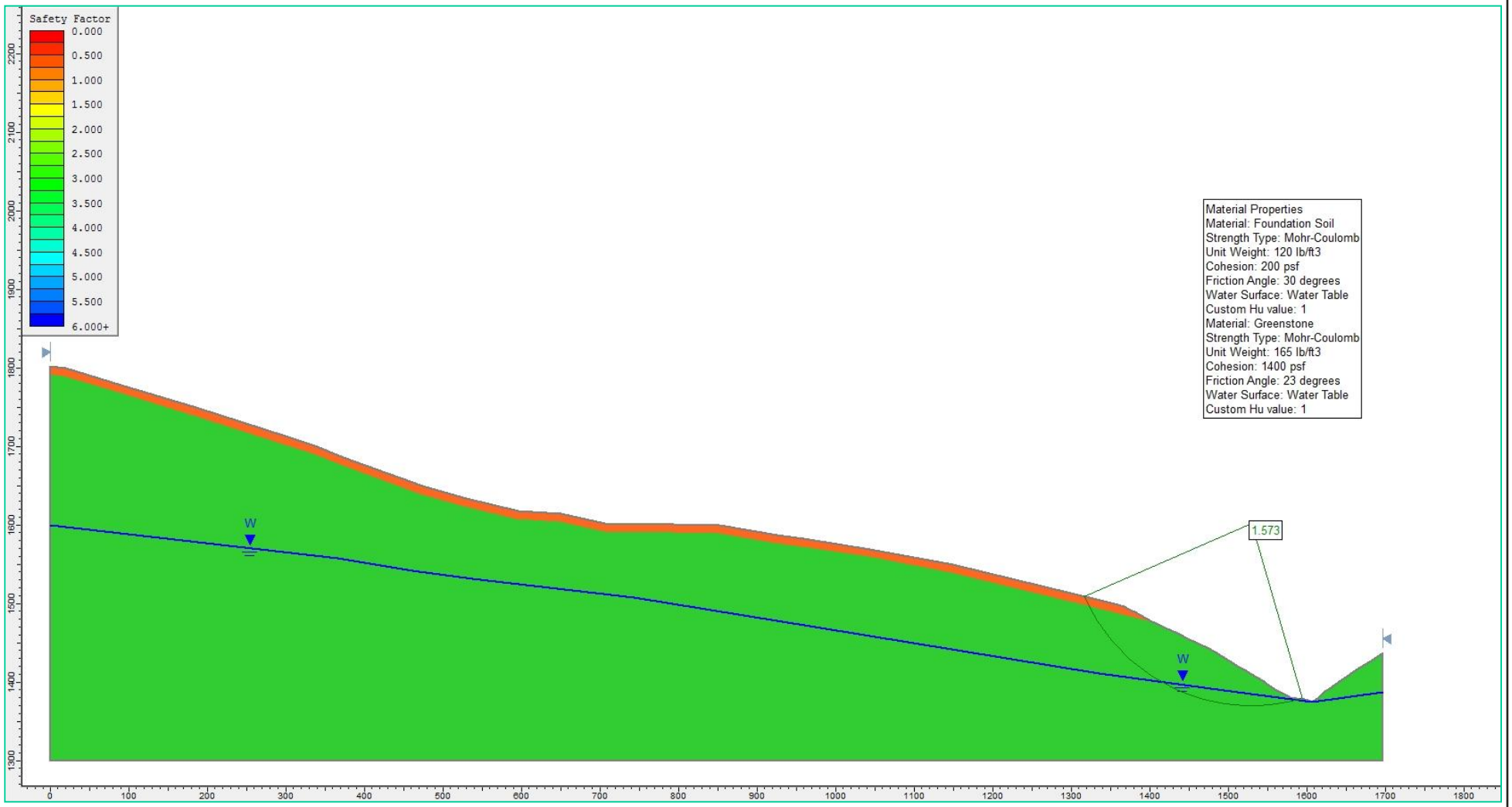
CONDITION: PSEUDO-STATIC (Ks = 0.15)

FAILURE MODE: BLOCK

Golder Associates		PSEUDO-STATIC ANALYSES PROPOSED SEC W1, WMSA LEHIGH SOUTHWEST CEMENT COMPANY, CA	
Drawn: AJS	App'd: KGH	Date: JULY, 2011	Figure: 10C-17

Project No.: 063-7109 Revision No.: 2

PROJECT NO. 063-7109904 DRAWN: AJS REVIEWED BY: KGH DATE: 07-07-11 FILE LOCATION:



SECTION W2 – WMSA FINAL RECLAMATION

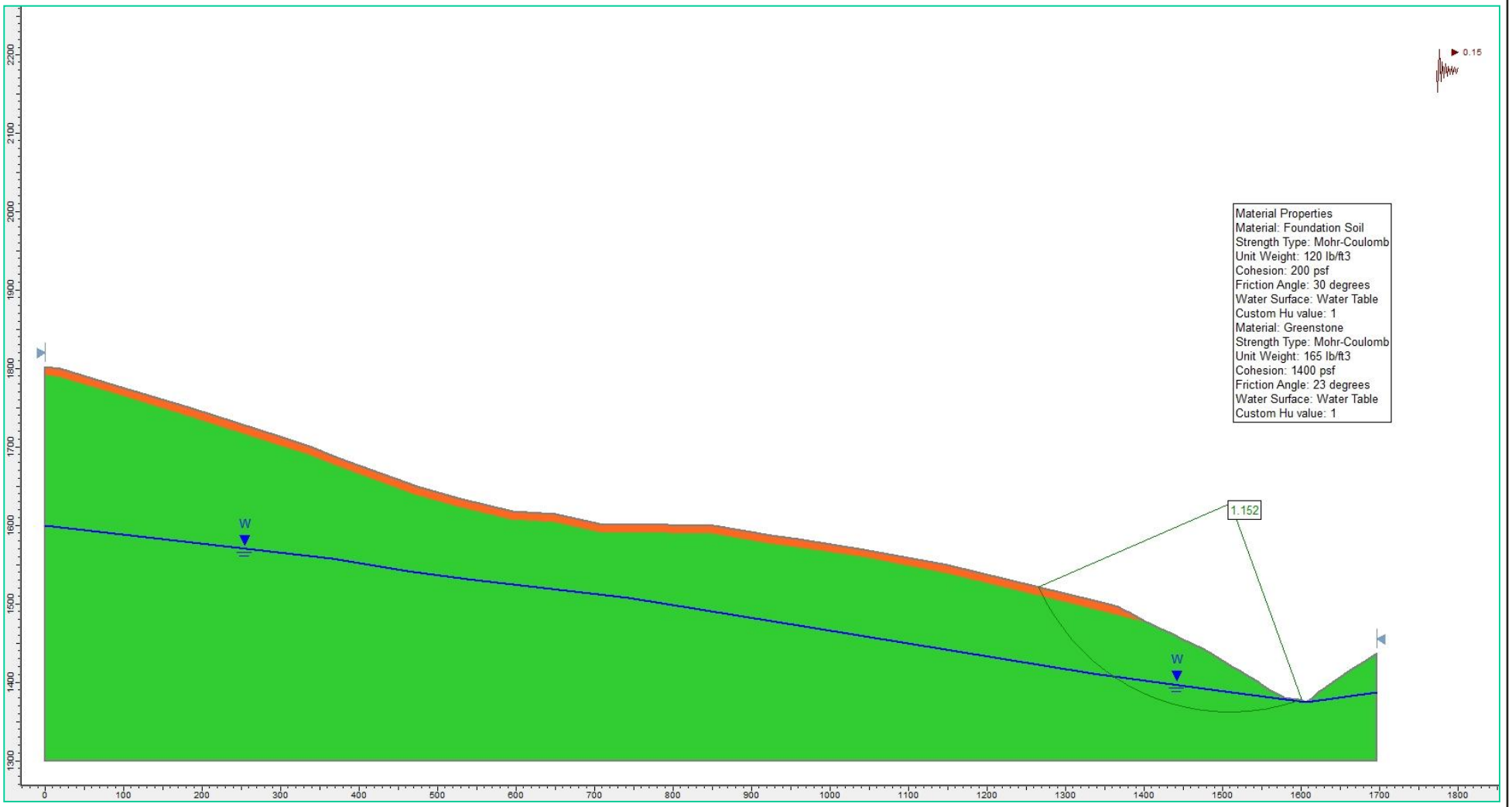
CONDITION: STATIC

FAILURE MODE: CIRCULAR

Golder Associates		STATIC CONDITION PROPOSED SEC W2, WMSA LEHIGH SOUTHWEST CEMENT COMPANY, CA	
Drawn: AJS	App'd: KGH	Date: JULY, 2011	Figure: 10C-18

Project No.: 063-7109 Revision No.: 2

PROJECT NO. 063-7109904 DRAWN: AJS REVIEWED BY: KGH DATE: 07-07-11 FILE LOCATION:



SECTION W2 – WMSA FINAL RECLAMATION

CONDITION: PSEUDO-STATIC (Ks = 0.15)

FAILURE MODE: CIRCULAR

Golder Associates		PSEUDO-STATIC ANALYSES PROPOSED SEC W2, WMSA LEHIGH SOUTHWEST CEMENT COMPANY, CA	
Drawn: AJS	App'd: KGH	Date: JULY, 2011	Figure: 10C-19

Project No.: 063-7109 Revision No.: 2

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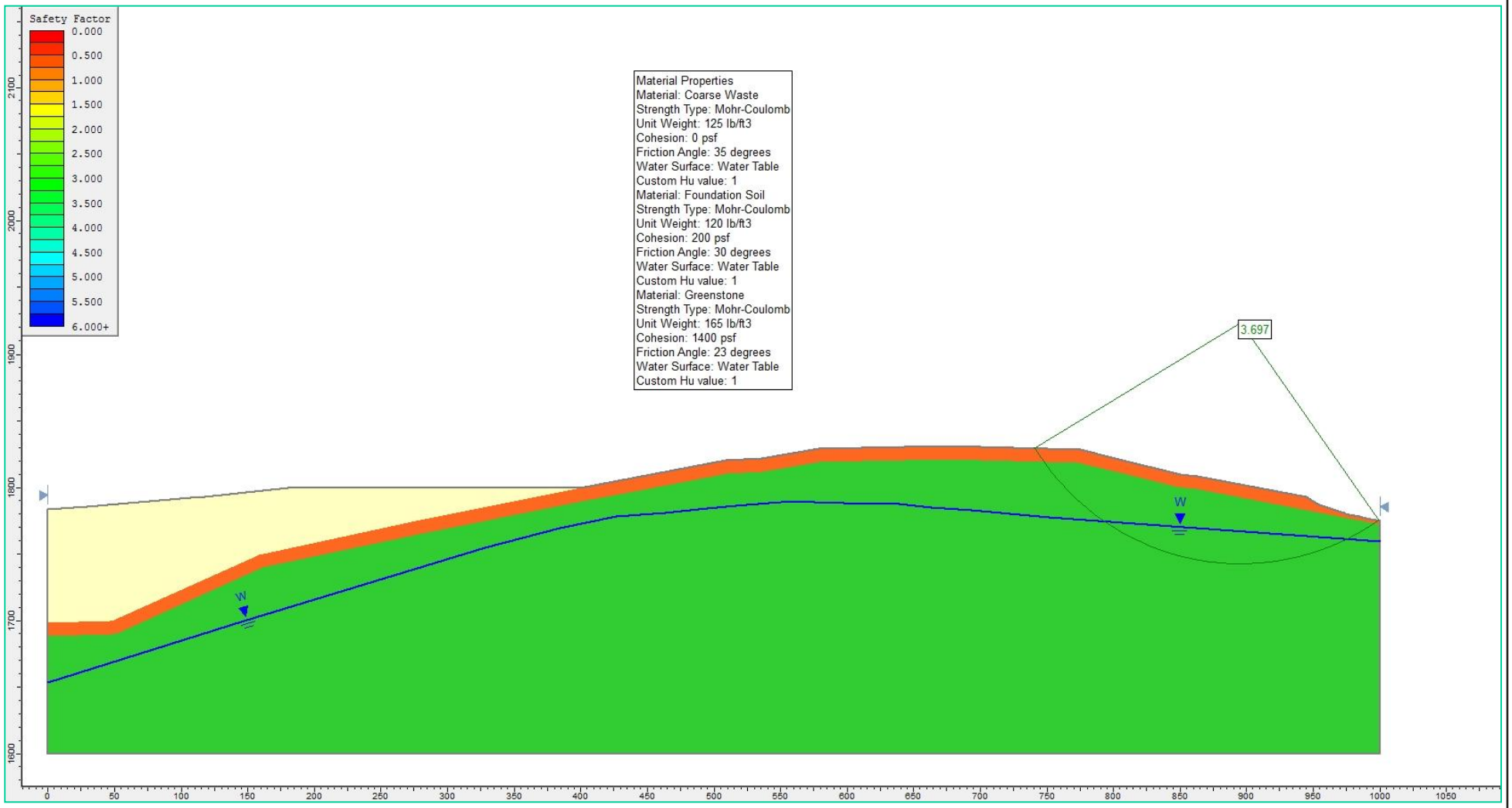


SECTION W3 – WMSA FINAL RECLAMATION

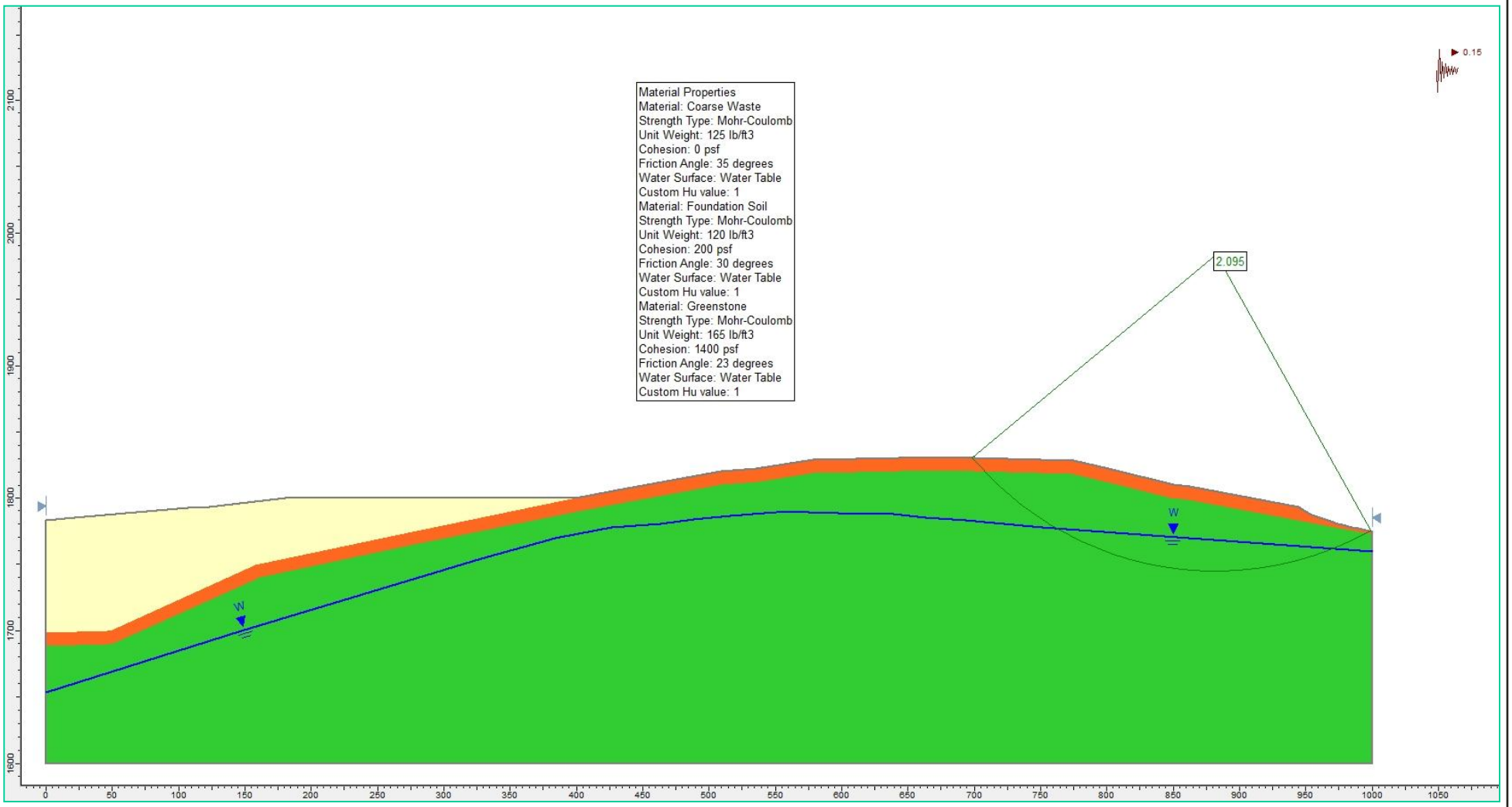
CONDITION: STATIC

FAILURE MODE: CIRCULAR

Golder Associates		STATIC CONDITION PROPOSED SEC W3, WMSA LEHIGH SOUTHWEST CEMENT COMPANY, CA	
Drawn: AJS	App'd: KGH	Date: JULY, 2011	Figure: 10C-20

Project No.: 063-7109 Revision No.: 2

PROJECT NO. 063-7109904 DRAWN: AJS REVIEWED BY: KGH DATE: 07-07-11 FILE LOCATION:



SECTION W3 – WMSA FINAL RECLAMATION

CONDITION: PSEUDO-STATIC (Ks = 0.15)

FAILURE MODE: CIRCULAR

Golder Associates		PSEUDO-STATIC ANALYSES PROPOSED SEC W3, WMSA LEHIGH SOUTHWEST CEMENT COMPANY, CA	
Drawn: AJS	App'd: KGH	Date: JULY, 2011	Figure: 10C-21

Project No.: 063-7109 Revision No.: 2

APPENDIX 11

Slope Stability Evaluation for Compliance with SMARA – EMSA Report

SLOPE STABILITY EVALUATION
FOR COMPLIANCE WITH SMARA
EAST MATERIALS STORAGE AREA
PERMANENTE QUARRY
Santa Clara County, California

Prepared for:

Lehigh Southwest Cement Company
Cupertino, California

Prepared by:

Golder Associates
425 Lakeside Drive
Sunnyvale, CA 94085

Distribution:

(3) Copies – Lehigh Southwest Cement Company
(3) Copies – Golder Associates Inc

April 2009 063-7109-400

SLOPE STABILITY EVALUATION FOR COMPLIANCE WITH SMARA EAST MATERIALS STORAGE AREA PERMANENTE QUARRY

SANTA CLARA COUNTY, CALIFORNIA

Prepared for:

Lehigh Southwest Cement Company
Cupertino, California

Prepared by:

Golder Associates
425 Lakeside Drive
Sunnyvale, CA 94085

REGISTERED PROFESSIONAL ENGINEER
KENNETH G. HASKELL
No. C053290
Exp. 6/30/09
CIVIL
STATE OF CALIFORNIA

PROFESSIONAL GEOLOGIST
WILLIAM L. FOWLER
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CERTIFIED ENGINEERING GEOLOGIST
STATE OF CALIFORNIA

Kenneth G. Haskell, P.E.
Principal/Practice Leader

William L. Fowler, P.G., C.E.G.
Associate/Senior Consultant

Peter Yuan, P.E.
Senior Project Engineer

April 2009

063-7109.400

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1.0 INTRODUCTION

Golder Associates Inc. (Golder) is submitting this report addressing the results of slope stability analyses completed for the East Materials Storage Area (EMSA) located at the Permanente Quarry near Cupertino, California. The slope stability evaluations were completed to verify that the proposed reclamation of these areas complies with the applicable slope stability-related provisions of the Surface Mining and Reclamation Act (SMARA).

The Permanente Quarry is located at the west end of Stevens Creek Road southwest of Cupertino, CA (Figure 1). The quarry mines limestone primarily for the production of cement and aggregate. The Permanente property is over 3000 acres in size and includes the following main areas (Figure 1):

- The main pit located near the center of the site where mining operations are conducted,
- The West Materials Storage Area (WMSA) located at the west end of the site utilized for permanent storage of waste rock materials,
- The East Materials Storage Area (EMSA) located near the site entrance to the east, and,
- The operations buildings, kilns and associated cement production facilities located near the site entrance and south of the EMSA.

Limestone that is of suitable grade is used for cement production. Unsuitable rock materials (waste rock) excavated from the pit area are placed in permanent stockpiles that are referred to as storage areas. Waste rock materials include low-grade limestone and non-limestone rock materials. The EMSA is a primary storage area for these materials.

The EMSA will be reclaimed in phases, referred to as Phases A, B, and C. Phase C represents the reclamation of the EMSA at the conclusion of Phases A through C. Phase C will bring the west end of the EMSA up to a maximum elevation of 900 feet mean sea level (msl). The maximum overall slope inclination of EMSA will be between 2.5H:1V (horizontal to vertical) to 2.6H:1V at reclamation. The slopes will be comprised of 2H:1V inter-bench slopes which are comprised of 25-foot wide bench spaced at 40-foot vertical intervals. As discussed in Section 4, the final EMSA slopes will be stable under static and seismic loading conditions provided Golder's construction recommendations are implemented as discussed in Section 5.

2.0 GEOLOGIC SETTING

2.1 Site Geology

The following information regarding the geologic setting of the EMSA and immediate surrounding area has been excerpted from Foruria (2004) who has performed detailed geologic mapping of the main quarry.

Cement-grade limestone and aggregate are extracted from the intricately folded and faulted limestones and metabasalts (greenstones) in the quarry. These rocks are part of the Permanente Terrain of the Jurassic-Cretaceous age Franciscan Assemblage. The Franciscan Assemblage represents a subduction zone assemblage of highly deformed, variably metamorphosed, marine sedimentary rocks with oceanic crust-related submarine basalt (greenstone), chert, and limestone. This limestone-metabasalt assemblage reaches a minimum total thickness of approximately 1,100 feet and is moderately inclined to the southeast.

All major stratigraphic horizons within the Franciscan rocks of the quarry are separated by low-angle faults forming a structurally imbricated thrust stack of layered and folded rock units. The Franciscan rocks are tectonically juxtaposed against an overlying section of undated, continentally-derived graywackes, shales, and argillites. The deformed thrust stack is a gently folded, northeast-trending, southeast dipping sequence in the eastern area of the quarry pit and transitions southwestward to a series of en-echelon, northwest-trending, southeast-plunging, anticlinal and synclinal folds in the western area of the pit, and beyond. High angle, brittle faults crosscut the Franciscan rocks, dissecting the rocks along prominent north-south and northwest-southeast orientations. A major through-going regional fault, the northwest strand of the Berrocal fault, crosses through the western end of the quarry. Figure 3 shows the major faults in the site vicinity.

The Santa Clara Formation overlies a portion of the Franciscan Complex rocks in the north-central portion of the EMSA (Figure 4). The Santa Clara Formation is a continental fluvial and alluvial deposit that is composed of unconsolidated to slightly consolidated conglomerate, sandstone, siltstone, and claystone (Vanderhurst, 1981). The age of the Santa Clara Formation ranges from late Tertiary to Pleistocene. Uplift of the Coast Ranges during this time resulted in increased erosion of the mountains and deposition of the Santa Clara Formation. The contact between the Franciscan rocks and Santa Clara Formation is considered to be unconformable, with the Santa Clara Formation deposited on an eroded Franciscan terrain (Rogers and Armstrong, 1973).

Subsequent uplift of the nearby foothills along the Monte Vista fault, which lies along the margin of the valley floor to the east of the site, has resulted in deformation of the Santa Clara Formation. In addition, faulting within the uplifted geologic terrane between the Monte Vista and Berrocal faults has juxtaposed the Santa Clara formation in fault contact with older Franciscan rocks in the western portion of the EMSA (Figure 4). To the east of the unnamed fault, the deformed Santa Clara formation overlies the Franciscan with south-southwest trending dips of up to 50 degrees (Rogers and Armstrong, 1973). A large erosional window east of the unnamed fault in the EMSA exposes greenstone, greywacke and limestone of the Franciscan Assemblage.

2.2 Regional Structure

The San Andreas Fault zone is located approximately 2 miles southwest of the quarry. The Sargent-Berrocal Fault Zone (SBFZ), part of the Santa Cruz Mountains front-range thrust fault system,

parallels the San Andreas to the east and forms the eastern-most structural boundary to the Permanente Terrain.

Near the quarry, the SBFZ consists of two northwest-trending, sub-parallel faults, namely the northeastern-most Monta Vista Fault Zone and the southwestern-most Berrocal Fault Zone (Sorg and McLaughlin, 1975). The Monta Vista Fault Zone is located approximately 1 mile to the northeast of the quarry. A strand of the Berrocal Fault Zone lies beneath the Permanente Cement Plant area to the south of the EMSA, and extends west to other portions of the quarry (Matheson, 1982; Sorg and McLaughlin, 1975).

2.3 Seismic Hazards

The Permanente Quarry is located within the San Francisco Bay Area, which is a region characterized by relatively high seismicity. SMARA does not specify a minimum seismic design event that should be used for slope stability analyses. However, SMARA does specify that the final slopes shall be flatter than the critical gradient, which is defined at the maximum stable slope inclination of a unsupported slope under the most adverse conditions (i.e. seismic loading) that it will likely experience, as determined by current engineering technology. Accordingly, Golder evaluated potential seismic impacts within the EMSA resulting from an earthquake event associated with 10 percent probability of exceedance (POE) in a 50-year period. Golder has used the 10 percent POE in a 50-year event to evaluate seismic impacts for other quarry reclamation projects in California, which has been accepted by the Office of Mine Reclamation, California Department of Conservation.

Using the California Geological Survey (CGS) earthquake data base (Ground Motions for User Selected Site, Probabilistic Seismic Hazards Assessment (http://www.consrv.ca.gov/cgs/rghm/pshamap/pshamap.asp), Golder estimates that design peak ground accelerations should be approximately 0.6g for the site.

3.0 SITE GEOTECHNICAL INVESTIGATIONS

3.1 Previous Site Investigations

A number of geotechnical studies have been completed to address slope stability in other areas of the quarry, including the main pit (Call and Nicolas, Inc., or CNI) and the WMSA (The Mines Group, Inc., or MGI; and Golder, 2008), that have relevance to the stability evaluation of the EMSA. These studies are summarized below.

3.1.1 Call and Nicolas

CNI performed a number of geotechnical evaluations of slope stability issues in the main pit in the early 1980's. This work was reviewed for basic geotechnical data for the Franciscan Assemblage rocks and also waste rock materials. The material shear strength data is summarized below:

Franciscan Melange

- Unit weight = 162 pcf
- Cohesion = 2,150 psf
- Internal friction angle = 20.1°

Franciscan Greenstone

- Unit weight = 175 pcf
- Cohesion = 1,000 psf
- Internal friction angle = 31.3°

Waste Fill

- Unit weight = 125 pcf
- Cohesion = 144 psf
- Internal friction angle = 38°

CNI also estimated the mean minus one standard deviation shear strengths in their 2003 report, provided estimates of the shear strength of good quality and poor quality greenstone, and estimate the shear strengths for other geologic materials.

3.1.2 The MINES Group, Inc.

The MINES Group, Inc. (MGI) reviewed the reclamation design for one portion of waste fill located at the northwest corner of the West Materials Storage Area (WMSA) and developed conceptual drainage and sediment control design for the remainder of the waste fill facility in 2001 (MGI, 2001). An evaluation of the slope stability was performed with the following model inputs and design criteria:

- Material Shear Strengths: all materials were modeled with Mohr-Coulomb criteria with the following strength parameters:

- Waste Rock: cohesion (c') = 0 psf; internal friction (ϕ') = 36°;
- Fine Waste: c' = 50 psf; ϕ' = 26°;
- Colluvial Soil: c' = 500 psf; ϕ' = 28°; and
- Greenstone Bedrock: c' = 1,882 psf; ϕ' = 27°

Development of the above strengths by MGI were based on the physical observed characteristics of the materials and review of past stability studies.

- Groundwater Level: for stability modeling purposes, MGI conservatively assumed the Greenstone Bedrock and most of Colluvial Soil contained groundwater and that the precipitation at the site supported a perched water table above the Colluvial Soil/Greenstone interface that eventually discharged to the surface contributing to the flow in Permanente Creek.

- Stability Criteria: MGI used a minimum design static factor of safety of 1.3 and a minimum pseudo-static (or seismic) factor of safety (FOS) of 1.0 as the stability design criteria. For pseudo-static analyses, a seismic coefficient of 0.15 g was used.

Based upon the stability analyses performed with the above inputs and assumptions, MGI concluded that the design 3H:1V overall slopes of waste rock were expected to be stable under both static and seismic loading. MGI also indicated the presence of fine-grained waste does not appear to control the stability of the waste rock slopes, even when placed within 10 ft horizontal of the final reclaimed slope face.

3.1.3 Golder Associates - WMSA Stability Review

Golder (2008) reviewed the stability of the reclamation design for the WMSA and used the following material strength properties based on review of previous stability evaluations for the main pit and the WMSA and a subsurface investigation by Golder to characterize the foundation conditions at the WMSA:

- Coarse Waste Rock: cohesion (c') = 0 psf; internal friction (ϕ') = 35°;
- WMSA Foundation Soil: c' = 200 psf; ϕ' = 30°;
- Greenstone Bedrock: c' = 1,440 psf; ϕ' = 23°; and
- Limestone Bedrock: c' = 12,500 psf; ϕ' = 30°

This stability evaluation uses the same strengths summarized above with the exception of the "Foundation Soil", which was characterized based on the subsurface investigation performed for the EMSA discussed in the following section.

3.2 Golder Investigations

Golder completed additional investigations of the EMSA to supplement the existing data for the Permanente Quarry consisting of the following:

- Aerial Photograph review and reconnaissance-level mapping;
- Subsurface drilling; and
- Geotechnical Laboratory Testing.

The following sections provide additonal detail on these investigations.

3.2.1 Surface Mapping/Aerial Photography Review

Golder performed a review of aerial photographs and reconnaissance level mapping of the EMSA to define areas of cut and fill, map surficial deposits where present, and to field check the bedrock geology.

A review of aerial photographs dating back to 1939 was performed to identify areas of cut and fill associated with the development of the EMSA and to map surficial deposits. Large areas of the southern and southeastern portion of the EMSA have been excavated to create flat building pads for existing and former structures associated with former industrial operations (Figure 5). Other areas have been previously used for disposal of waste rock materials, and for stockpiling of aggregate products.

The central and northern areas of the site consist of native soils and rock exposed at the surface except for access road construction. In this area several colluvial-filled drainages were mapped (shown where estimated to be greater than approximately five to six feet thick). Southeast of the site, Permanente creek parallels the southeast margin of the site, and is mapping as containing alluvium and artificial fill related to development of the railroads right-of-way and the main access road to the facility.

In general, exposures of bedrock are poor in the EMSA due to surface weathering and soil formation and heavy vegetation in native areas. Occasional, highly weathered outcrops are exposed in the larger cutslope. In general, with minor modifications, the bedrock geology conforms with that previously mapped by regional investigators (Rogers and Armstrong, 1973; Sorg and McLaughlin, 1975; Vanderhurst, 1981).

3.2.2 Subsurface Drilling

Five hollow stem auger borings (EMSA-1 through -5) were drilled in the EMSA with a CME 75 drilling rig (see Figure 4 for borehole locations). The borings were drilled at locations where the proposed waste rock fill will have greater thickness and steeper slopes. The borings were drilled under the supervision of a Golder geologist and logged and sampled using Golder's procedures and methods that follow industry standards (see Appendix A for summary boring logs).

The sampling sequence included the use of a Shelby tube pushed at the beginning of each borehole, if the material was suitable, followed by driven Standard Penetration Test (SPT) samples at approximate five-foot depth intervals. All boreholes were advanced until refusal or a depth of 45 feet. Refusal for the driven sampler (> 50 blows) was common below approximately 15 to 30 feet. Auger refusal was reached at depths starting at about 32 feet below ground surface (bgs).

Groundwater was not encountered during drilling. Borings were backfilled with cuttings to the ground surface. The geotechnical samples were sent to Cooper Testing Laboratory in Mountain View, California for laboratory testing.

3.2.3 Earth Materials

The following section describes the general geologic character of the surficial materials and bedrock units encountered in the field investigations.

3.2.3.1 Bedrock Materials

Bedrock materials in the EMSA included greenstone, limestone and graywacke (sandstone) within the sheared Franciscan Assemblage rocks, and poorly consolidated sandstone, gravels and siltstone of the Santa Clara Formation. All of the bedrock materials encountered in the EMSA were weathered to highly weathered and dry. The Franciscan materials were typically angular to sub-angular, and contained hard, consolidated clasts. Colors ranged from dark reddish brown to gray to green. The Santa Clara formation was typically mottled yellowish brown in color and contained sub-rounded to sub-angular gravels comprised of Franciscan Assemblage rocks.

3.2.3.2 Colluvium

Colluvial deposits were encountered at the surface in some of the EMSA borings and were also mapped in the larger natural swales in the area. The colluvial materials encountered were predominantly dark yellowish brown clayey sand with gravel to clayey gravel, with some gravelly clay. Gravel size was up to 3-inches. In general, the colluvium was dry and loose to very stiff/dense.

3.2.4 Geotechnical Laboratory Testing

Geotechnical testing consisted of grain-size distribution and Atterberg limits completed by Cooper Testing Laboratories located in Mountain View, California. Attempts were made to obtain intact samples of the clayey portion of the waste fill, and the native foundation soil at the base of the waste fill. However, the samples contained abundent gravel and larger rock fragmenets that were not suitable for use in laboratory shear strength testing.

The samples obtained of the native foundation soils at the EMSA ranged from a silty sand and gravel to gravelly and sandy clay. Atterberg limits were completed on the finer portion of the waste materials with Plastic Indices ranging from 14 to 26, but generally between 23 and 26.

In all cases, the Plastic Indices were measured on the finer portion of the soil materials that were sampled. These Atterberg limits results are represenative of individual soil samples and not necessarily of all of the soil materials sampled.

The geotechnical characterization of the units encountered is discussed in more detail in Section 4.

4.0 SLOPE STABILITY EVALUATIONS

The purpose of this study was to evaluate the geotechnical aspects of the EMSA reclamation for compliance with SMARA and the applicable requirements of Title 14 of the California Code of Regulations (CCR).

4.1 Regulatory Issues

SMARA (including the State Mining and Geology Board Reclamation Regulations) is flexible with respect to addressing geotechnical slope stability for both fill slopes and cut slopes. SMARA does not specify a minimum factor of safety for slope stability. However, Title 14, Chapter 8, CCR Section 3502(b)(3) indicates that final reclaimed slopes shall be flatter than the critical gradient, which implies that static factors of safety should be greater than 1.0. This section further states "Wherever final slopes approach the critical gradient for the type of material involved, regualtory agencies shall require an engineering analysis of slope stability. Special emphasis on slope stability and design shall be taken when public safety or adjacent property are affected."

For fill slopes, Section 3704 (d) states that fill slopes shall be 2H:1V or flatter. Slopes steeper than 2H:1V must be supported by site-specific geologic and engineering analyses to indicate that the minimum factor of safety is suitable for the proposed end use. For the Permanente Quarry, the proposed end use is undeveloped open space.

The proposed overall slopes for the EMSA are between 2.5H:1V and 2.6H:1V overall with interbench slopes of 2H:1V. Therefore, slope stability analyses are not explicitly required from a SMARA perspective for this project. However, due to the complex geological conditions of the region, the size of the EMSA fills, and the regional seismicity, it is Golder's opinion that prudent engineering of the EMSA will include slope stability analyses.

For this project, slope stability of the EMSA does not have the potential to adversly impact adjacent property or public safety. Therefore, we consider a minimum static factor of safety of 1.3 appropriate for the EMSA rock fill. For seismic conditions, pemanent seismically induced displacements of less than 2 to 3 feet under the design earthquake conditions were set as the seismic stability criterion.

