APPENDIX E

Laboratory Test Results

APPENDIX E.1

Current Laboratory Test Results

TABLE E-1
SR-710 Tunnel Technical Study
Summary of Laboratory Results

S.NO	Boring #	Depth (ft)	Sample #	Soil or Rock Description	Sample Type	Recovery (%)	Blow Count/ RQD (%)	Field Moisture Content (%)	Field Dry Density (pcf)	Corrected Expansion Index	Grain Size (G:S:F) (%)	Atterberg Limits			Consolidation Undisturbed		Direct Shear Test		UU Triaxial Test	UC Test	Modulus of Elasticity (ksi)	Cerchar Abrasivity Index	Point Load Test	Slake Durability Index	Corrosivity			
												LL	PL	PI	C_{ce}	C_{re}	Ult. Cohesion (psf)	Ult. ϕ (deg)	Undrained Shear Strength (psi)	Uniaxial Compression Strength (psi)			Uniaxial Compression Strength (psi) [=24x corr. point load]		pH	Min. Resistivity (Ω-cm)	Sulfate Content (ppm)	Chloride Content (ppm)
1	R-09-Z1-B2	123.2	C-25	SILTST/SANDSTONE	CORE	100	52	15.0	132.1											231.0	68.0			3.5				
	R-09-Z1-B2	124.5	C-25	SANDSTONE	CORE	100	52	15.9	140.0											357.0								
	R-09-Z1-B2	148.5	C-31	SANDSTONE	CORE	100	48		139.4											471.0	93.0							
	R-09-Z1-B2	158.8	C-33	SANDSTONE	CORE	77	10		159.4											11360.0	5880.0	3						
	R-09-Z1-B2	167.4	C-35	SANDSTONE	CORE	100	17	14.9	136.4											661.0	71.0			37.4				
	R-09-Z1-B2	173.0	C-36	SANDSTONE	CORE	100	90		158.5											10835.0	5360.0	2.7	811					
	R-09-Z1-B2	177.4	C-37	SANDSTONE	CORE	100	70		159.1											11238.0	5500.0	3.3						
	R-09-Z1-B2	191.1	C-40	SANDSTONE	CORE	125	63	14.4	137.8											339.0								
	R-09-Z1-B2	205.3	C-43	SILTST/CLAYSTONE	CORE	87	67		139.3											243.0	148.0							
	R-09-Z1-B2	229.5	C-48	SANDSTONE	CORE	102	48	13.1	157.3											11156.0								
	R-09-Z1-B2	231.5	C-49	SANDSTONE	CORE	100	87		156.8											4342.0	3570.0	2.9						
	R-09-Z1-B2	238.0	C-50	SANDSTONE	CORE	73	48	12.8	138.8											368.0								
	R-09-Z1-B2	243.0	C-51	SILTSTONE	CORE	100	58	14.3	136.0											514.0	176.0			6.3				
	R-09-Z1-B2	262.9	C-57	SILTST/SANDSTONE	CORE	103	77	13.0	137.6											700.0	238.0			62.9				
	R-09-Z1-B2	270.5	C-58	CLAYST/SILTSTONE	CORE	100	27	12.7	134.1											795.0	300.0			59.0				
	R-09-Z1-B2	285.0	C-61	SANDSTONE	CORE	92	53	14.8	137.5											276.0			1230					
	R-09-Z1-B2	299.0	C-64	CLAYST/SILTSTONE	CORE	100	54	16.3	133.2											438.0	171.0			27.0				
2	R-09-Z1-B3	20.0	D-4	SP-SM	RING		35	13.1	105.8		0:95:5																	
	R-09-Z1-B3	40.0	D-8	SP-SM	RING		52	16.1	137.1																7.20	2450	360	232
	R-09-Z1-B3	50.0	D-10	SP-SM	RING		87	14.4	138.3		11:63:6																	
	R-09-Z1-B3	60.0	D-12	SP-SM	RING		93	9.6	138.3		29:64:7		NP												6.30	2400	300	280
	R-09-Z1-B3	70.0	D-14	SP-SM	RING		77/11"	16.7	132.6		20:72:8																	
	R-09-Z1-B3	84.0	C-1	SANDSTONE	CORE	57	57		137.0											343.0								
	R-09-Z1-B3	95.5	C-4	SANDSTONE	CORE	100	63	2.6	154.9											4555.0								
	R-09-Z1-B3	109.5	C-6	SANDSTONE	CORE	71	39		162.7											15397.0								
	R-09-Z1-B3	116.3	C-7	SANDSTONE	CORE	100	70		137.4											258.0	91.0							
	R-09-Z1-B3	124.3	C-8	SANDSTONE	CORE	100	45		137.4											291.0								
	R-09-Z1-B3	168.5	C-13	SANDST/SILTSTONE	CORE	100	63	10.1	138.5											756.0				80.5				
	R-09-Z1-B3	177.5	C-15	SANDSTONE	CORE	89	89	3.1	156.2											9838.0								
	R-09-Z1-B3	184.0	C-16	SANDSTONE	CORE	100	100	8.2															1926	54.7				
	R-09-Z1-B3	194.6	C-17	SILTSTONE	CORE	100	100	10.2	136.5											2427.0	580.0			95.3				
	R-09-Z1-B3	198.0	C-17	SILTSTONE	CORE	100	100															0.2	1798					
	R-09-Z1-B3	217.0	C-21	SANDSTONE	CORE	79	79	6.7														0.7						
	R-09-Z1-B3	225.9	C-21	SANDSTONE	CORE	79	79		138.1											335.0	65.0							
	R-09-Z1-B3	232.4	C-23	SANDSTONE	CORE	107	102		135.9											422.0								
	R-09-Z1-B3	235.4	C-23	SANDSTONE	CORE	107	102		135.4											644.0								
	R-09-Z1-B3	239.5	C-23	SANDSTONE	CORE	107	102		137.5											714.0								
	R-09-Z1-B3	251.0	C-25	SANDSTONE	CORE	100	72	11.6																76.1				
	R-09-Z1-B3	251.5	C-25	SANDSTONE	CORE	100	72		135.1											435.0	88.0							
	R-09-Z1-B3	262.6	C-26	SANDSTONE	CORE	100	100		135.2											734.0								
	R-09-Z1-B3	280.0	C-29	SANDSTONE	CORE	100	44															3.3	514					
	R-09-Z1-B3	289.3	C-30	SANDSTONE	CORE	100	100		154.6											8404.0	5330.0		12970					
	R-09-Z1-B3	292.5	C-30	SILTSTONE	CORE	100	100		140.0											1470.0	290.0							
	R-09-Z1-B3	299.6	C-31	SANDSTONE	CORE	100	80	11.2	136.7											577.0	160.0							
	R-09-Z1-B4	13.2	C-01	CLAYEY SAND	BAG			13.1			1:59:40																	
	R-09-Z1-B4	21.2	C-07	SAND WITH GRAVEL	BAG			12.7			39:58:3																	
	R-09-Z1-B4	33.3	C-12	POORLY GRADED SAND	BAG			12.5																				
	R-09-Z1-B4	47.5	C-17	SILTY SAND	CORE	100		21.0	104.5		0:77:23																	
	R-09-Z1-B4	53.3	C-19	SILTY SAND	CORE	100		23.8																				
	R-09-Z1-B4	66.3	C-22	SILTSTONE	CORE	52	0	30.8	90.6		0:3:97	57	25	32														
	R-09-Z1-B4	90.7	C-26	SANDSTONE	CORE	90	0	12.6	121.5																			