4.2 Approach and Assumptions

4.2.1 Methodology

Golder completed static and seismic slope stability analyses to evaluate stability conditions of the proposed reclaimed slopes of the EMSA. The slopes of the EMSA at the conclusion of the Phase C reclamation represent the most critical condition for slope stability. The computer program SLIDE 5.0 (Rocscience, 2003) was used to calculate the factors-of-safety against potential slope failures. This program uses two-dimensional, limit-equilibrium theory to calculate safety factors (FOS) for slope stability problems. This program allows both circular and noncircular sliding surfaces to be either defined or generated automatically. Spencer's Method was used for FOS calculations.

Pseudo-static analyses were performed to evaluate slope stability under earthquake loading. In a pseudo-static limit equilibrium analysis, a lateral force is added to a potential failure mass, with magnitude equal to some fraction of the weight of the slide mass. The fraction is defined in the form of a seismic coefficient, which is typically assumed to be less than the peak ground acceleration and is expressed as a percentage of gravity. Selection of a seismic coefficient and allowable factor of safety was based on the recommendations by Seed (1979), i.e., k_s = 0.10 for earthquakes of magnitude 6-1/2 or less, and k_s = 0.15 for earthquakes of magnitude as great as 8-1/4, with an

acceptable FOS on the order of 1.15. If the calculated FOS is greater than the acceptable value, the slope is expected to experience acceptable deformation; if the calculated factor of safety is below the acceptable, a more rigorous method, such as dynamic deformation analyses, is performed.

Dynamic deformation analyses were performed using a predictive model recently developed by Bray and Travasarou (2007). The Bray and Travasarou model is a semi-empirical simplified model for estimating permanent displacements due to earthquake-induced deviatoric deformations. The Bray and Travasarou model can also be implemented within a fully probabilistic framework or be used deterministically to evaluate seismic displacement potential. The following equation is used by Bray and Travasarou (2007) to predict the seismic displacement (D) assuming potential slide mass is a rigid sliding block:

$$\ln(D) = -0.22 - 2.83 \ln(k_y) - 0.333 (\ln(k_y))^2 + 0.566 \ln(k_y) \ln(PGA) + 3.04 \ln(PGA) - 0.244 (\ln(PGA))^2 + 0.287 (M - 7) \pm \varepsilon$$

Where, D = seismic displacement in cm

k_y = yield coefficient

PGA = peak ground acceleration

M = moment magnitude

ε = normally distributed random variable with zero mean and standard deviation σ = 0.67.

4.2.2 Modeling Inputs and Assumptions

4.2.2.1 Model Geometries

Sections E1 and E3 for the EMSA (Figure 6) were used as representative sections for stability evaluation. These sections were developed based on pre-storage and current topographic maps, and proposed reclamation designs, provided by Lehigh, as well as on subsurface investigations performed by Golder.

4.2.2.2 Material Properties

The following units were included in the stability modeling of the EMSA:

- **Coarse Waste Fill**: For cohesionless rock materials characteristic of the coarse waste at the site, the angle-of-repose of waste fill slopes is often used to approximate the shear strength of a rock material. Based on review of existing topographic maps, the angle-of-repose of the WMSA and EMSA fills generally ranges from 34 degrees to 37 degrees, and averages around 35 degrees. Assuming a cohesion value of zero, this corresponds with an internal friction angle of approximately 35 degrees. Accordingly, coarse waste was assigned average strength parameters based on an internal friction angle of 35 degrees and no cohesion. This friction angle is slightly lower than the value of 36 degrees that Mines Group used (MGI, 2001). A moist unit weight of 125 pcf was assumed for stability modeling.

- **Foundation Soils**: According to the subsurface investigation summarized in Section 3, the foundation soils beneath the proposed EMSA are generally characterized as "a sandy clay to clayey sand with gravel to a silty or clayey gravel with sand". Based on in-situ strength characterization performed using Standard Penetration Testing (SPT), an internal friction angle of 28 degrees with no cohesion was conservatively used to represent the mean drained strength of the Foundation Soil under the EMSA for long-term stability modeling. An average thickness of 10 ft and a moist unit weight of 120 pcf were assumed.

- **Bedrock**: As discussed in Section 3.1.3, a shear strength characterized with a cohesion of 10 psi or 1,440 psf and a friction angle of 23 degrees was used in stability models to represent the Greenstone in Section E1 in accordance with Golder (2008) and the Greywacke in Section E3.

The material properties used for stability modeling are summarized in Table 1.

4.2.2.3 Water Level

Available historical data indicate groundwater depths ranging from approximately 40 feet to over 200 feet below ground surface. No groundwater was encountered in any of the Golder borings drilled at the EMSA in 2007. Golder conservatively assumed that permanent groundwater is approximately 30 ft to 100 ft below existing ground surface with water levels more shallow at the toe of the proposed waste fill slope. The estimated groundwater depths do not adversely affect the stability of the EMSA slopes.

4.2.2.4 Seismic Parameters

Consistent with previous discussions, the waste fill reclamation stability modeling was based on the following seismic parameters:

- Horizontal seismic coefficient of 0.15g;
- Design Moment Magnitude: M_w = 6.8~7.1; and
- Peak horizontal ground acceleration (a_{max}) = 0.6 g (Golder, 2007).

4.3 Static Analyses

4.3.1 Static Stability Conditions of EMSA

As shown in Figure 2, the proposed reclamation plan for the EMSA has overall slopes no steeper than 2.5H:1V to 2.6H:1V and inter-bench slopes no steeper than 2H:1V. Sections E1 and E3 were developed as a representative section to evaluate the stability of the proposed EMSA reclamation slopes. The static stability modeling results were presented in Appendix C. The calculated FOS values against potential multi-bench failure (or global failure) are 1.69 for Section E1 and 1.73 for Section E3, which exceed the minimum static slope stability design criterion of 1.3. The calculated FOS against potential inter-bench slope failure is approximately 1.42, which also exceeds the acceptable minimum FOS value.

4.4 Seismic Analyses

The pseudo-static limit equilibrium analyses for Sections E1 and E3 with the horizontal seismic coefficient of 0.15g are shown in Appendix C (see Appendices C-3 and C-4), which indicate that the minimum FOS against global failure is about 1.16 for Section E1 and 1.12 for Section E3. Seismic displacement analyses (Table 2) were completed on Section E3, which is the more critical section with respect to seismic slope stability. The computed permanent slope deformations could range between 2-inches and 8-inches with an average of approximately 4-inches.

The pseudo-static limit equilibrium analyses on potential inter-bench failure result in a computed minimum FOS of approximately 1.01 to 1.02. Seismic displacement analyses (Table 2) estimate that the potential inter-bench permanent slope deformation could range between 3-inches and 13-inches with an average of 6-inches. The inter-bench seismic displacement is anticipated to be shallow and will be contained with the 25-foot wide benches between lifts.

4.5 Additional Analyses

Additional slope stability analyses were completed to address specific waste storage area construction requirements.

4.5.1 Presence of Fine Waste

The washing of limestone aggregate produces a fine waste material that consists of an unconsolidated saturated clayey silt (ML) and silty clay (CL). The fine waste fill is placed in the middle portion of the waste storage areas in lifts no higher than 8 feet. These lifts are then covered by at least a 25-foot thick lift of coarse waste. The fine waste is maintained at a minimum offset of 30 feet from the final outer slope of the waste storage area.

To evaluate the impact of the fine waste deposit on local slope stability, slope stability analyses were completed. The drained strength of the fine waste was modeled using Mohr-Coulomb shear strength envelope characterized by an internal friction angle of 28 degree with no cohesion. This assumed shear strength is consistent with the results of the soil index laboratory tests and slightly lower than the results from two consolidated undrained (CU) triaxial tests performed on the fine waste material (Appendix B).

The stability modeling results shown in Appendix C-5 indicate that under static conditions, block failures through fine waste will unlikely become critical or controlling failure paths and the local stability of the EMSA slope with the fine waste fill is unlikely affected by the presence of the fine waste fill provided the fine wastes remain drained.

Pseudo-static analysis was also performed to evaluate the stability of the EMSA with the fine waste fill. Since the fine waste fill mostly consists of clay and silt and could be locally or partially saturated due to its relatively lower permeable nature, a strength reduction of 20 percent was conservatively applied to the peak undrained strength for seismic stability modeling. As shown in Appendix C-5, the calculated minimum FOS against local block failures through Fine Waste is approximately 0.91. Seismic slope displacement analyses (Table 2) indicate that the permanent slope deformation caused by the design earthquake loading is estimated to be between 6 and 24-inches, with a mean displacement of 12-inches, which is within the acceptable displacement criterion.

4.5.2 Subgrade Preparation

The placement of the EMSA materials on organic rich topsoil, soft or clayey colluvium, or over saturated soils could result in foundation soil conditions with lower effective shear strengths than assumed in this study. A series of slope stability analyses were completed to determine the extent of foundation improvements that should be completed for the EMSA construction.

Based on the results of these analyses, Golder concludes that foundation preparation should be completed on the outer 50 feet of the EMSA fill. The foundation preparation should include over-excavation of the upper topsoil, organic debris, and fine grained colluvium with high plasticity index to expose firm bedrock, granular soils or lean clay. In areas where the outer 50 feet of the footprint is founded on a native slope that is steeper than 5H:1V, the topsoil and colluvium over-excavation should be extended to 100 feet from the outer slope. Appendices C-6 through C-9 present the slope stability analyses.

5.0 CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

Based on previous studies and investigations, laboratory testing, and slope stability analyses completed by Golder, the following conclusions are provided for the EMSA:

- The EMSA will be reclaimed as undeveloped open space and will not pose a threat to public safety or to adjacent properties.

- The static FOS for global slope stability is approximately 1.7. The static FOS for the 2H:1V slope between benches is 1.4. These values exceed the minimum factor of safety of 1.3 criterion for static conditions established for the EMSA.

- Permanent, seismically-induced displacements are estimated to be an average of 6-inches or less for the waste rock fill. These displacements could average 12-inches when considering the placement of fine waste material in maximum 8-foot lifts with an offset of 30 feet from the final outer slope face. These computed displacements are well within the maximum displacement criterion of 2 to 3 feet for the EMSA.

Therefore, the proposed reclaimed EMSA slopes are stable under static and the design seismic loading conditions.

5.2 Recommendations

Golder recommends implementing the following recommendations during construction of the EMSA:

- Foundation preparation should be completed prior to fill placement of the outer 50 feet beneath the EMSA fill. Foundation preparation should consist of over-excavation of outer 50 feet of topsoil, organic materials (trees, brush, grasses), fine-grained colluvium with a Plastic Index greater than 25, or other unsuitable soils until firm bedrock, granular soils, or clay soils with a Plastic Index less than 25 are exposed. If the exposed foundation surface is inclined at 5H:1V or steeper, the over-excavation distance from the outer slope should be extended from 50 feet to 100 feet. Furthermore, the fill placed on slopes of 5H:1V or steeper should be benched into the slope with individual bench heights of at least 2 feet and up to approximately 5 feet. Figure 7 illustrates the subgrade preparation requirements.

- A qualified California Professional Geologist, Certified Engineering Geologist, or a California Registered Civil Engineer with geotechnical experience should inspect the foundation preparation to ensure all unsuitable materials are removed prior to placement of the outer 50 to 100 feet of EMSA fill.

- If seepage or wet zones are observed in the foundation, suitable drainage provisions should be incorporated into the foundation prior to fill placement. Suitable drainage provisions include the placement of a blanket of free-draining sand or gravel over the seepage/wet zone in conjunction with a perforated, polyvinyl (PVC) or high-density polyethylene (HDPE) drain pipe that drains positively toward and daylights at the slope face. The sand or gravel drainage material should be fully covered with a minimum 8-oz/square yard, non-woven, geotextile filter to provide separation from the EMSA materials.

- The fine waste materials should be placed in maximum 8-foot thick lifts and offset a minimum of 30 feet from the final slope face. Each lift of fine waste should be covered by a minimum 25-foot thick lift of waste rock.

- Golder should be contacted to review any modifications to EMSA fill geometry including increases to the maximum overall slope inclination, maximum inter-bench slope inclination, slope height, or footprint. Such modifications may require further slope stability analyses.

6.0 LIMITATIONS

This report has been prepared for the exclusive use of Lehigh Southwest Cement Company for specific application to the evaluation of the EMSA slope reclamation for compliance with SMARA. The findings, conclusions, and recommendations presented in this report were prepared in accordance with generally accepted geotechnical engineering practice that exists within the area at the time of the work. No other warranty, expressed or implied, is made.

The analyses and recommendations contained in this report are based on data obtained from the results of previous subsurface explorations by others as well as the explorations and mapping conducted by Golder. The methods used generally indicate subsurface conditions at the time and locations explored and sampled. Boring logs may not reflect strata variations that may exist between all sampling locations. In addition, groundwater conditions can vary with time.

7.0 REFERENCES

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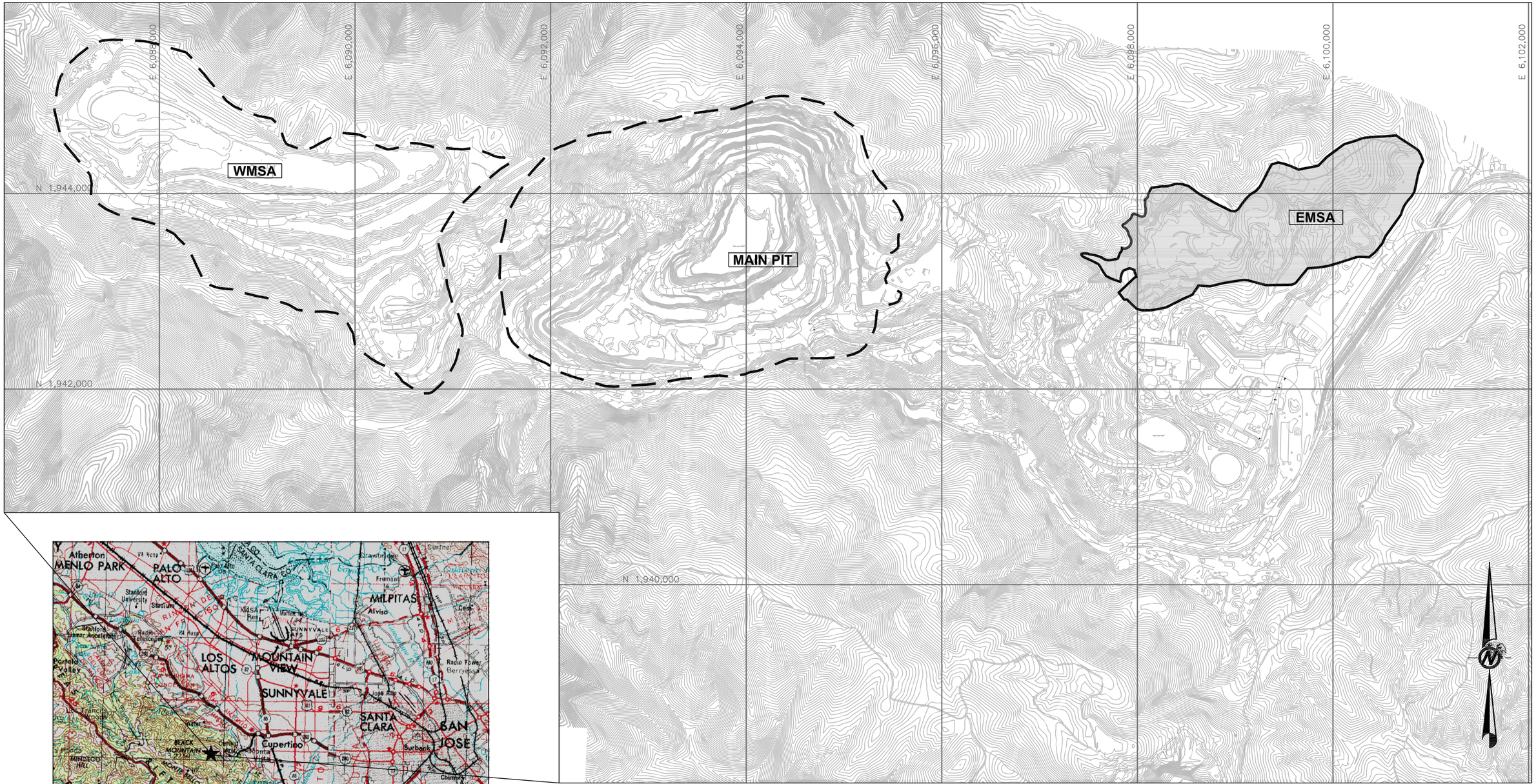
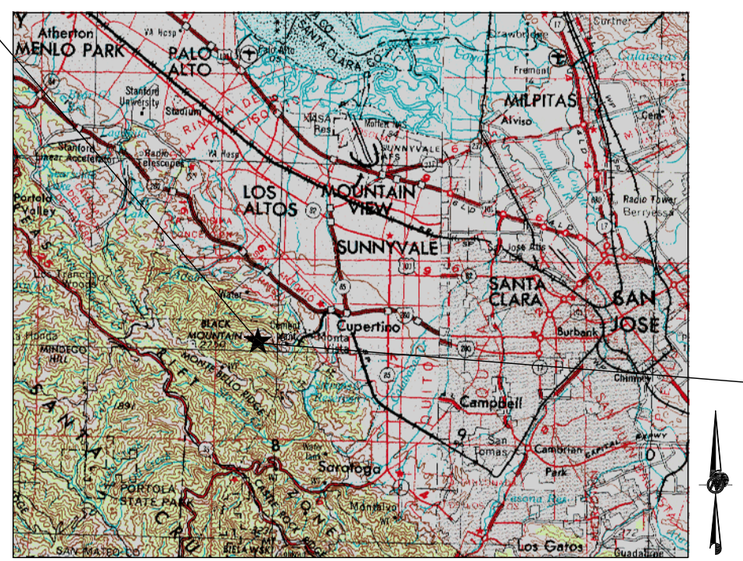
FIGURES





MAP OF REGION

LEGEND

★ PROJECT LOCATION

APPROXIMATE LIMIT OF STUDIED AREA

NOTE

1. REGIONAL MAP BASED FROM USGS 250K QUAD MAPS:
   - SAN FRANCISCO, 1980
   - SAN JOSE, 1969

PROJECT
PROPOSED RECLAMATION PLAN
EAST MATERIALS STORAGE AREA
LEHIGH HANSON PERMANENTE, CALIFORNIA

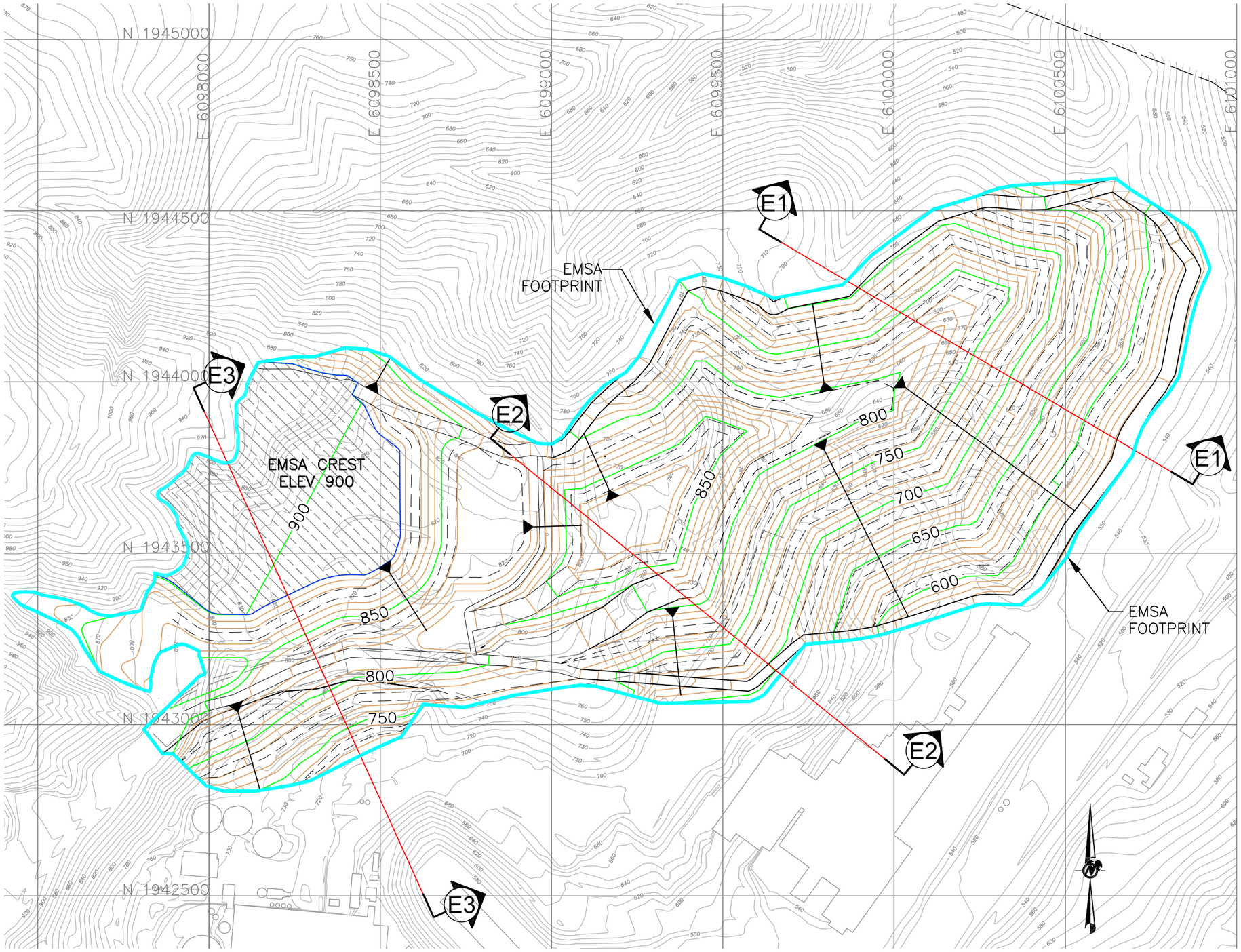
TITLE
SITE LOCATION MAP

Golder Associates
Sunnyvale, California

PROJECT No.		063-7109	FILE No.	FIGURE 1
DESIGN	PHY	03/09	SCALE AS SHOWN	REV. A
CADD	CJM	03/09		
CHECK	PHY	03/09	**FIGURE 1**	
REVIEW	KGH	03/09		

PROJECT No. 063-7109 FILE No. 063-7109-Fi CADD JDR DATE 07/23/07

Drawing file: Figure 1.dwg Mar 30, 2009 – 4:28pm



LEGEND

- PREDUMP TOPOGRAPHY AS OF APRIL 2007 (10 FT INTERVAL)
- EMSA DESIGN TOPOGRAPHY
- ADJACENT STRUCTURES AND FACILITIES
- E2 SECTION ID
- EMSA CREST ELEV. 900
- EMSA FOOTPRINT

NOTE

1. PRE–DUMP TOPOGRAPHIC INFORMATION PROVIDED BY HAMMON, JENSEN, WALLEN AND ASSOCIATES. DATE OF TOPOGRAPHY: 4–9–07.

EAST MATERIALS STORAGE AREA SITE PLAN

SCALE: 1"=300'

CONTOUR INTERVAL = 10'

300 0 300 600

SCALE FEET

PROJECT No. 063–7109 FILE No. 063–7109–Fi CADD CJM DATE 07/24/07

PROJECT

PROPOSED RECLAMATION PLAN
EAST MATERIALS STORAGE AREA
LEHIGH HANSON PERMANENTE, CALIFORNIA

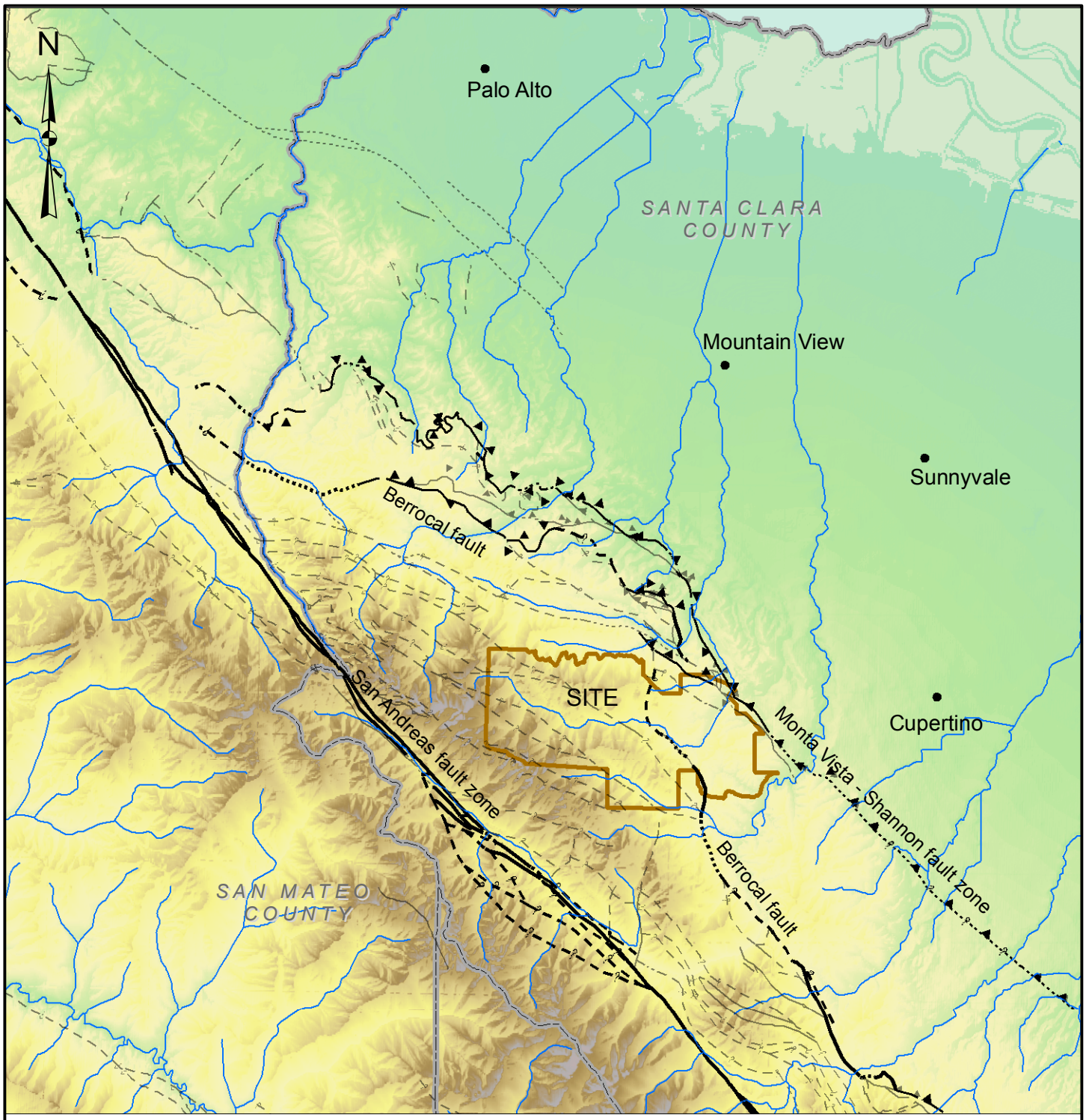
TITLE

SITE PLAN
EAST MATERIALS STORAGE AREA

Golder Associates
Sunnyvale, California

PROJECT No.		063–7109	FILE No.	FIGURE 2
DESIGN	PHY	03/09	SCALE AS SHOWN	REV. A
CADD	CJM	03/09		
CHECK	PHY	03/09	**FIGURE 2**	
REVIEW	KGH	03/09		

Drawing file: Figure 2.dwg Mar 30, 2009 – 4:27pm



Legend

- Stream
- *Fault (surface expression):*
  - Certain
  - Concealed
  - Inferred
  - Thrust (teeth in dip direction)

    Dashed where approx., querried where uncertain; dotted where concealed.

0 1 2 Miles

REV.	DATE	DES	REVISION DESCRIPTION	GIS	CHK	RVW

PROJECT

PROPOSED RECLAMATION PLAN
EAST MATERIALS STORAGE AREA
HANSON PERMANENTE CEMENT, CALIFORNIA

TITLE

REGIONAL GEOTECTONIC SETTING

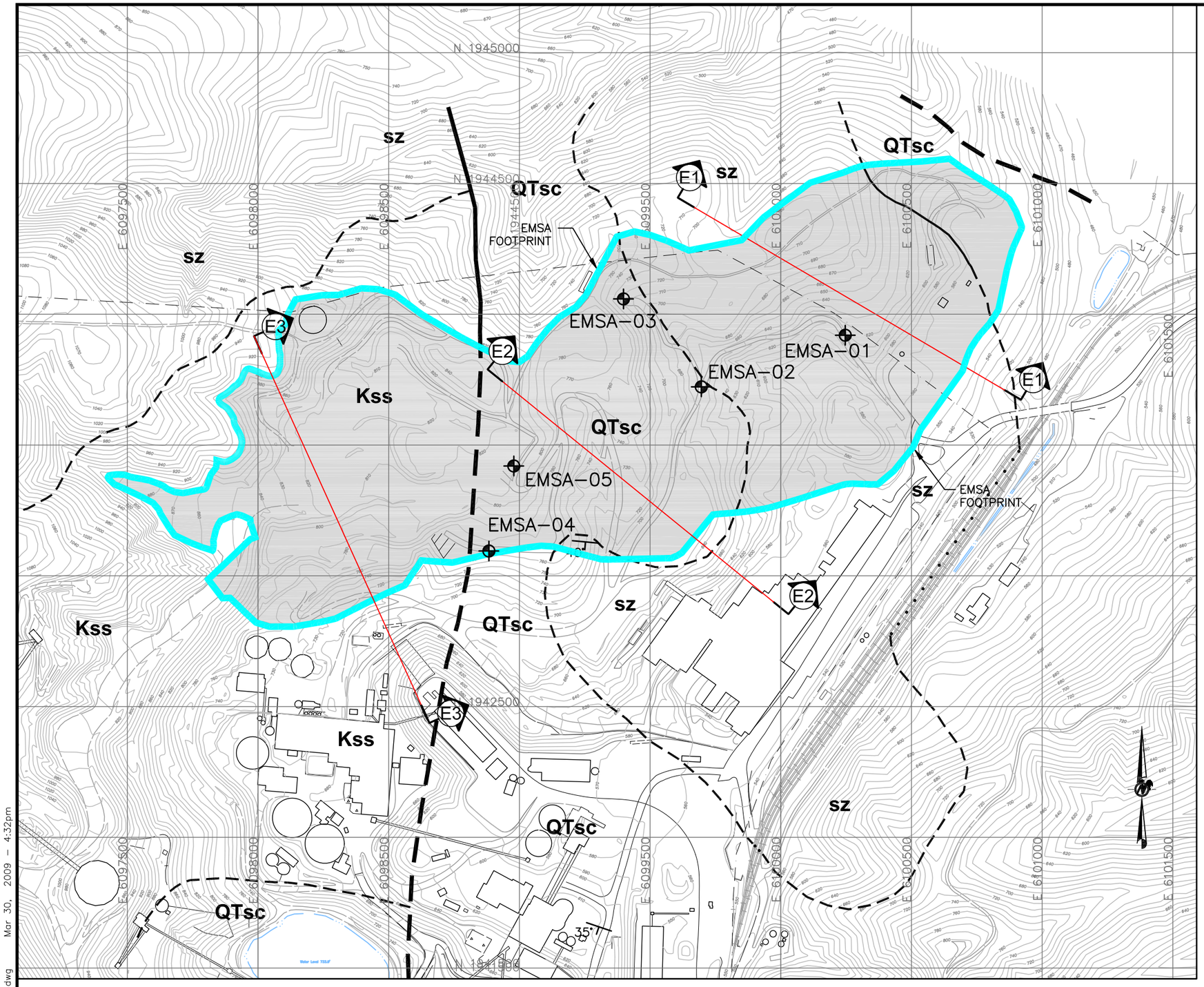
Fault source: Brabb, et. al. (2000)
Faults discussed in text have heavier line weight.

Golder Associates
Sunnyvale, CA

PROJECT No.		063-7109	FILE No.	
DESIGN	DLM	3/13/2009	SCALE: AS SHOWN	REV. 0
GIS	DLM	3/13/2009		
CHECK	WLF	3/25/2009		
REVIEW	WLF	3/25/2009		

FIGURE 3

G:\Projects\063-7109 (Hanson Permanente Quarry\GIS\Hanson_geotectonic_map_20Mar2009.mxd



EAST MATERIALS STORAGE AREA GEOLOGIC MAP

SCALE: 1"=400'

400 0 400 800

SCALE FEET

PROJECT No. 063–7109 FILE No. GeologicMaps CADD JDR DATE 07/05/07

Drawing file: Figure 4.dwg Mar 30, 2009 – 4:32pm

LEGEND

- GEOLOGIC CONTACT, CERTAIN
- GEOLOGIC CONTACT, APPROXIMATE
- GEOLOGIC CONTACT, CONCEALED
- FAULT CONTACT, CERTAIN
- FAULT CONTACT, APPROXIMATE
- 35° STRIKE AND DIP OF BEDDING
- **QTsc** SANTA CLARA FORMATION
- **Kss** FRANCISCAN COMPLEX SANDSTONE (GREYWACKE)
- **sz** SHEAR ZONE, MELANGE OF FRANCISCAN COMPLEX ROCKS – METABASALTS (GREENSTONE), SANDSTONE (GREYWACKE), LIMESTONE, AND SERPENTINE
- E2 SECTION ID
- EMSA FOOTPRINT
- EMSA–05 GEOTECHNICAL BOREHOLE – GOLDER, 2007

NOTE

1. GEOLOGY MODIFIED AFTER ROGERS, T.H. AND ARMSTRONG, C.F., 1973, ENVIRONMENTAL GEOLOGIC ANALYSIS OF THE MONTE BELLO RIDGE MOUNTAIN STUDY AREA, SANTA CLARA COUNTY, CALIFORNIA, CALIFORNIA DIVISION OF MINES AND GEOLOGY PRELIMINARY REPORT 17.

PROJECT

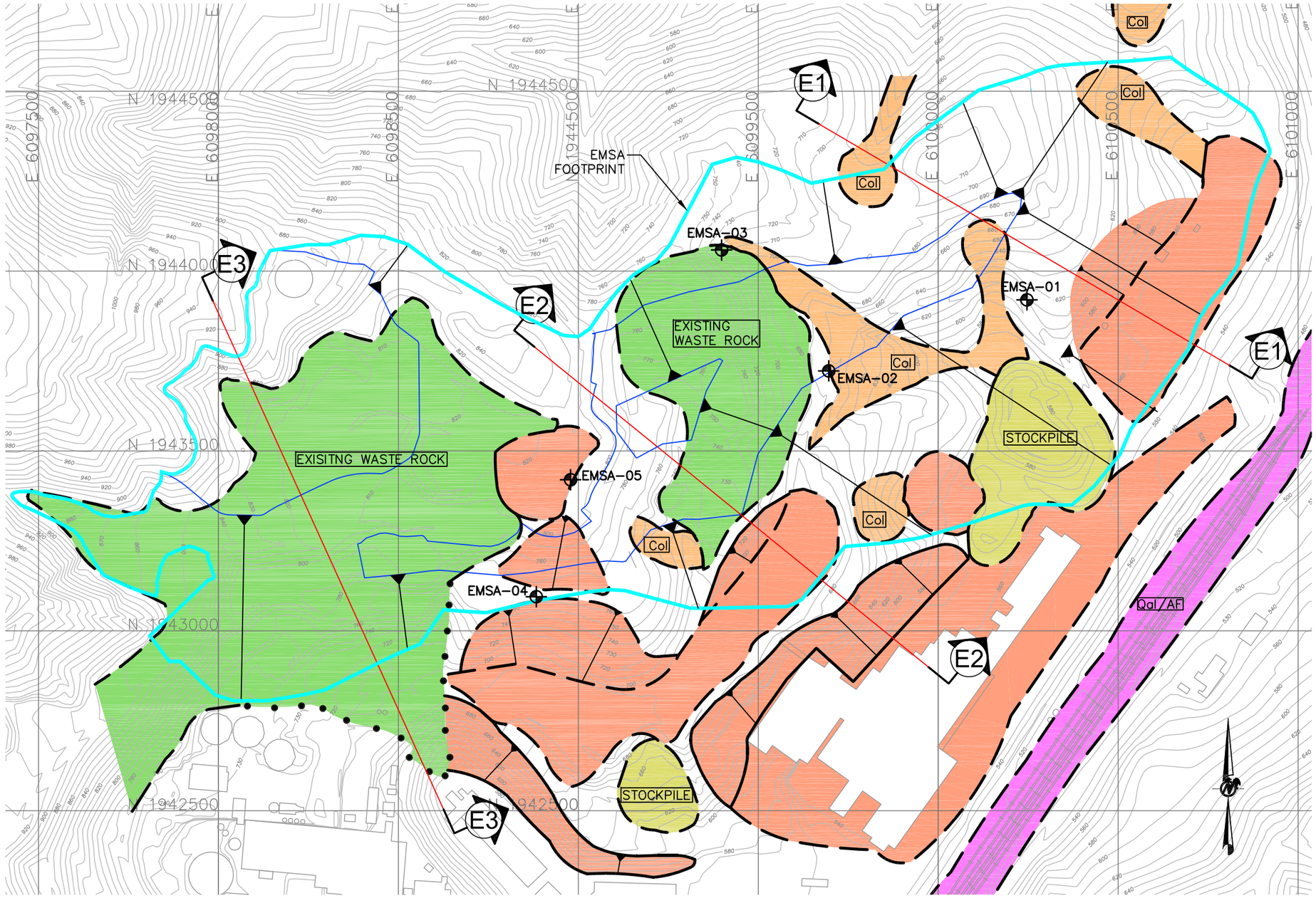
PROPOSED RECLAMATION PLAN
EAST MATERIALS STORAGE AREA
LEHIGH HANSON PERMANENTE, CALIFORNIA

TITLE

GEOLOGIC MAP
EAST MATERIALS STORAGE AREA

Golder Associates
Sunnyvale, California

PROJECT No.		063–7109	FILE No.	FIGURE 4
DESIGN	PHY	03/09	SCALE AS SHOWN	REV. A
CADD	CJM	03/09	**FIGURE 4**	
CHECK	PHY	03/09		
REVIEW	KGH	03/09		



LEGEND:

- PREDUMP TOPOGRAPHY AS OF APR-07 (10 FT INTERVAL)
- E2 — SECTION ID
- EMSA-05 — GEOTECHNICAL BOREHOLE – GOLDER, 2007
- EMSA FOOTPRINT
- EMSA CREST
- COLLUVIUM (>5 FEET THICK)
- Qal / ARTIFICIAL FILL
- STOCKPILE
- EXISTING WASTE ROCK
- CUT AREA

SURFACE SEPARATION:

- CERTAIN
- APPROXIMATE
- UNCERTAIN

EAST MATERIALS STORAGE AREA SURFACE MAPPING

SCALE: 1"=300'

300 0 300 600

SCALE FEET

PROJECT No. 063-7109 FILE No. 063-7109-Fi CADD JDr DATE 07/24/07

Drawing file: Figure 5.dwg Mar 30, 2009 - 4:38pm

PROJECT

PROPOSED RECLAMATION PLAN
EAST MATERIALS STORAGE AREA
HANSON PERMANENTE CEMENT, CALIFORNIA

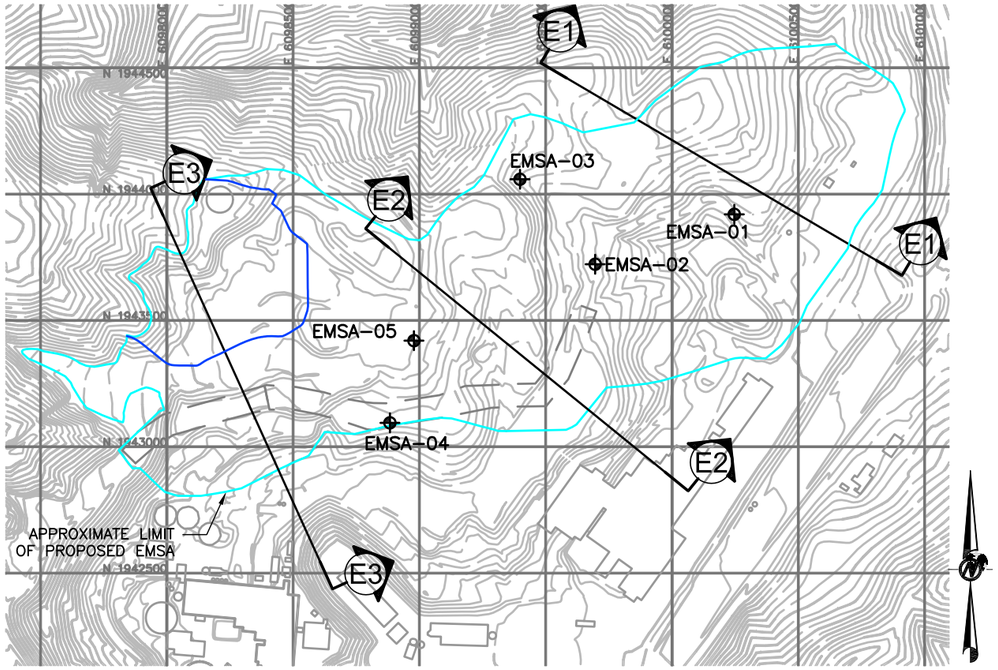
TITLE

SURFACE MAPPING
EAST MATERIALS STORAGE AREA

Golder Associates
Sunnyvale, California

PROJECT No.		063-7109	FILE No.	FIGURE 5
DESIGN	PHY	03/09	SCALE AS SHOWN	REV. A
CADD	CJM	03/09		
CHECK	PHY	03/09		
REVIEW	KGH	03/09		

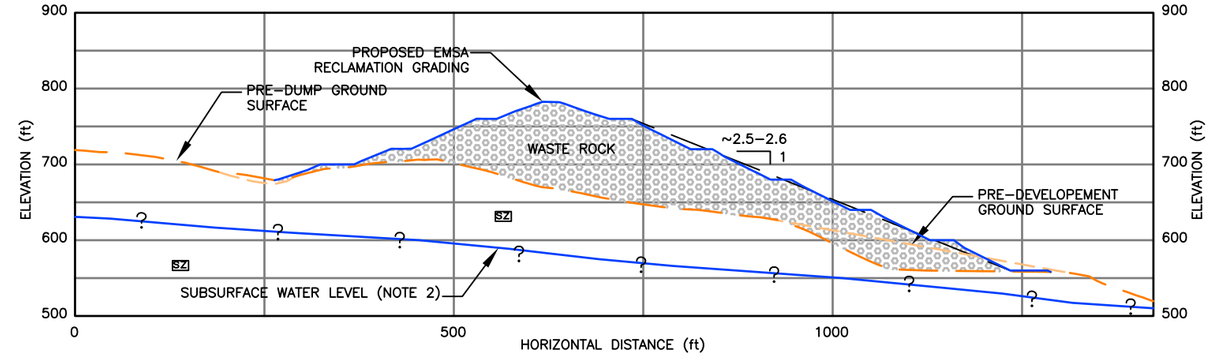
FIGURE 5



EAST MATERIALS STORAGE AREA SITE PLAN

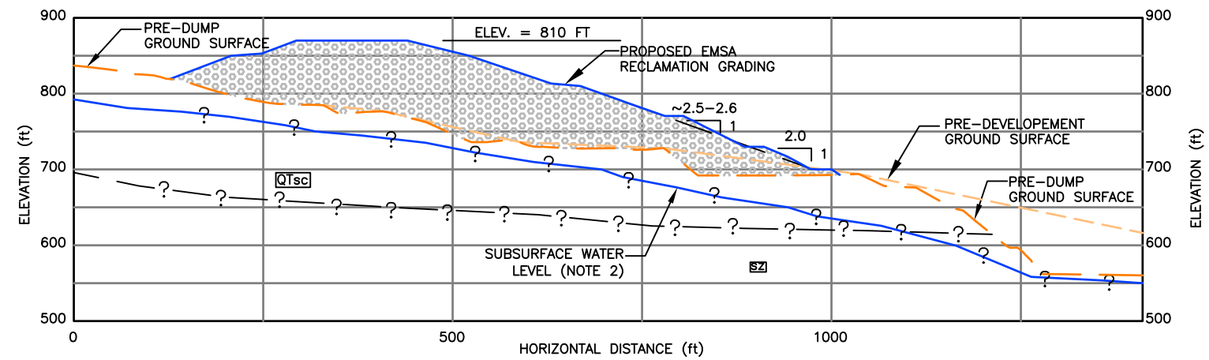
SCALE: 1"=600'
CONTOUR INTERVAL = 10'

600 0 600 1200
SCALE FEET



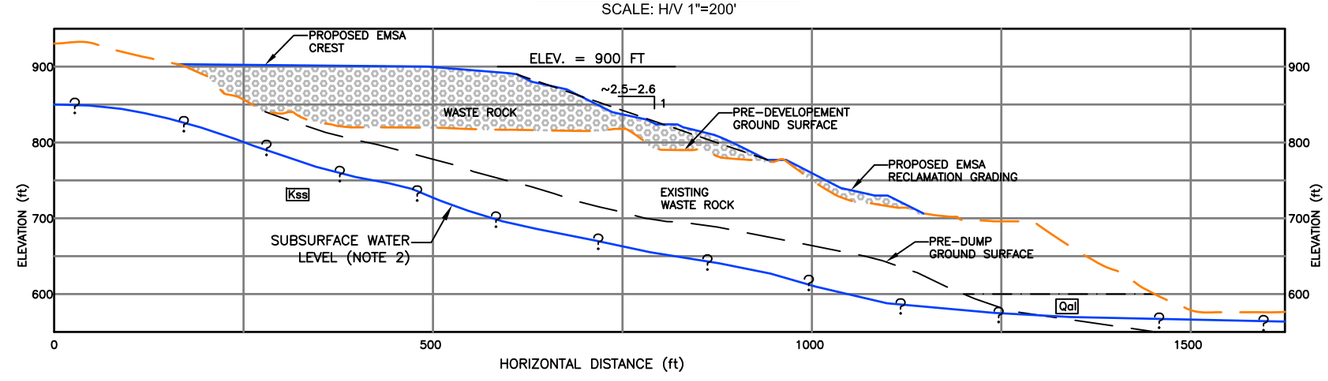
EMSA SECTION E1

SCALE H/V: 1"=200"



EMSA SECTION E2

SCALE: H/V 1"=200'



EMSA SECTION E3

SCALE: H/V 1"=200'

200 0 200 400
SCALE FEET

LEGEND

- 1550 — EIXSTING TOPOGRAPHY (10 FT INTERVAL)
- ADJACENT STRUCTURES AND FACILITIES
- E2 — SECTION ID/REFERENCE FIGURE NUMBER
- EMSA FOOTPRINT
- EMSA CREST
- ? — SUBSURFACE WATER LEVEL PROFILE (NOTE 2)
- ? — GEOLOGIC UNITS CONTACT PROFILE
- EMSA-05 — GEOTECHNICAL BOREHOLE – GOLDER, 2007
- QTsc — SANTA CLARA FORMATION
- Kss — FRANCISCAN COMPLEX SANDSTONE (GREYWACKE)
- SZ — SHEAR ZONE, MELANGE OF FRANCISCAN COMPLEX ROCKS – METABASALTS (GREENSTONE), SANDSTONE (GREYWACKE), LIMESTONE, AND SERPENTINE
- Qal — ARTIFICIAL FILL

NOTE

1. TOPOGRAPHIC INFORMATION PROVIDED BY HAMMON, JENSEN, WALLEN AND ASSOCIATES. DATE OF TOPOGRAPHY: APRIL 9, 2007.
2. WATER LEVELS ARE ASSUMED BASED ON SUBSURFACE INVESTIGATIONS BY GOLDER (2007) AND OTHER HISTORIC DATA.

PROJECT
PROPOSED RECLAMATION PLAN
EAST MATERIALS STORAGE AREA
LEHIGH HANSON PERMANENTE, CALIFORNIA

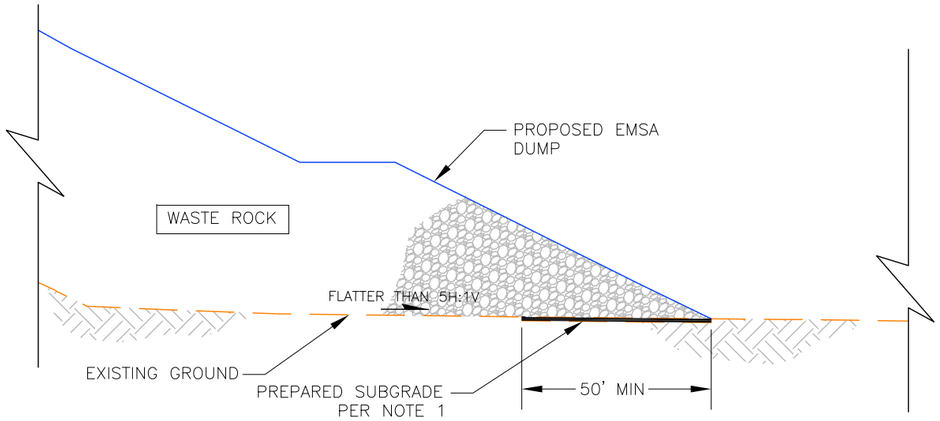
TITLE
CROSS-SECTIONS
EAST MATERIALS STORAGE AREA

Golder Associates
Sunnyvale, California

PROJECT No.		063-7109	FILE No.	FIGURE 6
DESIGN	PHY	02/09	SCALE AS SHOWN	REV. A
CADD	CJM	02/09		
CHECK	PHY	02/09	**FIGURE 6**	
REVIEW	KGH	02/09		

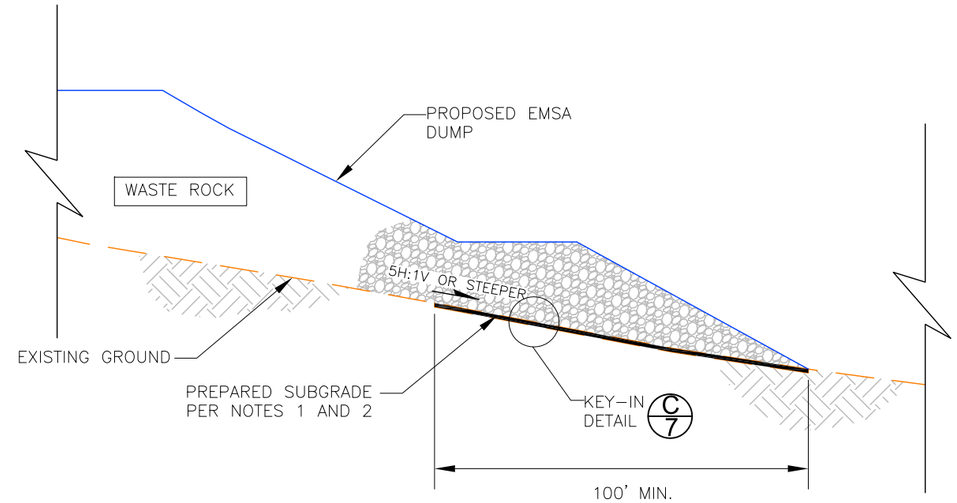
PROJECT No. 063-7109 FILE No.063-7109-X2 CADD CJM DATE 01/20/09

Drawing file: Figure 6.dwg Mar 31, 2009 – 8:16am



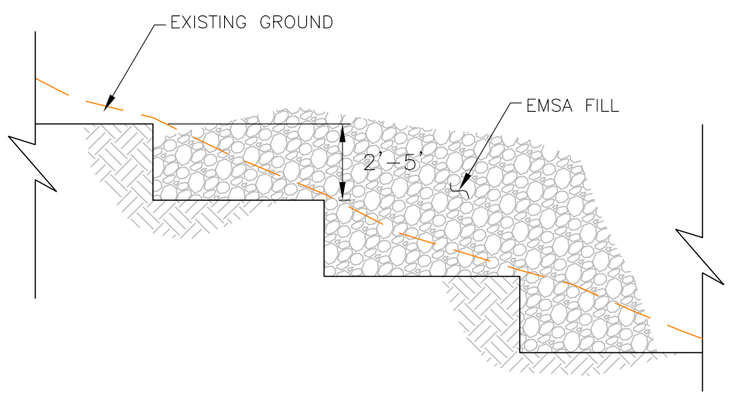
A SUBGRADE PREPARATION FOR OUTWARD SLOPING EXISITING GROUND FLATTER THAN 5H:1V

NTS



B SUBGRADE PREPARATION FOR OUTWARD SLOPING EXISITING GROUND 5H:1V OR STEEPER

NTS



C BENCH KEY-IN DETAIL

NTS

NOTE

1. SUBGRADE PREPARATION SHALL CONSIST OF OVER-EXCAVATION OF TOPSOIL, VEGETATION, AND FAT CLAYS. OVER-EXCAVATION SHALL BE PERFORMED UNTIL BEDROCK, GRANULAR SOIL, OR LEAN CLAY IS ENCOUNTERED. LEAN CLAY SHALL BE BE MEASURED TO HAVE A PLASTICITY INDEX (PI) NO GREATER THAN 25.

2. SUBGRADE PREPARATION OF SLOPES 5H:1V OR STEEPER SHOULD ALSO CONSIST OF BENCHING THE SLOPES WITH INDIVIDUAL BENCH HEIGHTS OF AT LEAST 5 FEET AS SHOWN IN DETAIL C.

PROJECT
PROPOSED RECLAMATION PLAN
EAST MATERIALS STORAGE AREA
LEHIGH HANSON PERMANENTE, CALIFORNIA

TITLE
SUBGRADE PREPARATION EAST MATERIALS STORAGE AREA

Golder Associates
Sunnyvale, California

PROJECT No.		063-7109	FILE No.	FIGURE 7
DESIGN	PHY	03/09	SCALE AS SHOWN	REV. A
CADD	CJM	03/09		
CHECK	PHY	03/09	**FIGURE 7**	
REVIEW	KGH	03/09		

PROJECT No. 063-7109 FILE No.063-7109-X2 CADD CJM DATE 01/20/09

Drawing file: Figure 7.dwg Mar 31, 2009 - 8:22am

APPENDIX A

GEOTECHNICAL BORING LOGS

SUMMARY: BORING NO. EMSA-1

COORDINATES: N 1,943,921.0 FT
E 610,028.0 FT

DATE DRILLED: 5/21/07 - 5/21/07
DRILLING METHOD: CME 75 / 6" Hollow Stem Auger / SPT-Automatic 140LB Hammer
SURFACE CONDITIONS: Sand AND gravel to 3" diameter, dry

ELEVATION: 614.0 FT

DEPTH IN FEET	SAMPLE NO.	REOVERY	BLOWS/6"	SAMPLE TYPE	LAB MOISTURE % OF DRY WEIGHT	LAB TEST	LITHOLOGY	DESCRIPTION	SYMBOL	MOISTURE	CONSISTENCY	DEPTH IN FEET
0								CLAYEY SAND (SC) w/ few gravel, dark brown, gravel to 1" diameter, loose, dry	SC	dry	medium dense	0
5	EMSA-1-5 EMSA-1-(5-7		4 4 6	SPT Shelby		G G						5
								LIMESTONE (low grade), grey, to 3" diameter, subangular, medium weathered, hard, dry	LS			
	EMSA-1-10		12 13 18	SPT		A, G					dense	
10								GREENSTONE, dark brown/green, to 2" diameter, subangular, fine grained, medium to highly weathered, hard, dry	GS			10
			5 10 15	SPT				LIMESTONE (low grade), grey/dark red, to 3" diameter, fine grained, subangular, some calcite fractures, medium weathered, hard, dry	LS		medium dense	
15												15
	EMSA-1-20		10 19 21	SPT		A, G		GREENSTONE, green, to 1.5" diameter, fine grained, subrounded, trace calcite, medium weathered, dry	GS		dense	
20												20

Continued Next Page

A. 2" O.D. SPLIT-SPOON SAMPLER
B. 3" O.D. THIN WALL SAMPLER
C. 3-1/4" O.D. x 2-1/2" LINER
D. 3-1/2" O.D. SPLIT-BARREL SAMPLER
E. 2" I.D. SPLIT-SPOON SAMPLER
X. SAMPLE NOT RECOVERED
A. - ATTERBERG
G. - GRAIN SIZE
C. - CONSOLIDATION
DS - DIRECT SHEAR
T - TRIAXIAL
P - PERMEABILITY
WATER LEVEL - ATD
WATER LEVEL - AD

Golder Associates

Hanson Permanente Cement Quarry

Job No 063-7109
Engr D.S.F.
Date 2/11/09

Hanson Permanente Cement Quarry
Cupertino, CA
East Materials Storage Area

SUMMARY: BORING NO. EMSA-1

COORDINATES: N 1,943,921.0 FT
E 610,028.0 FT

DATE DRILLED: 5/21/07 - 5/21/07
DRILLING METHOD: CME 75 / 6" Hollow Stem Auger / SPT-Automatic 140LB Hammer
SURFACE CONDITIONS: Sand AND gravel to 3" diameter, dry

ELEVATION: 614.0 FT

DEPTH IN FEET	SAMPLE NO.	REOVERY	BLOWS/6"	SAMPLE TYPE	LAB MOISTURE % OF DRY WEIGHT	LAB TEST	LITHOLOGY	DESCRIPTION	SYMBOL	MOISTURE	CONSISTENCY	DEPTH IN FEET
20												20
			13 19 21	SPT							dense	
25								@25': Green/dark brown, highly weathered, to 0.5" diameter, loose				25
			10 50 >50	SPT							very dense	
30								@30': No recovery	GS			30
			>50 >50 >50	SPT							very dense	
35												35
			>50 >50 >50	SPT				@39': Very hard			very dense	
40												40

Continued Next Page

A. 2" O.D. SPLIT-SPOON SAMPLER
B. 3" O.D. THIN WALL SAMPLER
C. 3-1/4" O.D. x 2-1/2" LINER
D. 3-1/2" O.D. SPLIT-BARREL SAMPLER
E. 2" I.D. SPLIT-SPOON SAMPLER
X. SAMPLE NOT RECOVERED
A. - ATTERBERG
G. - GRAIN SIZE
C. - CONSOLIDATION
DS - DIRECT SHEAR
T - TRIAXIAL
P - PERMEABILITY
WATER LEVEL - ATD
WATER LEVEL - AD

Golder Associates

Hanson Permanente Cement Quarry

Job No 063-7109
Engr D.S.F.
Date 2/11/09

Hanson Permanente Cement Quarry
Cupertino, CA
East Materials Storage Area

SUMMARY: BORING NO. EMSA-1

COORDINATES: N 1,943,921.0 FT
E 610,028.0 FT

DATE DRILLED: 5/21/07 - 5/21/07
DRILLING METHOD: CME 75 / 6" Hollow Stem Auger / SPT-Automatic 140LB Hammer
SURFACE CONDITIONS: Sand AND gravel to 3" diameter, dry

ELEVATION: 614.0 FT

DEPTH IN FEET	SAMPLE NO.	REOVERY	BLOWS/6"	SAMPLE TYPE	LAB MOISTURE % OF DRY WEIGHT	LAB TEST	LITHOLOGY	DESCRIPTION	SYMBOL	MOISTURE	CONSISTENCY	DEPTH IN FEET
40									GS			40
								Auger Refusal @ 40.5' BGS End of Boring @40.5' BGS No Water Encountered				
45												45
50												50
55												55
60												60

A. 2" O.D. SPLIT-SPOON SAMPLER
B. 3" O.D. THIN WALL SAMPLER
C. 3-1/4" O.D. x 2-1/2" LINER
D. 3-1/2" O.D. SPLIT-BARREL SAMPLER
E. 2" I.D. SPLIT-SPOON SAMPLER
X. SAMPLE NOT RECOVERED
A. - ATTERBERG
G. - GRAIN SIZE
C. - CONSOLIDATION
DS - DIRECT SHEAR
T - TRIAXIAL
P - PERMEABILITY
WATER LEVEL - ATD
WATER LEVEL - AD

Golder Associates

Hanson Permanente Cement Quarry

Job No 063-7109
Engr D.S.F.
Date 2/11/09

Hanson Permanente Cement Quarry
Cupertino, CA
East Materials Storage Area

SUMMARY: BORING NO. EMSA-2

COORDINATES: N 1,943,814.0 FT
E 6,099,713.0 FT

DATE DRILLED: 5/22/07 - 5/22/07
DRILLING METHOD: CME 75 / 6" Hollow Stem Auger / SPT-Automatic 140LB Hammer
SURFACE CONDITIONS: Gravel to 3" diameter

ELEVATION: 640.0 FT

DEPTH IN FEET	SAMPLE NO.	REOVERY	BLOWS/6"	SAMPLE TYPE	LAB MOISTURE % OF DRY WEIGHT	LAB TEST	LITHOLOGY	DESCRIPTION	SYMBOL	MOISTURE	CONSISTENCY	DEPTH IN FEET
0								CLAYEY SAND (SC) w/ little gravel, dark yellowish brown, gravel to 2" diameter, loose, dry				0
	EMSA-2-5		2 4 2	SPT		A, G					loose	
5				Shelby				@5.5': Increasing gravel size (limestone), medium to high plasticity fines	SC			5
			3 6 27	SPT				@9': Mottled, greenstone and limestone gravel to 2" diameter			dense	
10												10
	EMSA-2-15		4 8 10	SPT		A, G		GREENSTONE, yellowish brown, mottled, to 3" diameter, subrounded, highly weathered, hard, dry			medium dense	
15									GS			15
			3 5 10	SPT							medium dense	
20												20

Continued Next Page

A. 2" O.D. SPLIT-SPOON SAMPLER
B. 3" O.D. THIN WALL SAMPLER
C. 3-1/4" O.D. x 2-1/2" LINER
D. 3-1/2" O.D. SPLIT-BARREL SAMPLER
E. 2" I.D. SPLIT-SPOON SAMPLER
X. SAMPLE NOT RECOVERED
A. - ATTERBERG
G. - GRAIN SIZE
C. - CONSOLIDATION
DS - DIRECT SHEAR
T - TRIAXIAL
P - PERMEABILITY
WATER LEVEL - ATD
WATER LEVEL - AD

Golder Associates

Hanson Permanente Cement Quarry

Job No 063-7109
Engr D.S.F.
Date 2/11/09

Hanson Permanente Cement Quarry
Cupertino, CA
East Materials Storage Area

SUMMARY: BORING NO. EMSA-2

COORDINATES: N 1,943,814.0 FT
E 6,099,713.0 FT

DATE DRILLED: 5/22/07 - 5/22/07
DRILLING METHOD: CME 75 / 6" Hollow Stem Auger / SPT-Automatic 140LB Hammer
SURFACE CONDITIONS: Gravel to 3" diameter

ELEVATION: 640.0 FT

DEPTH IN FEET	SAMPLE NO.	REOVERY	BLOWS/6"	SAMPLE TYPE	LAB MOISTURE % OF DRY WEIGHT	LAB TEST	LITHOLOGY	DESCRIPTION	SYMBOL	MOISTURE	CONSISTENCY	DEPTH IN FEET
20												20
			3 8 15	SPT							medium dense	
25								@25': Very mottled, brown/green/orange/red, mostly dark brown, some fines, completely weathered, fine gravel				25
			10 14 30	SPT							dense	
30									GS			30
			6 23 39	SPT							very dense	
35								@35': Medium to highly weathered				35
			8 21 42	SPT							very dense	
40												40

Continued Next Page

A. 2" O.D. SPLIT-SPOON SAMPLER
B. 3" O.D. THIN WALL SAMPLER
C. 3-1/4" O.D. x 2-1/2" LINER
D. 3-1/2" O.D. SPLIT-BARREL SAMPLER
E. 2" I.D. SPLIT-SPOON SAMPLER
X. SAMPLE NOT RECOVERED
A. - ATTERBERG
G. - GRAIN SIZE
C. - CONSOLIDATION
DS - DIRECT SHEAR
T - TRIAXIAL
P - PERMEABILITY
WATER LEVEL - ATD
WATER LEVEL - AD

Golder Associates

Hanson Permanente Cement Quarry

Job No 063-7109
Engr D.S.F.
Date 2/11/09

Hanson Permanente Cement Quarry
Cupertino, CA
East Materials Storage Area

SUMMARY: BORING NO. EMSA-2

COORDINATES: N 1,943,814.0 FT
E 6,099,713.0 FT

DATE DRILLED: 5/22/07 - 5/22/07
DRILLING METHOD: CME 75 / 6" Hollow Stem Auger / SPT-Automatic 140LB Hammer
SURFACE CONDITIONS: Gravel to 3" diameter

ELEVATION: 640.0 FT

DEPTH IN FEET	SAMPLE NO.	REOVERY	BLOWS/6"	SAMPLE TYPE	LAB MOISTURE % OF DRY WEIGHT	LAB TEST	LITHOLOGY	DESCRIPTION	SYMBOL	MOISTURE	CONSISTENCY	DEPTH IN FEET
40												40
									GS			
			6 50 >50	SPT							very dense	
45								End of Borehole @ 45' BGS No Water Encountered				45
50												50
55												55
60												60

A. 2" O.D. SPLIT-SPOON SAMPLER
B. 3" O.D. THIN WALL SAMPLER
C. 3-1/4" O.D. x 2-1/2" LINER
D. 3-1/2" O.D. SPLIT-BARREL SAMPLER
E. 2" I.D. SPLIT-SPOON SAMPLER
X. SAMPLE NOT RECOVERED
A. - ATTERBERG
G. - GRAIN SIZE
C. - CONSOLIDATION
DS - DIRECT SHEAR
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WATER LEVEL - ATD
WATER LEVEL - AD

Golder Associates

Hanson Permanente Cement Quarry

Job No 063-7109
Engr D.S.F.
Date 2/11/09

Hanson Permanente Cement Quarry
Cupertino, CA
East Materials Storage Area

SUMMARY: BORING NO. EMSA-3

COORDINATES: N 1,944,094.0 FT
E 6,099,499.0 FT

DATE DRILLED: 5/23/07 - 5/23/07
DRILLING METHOD: CME 75 / 6" Hollow Stem Auger / SPT-Automatic 140LB Hammer
SURFACE CONDITIONS: High grass

ELEVATION: 709.0 FT

DEPTH IN FEET	SAMPLE NO.	REOVERY	BLOWS/6"	SAMPLE TYPE	LAB MOISTURE % OF DRY WEIGHT	LAB TEST	LITHOLOGY	DESCRIPTION	SYMBOL	MOISTURE	CONSISTENCY	DEPTH IN FEET
0								SANDSTONE (Santa Clara Fm), yellowish brown, red, mottled, some gravel to 1", fine grained, poorly sorted, subrounded, highly weathered, dry				0
	EMSA-3-5		8 15 17	SPT		G				dry	dense	
5												5
			11 24 30	SPT				@9': Trace fines, gravel, to 1.5" diameter, some quartz veins	SS		very dense	
10												10
			15 50 >50	SPT				@14': Greywacke, quartz			very dense	
15												15
			11 17 30	SPT				@19': Large pieces of quartz			dense	
20												20

Continued Next Page

A. 2" O.D. SPLIT-SPOON SAMPLER
B. 3" O.D. THIN WALL SAMPLER
C. 3-1/4" O.D. x 2-1/2" LINER
D. 3-1/2" O.D. SPLIT-BARREL SAMPLER
E. 2" I.D. SPLIT-SPOON SAMPLER
X. SAMPLE NOT RECOVERED
A. - ATTERBERG
G. - GRAIN SIZE
C. - CONSOLIDATION
DS - DIRECT SHEAR
T - TRIAXIAL
P - PERMEABILITY
WATER LEVEL - ATD
WATER LEVEL - AD

Golder Associates

Hanson Permanente Cement Quarry

Job No 063-7109
Engr D.S.F.
Date 2/11/09

Hanson Permanente Cement Quarry
Cupertino, CA
East Materials Storage Area

SUMMARY: BORING NO. EMSA-3

COORDINATES: N 1,944,094.0 FT
E 6,099,499.0 FT

DATE DRILLED: 5/23/07 - 5/23/07
DRILLING METHOD: CME 75 / 6" Hollow Stem Auger / SPT-Automatic 140LB Hammer
SURFACE CONDITIONS: High grass

ELEVATION: 709.0 FT

DEPTH IN FEET	SAMPLE NO.	REOVERY	BLOWS/6"	SAMPLE TYPE	LAB MOISTURE % OF DRY WEIGHT	LAB TEST	LITHOLOGY	DESCRIPTION	SYMBOL	MOISTURE	CONSISTENCY	DEPTH IN FEET
20												20
			16 50 >50	SPT				@24': Dark yellowish brown, little fines, more cemented, damp		moist	very dense	
25									SS			25
			50 >50 >50	SPT							very dense	
30								@30': Gravel to 2" diameter, very hard				30
								Auger Refusal @ 32' BGS End of Borehole @ 32' BGS No Water Encountered				
35												35
40												40

A. 2" O.D. SPLIT-SPOON SAMPLER
B. 3" O.D. THIN WALL SAMPLER
C. 3-1/4" O.D. x 2-1/2" LINER
D. 3-1/2" O.D. SPLIT-BARREL SAMPLER
E. 2" I.D. SPLIT-SPOON SAMPLER
X. SAMPLE NOT RECOVERED
A. - ATTERBERG
G. - GRAIN SIZE
C. - CONSOLIDATION
DS - DIRECT SHEAR
T - TRIAXIAL
P - PERMEABILITY
WATER LEVEL - ATD
WATER LEVEL - AD

Golder Associates

Hanson Permanente Cement Quarry

Job No 063-7109
Engr D.S.F.
Date 2/11/09

Hanson Permanente Cement Quarry
Cupertino, CA
East Materials Storage Area

SUMMARY: BORING NO. EMSA-4

COORDINATES: N 1,943,135.0 FT
E 6,098,783.0 FT

DATE DRILLED: 5/22/07 - 5/22/07
DRILLING METHOD: CME 75 / 6" Hollow Stem Auger / SPT-Automatic 140LB Hammer
SURFACE CONDITIONS: Gravel to 2" diameter

ELEVATION: 746.0 FT

DEPTH IN FEET	SAMPLE NO.	REOVERY	BLOWS/6"	SAMPLE TYPE	LAB MOISTURE % OF DRY WEIGHT	LAB TEST	LITHOLOGY	DESCRIPTION	SYMBOL	MOISTURE	CONSISTENCY	DEPTH IN FEET
0								SANDSTONE (Shear Zone), w/ some greywacke, gravel to 2" diameter, yellowish brown, red, mottled, fine grained, subrounded to subangular, highly weathered, dry				0
	EMSA-4-5		10 11 12	SPT		G				dry	medium dense	
5	EMSA-4-(5.5-			Shelby		G		@ 5.5': Cobbles to 4" diameter				5
			6 8 13	SPT					SS		medium dense	10
15			6 7 12	SPT				@14': Increasing greywacke to 3" diameter, green, brown, fine grained, subangular, highly weathered, dry			medium dense	15
20			7 10 13	SPT				@19': Mottled, red, yellow, brown, completely weathered			medium dense	20

Continued Next Page

A. 2" O.D. SPLIT-SPOON SAMPLER
B. 3" O.D. THIN WALL SAMPLER
C. 3-1/4" O.D. x 2-1/2" LINER
D. 3-1/2" O.D. SPLIT-BARREL SAMPLER
E. 2" I.D. SPLIT-SPOON SAMPLER
X. SAMPLE NOT RECOVERED
A. - ATTERBERG
G. - GRAIN SIZE
C. - CONSOLIDATION
DS - DIRECT SHEAR
T - TRIAXIAL
P - PERMEABILITY
WATER LEVEL - ATD
WATER LEVEL - AD

Golder Associates

Hanson Permanente Cement Quarry

Job No 063-7109
Engr D.S.F.
Date 2/11/09

Hanson Permanente Cement Quarry
Cupertino, CA
East Materials Storage Area

SUMMARY: BORING NO. EMSA-4

COORDINATES: N 1,943,135.0 FT
E 6,098,783.0 FT

DATE DRILLED: 5/22/07 - 5/22/07
DRILLING METHOD: CME 75 / 6" Hollow Stem Auger / SPT-Automatic 140LB Hammer
SURFACE CONDITIONS: Gravel to 2" diameter

ELEVATION: 746.0 FT

DEPTH IN FEET	SAMPLE NO.	REOVERY	BLOWS/6"	SAMPLE TYPE	LAB MOISTURE % OF DRY WEIGHT	LAB TEST	LITHOLOGY	DESCRIPTION	SYMBOL	MOISTURE	CONSISTENCY	DEPTH IN FEET
20									SS	moist	medium dense	20
			5 6 8	SPT								
25								SILTY SAND (SM) w/ little gravel to 0.5", very dark brown, soft, moist, slight sheen, slight odor	SM	dry	dense	25
			7 14 18	SPT								
30								SANDSTONE (Shear Zone), w/ some greywacke, gravel to 2" diameter, yellowish brown, red, mottled, fine grained, subrounded to subangular, highly weathered, dry	SS		very dense	30
			13 50 >50	SPT								
35												35
								Auger Refusal @ 38' BGS End of Borehole @ 38' BGS No Water Encountered				
40												40

A. 2" O.D. SPLIT-SPOON SAMPLER
B. 3" O.D. THIN WALL SAMPLER
C. 3-1/4" O.D. x 2-1/2" LINER
D. 3-1/2" O.D. SPLIT-BARREL SAMPLER
E. 2" I.D. SPLIT-SPOON SAMPLER
X. SAMPLE NOT RECOVERED
A. - ATTERBERG
G. - GRAIN SIZE
C. - CONSOLIDATION
DS - DIRECT SHEAR
T - TRIAXIAL
P - PERMEABILITY
WATER LEVEL - ATD
WATER LEVEL - AD

Golder Associates

Hanson Permanente Cement Quarry

Job No 063-7109
Engr D.S.F.
Date 2/11/09

Hanson Permanente Cement Quarry
Cupertino, CA
East Materials Storage Area

SUMMARY: BORING NO. EMSA-5

COORDINATES: N 1,943,360.0 FT
E 6,098,978.0 FT

DATE DRILLED: 5/22/07 - 5/22/07
DRILLING METHOD: CME 75 / 6" Hollow Stem Auger / SPT-Automatic 140LB Hammer
SURFACE CONDITIONS: Grass, sand, gravel to 3"

ELEVATION: 792.0 FT

DEPTH IN FEET	SAMPLE NO.	REOVERY	BLOWS/6"	SAMPLE TYPE	LAB MOISTURE % OF DRY WEIGHT	LAB TEST	LITHOLOGY	DESCRIPTION	SYMBOL	MOISTURE	CONSISTENCY	DEPTH IN FEET
0								SANDSTONE (Santa Clara Fm), yellowish brown, red, mottled, greywacke, to 0.5" diameter, fine grained, subrounded, unconsolidated, highly weathered, dry				0
	EMSA-5-5		22 50 >50	SPT		G				dry	very dense	
5												5
	EMSA-5-10		50 >50 >50	SPT		G			SS		very dense	
10												10
			50 >50 >50	SPT							very dense	
15												15
			20 50 >50	SPT							very dense	
20												20

Continued Next Page

A. 2" O.D. SPLIT-SPOON SAMPLER
B. 3" O.D. THIN WALL SAMPLER
C. 3-1/4" O.D. x 2-1/2" LINER
D. 3-1/2" O.D. SPLIT-BARREL SAMPLER
E. 2" I.D. SPLIT-SPOON SAMPLER
X. SAMPLE NOT RECOVERED
A. - ATTERBERG
G. - GRAIN SIZE
C. - CONSOLIDATION
DS - DIRECT SHEAR
T - TRIAXIAL
P - PERMEABILITY
WATER LEVEL - ATD
WATER LEVEL - AD

Golder Associates

Hanson Permanente Cement Quarry

Job No 063-7109
Engr D.S.F.
Date 2/11/09

Hanson Permanente Cement Quarry
Cupertino, CA
East Materials Storage Area

SUMMARY: BORING NO. EMSA-5

COORDINATES: N 1,943,360.0 FT
E 6,098,978.0 FT

DATE DRILLED: 5/22/07 - 5/22/07
DRILLING METHOD: CME 75 / 6" Hollow Stem Auger / SPT-Automatic 140LB Hammer
SURFACE CONDITIONS: Grass, sand, gravel to 3"

ELEVATION: 792.0 FT

DEPTH IN FEET	SAMPLE NO.	REOVERY	BLOWS/6"	SAMPLE TYPE	LAB MOISTURE % OF DRY WEIGHT	LAB TEST	LITHOLOGY	DESCRIPTION	SYMBOL	MOISTURE	CONSISTENCY	DEPTH IN FEET
20								@20': Gravel to 1.5" diameter, more consolidated				20
			32 50 >50	SPT							very dense	
25								@25': Calcite veins in rock fragments, subangular	SS			25
30			26 50 >50	SPT							very dense	30
								Auger Refusal @ 32' BGS End of Borehole @ 32' BGS No Water Encountered				
35												35
40												40

A. 2" O.D. SPLIT-SPOON SAMPLER
B. 3" O.D. THIN WALL SAMPLER
C. 3-1/4" O.D. x 2-1/2" LINER
D. 3-1/2" O.D. SPLIT-BARREL SAMPLER
E. 2" I.D. SPLIT-SPOON SAMPLER
X. SAMPLE NOT RECOVERED
A. - ATTERBERG
G. - GRAIN SIZE
C. - CONSOLIDATION
DS - DIRECT SHEAR
T - TRIAXIAL
P - PERMEABILITY
WATER LEVEL - ATD
WATER LEVEL - AD

Golder Associates

Hanson Permanente Cement Quarry

Job No 063-7109
Engr D.S.F.
Date 2/11/09

Hanson Permanente Cement Quarry
Cupertino, CA
East Materials Storage Area

APPENDIX B

SUMMARY OF LABORATORY TEST RESULTS

APPENDIX B-1

FOUNDATION SOILS

#200 Sieve Wash Analysis
ASTM D 1140

Job No.:	287-031a	**Project No.:**	063-7109.011	**Run By:**	MD
Client:	Golder Associates	**Date:**	6/21/2007	**Checked By:**	DC
Project:	Hanson/East Materials Storage Area				

Boring:	EMSA-1	EMSA-1	EMSA-1	EMSA-2	EMSA-2	EMSA-3	EMSA-4	EMSA-5
Sample:	1	3	5	1	4	1	1	1
Depth, ft.:	5	10	20	5	15	5	5	5
Soil Type:	Brown Clayey SAND w/ Gravel	Marbled Blue & Greenish Brown Lean Clayey SAND w/ Gravel	Mottled Gray & Black Sandy Lean CLAY	Brown Lean Clayey SAND	Mottled Brown & Gray Lean Clayey SAND	Light Brownish Yellow Sandy CLAY	Brown Clayey SAND w/ Gravel	Light Bown Clayey SAND
Wt of Dish & Dry Soil, gm	290.8	452.4	657.4	426.9	384.1	564.9	810.3	370.9
Weight of Dish, gm	83.5	77.9	80.4	84.4	84.5	79.8	84.5	81.1
Weight of Dry Soil, gm	207.3	374.5	577.0	342.5	299.6	485.1	725.8	289.8
Wt. Ret. on #4 Sieve, gm	42.5	89.0	79.2	48.7	34.4	25.2	227.5	27.7
Wt. Ret. on #200 Sieve, gm	166.9	225.2	271.2	200.8	161.4	205.4	535.7	168.4
% Gravel	**20.5**	**23.8**	**13.7**	**14.2**	**11.5**	**5.2**	**31.3**	**9.6**
% Sand	**60.0**	**36.4**	**33.3**	**44.4**	**42.4**	**37.1**	**42.5**	**48.6**
% Silt & Clay	**19.5**	**39.9**	**53.0**	**41.4**	**46.1**	**57.7**	**26.2**	**41.9**

Remarks: As an added benefit to our clients, the gravel fraction may be included in this report. Whether or not it is included is dependent upon both the technician's time available and if there is a significant enough amount of gravel. The gravel is always included in the percent retained on the #200 sieve but may not be weighed separately to determine the percentage, especially if there is only a trace amount, (5% or less).

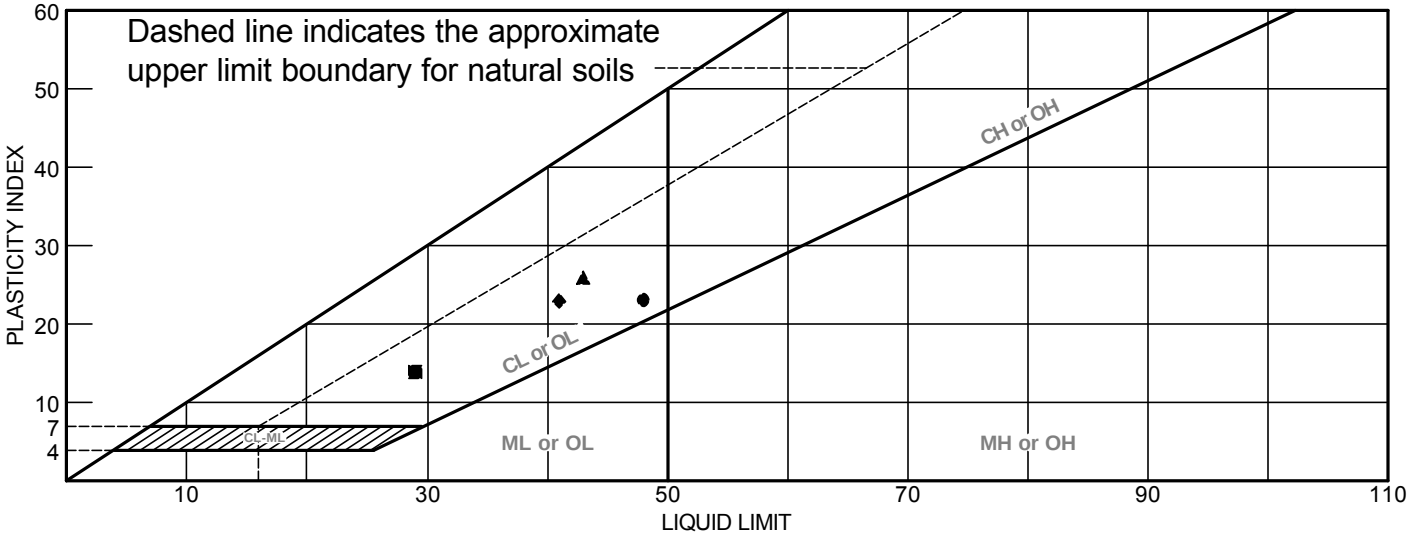
#200 Sieve Wash Analysis
ASTM D 1140

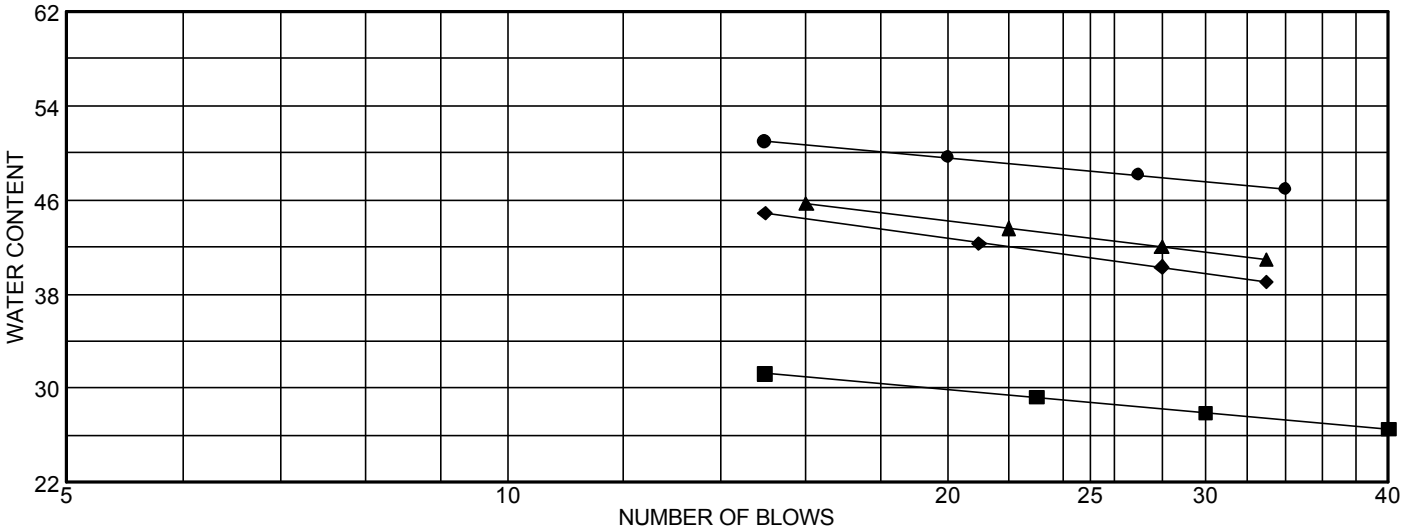
Job No.:	287-031b	**Project No.:**	063-7109.011	**Run By:**	MD
Client:	Golder Associates	**Date:**	6/21/2007	**Checked By:**	DC
Project:	Hanson/East Materials Storage Area				

Boring:	EMSA-5	EMSA-1	EMSA-4					
Sample:	2							
Depth, ft.:	10	5-7	5.5-8					
Soil Type:	Light Brown Clayey SAND	Gray Sandy CLAY w/ Gravel	Light Yellowish Brown Clayey SAND w/ Gravel					
Wt of Dish & Dry Soil, gm	631.0	611.3	784.5					
Weight of Dish, gm	100.2	174.3	329.5					
Weight of Dry Soil, gm	530.8	437.1	455.0					
Wt. Ret. on #4 Sieve, gm	53.7	66.2	95.7					
Wt. Ret. on #200 Sieve, gm	318.1	188.2	314.1					
% Gravel	**10.1**	**15.1**	**21.0**					
% Sand	**49.8**	**27.9**	**48.0**					
% Silt & Clay	**40.1**	**56.9**	**31.0**					

Remarks: As an added benefit to our clients, the gravel fraction may be included in this report. Whether or not it is included is dependent upon both the technician's time available and if there is a significant enough amount of gravel. The gravel is always included in the percent retained on the #200 sieve but may not be weighed separately to determine the percentage, especially if there is only a trace amount, (5% or less).

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Brown Lean Clayey SAND	48	25	23			
■	Mottled Brown & Gray Lean Clayey SAND	29	15	14			
▲	Marbled Blue & Greenish Brown Lean Clayey SAND w/ Gravel	43	17	26			
◆	Mottled Gray & Black Sandy Lean CLAY	41	18	23			

Project No. 287-031 **Client:** Golder Associates

Project: Hanson/East Materials Storage Area - 063-7109.011

● **Source:** EMSA-2 **Sample No.:** 1 **Elev./Depth:** 5'
■ **Source:** EMSA-2 **Sample No.:** 4 **Elev./Depth:** 15'
▲ **Source:** EMSA-1 **Sample No.:** 3 **Elev./Depth:** 10'
◆ **Source:** EMSA-1 **Sample No.:** 5 **Elev./Depth:** 20'

Remarks:
●
■
▲
◆

LIQUID AND PLASTIC LIMITS TEST REPORT

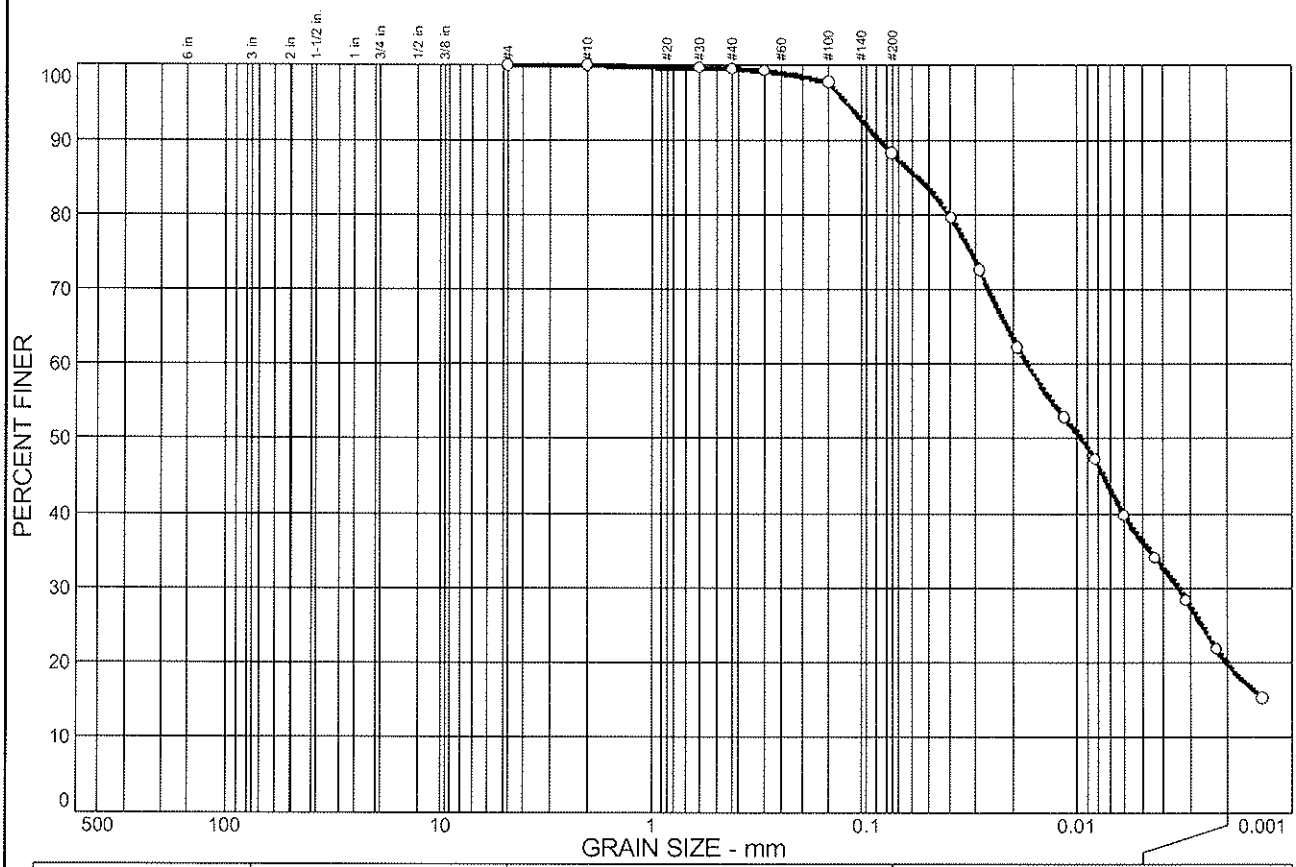
COOPER TESTING LABORATORY

Figure

APPENDIX B-2

FINE WASTE

PARTICLE SIZE DISTRIBUTION TEST REPORT



% + 3"	% GRAVEL		% SAND			% FINES	
	CRS.	FINE	CRS.	MEDIUM	FINE	SILT	CLAY
0.0	0.0	0.0	0.0	0.5	11.3	68.3	19.9

SIEVE SIZE	PERCENT FINER	SPEC.* PERCENT	PASS? (X=NO)
#4	100.0		
#10	100.0		
#30	99.6		
#40	99.5		
#50	99.2		
#100	97.7		
#200	88.2		
0.0393 mm.	79.5		
0.0288 mm.	72.5		
0.0191 mm.	62.2		
0.0115 mm.	52.8		
0.0083 mm.	47.2		
0.0060 mm.	39.7		
0.0043 mm.	34.1		
0.0031 mm.	28.4		
0.0023 mm.	21.9		
0.0014 mm.	15.3		

* (no specification provided)

Soil Description

Gray Silty CLAY

Atterberg Limits

PL= 19 LL= 24 PI= 5

Coefficients

D_{85}= 0.0570 D_{60}= 0.0172 D_{50}= 0.0096
D_{30}= 0.0034 D_{15}= D_{10}=
C_u= C_c=

Classification

USCS= CL-ML AASHTO=

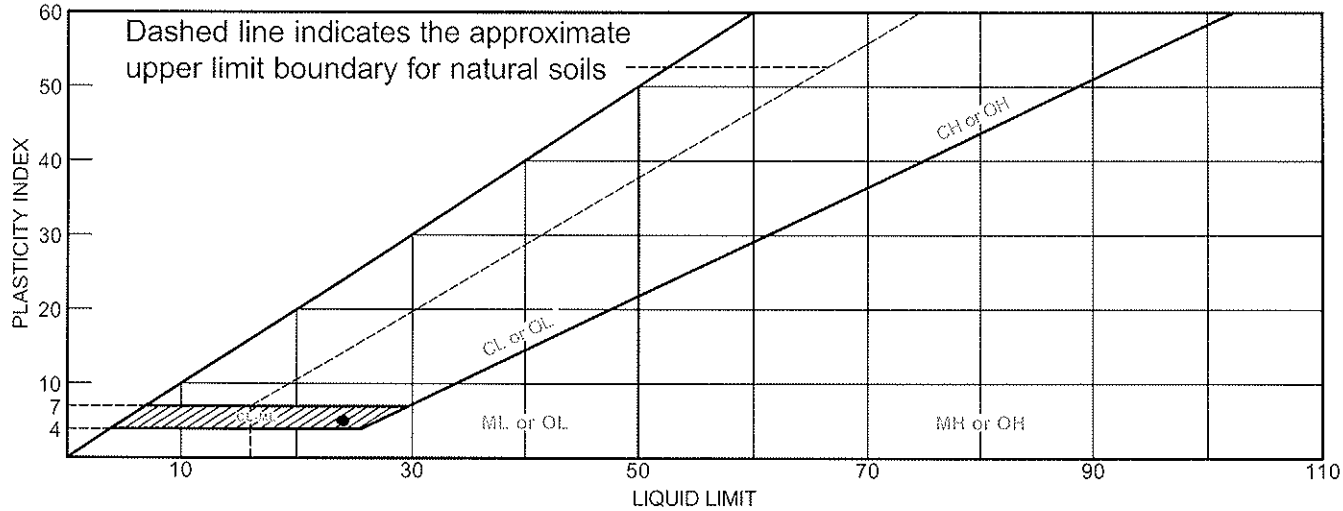
Remarks

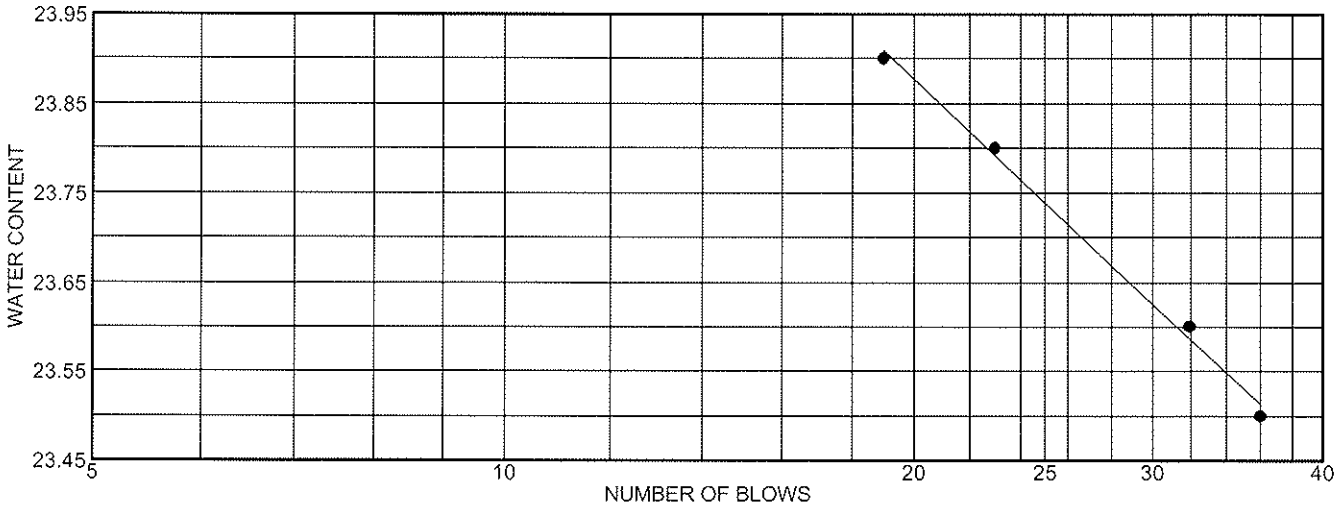
Sample No.: **Source of Sample:** (In House 3/5/08) **Date:**
Location: **Elev./Depth:**

COOPER TESTING LABORATORY

Client: Golder & Associates
Project: Hanson - 0637109-100-103
Project No: 287-035 **Figure**

LIQUID AND PLASTIC LIMITS TEST REPORT





	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Gray Silty CLAY	24	19	5	99.5	88.2	CL-ML

Project No. 287-035 **Client:** Golder & Associates

Project: Hanson - 0637109-100-103

● **Source:** (In House 3/5/08)

Remarks:

●

LIQUID AND PLASTIC LIMITS TEST REPORT

COOPER TESTING LABORATORY

Figure

Moisture-Density-Porosity Report
Cooper Testing Labs, Inc.

Job No:	287-035	**Date:**	03/07/08
Client:	Golder Associates	**By:**	RU
Project:	Hanson - 0637109-100-103	**Remarks:**	

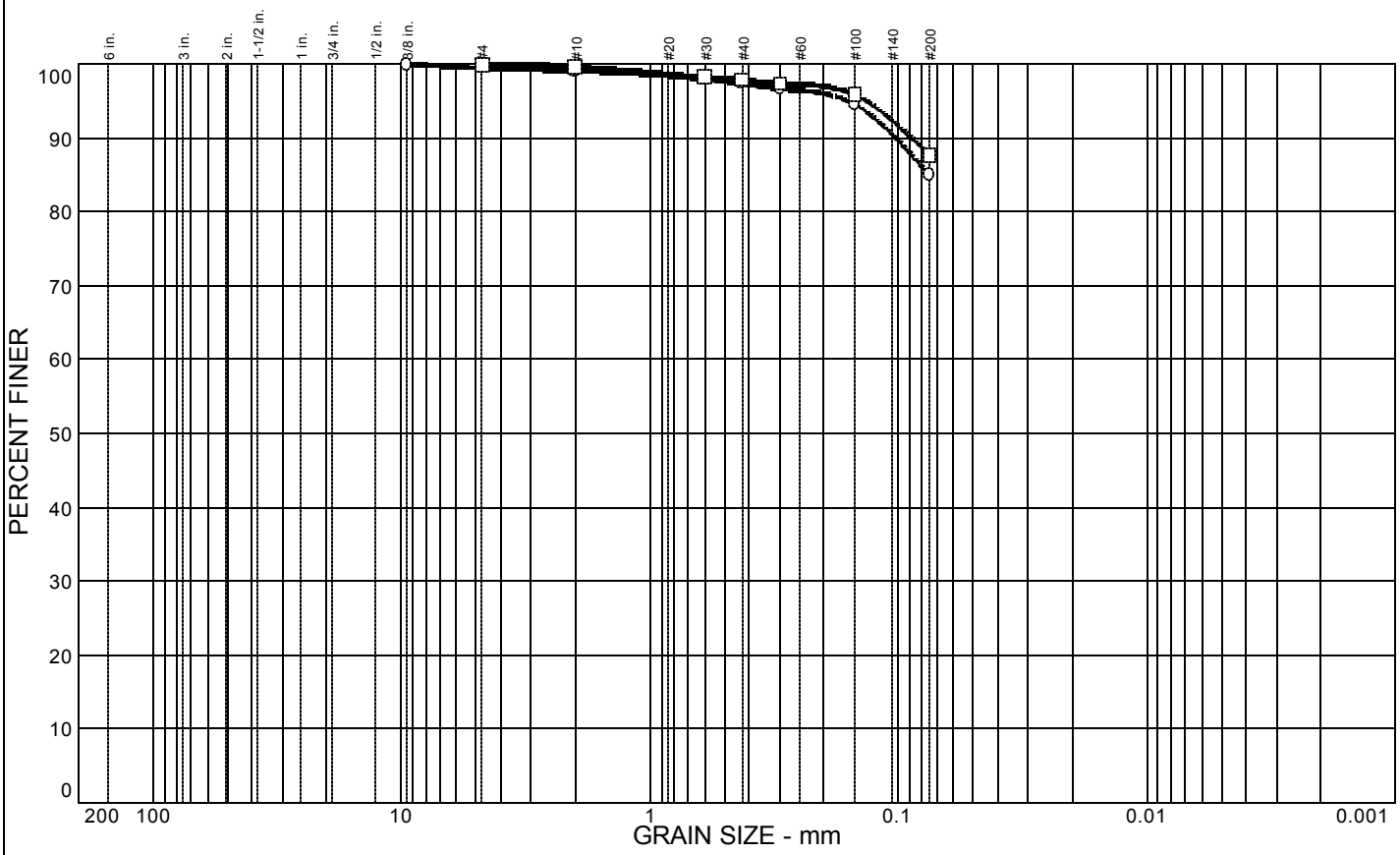
Boring: **Sample:** **Depth, ft:**	(In House 3/5/08)						
Visual Description:	Gray Silty CLAY						
Actual G_s							
Assumed G_s	2.70						
Total Vol cc	250.3						
Vol Solids,cc	99.7						
Vol Voids,cc	150.6						
Moisture, %	53.8						
Wet Unit wt, pcf	103.3						
Dry Unit wt, pcf	67.2						
Saturation, %	96.2						
Porosity, %	60.2						
Air filled Poros.,%	2.3						
Water filled Poros.,%	57.9						
Void Ratio	1.51						
Series	1	2	3	4	5	6	7

Note: If an assumed specific gravity (Gs) was used then the saturation, porosities, and void ratio should be considered approximate.

The Zero Air-Voids curves represent the dry density at 100% saturation for each value of specific gravity

COOPER TESTING LABORATORY

Particle Size Distribution Report



	% COBBLES	% GRAVEL	% SAND	% SILT	% CLAY	USCS	AASHTO	PL	LL
○		0.5	14.4	85.1		CL		18	30
□			12.3	87.7		CL		18	32

SIEVE inches size	PERCENT FINER ○	PERCENT FINER □	
3/8	100.0		
GRAIN SIZE			
D_{60}			
D_{30}			
D_{10}			
COEFFICIENTS			
C_c			
C_u			

SIEVE number size	PERCENT FINER ○	PERCENT FINER □	
#4	99.5	100.0	
#10	99.1	99.7	
#30	98.0	98.3	
#40	97.4	97.9	
#50	96.7	97.4	
#100	94.6	95.9	
#200	85.1	87.7	

SOIL DESCRIPTION

○ Gray Lean CLAY

□ Gray Lean CLAY

REMARKS:

○

□

○ Source: FW-1 1/3

□ Source: FW-2 1/3

COOPER TESTING LABORATORY

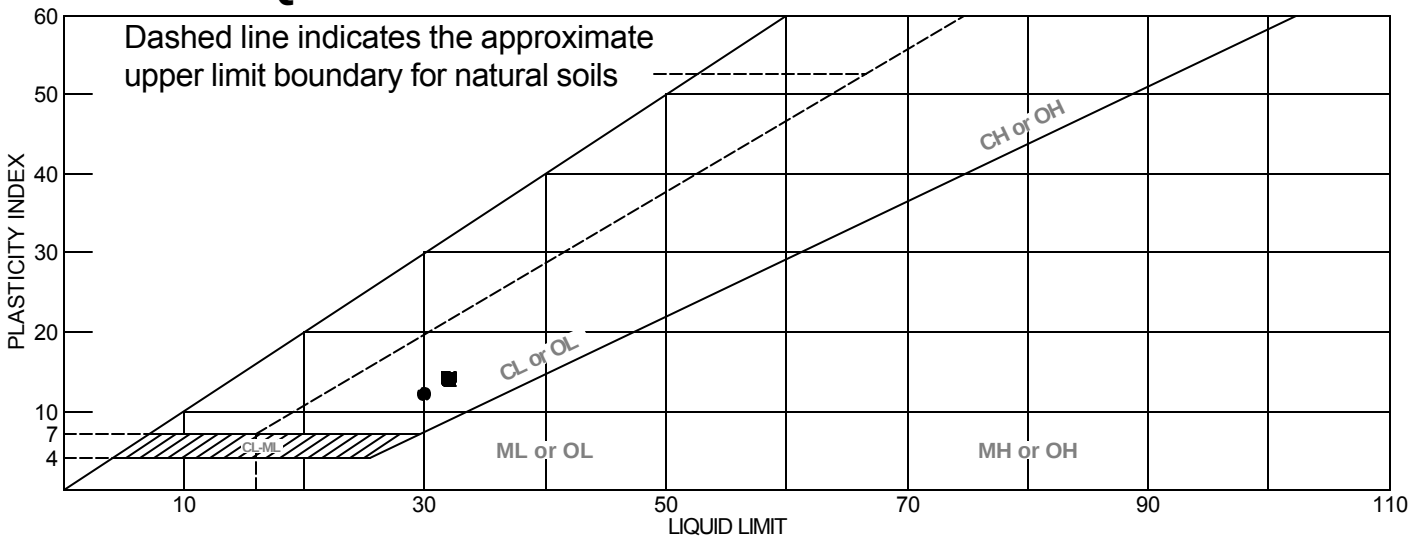
Client: Golder Associates

Project: Hanson Dump Review - 063.730

Project No.: 287-037

Figure

LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Gray Lean CLAY	30	18	12	97.4	85.1	CL
■	Gray Lean CLAY	32	18	14	97.9	87.7	CL

Project No. 287-037 **Client:** Golder Associates

Project: Hanson Dump Review - 063.730

● **Source:** FW-1 1/3

■ **Source:** FW-2 1/3

Remarks:

●

■

LIQUID AND PLASTIC LIMITS TEST REPORT

COOPER TESTING LABORATORY

Figure

Moisture-Density-Porosity Report
Cooper Testing Labs, Inc.

Job No:	287-037	**Date:**	06/24/08
Client:	Golder Associates	**By:**	RU
Project:	Hanson Dump Review - 063.730	**Remarks:**	FW-2;2/3 - sample disturbed; m/c only.

Boring:	FW-1	FW-2	FW-2					
Sample:	1/3	1/3	2/3					
Depth, ft:	0	0	0					
Visual Description:	Gray Lean CLAY	Gray Lean CLAY	Gray Lean CLAY					
Actual G_s								
Assumed G_s	2.70	2.70	2.70					
Total Vol cc	147.1	150.9	374.1					
Vol Solids,cc	72.0	62.1	180.7					
Vol Voids,cc	75.1	88.7	193.3					
Moisture, %	38.5	50.7	30.6					
Wet Unit wt, pcf	114.4	104.7	106.4					
Dry Unit wt, pcf	82.6	69.5	81.5					
Saturation, %	99.7	95.8	77.2					
Porosity, %	51.0	58.8	51.7					
Air filled Poros.,%	0.1	2.5	11.8					
Water filled Poros.,%	50.9	56.4	39.9					
Void Ratio	1.04	1.43	1.07					
Series	1	2	3	4	5	6	7	8

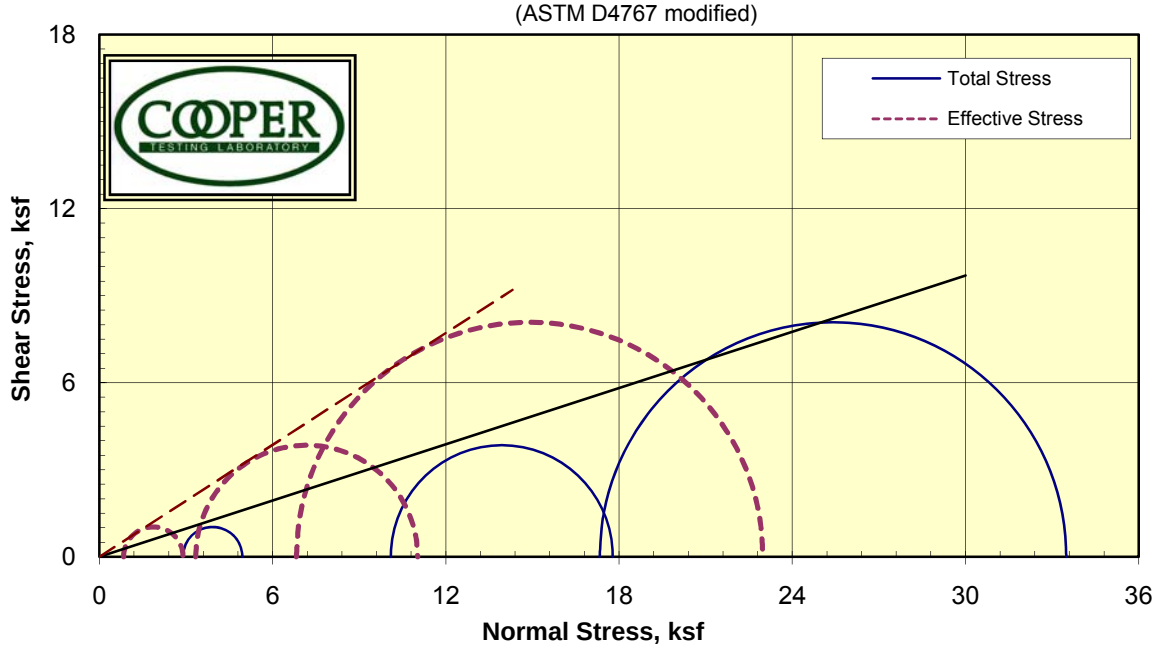
Note: If an assumed specific gravity (Gs) was used then the saturation, porosities, and void ratio should be considered approximate.

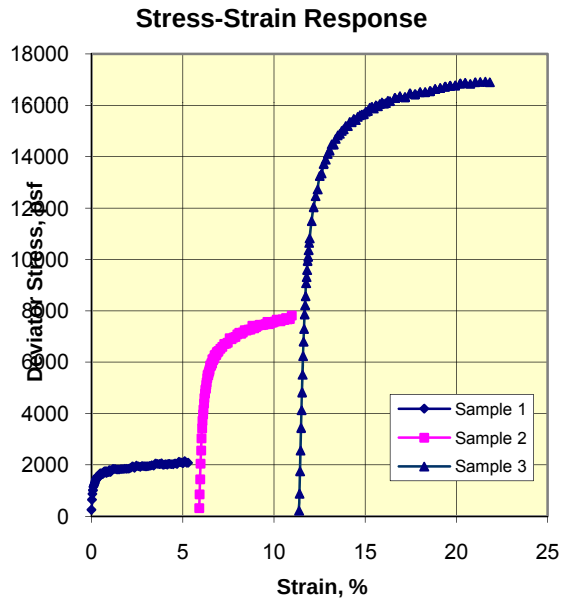
The Zero Air-Voids curves represent the dry density at 100% saturation for each value of specific gravity

COOPER TESTING LABORATORY

Triaxial Consolidated Undrained

(ASTM D4767 modified)





Stage	1	2	3
MC, %	36.8		
Dry Dens., pcf.	82.5		
Sat. %	95.4		
Void Ratio	1.042		
Diameter in	2.41		
Height, in	5.00		
	Final		
MC, %	21.9	18.6	17.3
Dry Dens., pcf.	91.5	96.1	98.1
Sat. %	100.0	100.0	100.0
Void Ratio	0.590	0.502	0.467
Diameter, in	2.35	2.30	2.33
Height, in	4.73	4.72	4.49
Cell, psi	70.0	120.0	170.0
BP, psi	49.9	49.9	49.7
	Effective Stresses At:		
Strain, %	5.0	5.0	5.0
Deviator ksf	2.058	7.691	16.165
Excess PP	2.052	6.758	10.504
Sigma 1	2.899	11.026	22.989
Sigma 3	0.842	3.335	6.823
P, ksf	1.870	7.180	14.906
Q, ksf	1.029	3.845	8.083
Stress Ratio	3.445	3.306	3.369
Rate in/min	0.001	0.001	0.001

Total C	0	Effective C	0.0
Total Phi	17.9	Effective Phi	32.7

Job No.: 287-037 **Date:** 6/18/2008

Client: Golder Associates BY:DC

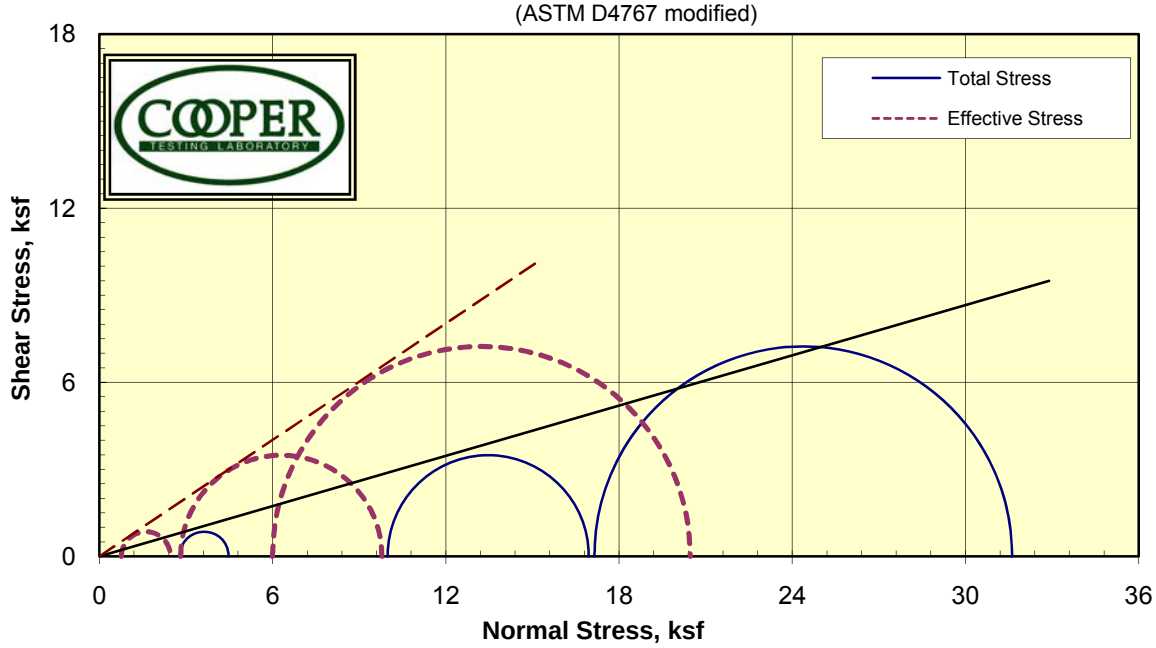
Project: Hanson Dump Review - 063.730

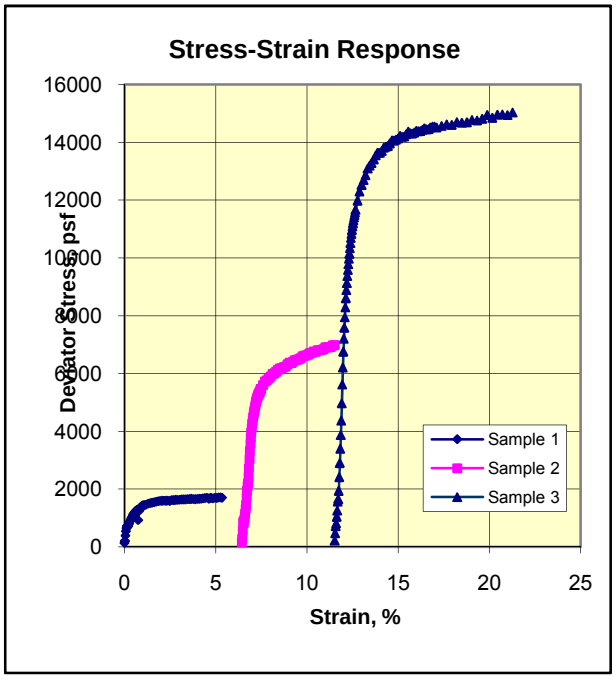
Sample: FW-1;2/3 Gray Lean CLAY

Remarks: ** Staged Test ** Strengths at 5% strain.

Triaxial Consolidated Undrained

(ASTM D4767 modified)





Stage	1	2	3
MC, %	52.5		
Dry Dens., pcf.	68.7		
Sat. %	97.4		
Void Ratio	1.454		
Diameter in	2.41		
Height, in	5.00		
	Final		
MC, %	22.8	19.2	17.7
Dry Dens., pcf.	77.7	81.3	82.9
Sat. %	100.0	100.0	100.0
Void Ratio	0.615	0.519	0.478
Diameter, in	2.34	2.28	2.32
Height, in	4.68	4.70	4.48
Cell, psi	70.0	120.0	170.0
BP, psi	50.7	50.7	51.0
	Effective Stresses At:		
Strain, %	5.0	5.0	5.0
Deviator ksf	1.701	6.973	14.476
Excess PP	2.015	7.164	11.145
Sigma 1	2.466	9.787	20.470
Sigma 3	0.764	2.814	5.993
P, ksf	1.615	6.301	13.231
Q, ksf	0.851	3.486	7.238
Stress Ratio	3.226	3.478	3.415
Rate in/min	0.001	0.001	0.001

Total C	0	Effective C	0.0
Total Phi	16.1	Effective Phi	33.8

Job No.: 287-037 **Date:** 6/24/2008

Client: Golder Associates BY:DC

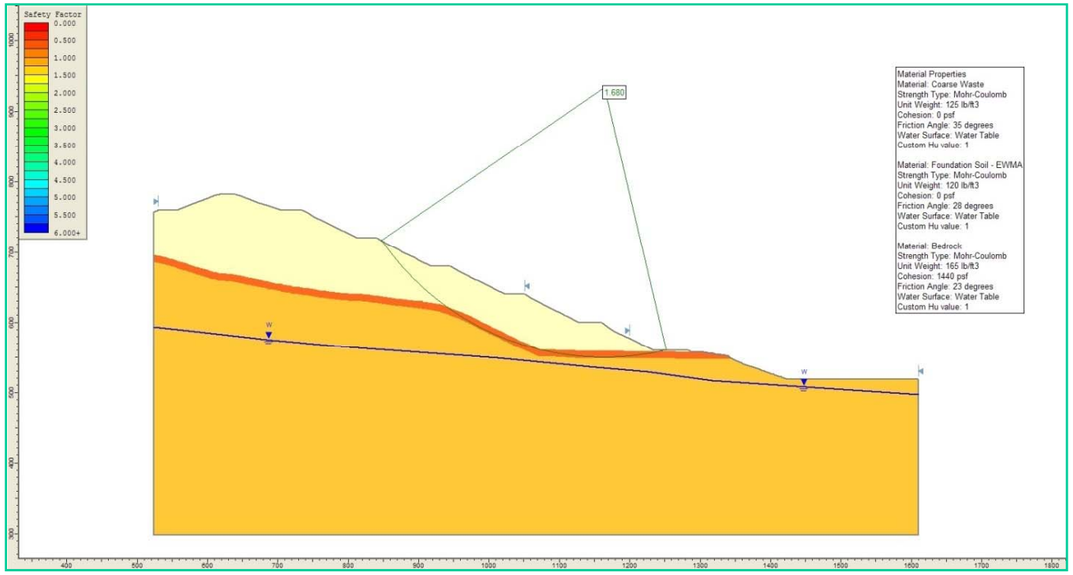
Project: Hanson Dump Review - 063.730

Sample: FW-2;3/3 Gray Lean CLAY

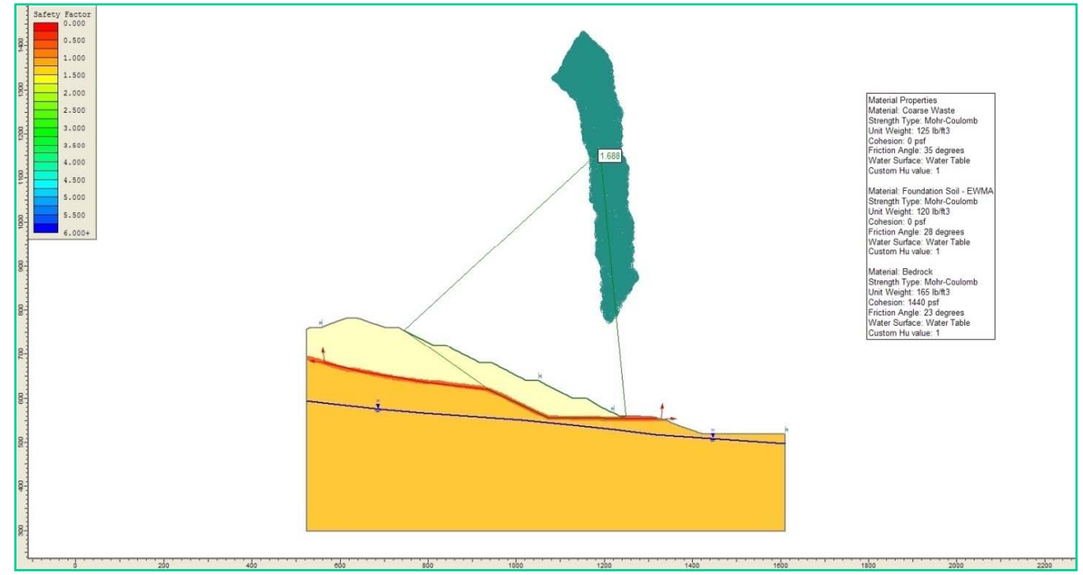
Remarks: ** Staged Test ** Strengths at 5% strain.

APPENDIX C

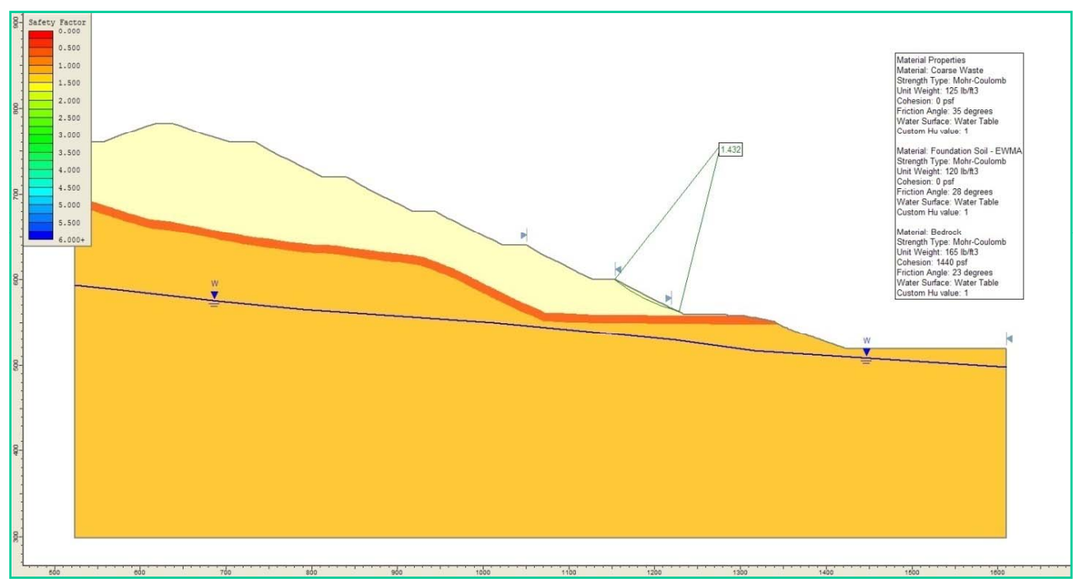
SLOPE STABILITY EVALUATION OF PROPOSED RECLAMATION PLAN – EAST MATERIALS STORAGE AREA



SECTION E1 – STATIC
GLOBAL FAILURE - CIRCULAR
(FOS = 1.68)



SECTION E1 –STATIC
GLOBAL FAILURE - BLOCK
(FOS = 1.69)



SECTION E1 –STATIC
SINGLE-LIFT FAILURE
(FOS = 1.43)

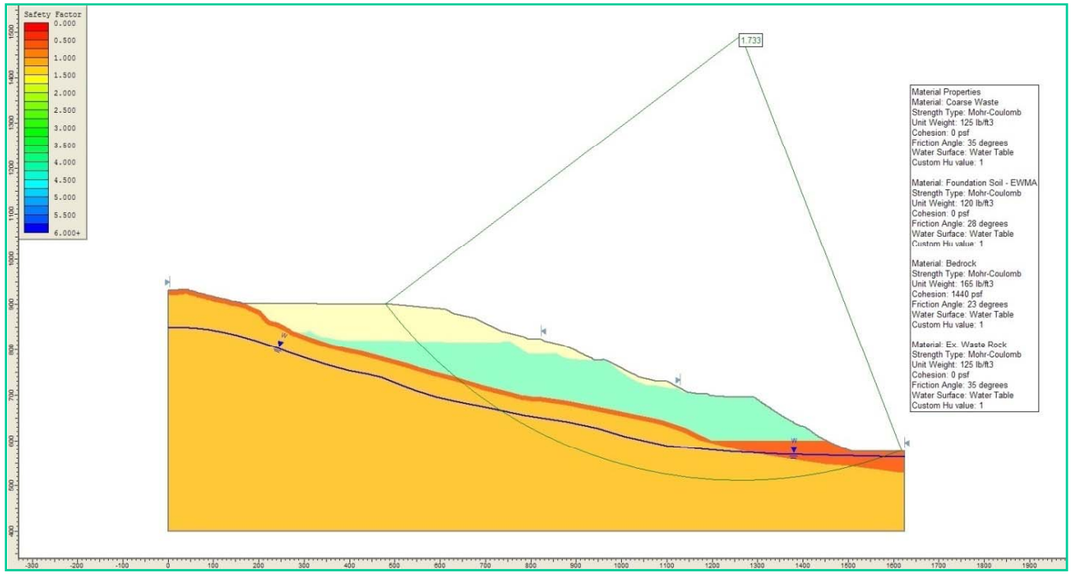
Golder Associates

Job no. 063-7109.100

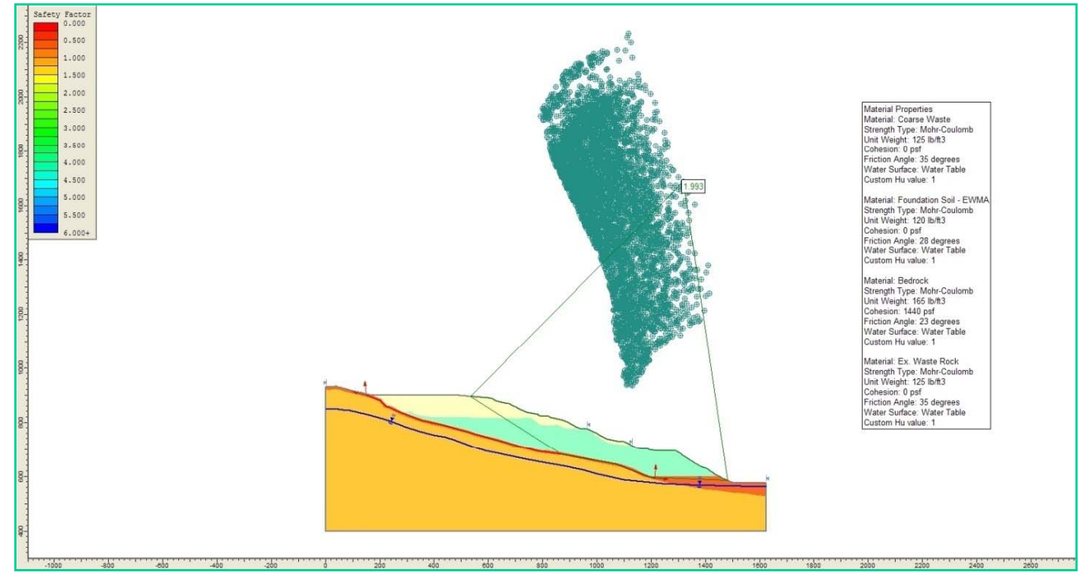
APPENDIX C1

EMSA STABILITY REVIEW
PERMANENTE QUARRY, CALIFORNIA

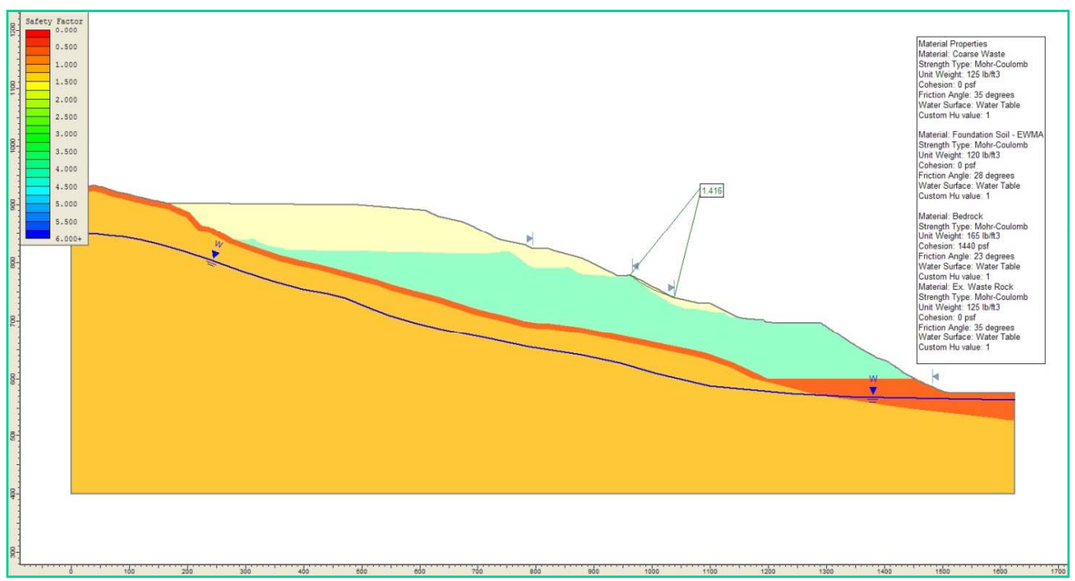
STATIC ANALYSES OF PROPOSED
RECLAMATION SLOPE – SECTION EI



SECTION E3 – STATIC
GLOBAL FAILURE - CIRCULAR
(FOS = 1.73)



SECTION E3 –STATIC
GLOBAL FAILURE - BLOCK
(FOS = 1.99)



SECTION E3 –STATIC
SINGLE-LIFT FAILURE
(FOS = 1.42)

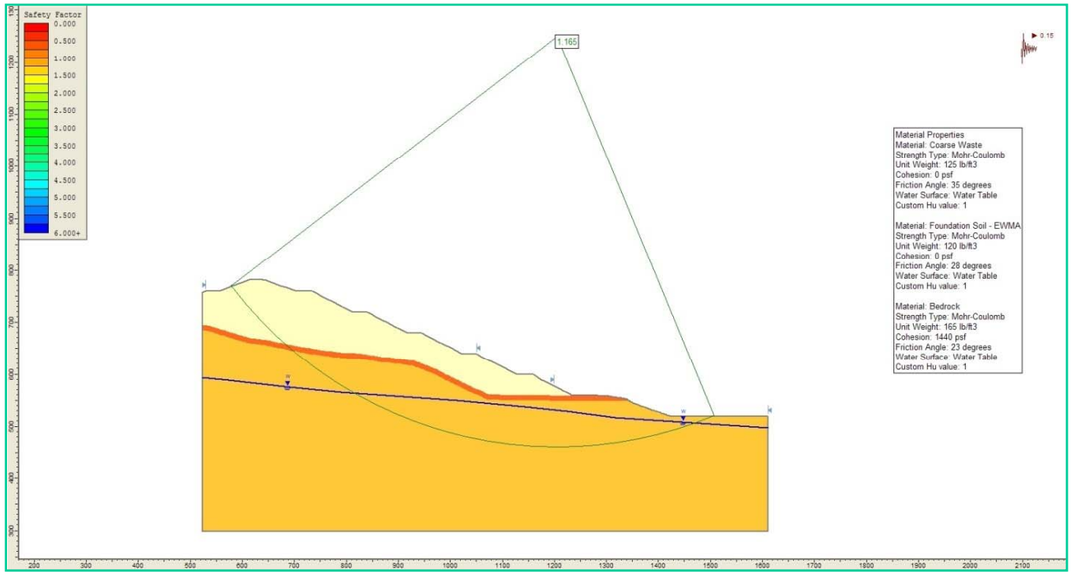
Golder Associates

Job no. 063-7109.100

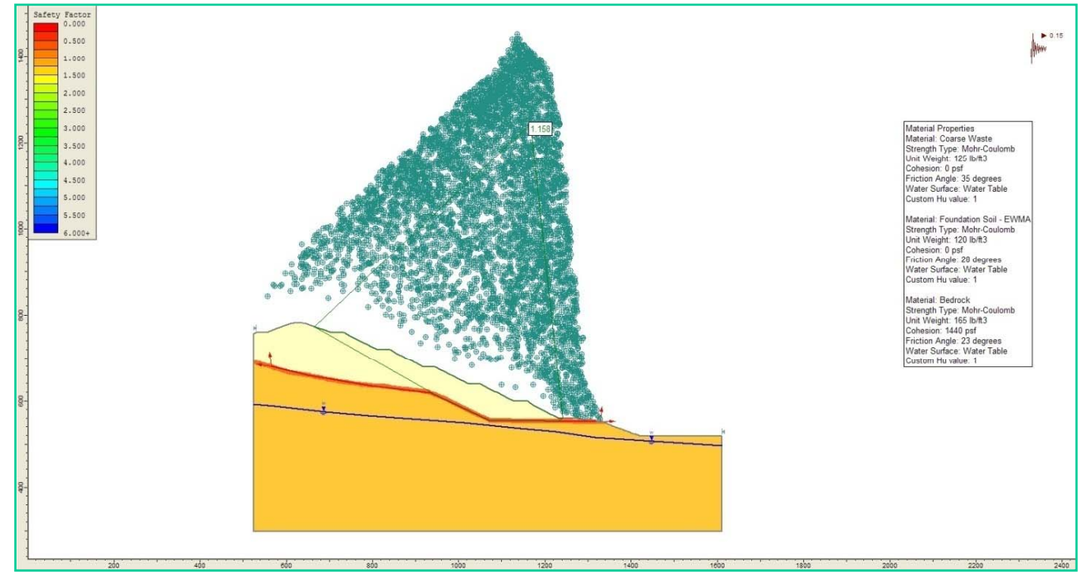
APPENDIX C2

EMSA STABILITY REVIEW
PERMANENTE QUARRY, CALIFORNIA

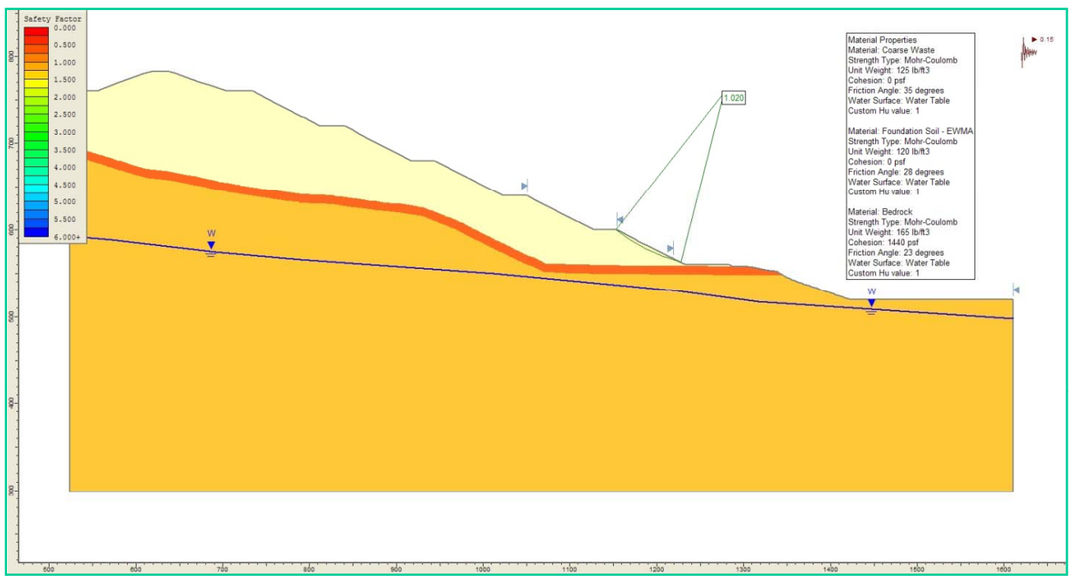
STATIC ANALYSES OF PROPOSED
RECLAMATION SLOPE – SECTION E3



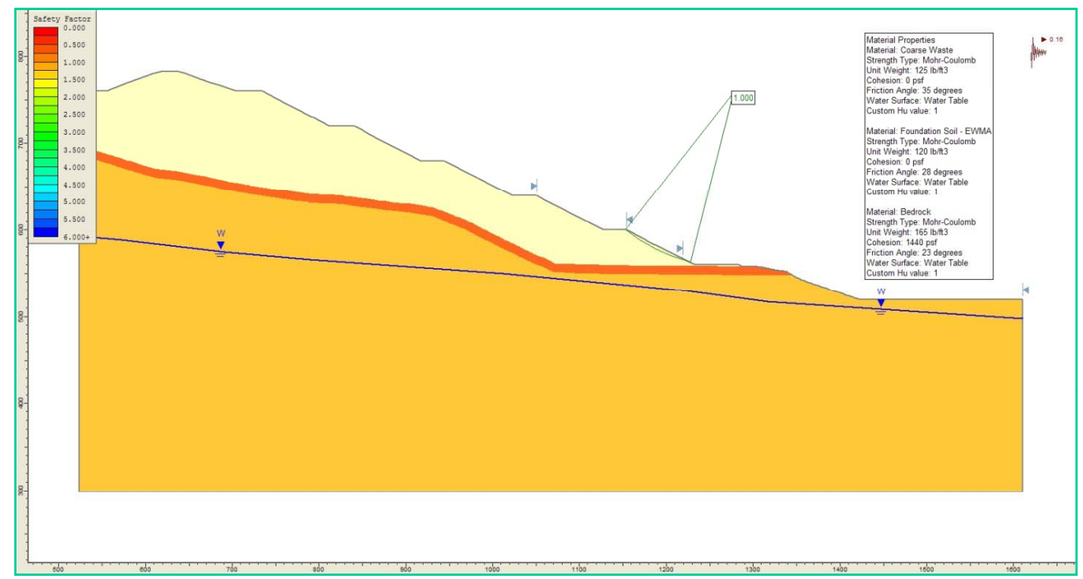
SECTION E3 – PSEUDO-STATIC
GLOBAL FAILURE - CIRCULAR
(FOS = 1.17)



SECTION E3 – PSEUDO-STATIC
GLOBAL FAILURE - BLOCK
(FOS = 1.16)



SECTION E3 – PSEUDO-STATIC
SINGLE-LIFT FAILURE
(FOS = 1.02)



SECTION E3 – YIELD ACCELARATION
SINGLE-LIFT FAILURE
(ky = 0.16g)

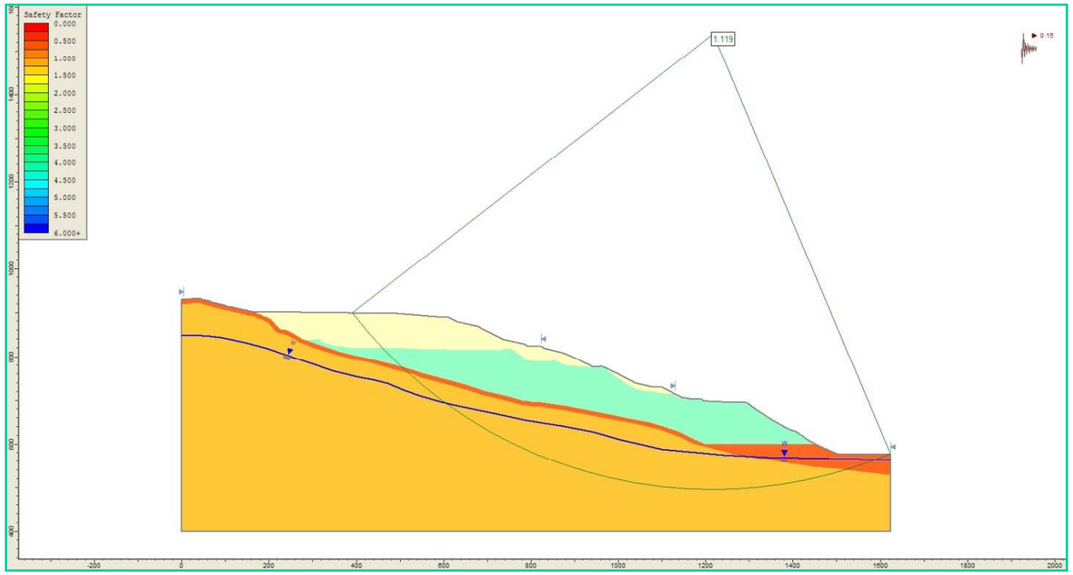
Golder Associates

Job no. 063-7109.100

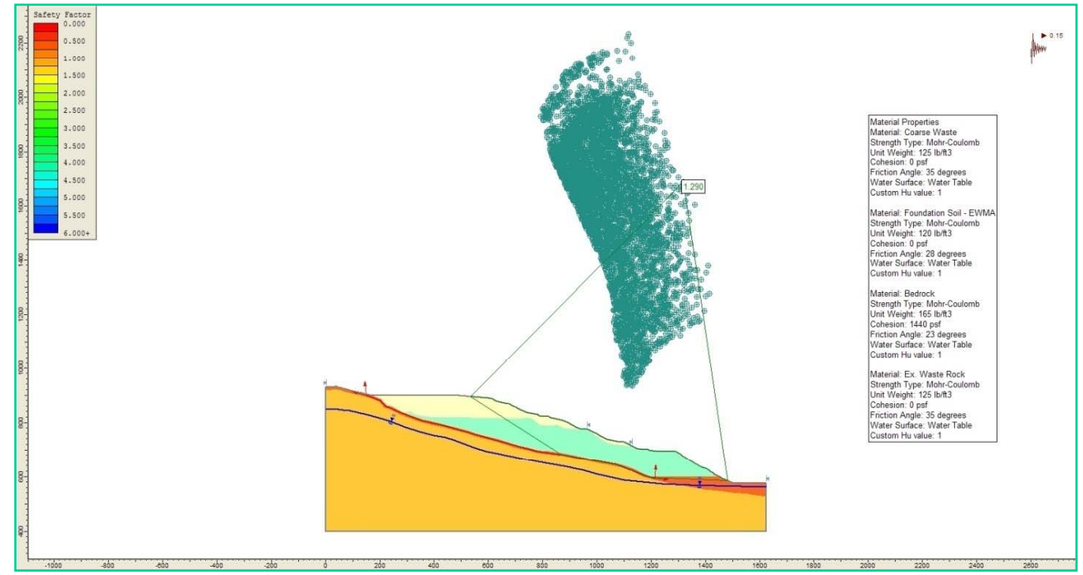
APPENDIX C3

EMSA STABILITY REVIEW
PERMANENTE QUARRY, CALIFORNIA

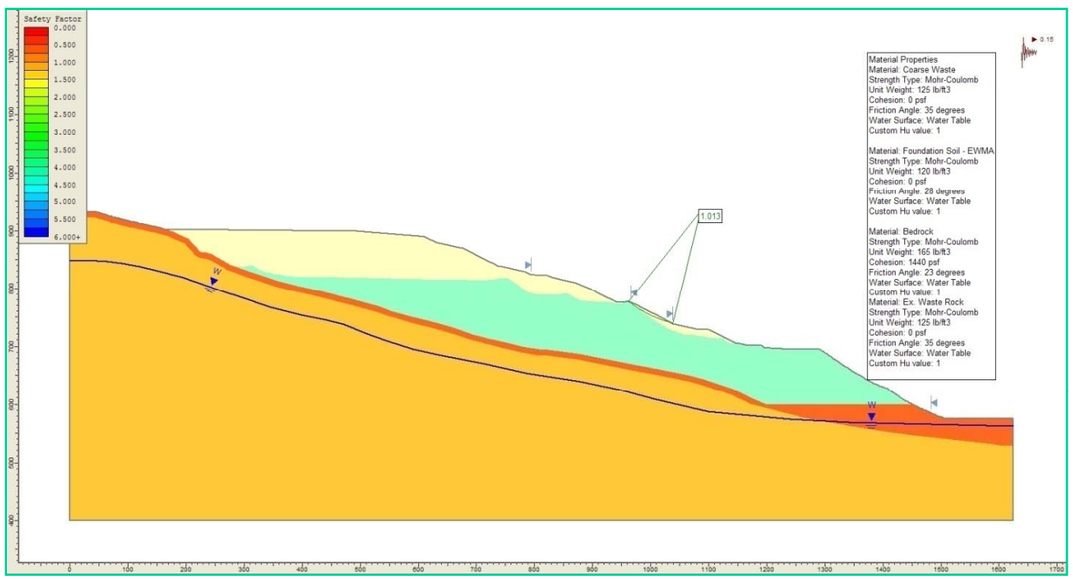
SEISMIC STABILITY OF PROPOSED
RECLAMATION SLOPE – SECTION EI



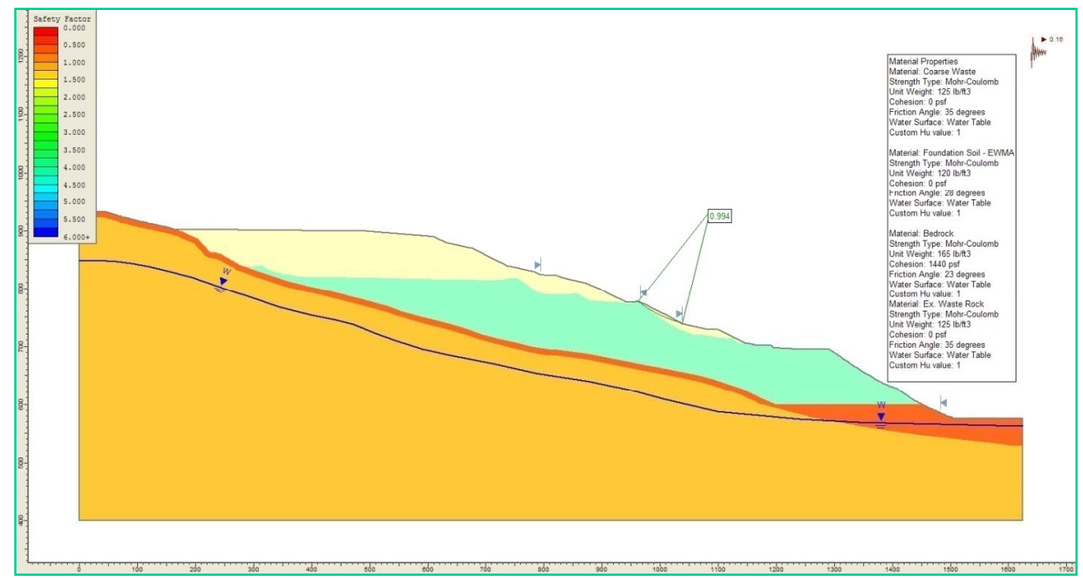
SECTION E3 – PSEUDO-STATIC
GLOBAL FAILURE - CIRCULAR
(FOS = 1.12)



SECTION E3 – PSEUDO-STATIC
GLOBAL FAILURE - BLOCK
(FOS = 1.29)



SECTION E3 – PSEUDO-STATIC
SINGLE-LIFT FAILURE
(FOS = 1.01)



SECTION E3 – YIELD ACCELARATION
SINGLE-LIFT FAILURE
(ky = 0.16g)

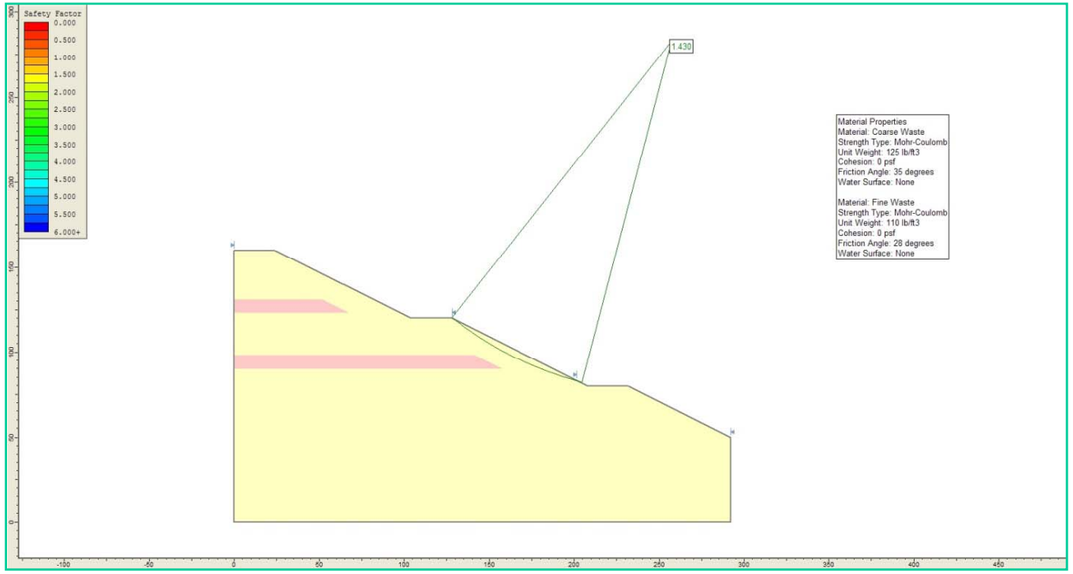
Golder Associates

Job no. 063-7109.100

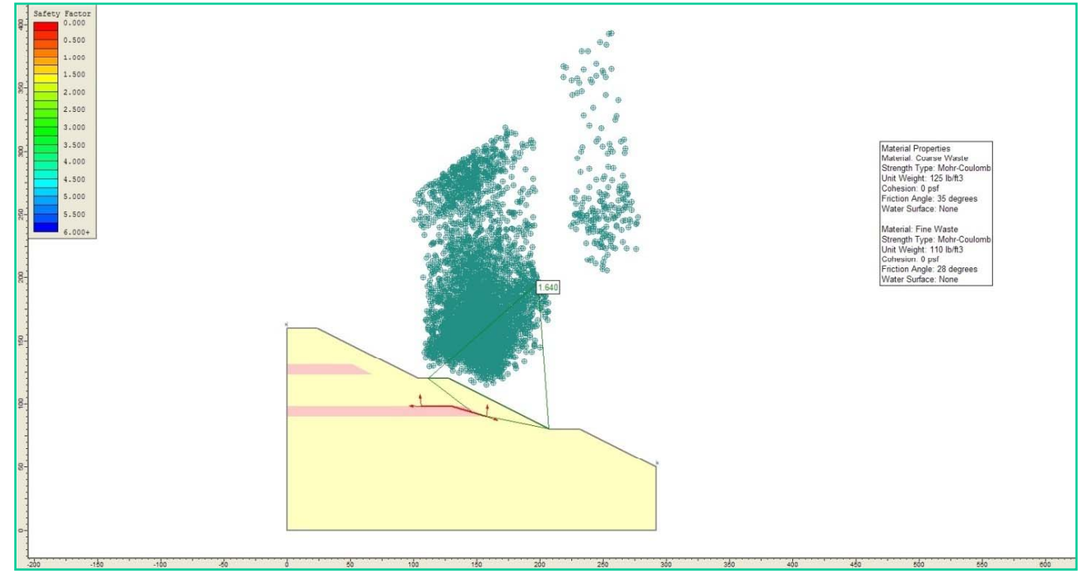
APPENDIX C4

EMSA STABILITY REVIEW
PERMANENTE QUARRY, CALIFORNIA

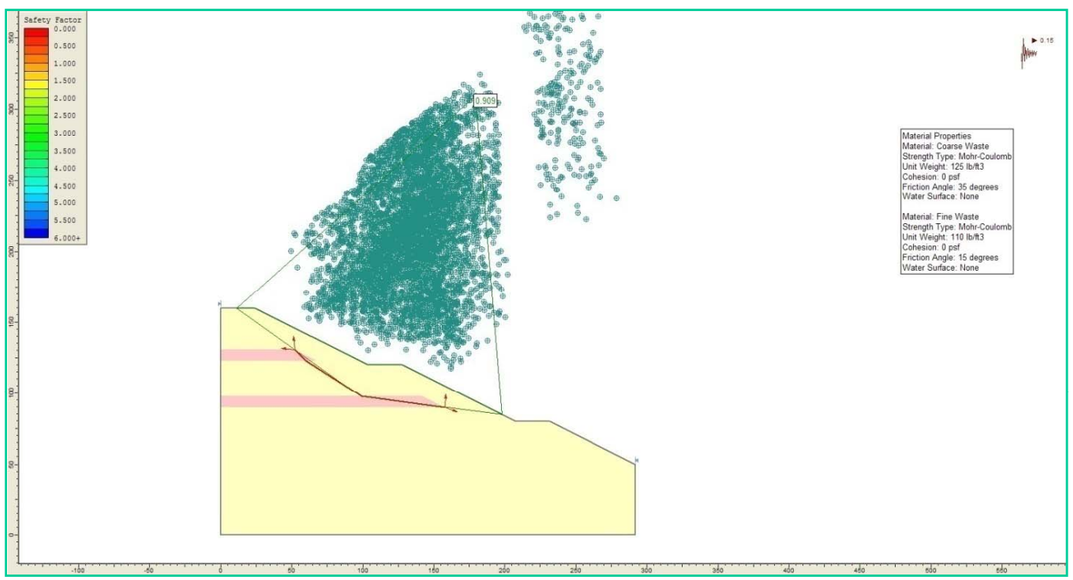
SEISMIC STABILITY OF PROPOSED
RECLAMATION SLOPE – SECTION E3



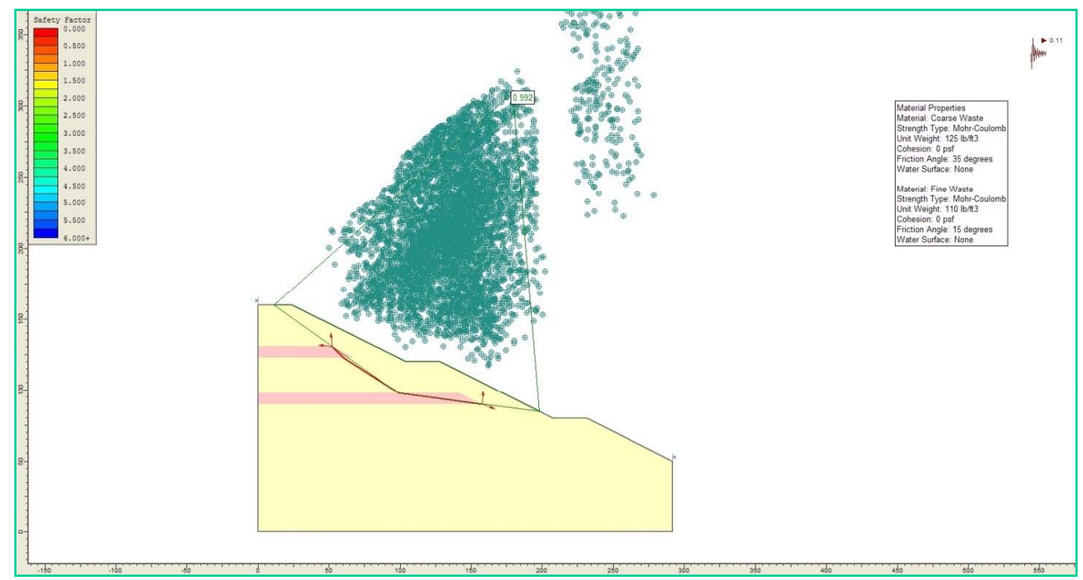
CONCEPTUALSECTION – STATIC
LOCAL FAILURE - CIRCULAR
(FOS = 1.43)



CONCEPTUALSECTION –STATIC
LOCAL BLOCK FAILURE THROUGH FINE WASTE
(FOS = 1.64)



CONCEPTUALSECTION – PSEUDO-STATIC
LOCAL BLOCK FAILURE THROUGH FINE WASTE
(FOS = 0.91)



CONCEPTUAL SECTION – YIELD ACCELARATION
LOCAL BLOCK FAILURE THROUGH FINE WASTE
(ky = 0.11g)

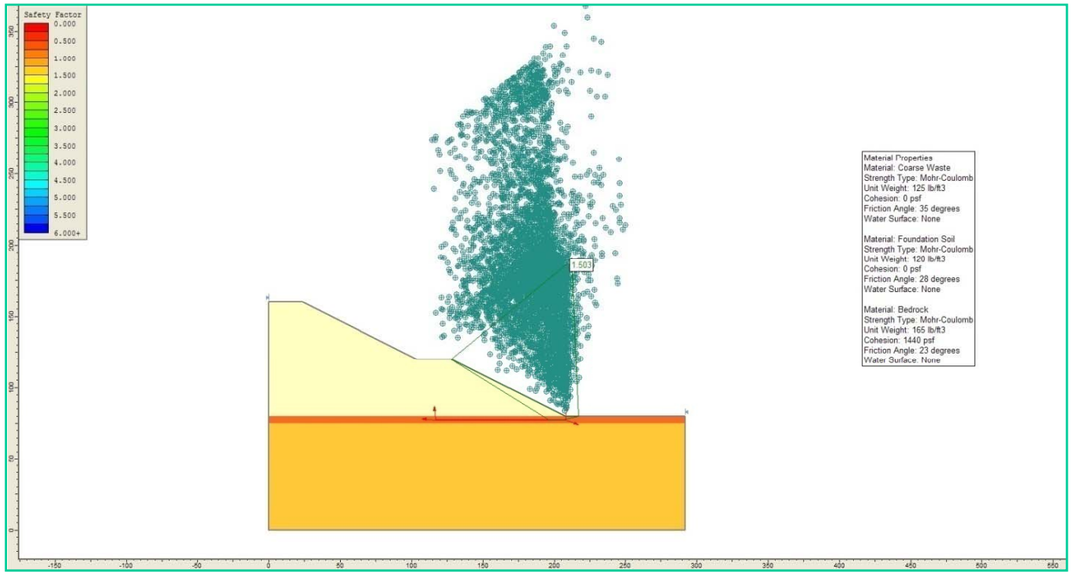
Golder Associates

Job no. 063-7109.100

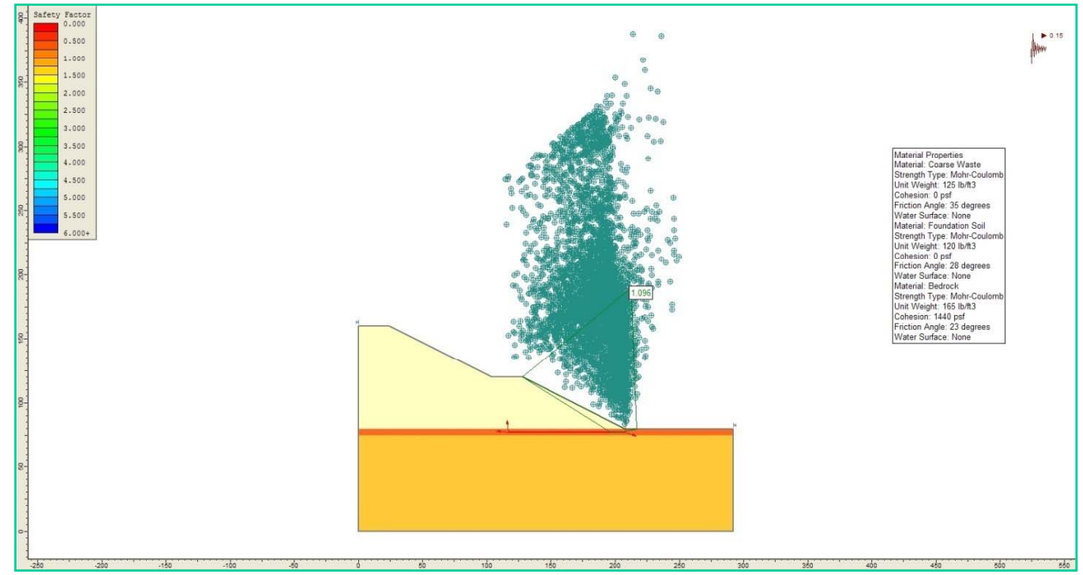
APPENDIX C5

EMSA STABILITY REVIEW
PERMANENTE QUARRY, CALIFORNIA

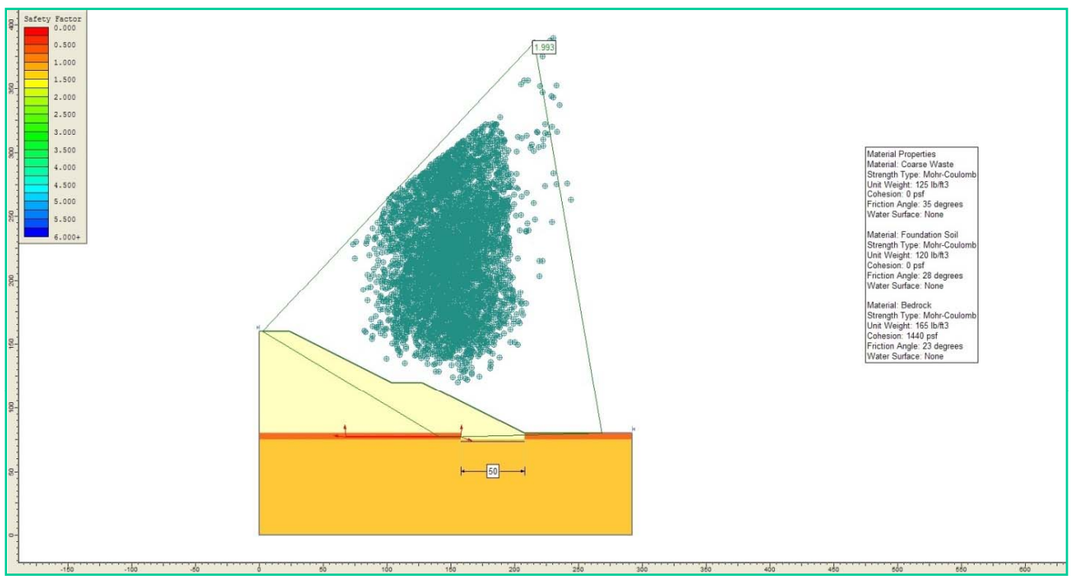
LOCAL STABILITY OF RECLAIMED SLOPES
WITH FINE WASTE



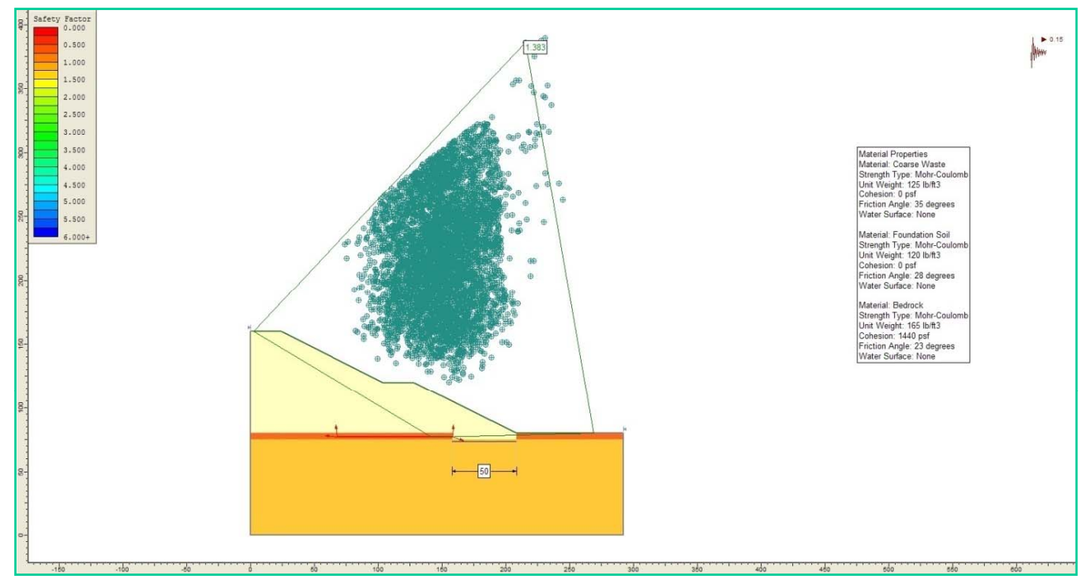
CONCEPTUAL MODEL OF UNPREPARED SUBGRADE – STATIC
LOCAL BLOCK FAILURE THROUGH FOUNDATION SOIL (FLAT)
(FOS = 1.50)



CONCEPTUAL MODEL OF UNPREPARED SUBGRADE – PSEUDO-STATIC
LOCAL BLOCK FAILURE THROUGH FOUNDATION SOIL (FLAT)
(FOS = 1.10)



CONCEPTUAL MODEL OF PREPARED SUBGRADE – STATIC
LOCAL BLOCK FAILURE THROUGH FOUNDATION SOIL (FLAT)
(FOS = 1.99)



CONCEPTUAL MODEL OF UNPREPARED SUBGRADE – PSEUDO-STATIC
LOCAL BLOCK FAILURE THROUGH FOUNDATION SOIL (FLAT)
(FOS = 1.38)

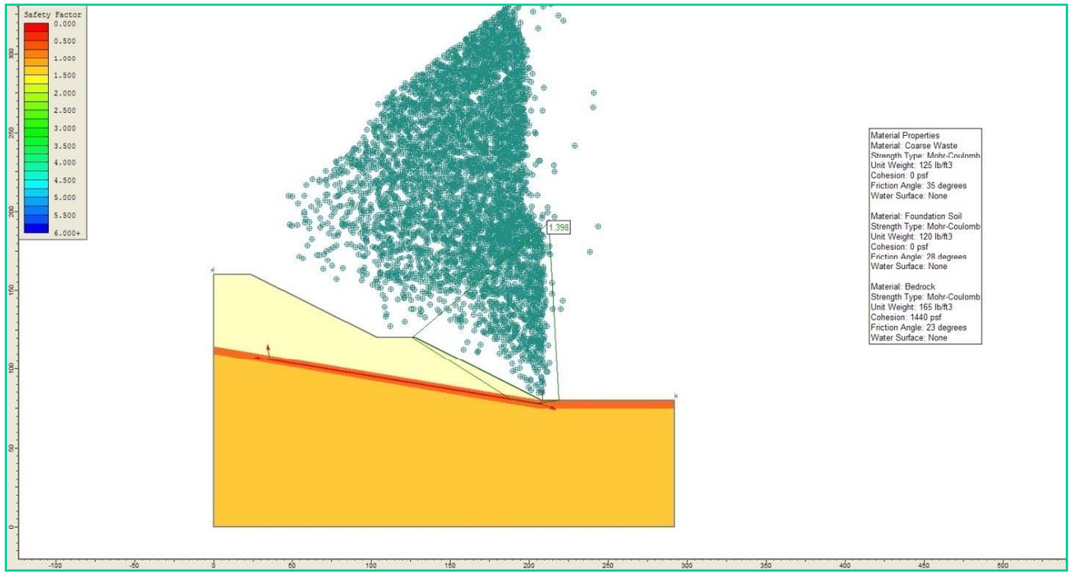
Golder Associates

Job no. 063-7109.100

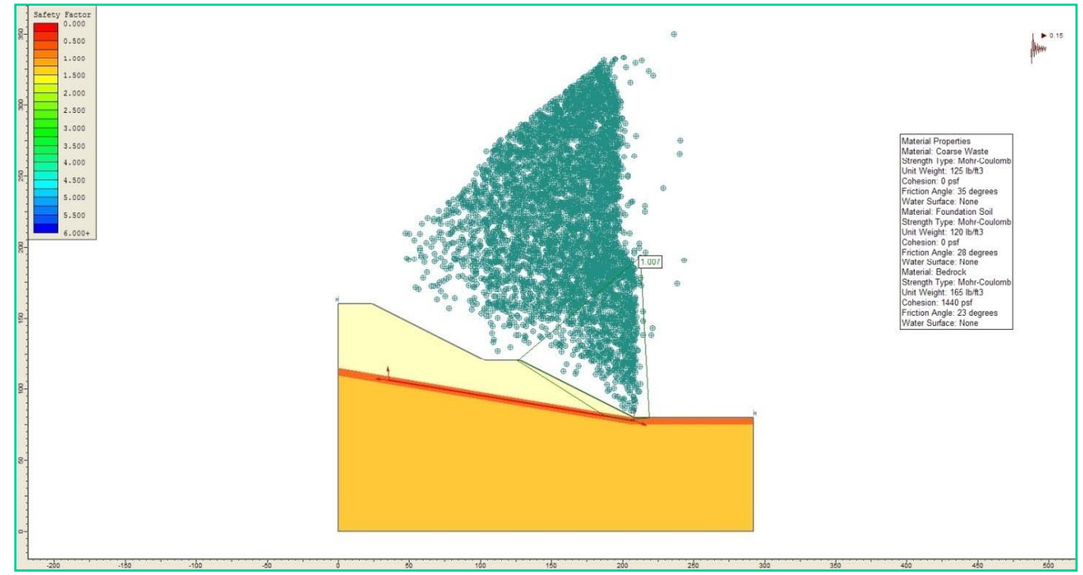
APPENDIX C6

EMSA STABILITY REVIEW
PERMANENTE QUARRY, CALIFORNIA

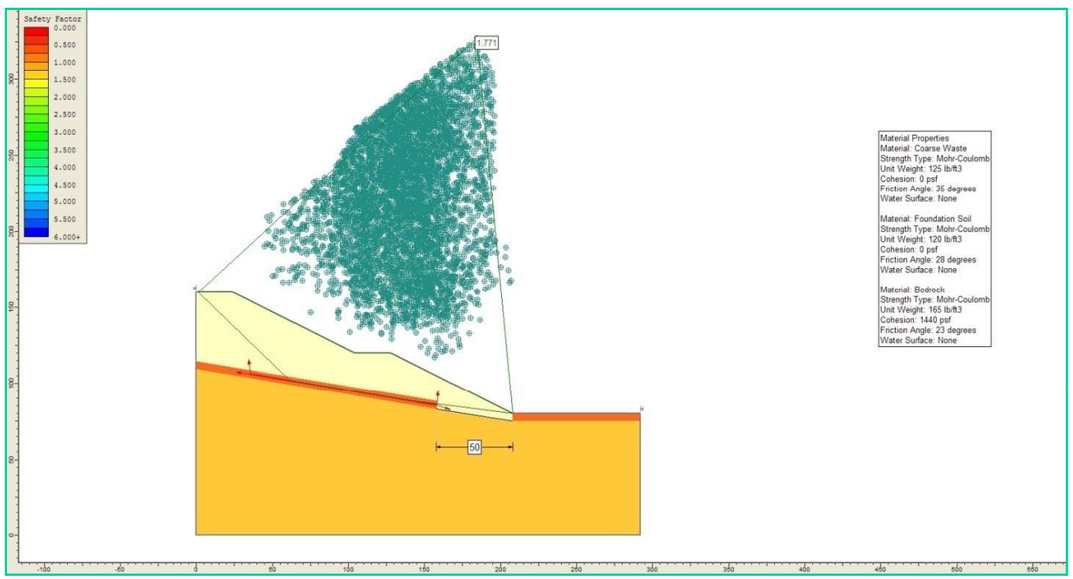
SENSITIVITY STUDY – VARIATION OF SUBGRADE (FLAT)



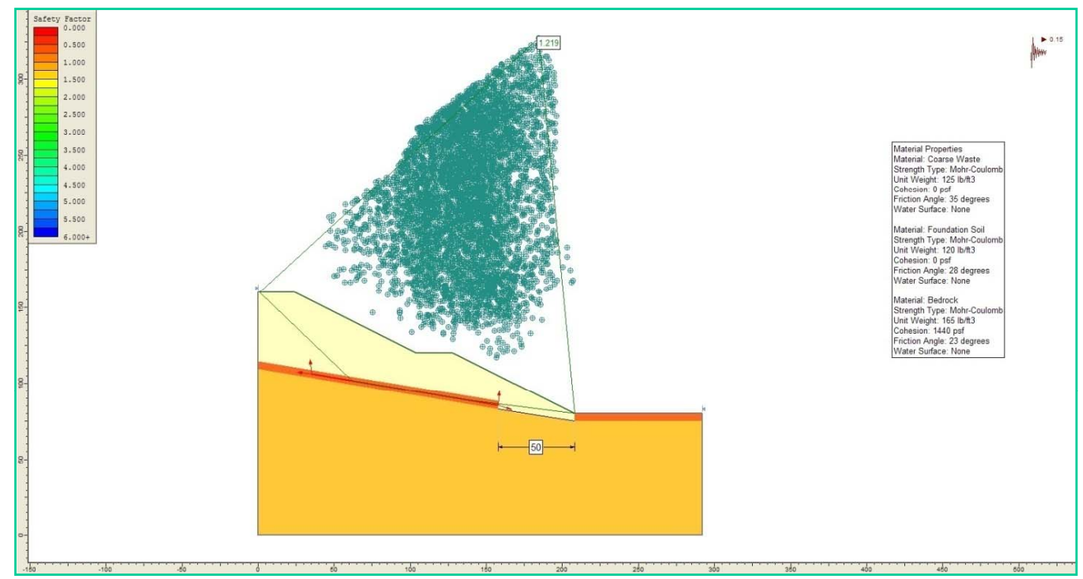
CONCEPTUAL MODEL OF UNPREPARED SUBGRADE – STATIC
LOCAL BLOCK FAILURE THROUGH FOUNDATION SOIL (6H:1V)
(FOS = 1.40)



CONCEPTUAL MODEL OF UNPREPARED SUBGRADE – PSEUDO-STATIC
LOCAL BLOCK FAILURE THROUGH FOUNDATION SOIL (6H:1V)
(FOS = 1.01)



CONCEPTUAL MODEL OF PREPARED SUBGRADE – STATIC
LOCAL BLOCK FAILURE THROUGH FOUNDATION SOIL (6H:1V)
(FOS = 1.77)



CONCEPTUAL MODEL OF UNPREPARED SUBGRADE – PSEUDO-STATIC
LOCAL BLOCK FAILURE THROUGH FOUNDATION SOIL (6H:1V)
(FOS = 1.22)

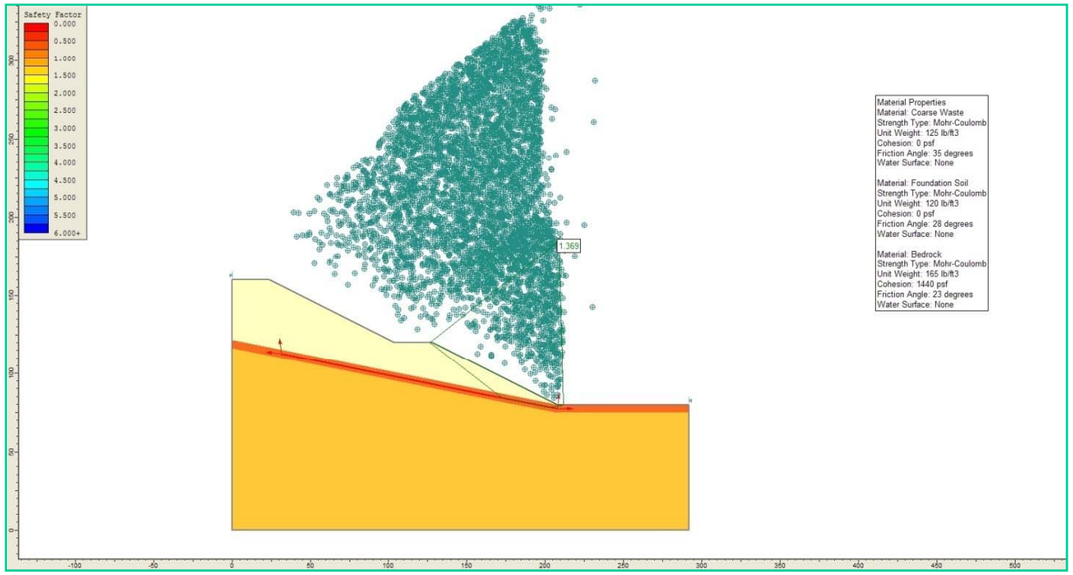
Golder Associates

Job no. 063-7109.100

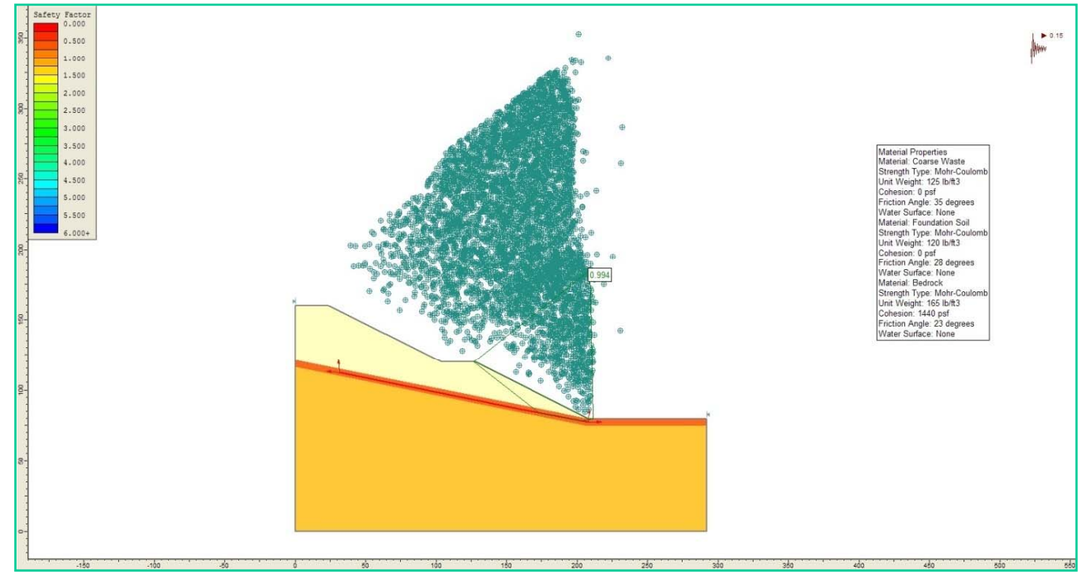
APPENDIX C7

EMSA STABILITY REVIEW
PERMANENTE QUARRY, CALIFORNIA

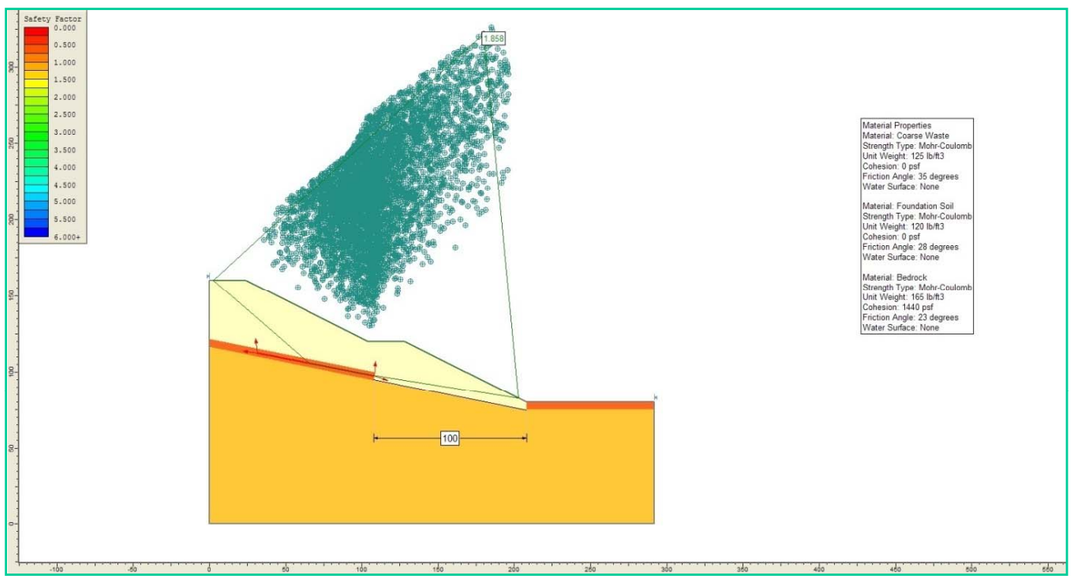
SENSITIVITY STUDY – VARIATION OF SUBGRADE (6H:1V)



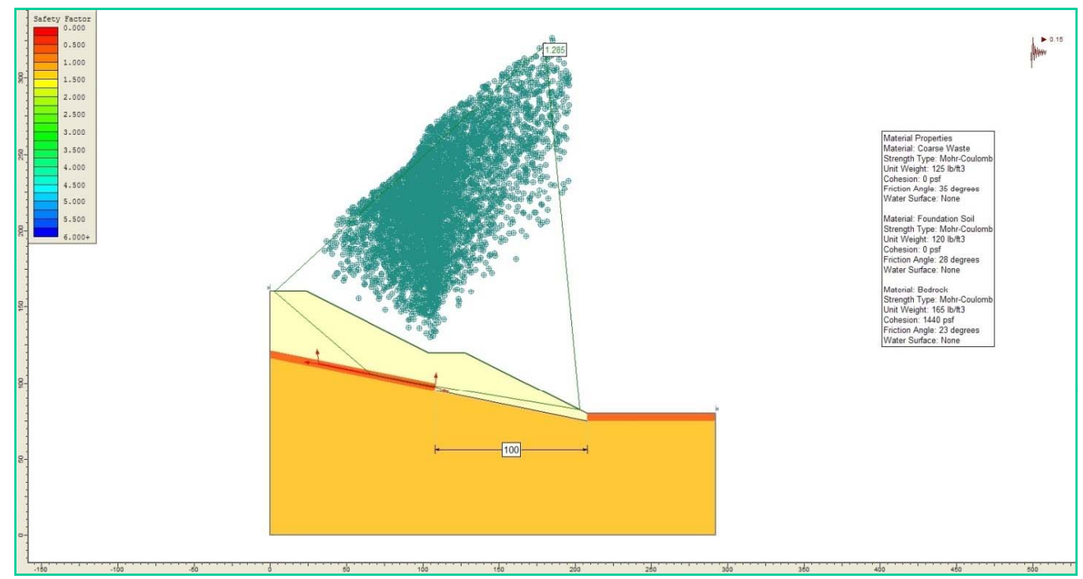
CONCEPTUAL MODEL OF UNPREPARED SUBGRADE – STATIC LOCAL BLOCK FAILURE THROUGH FOUNDATION SOIL (5H:1V) (FOS = 1.37)



CONCEPTUAL MODEL OF UNPREPARED SUBGRADE – PSEUDO-STATIC LOCAL BLOCK FAILURE THROUGH FOUNDATION SOIL (5H:1V) (FOS = 0.99)



CONCEPTUAL MODEL OF PREPARED SUBGRADE – STATIC LOCAL BLOCK FAILURE THROUGH FOUNDATION SOIL (5H:1V) (FOS = 1.86)



CONCEPTUAL MODEL OF UNPREPARED SUBGRADE – PSEUDO-STATIC LOCAL BLOCK FAILURE THROUGH FOUNDATION SOIL (5H:1V) (FOS = 1.29)

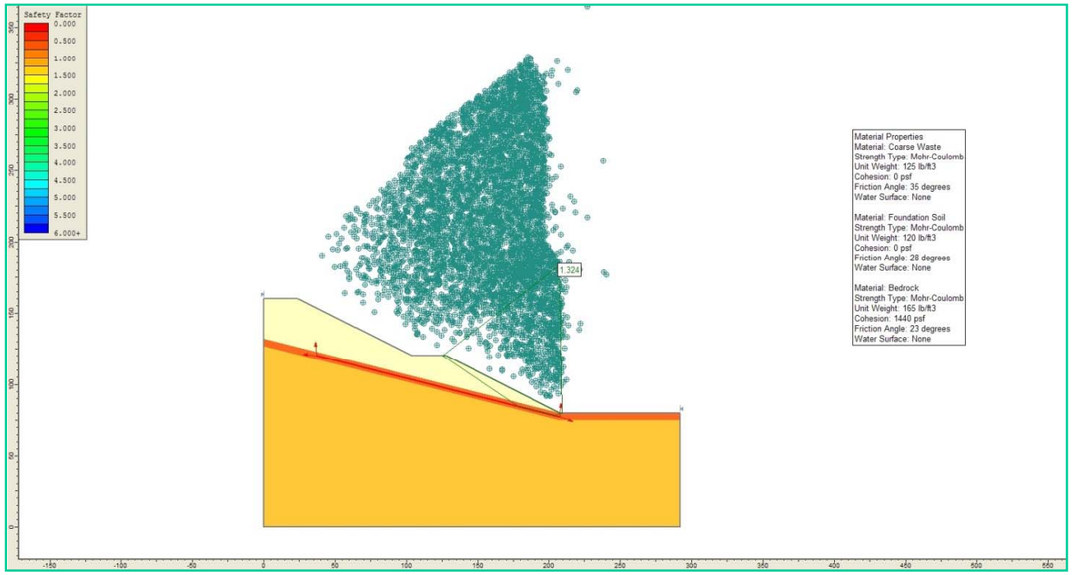
Golder Associates

Job no. 063-7109.100

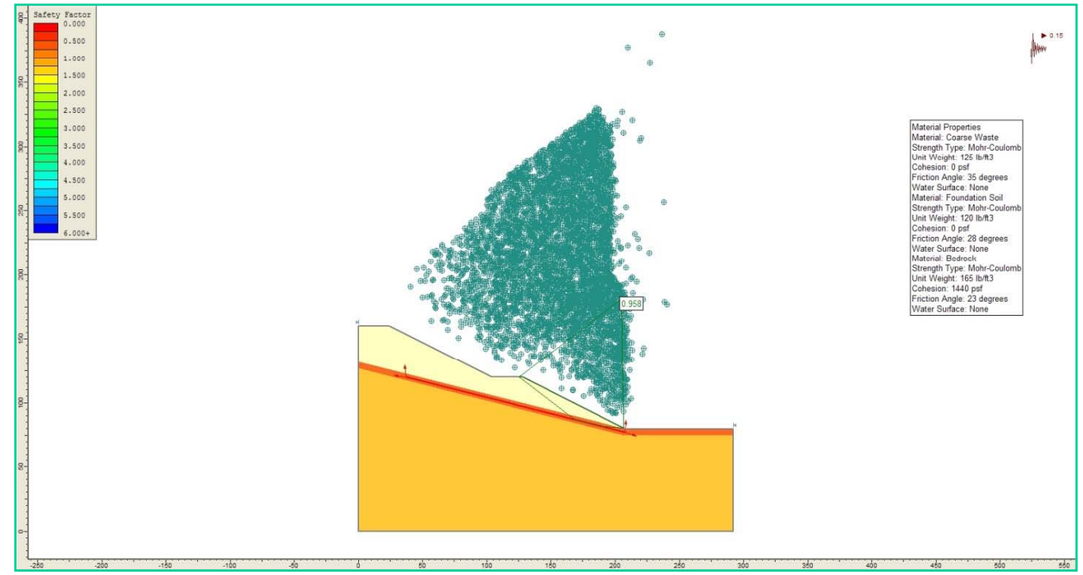
APPENDIX C8

EMSA STABILITY REVIEW
PERMANENTE QUARRY, CALIFORNIA

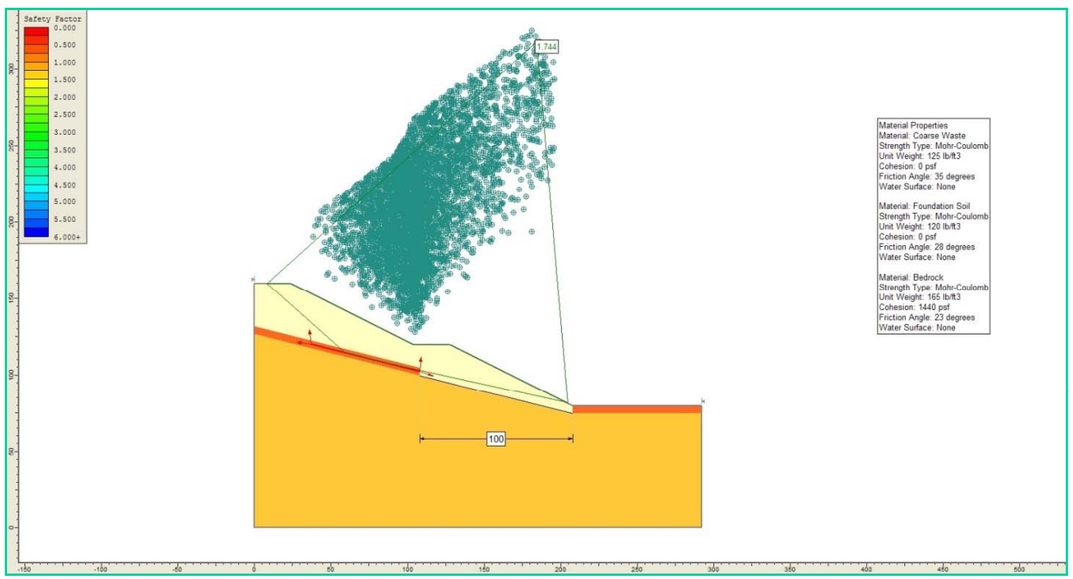
SENSITIVITY STUDY – VARIATION OF SUBGRADE (5H:1V)



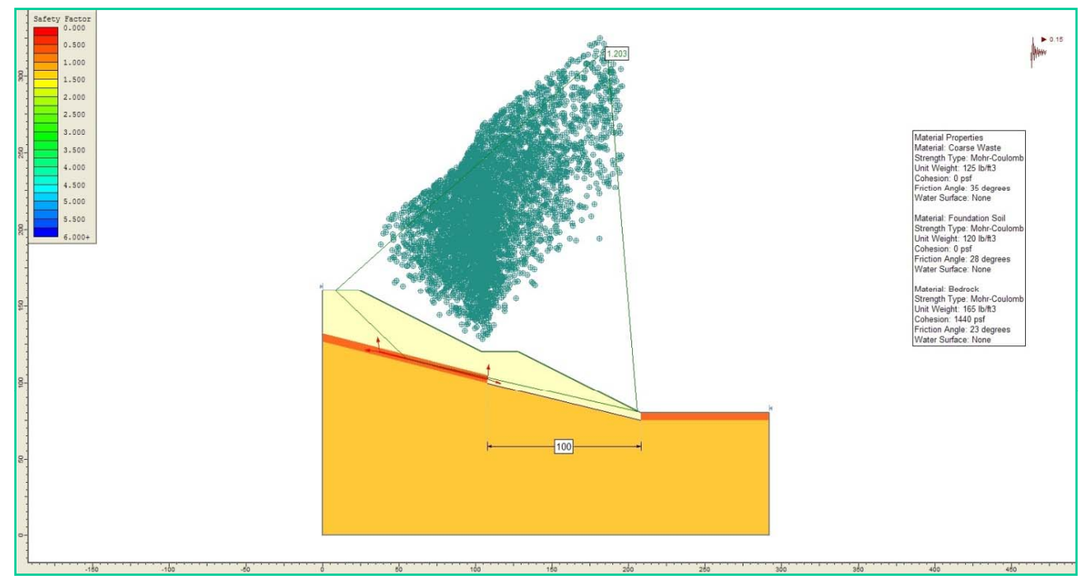
CONCEPTUAL MODEL OF UNPREPARED SUBGRADE – STATIC
LOCAL BLOCK FAILURE THROUGH FOUNDATION SOIL (4H:1V)
(FOS = 1.32)



CONCEPTUAL MODEL OF UNPREPARED SUBGRADE – PSEUDO-STATIC
LOCAL BLOCK FAILURE THROUGH FOUNDATION SOIL (4H:1V)
(FOS = 0.96)



CONCEPTUAL MODEL OF PREPARED SUBGRADE – STATIC
LOCAL BLOCK FAILURE THROUGH FOUNDATION SOIL (4H:1V)
(FOS = 1.74)



CONCEPTUAL MODEL OF UNPREPARED SUBGRADE – PSEUDO-STATIC
LOCAL BLOCK FAILURE THROUGH FOUNDATION SOIL (4H:1V)
(FOS = 1.20)

Golder Associates

Job no. 063-7109.100

APPENDIX C9

EMSA STABILITY REVIEW
PERMANENTE QUARRY, CALIFORNIA

SENSITIVITY STUDY – VARIATION OF SUBGRADE (4H:1V)

APPENDIX 12

Permanente Creek Reclamation Area

Geotechnical Evaluation Letter

December 12, 2011 Project No. 063-7109.904

Mr. Marvin Howell
Lehigh Southwest Cement Company
24001 Stevens Creek Boulevard
Cupertino, CA 95014

RE: GEOTECHNICAL EVALUATION OF PROPOSED SUBAREAS 1 THROUGH 7 RECLAMATION ACTIVITIES, LEHIGH HANSON SOUTHWEST CEMENT, PERMANENTE CREEK RECLAMATION AREA, SANTA CLARA COUNTY, CALIFORNIA

Dear Mr. Howell:

Golder is submitting our geotechnical evaluation of the proposed reclamation of Subareas 1 through 7 of the Permanente Creek Reclamation Area (PCRA) located at the Permanente Quarry in Cupertino, California. The Permanente Quarry is owned and operated by Lehigh Southwest Cement Company (Lehigh).

Lehigh is incorporating reclamation measures for several areas along the slopes adjacent to Permanente Creek, referred to as the PCRA, as part of the overall reclamation plan for Permanente Quarry.

This letter addresses the geotechnical evaluation of the seven subareas as requested by the County during a meeting between Lehigh and the County on November 14, 2011 and clarified by subsequent communication between Lehigh and the County. Subareas 1 through 7 occur along Permanente Creek as shown on Figure 1. Our geotechnical evaluation of these areas is summarized in the following sections.

1.0 SUBAREA 1

Subarea 1 occurs primarily below the western end of the southern slope of the WMSA. The primary area of concern identified by County staff is associated with a post-SMARA access road that was constructed across the waste rock fill of the WMSA and then excavated into a native slope. It is our understanding from Lehigh that the purpose of this road was to provide access for heavy equipment to allow for construction and/or maintenance of a catch basin and other erosion-control measures in order to address potential sediment discharge to the creek. The native slope is inclined at approximately 1.5H:1V (horizontal to vertical) and is more than 400 feet in height.

The County requested that a geotechnical evaluation be completed for the cut slope for the access road. The access road measures approximately 10 to 12 feet in width and the slope cut is typically between 6 and 13 feet in height. Field measurements indicate the cut slope is inclined at approximately 63 degrees (0.5H:1V) with localized areas as steep as 68 degrees (0.4H:1V). Field observations indicate that the cut is contained within weathered greenstone consistent with the geologic unit underlying the WMSA as described in Golder's 2011 geotechnical analysis of the WMSA (Golder's 2011 Geotechnical Report).[1]

As noted in the Golder 2011 Geotechnical Report, the strength of the greenstone varies widely. Based on field explorations, laboratory testing by Golder and others, and back-analyses, the strength of weathered greenstone has been characterized by shear strength envelopes ranging from a conservative upper bound represented by a cohesion of 1,882 psf and an effective internal friction of 27 degrees (for the WMSA area); to a lower bound represented by a cohesion of 1,400 psf and an effective internal friction

[1] Golder, July 2011, "Geotechnical Evaluations and Design Recommendations (Updated), Permanente Quarry Reclamation Plan Update, Santa Clara, California."

angle of 19 degrees (for the Scenic Easement area where past slope instability has occurred) (Golder, 2011).

For the Subarea 1 road cut analysis, we assumed a "mid-range" shear strength for greenstone represented by a cohesion of 1,600 psf and effective internal friction angle of 23 degrees, which is consistent with shear strength parameters assume for greenstone in other parts of the quarry (Golder, 2011). This assigned shear strength is lower than that previously assumed for the WMSA because the road cut is in the uppermost, relatively highly weathered portion of the greenstone.

Golder's field observation of the road cut indicated that it appeared stable overall. Some minor erosion was observed that was primarily attributed to direct precipitation on the slope face and surface runoff with resulting accumulation of soil-like talus materials at the toe of the cut.

Slope stability analyses were completed using the computer program Slope-W (Version 7.14), which computes the factor of safety using a two-dimensional, limit-equilibrium methodology. The results of the static and seismic analyses are illustrated in Attachment 1. The critical failure surfaces in these analyses extend from above the cut and just underneath the road. Potential failure surfaces limited to just the cut slope itself (i.e., failure surface intersecting the toe of the cut slope) would result in even higher static and pseudostatic factors of safety.

The results of our stability analyses indicate a minimum static factor of safety of 3.8 and a pseudostatic factor of safety of 3. The pseudostatic factor of safety is based on a seismic coefficient of 0.15 consistent with the site's design earthquake event and the seismic analyses completed previously for the quarry reclamation (Golder 2011 Geotechnical Report). The relatively high factors of safety indicate that the overall cut slope will remain stable under static and the design seismic conditions, and therefore, no further grading is required for reclamation.

2.0 SUBAREA 2 STORMWATER BASINS

Subarea 2 is located immediately east of Subarea 1. Two small stormwater ponds will be constructed near the toe of the excavated waste rock fill in the WMSA, which are referred as Basins 40B and 40C. The ponds are proposed to be 10 feet deep with side slopes inclined at 2H:1V or less. The ponds will be lined with concrete. Figure 4 shows the proposed grading of the ponds.

Based on comparison of the reclaimed grades to a 1948 USGS topographic map, and review of historical aerial photographs, the bottom of the ponds are expected to be founded in waste rock that overlies alluvium and greenstone at depth (Figures 5 and 6). The estimated thickness of the waste rock ranges from 60 to 90 feet at the basin locations.

Stability analyses were completed for Section A-A' through Basin 40C, which appears more critical based on inspection of schematic geologic cross-sections through the two basins (Figures 5 and 6). Key assumptions in the stability analyses included the following:

- The inclusion of a concrete liner should prevent substantial seepage from the basins that could otherwise saturate the basin slopes.
- The shear strength of the waste rock was assumed to be characterized by an effective internal friction of 35 degrees with no cohesion consistent with previous stability analyses for the WMSA (Golder, 2011)
- The shear strength of the alluvium was assumed to be characterized by an effective internal friction of 26 degrees with no cohesion. Due to the depth of the alluvium, the assumed shear strength of the alluvium did not impact the stability analyses.
- The shear strength of the underlying bedrock was assumed to be characterized by an effective internal friction angle of 23 degrees and a cohesion of 1600 psf consistent with the weathered greenstone material discussed previously for Subarea 1. As with the

alluvium, the greenstone is at sufficient depth that it does not impact the slope stability analyses.

Figures 7 and 8 present the results of the slope stability analyses for a critical section through the ponds. The critical failure surfaces are shallow failures through the outer waste rock fill slope. Under static conditions the critical failure surface is very shallow and is restricted to within a few feet of the outboard edge of the slope resulting a minimum static FOS of 1.1 (Figure 7).

To mitigate slope stability impacts to the basin, Golder recommends that the basin should be offset from the slope to ensure that a critical failure surface that intersects the basin have a minimum static FOS of 1.3 and pseudo-static FOS of 1.0. Based on the failure surfaces shown in Figures 7 and 8, the critical failure surface for static conditions and a FOS of 1.3 extends 13 feet from the edge of the slope. Under seismic loading, the failure surface is slightly deeper and involves the outboard 20 feet of the slope. In order to ensure a minimum static factor of safety of 1.3, and a minimum pseudo-static factor of safety of 1.0 against a slope failure extending through the basin, Golder recommends that the basins be offset at least 30 feet from the outer edge of the waste rock fill slope. This will require moving the basins 10 to 15 feet to the north from the locations shown in Figure 4.

3.0 SUBAREAS 2, 3, 4, 6, AND 7 SIDE-CAST FILLS

Subarea 2 includes side cast fills along the lower portion of the WMSA slope that will remain following removal of the main portion of the WMSA. This portion of the slope generally involves filling along the WMSA that occurred to construct the access road previously discussed for Subarea 1. In general, the road filling resulted in sidecast waste rock material down-slope with the most significant fills occurring along existing drainage ravines. The waste rock slope is inclined at approximately 1.5H:1V. Following removal of the main portion of the WMSA, the remaining slope will range from approximately 150 to 450 feet in height. Previous review of historic aerial photographs for the WMSA indicate that the fill slope has been stable over time with no evidence of deep-seated slope failures.

Subareas 3, 4, 6 and 7 occur east of Subarea 2. The geotechnical issue of concern with these areas generally consists of the stability of localized areas of waste rock fill that was cast down slope toward Permanent Creek.

The proposed reclamation of Subareas 2, 3, 4, 6 and 7 will consist of implementing erosion best management practices (BMP's) consisting of rolling the remaining waste rock fill slope with a pad-foot type (i.e. sheepsfoot) compactor and reseeding the slope with a mixture of grasses and shrubs. Additional erosion BMPs may include installation of fiber rolls and other erosion controls placed along the slope. The County has requested a qualitative geotechnical evaluation of the proposed erosion BMPs and their effectiveness with respect to improvements in slope stability.

It is Golder's opinion that the proposed erosion control BMP's are appropriate for these subareas and will help to improve stability. For the waste rock fill slopes, previous work performed by Golder indicate that the lowest factors of safety are associated with relatively thin, shallow failure surfaces extending near the slope surface (i.e., shallow translational slides). Establishment of vegetation, particularly woody shrub species, will increase the shear strength along a potential shallow failure surface for the near surface materials (upper several feet) due to the presence of woody roots. This will provide for a slight increase in shear strength in the shallow subsurface, and therefore will result in a slight decrease in the likelihood of shallow failures.

4.0 SUBAREA 5

Subarea 5 occurs along the slope north of the Permanente Creek and south of the main North Quarry access road. Two specific areas of concern are referred to as Subareas 5a and 5b as discussed below.

4.1 Subarea 5a

Areas of concern identified by the County in Subarea 5a are a series of small erosion gullies and/or shallow slumps located downgradient of the access road to sedimentation Pond 4. The shallow slumps

appear to be formed in former rock fill materials placed during early mining operations which occurred along the creek alignment in the 1960's. Remedial grading will be performed in these areas to layback the slope below the road to a uniform 2H:1V slope, and appropriate drainage and erosion control measures consistent with those described for Subareas 2, 3, 4, 6, and 7 would be implemented.

Regrading these areas to 2H:1V will result in stable slopes. Based on assumed rock fill shear strengths discussed for Subarea 5b, the 2H:1V slopes in rock fill for Subarea 5a will have a minimum static factor of safety of 1.4 and a minimum pseudostatic factor of safety of 1.02, which are suitable for the post-reclamation land use.

4.2 Subarea 5b

Subarea 5b is located just east of Sedimentation Pond 4, just south of and below the main quarry road. The County identified an area of possible landsliding in 1995 ortho-photos of the area. The ortho-photo appears to show a relatively steep sideslope below the existing quarry haul road which is covered in sidecast mine spoil which has locally covered native vegetation. The mine spoil shows arcuate "headscarps" which are characteristic of end-dumped, or side-cast, mine spoil at the angle-of-repose with apparent flow of the material down the slope. At the break-in-slope at the toe of the hillside, the ortho-photo shows what appears to be a lobe of mine spoil, or landslide debris, that has cascaded over a former access road and onto the flood plain below the road. The debris extends to the flow line of the Creek.

Golder evaluated a series of stereoscopic aerial photographs to confirm the conditions observed in the ortho-photo. We reviewed stereo pairs from 1939, 1975, 1981, and 2005. Brief notes from each photo set are provided below:

- 1939 – Pioneered road visible along north bank of Permanente Creek floodplain. Road is flanked to north by relatively steep natural rock slopes. The slopes are incised with two or three first-order drainages, sparsely vegetated, with no evidence of deep-seated landslides. There is a graded bench in the approximate area of the future sediment basin.
- 1975 – A conveyor alignment trends along the north side of creek, just downslope from the access road. Relatively fresh, sidecast fill is apparent all along the Subarea 5a slopes extending to the area of the future basin. The Subarea 5b slope is still native with some side-cast fill apparent at the top of slope along the outboard edge of the mine access road. The mine road is cut into bedrock and mining activities, i.e., bench development, has progressed nearly to the ridge in this area of the site.
- 1981 – The pioneered road at the base of the slope is still present. The slope above remains undisturbed, with heavy native vegetation, and a small wedge sidecast fill. A new road from the mine access road down to the future basin is present. There is significant grading in the area of the pond and to the west in the creek bottom (the conveyor has been removed), with a pioneered road across the creek to drill pad locations on opposite flank of creek (i.e. south flank).
- 2005 - There is active mining of the slope (quarry side) above the Subarea 5a and 5b slopes. The basin is present, with a steep cutslope above the basin. An outboard sidecast fill for the road and pond is apparent. The former drainage swales above the Subarea 5b lower road have a thin cover of mine spoil. The lower creek road is present and clear of spoil. The area below the road is less vegetated in the area below the road where the former mine spoil (1995 ortho-photo) apparently cascaded across the road (i.e., mine spoil remains below the road).

In summary, we concur with the County interpretation that loose granular materials, either mine spoil or landslide debris, exist in the area of the former floodplain. Currently, there is also an angle-of-repose, side-cast fill apparent just outboard of the existing mine road at the top of the slope. The quarry road at the top of the slope appears to be founded on native bedrock materials. We have reinterpreted the cross section in this area to reflect the above observations.

Proposed remedial grading for Subarea 5b (Figure 9) will include excavation of the loose and unstable material extending from the creek up to the existing mine road. This will entail excavation of a keyway for placement of a rock fill to flatten the slope to 2H:1V. Upon final grading, the final slope height will typically range between 40 and 60 feet in height. The rock fill will be keyed into native materials as appropriate, which are expected to consist of either greenstone or limestone in this area of the site. Some alluvial materials or mine spoils may remain in-place near the edge of the creek outboard of the keyway. Figure 10 shows a cross-section through the remedial grading for Subarea 5b.

Based on Golder's previous analyses of rock fill slopes at the quarry (Golder 2011), the rock fill shear strength is characterized by an internal friction angle of 35 degrees with no cohesion. For a material with a "frictional" shear strength, a conservative, minimum static factor of safety for a 2H:1V slope is estimated to be 1.4 using the following equation:

Factor of Safety = Tan(Φ)/Tan(α) where:

Φ = internal friction angle of the rock fill (degrees)

α = fill slope angle (degrees)

The above equation tends to provide slightly conservative estimates in comparison to two-dimensional, limit equilibrium analyses. This statement is supported by comparing previous slope stability analyses completed by Golder for the East Materials Storage Area (EMSA)[2]. Section E1 in the EMSA, which consisted of a 2H:1V rock fill slope was computed to have a minimum static factor of safety of 1.43. Similarly, the pseudostatic stability of the remedial grading for Subarea 5b is expected to be the same as that for the Section E1 of the EMSA, which was computed to be 1.02. A minimum static factor of safety of 1.4 and pseudostatic factor of safety of 1.02 are suitable for the post-reclamation land use, which is undeveloped open space.

5.0 CLOSING

We appreciate the opportunity to support Lehigh Southwest Cement Company on this project. If you have any questions regarding our recommendations, please contact me at (916) 786-2424.

Sincerely,

GOLDER ASSOCIATES INC.

REGISTERED PROFESSIONAL ENGINEER
KENNETH G. HASKELL
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Exp. 6/30/13
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STATE OF CALIFORNIA

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STATE OF CALIFORNIA

Kenneth G. Haskell, P.E.
Principal/Practice Leader

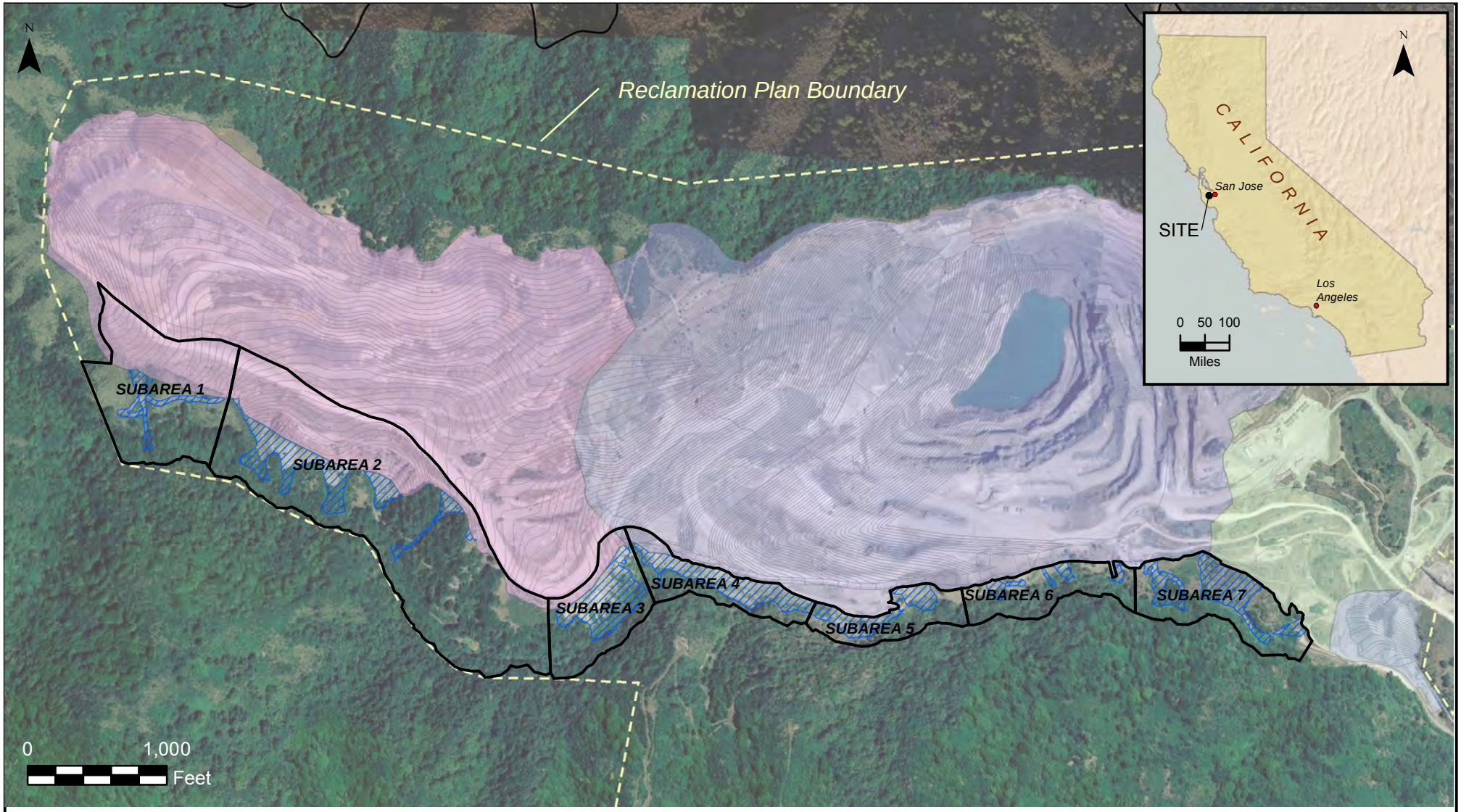
William L. Fowler, PG, CEG
Associate/Program Manager

KGH/kgh

Attachments:
Figure 1 – Site Location Map
Figure 2 – Static Slope Stability Analysis For Subarea 1
Figure 3 – Seismic Static Slope Stability Analyses For Subarea 1
Figure 4 – Grading Plan for Ponds 40B and 40C
Figure 5 – Schematic Geologic Cross Section Pond 40B
Figure 6 – Schematic Geologic Cross Section Pond 40C
Figure 7 – Static Slope Stability Analysis For Ponds 40B and 40C
Figure 8 – Seismic Slope Stability Analyses For Ponds 40B and 40C

[2] Golder Associates, December 2009, "Slope Stability Evaluation of the East Materials Storage Area, Permanente Quarry"

Figure 9 – Regrading Plan for Subarea 5b
Figure 10 – Schematic Geologic Cross Section for Subarea 5b



LEGEND

- Permanente Creek Restoration Area (PCRA)
- PCRA treatment area

REFERENCES

Background: http://services.arcgisonline.com/arcgis/services
1) ESRI_ShadedRelief_World_2D
2) 13_Imagery_Prime_World_2D

PROJECT

EVALUATION OF SLOPE STABILITY - SUBAREAS 1 - 7
PERMANENTE CREEK RECLAMATION AREA
SANTA CLARA COUNTY, CALIFORNIA

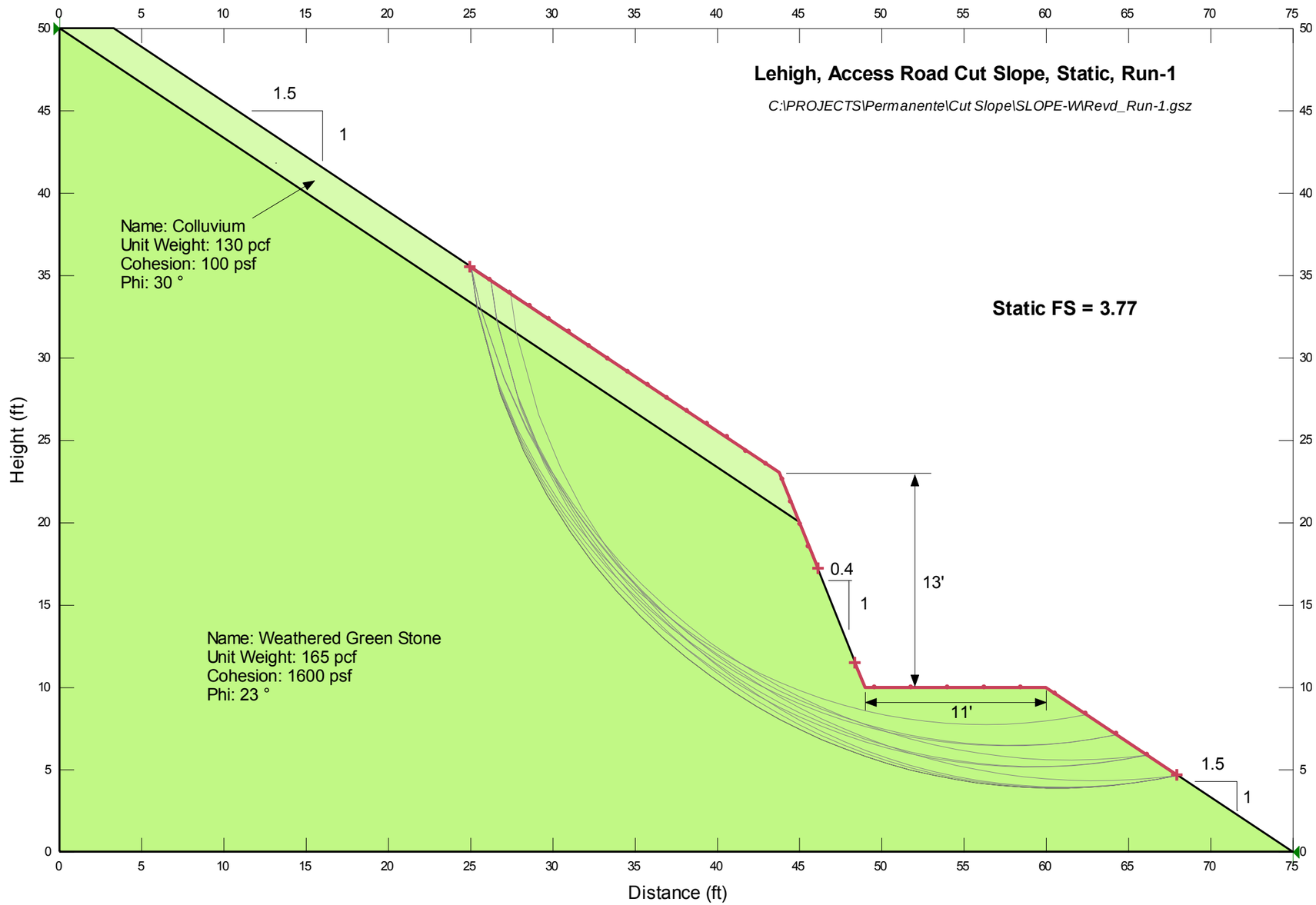
TITLE

SITE LOCATION MAP

Golder Associates

PROJECT No.		063-7109	FILE No.	
DESIGN	DLM	11/17/2011	SCALE: AS SHOWN	REV. 0
GIS	DLM	11/17/2011		
CHECK	BF	11/17/2011	**FIGURE 1**	
REVIEW	KH	11/17/2011		

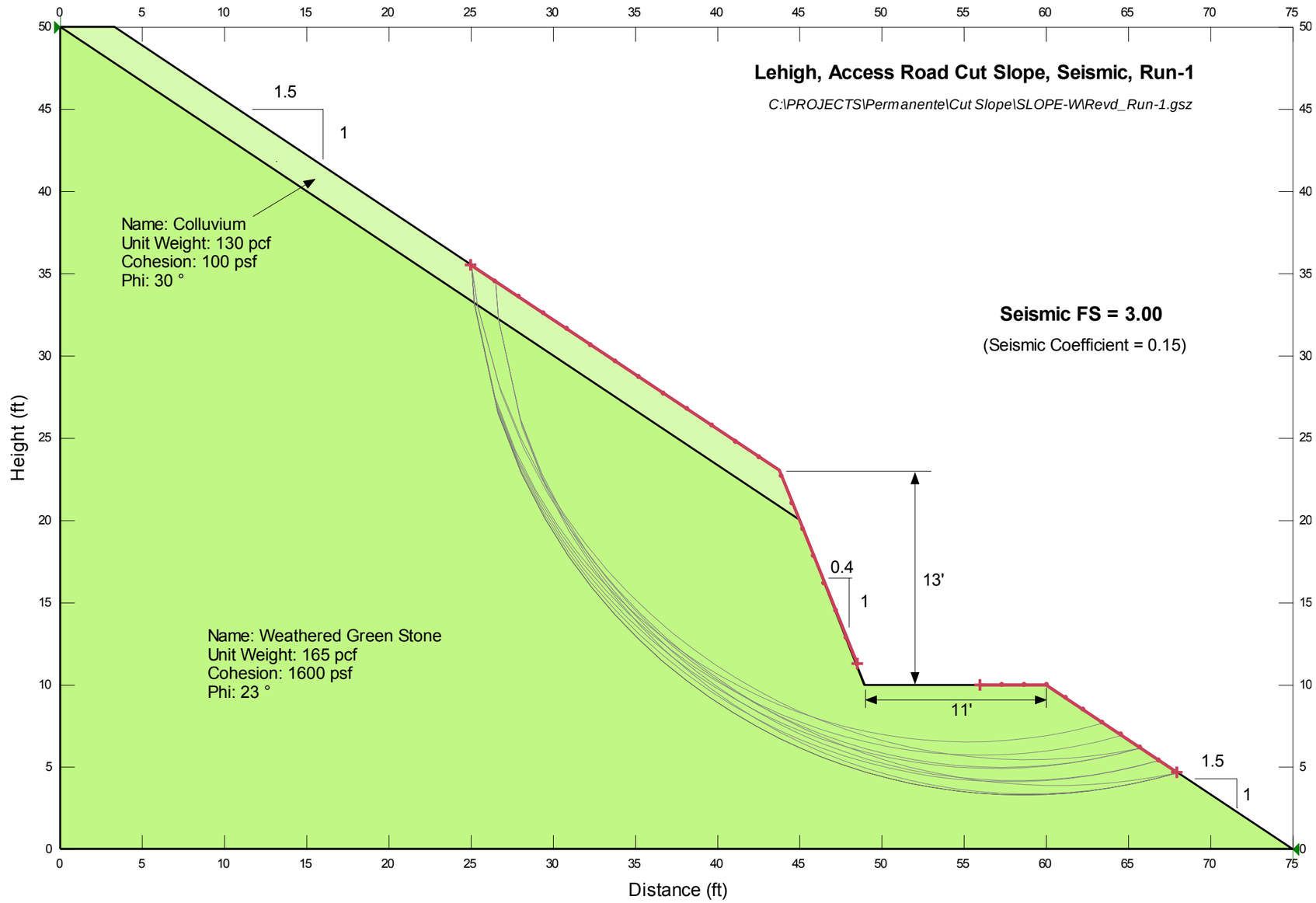
G:\GIS\Sites\Lehigh_Permanente_Quarry\mxd\SiteLocationMap.mxd



Golder Associates

Lehigh Permanente
Area 1 Access Road Cut Slope Stability
Static Slope Stability Analysis

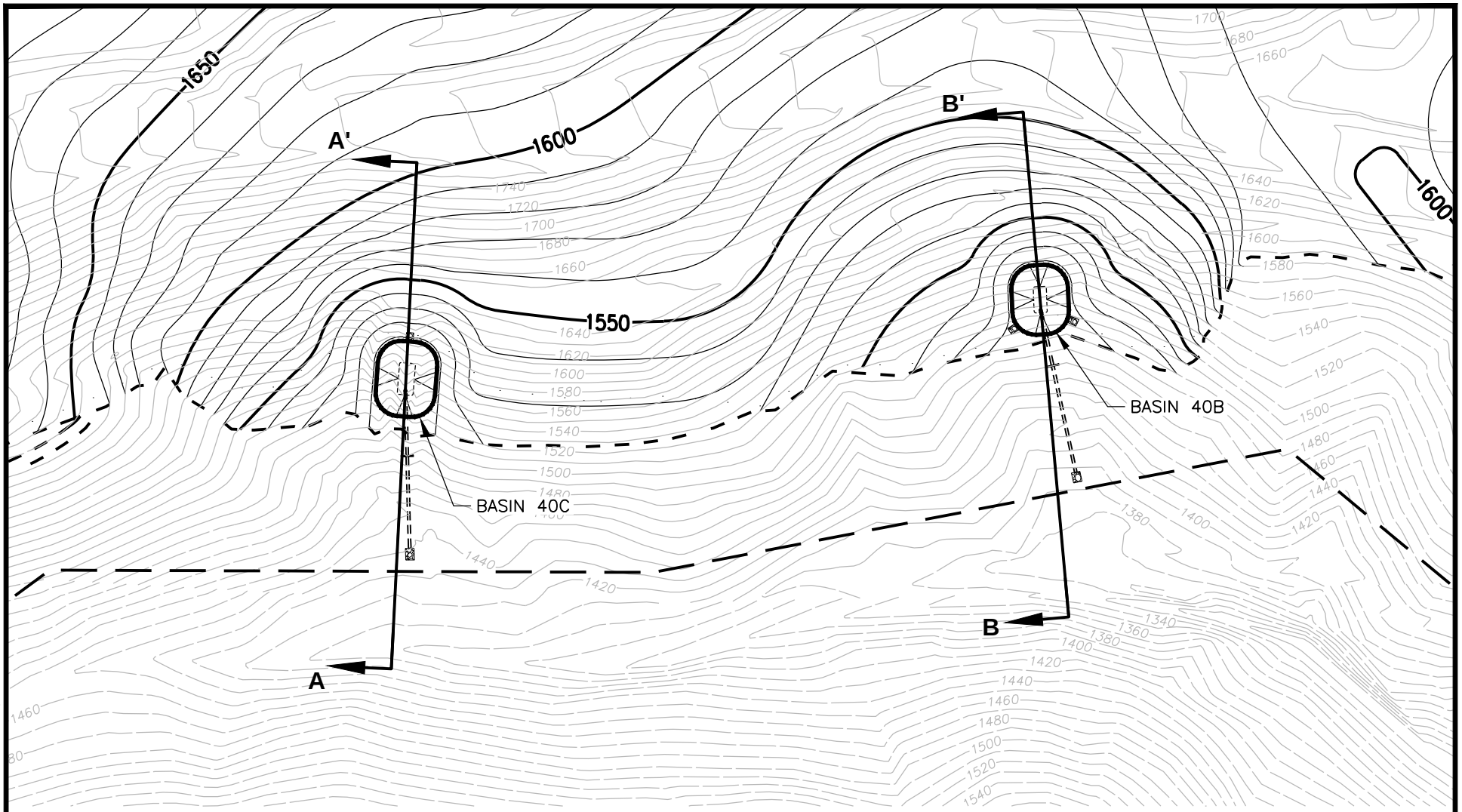
Design: **NK**	Check:	Date: November **2011**	Figure: 2



Golder Associates

Lehigh Permanente
Area 1 Access Road Cut Slope Stability
Seismic Slope Stability Analysis

Design: **NK**	Check:	Date: **November 2011**	Figure: 3



NOTES

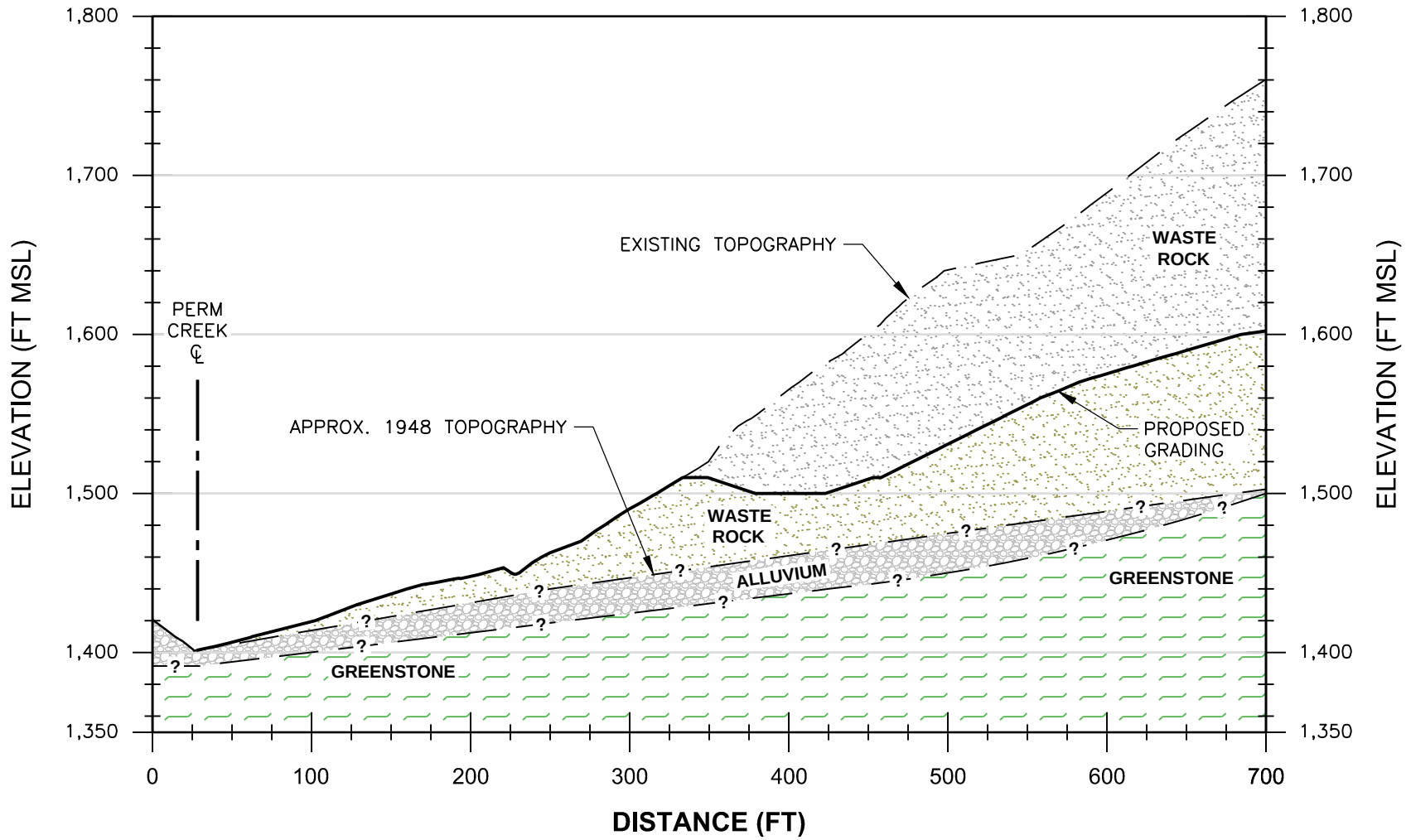
1. TOPOGRAPHIC INFORMATION BASED ON COMBINED 2007, 2008, AND 2009 TOPOGRAPHY.

200 0 200
SCALE FEET

Golder Associates
Roseville, California

FIGURE 4
GRADING PLAN FOR PONDS 40B & 40C
PERMANENTE QUARRY

Drawing file: WMSA X-SECTIONS.dwg Dec 12, 2011 - 1:22pm



LEGEND

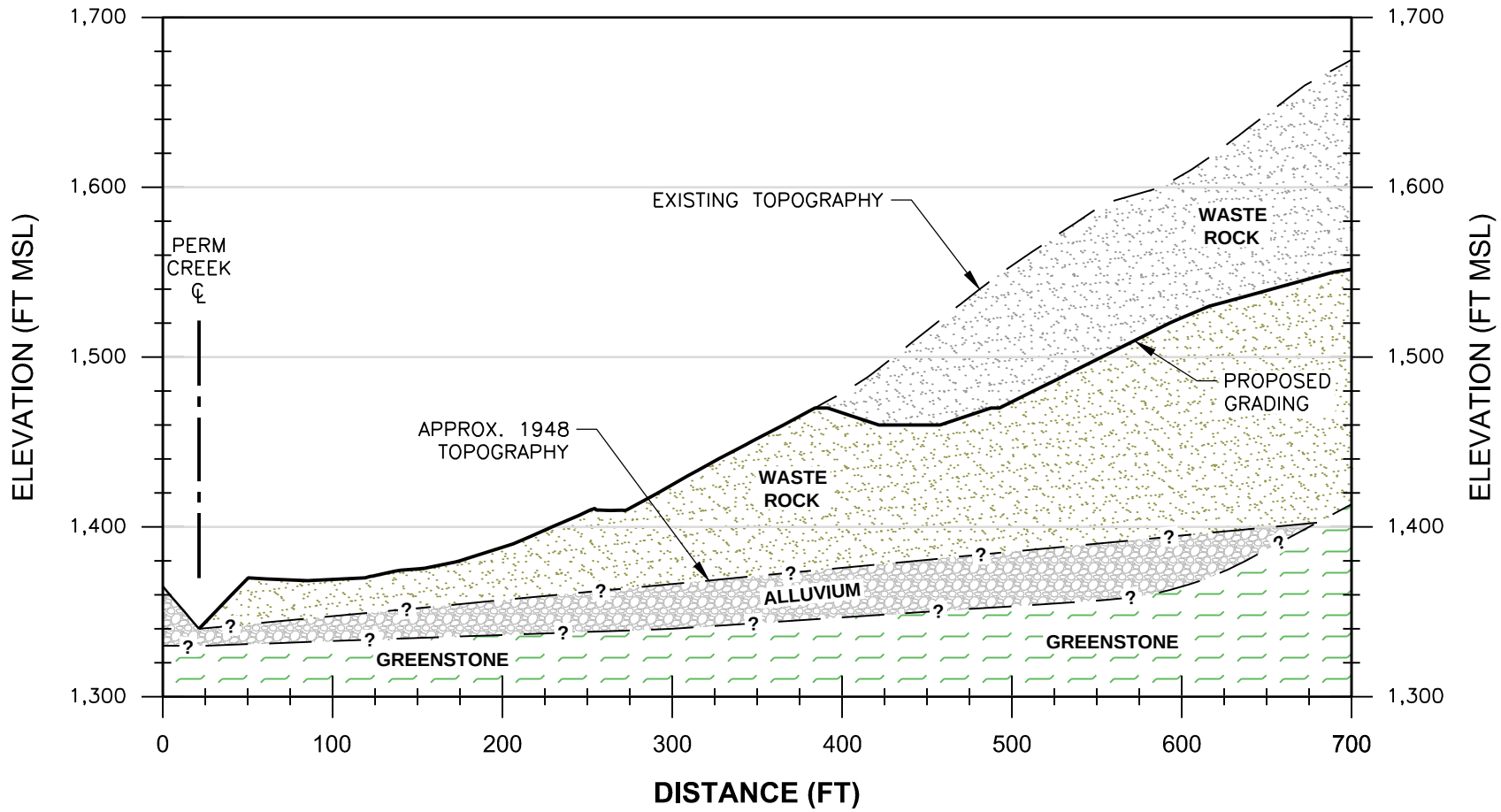
- WASTE ROCK
- WASTE ROCK TO BE REMOVED
- ALLUVIUM
- GREENSTONE
- –?– APPROXIMATE GEOLOGIC CONTACT

100 0 100
SCALE FEET

Golder Associates
Roseville, California

FIGURE 5
GEOLOGIC CROSS SECTION A-A'
PERMANENTE QUARRY

Drawing file: WMSA X-SECTIONS.dwg Dec 12, 2011 – 12:06pm



LEGEND

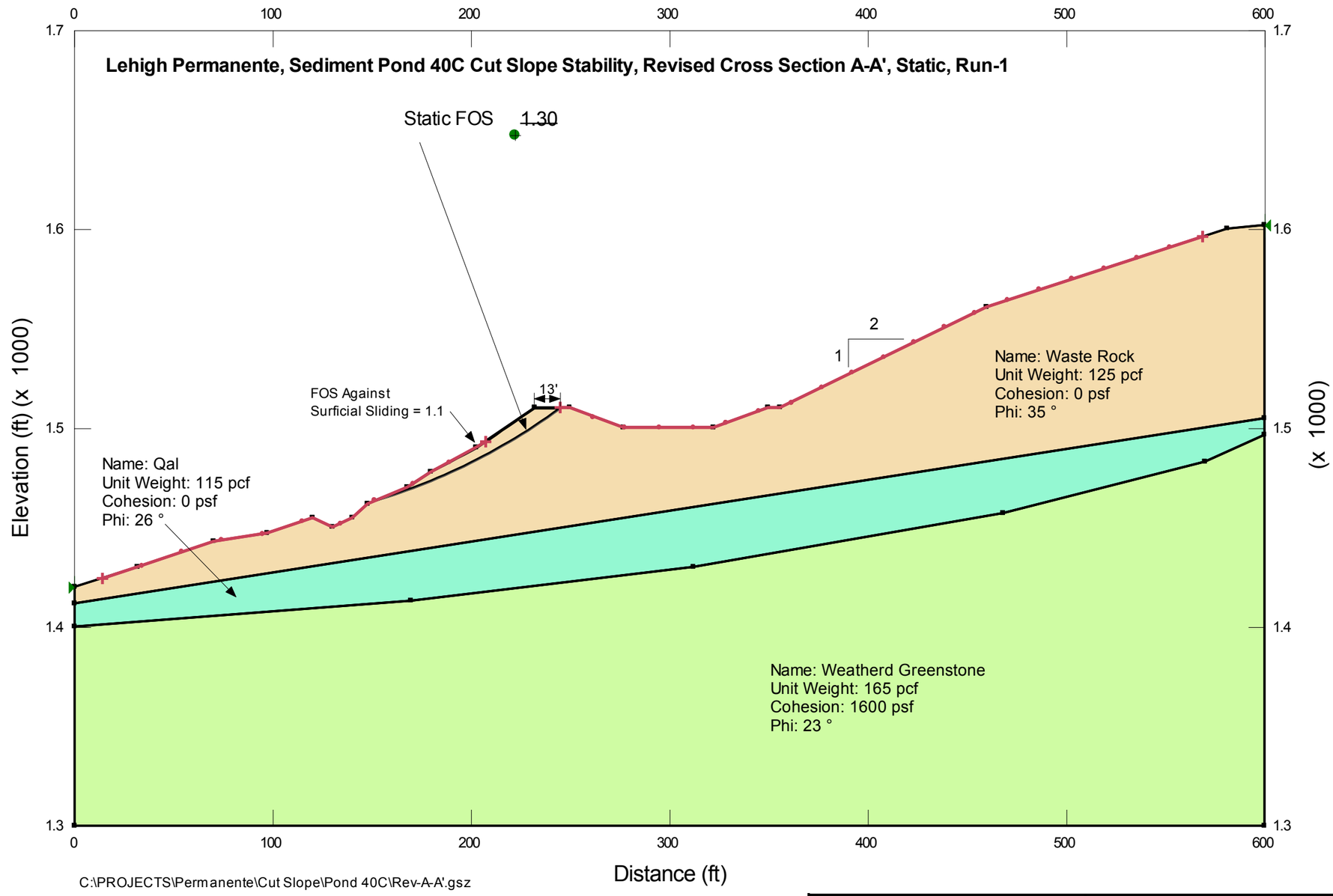
- WASTE ROCK
- WASTE ROCK TO BE REMOVED
- ALLUVIUM
- GREENSTONE
- –?– APPROXIMATE GEOLOGIC CONTACT

100 0 100
SCALE FEET

Golder Associates
Roseville, California

FIGURE 6
GEOLOGIC CROSS SECTION B-B'
PERMANENTE QUARRY

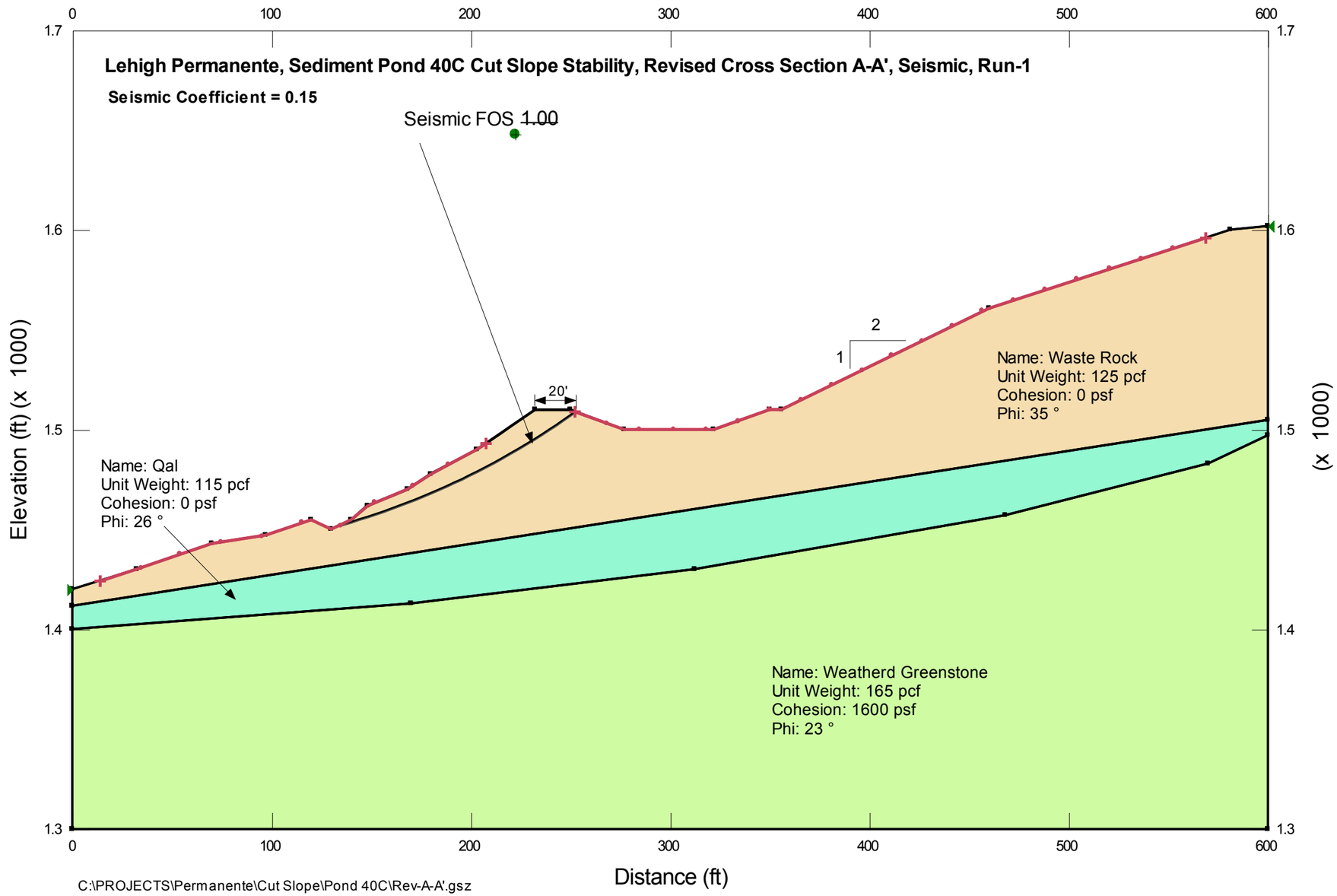
Drawing file: WMSA X-SECTIONS.dwg Dec 12, 2011 – 12:05pm



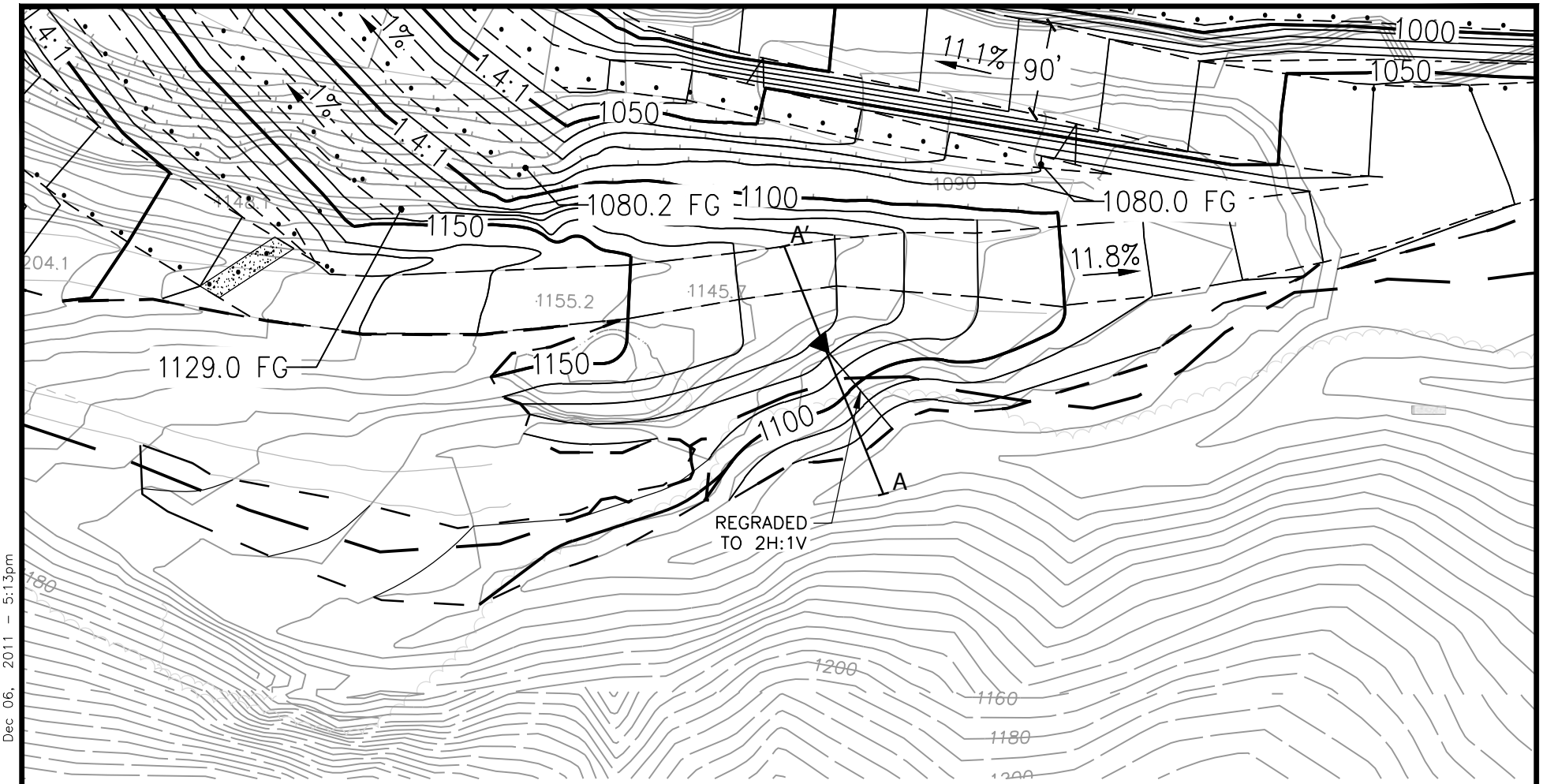
Golder Associates

Lehigh Permanente
Sediment Pond 40C Cut Slope Stability
Cross Section A-A'
Static Slope Stability Analysis

Design: **NK**	Check:	Date: December **2011**	Figure: **7**



Golder Associates		Lehigh Permanente Sediment Pond 40C Cut Slope Stability **Cross Section A-A'** **Seismic Slope Stability Analysis**	
Design: **NK**	Check:	Date: **December 2011**	Figure: **8**



NOTES

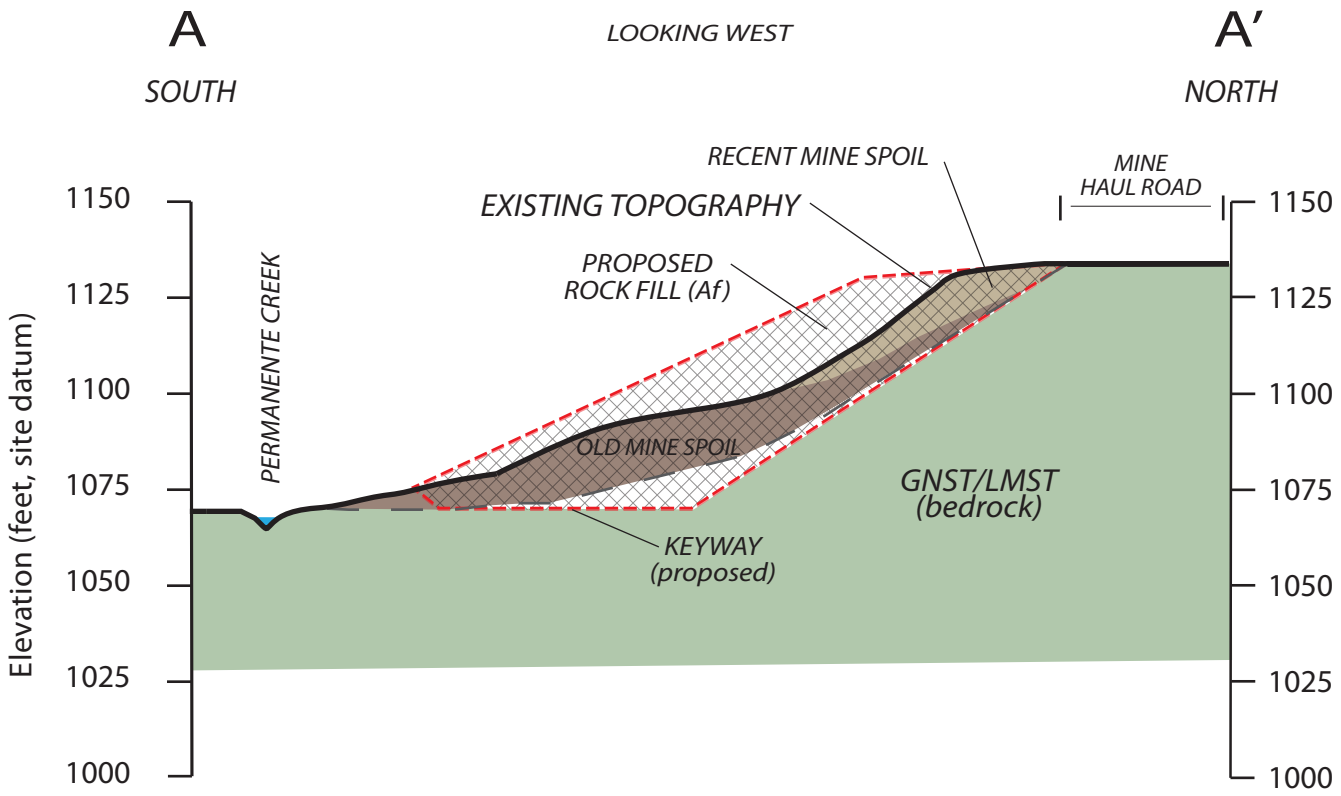
1. TOPOGRAPHIC INFORMATION BASED ON COMBINED 2007, 2008, AND 2009 TOPOGRAPHY.

150 0 150
SCALE FEET

Golder Associates
Roseville, California

FIGURE 9
REGRADING PLAN FOR SUBAREA 5B
PERMANENTE QUARRY

Drawing file: northquarry_wmsa_Subarea 5b Regrading.dwg Dec 06, 2011 - 5:13pm



PROJECT

EVALUATION OF SLOPE STABILITY - SUBAREAS 1 - 7
PERMANENTE CREEK RECLAMATION AREA
SANTA CLARA COUNTY, CALIFORNIA

TITLE

SCHEMATIC GEOLOGIC SECTION A-A'
(SUBAREA 5B)

Golder Associates

PROJECT No.		063-7109	FILE No.	
DESIGN	DLM	12/12/2011	SCALE: AS SHOWN	REV. 0
GIS	DLM	12/12/2011		
CHECK	BF	12/12/2011	**FIGURE 10**	
REVIEW	KH	12/12/2011		