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S.NO	Boring #	Depth (ft)	Sample #	Soil or Rock Description	Sample Type	Recovery (%)	Blow Count/ RQD (%)	Field Moisture Content (%)	Field Dry Density (pcf)	Corrected Expansion Index	Grain Size (G:S:F) (%)	Atterberg Limits			Consolidation Undisturbed		Direct Shear Test		UU Triaxial Test	UC Test	Modulus of Elasticity (ksi)	Cerchar Abrasivity Index	Point Load Test	Slake Durability Index	Corrosivity			
												LL	PL	PI	C_{ce}	C_{re}	Ult. Cohesion (psf)	Ult. ϕ (deg)	Undrained Shear Strength (psi)	Uniaxial Compression Strength (psi)			Uniaxial Compression Strength (psi) [=24x corr. point load]		pH	Min. Resistivity (Ω-cm)	Sulfate Content (ppm)	Chloride Content (ppm)
3	R-09-Z1-B4	105.4	C-30	SANDSTONE	CORE	90	70	13.3	116.8																			
	R-09-Z1-B4	132.5	C-34	SANDSTONE	CORE	100	100	14.1	117.0		0:80:20																	
	R-09-Z1-B4	164.7	C-40	SILTSTONE	CORE	100	100	17.5	109.7			52	31	21					189.3									
	R-09-Z1-B4	171.7	C-42	SANDSTONE	CORE	100	68	13.7	135.0															57.3				
	R-09-Z1-B4	203.5	C-48	SANDSTONE	CORE	100	95	14.3	117.5											593.0	34.2							
	R-09-Z1-B4	212.7	C-50	MUDSTONE	CORE	100	50	27.1	111.8															0.0				
	R-09-Z1-B4	226.4	C-53	SANDSTONE	CORE	100	56	8.3	136.2											871.0	70.7							
	R-09-Z1-B4	243.4	C-56	SANDSTONE	CORE	96	30	13.0	119.0										352.8									
	R-09-Z1-B4	289.1	C-65	SILTSTONE	CORE	100	85	22.7	114.4															31.5				
	R-09-Z1-B4	307.4	C-69	MUDSTONE	CORE	100	55	17.2	112.8											394.0	17.0			69.1				
	R-09-Z1-B4	318.4	C-71	SANDSTONE	CORE	100	30	1.8	157.1											5458.0	216.3							
4	R-09-Z1-B5	15.0	S-3	SANDY SILT	RING		20	17.3	109.0		0:43:57																	
	R-09-Z1-B5	25.0	S-5	SANDY SILTY CLAY	RING		55	16.5	111.3																			
	R-09-Z1-B5	35.0	S-7	SANDY lean CLAY	RING		39	18.1	111.1		0:42:58	27	15	12														
	R-09-Z1-B5	45.0	S-9	SILTY SAND	RING		32	22.2	103.7		0:55:45																	
	R-09-Z1-B5	55.0	S-11	SILTY SAND	RING		24	16.7	111.1																			
	R-09-Z1-B5	65.0	S-13	SILT	RING		91/11"	30.5	88.1																			
	R-09-Z1-B5	75.0	S-15	SILTY SAND	RING		50/4"	18.2	106.0																			
	R-09-Z1-B5	81.7	C-17	SILTY SAND	CORE	90	60	18.8	106.9																			
	R-09-Z1-B5	108.3	C-20	SILTY SANDSTONE	CORE	100	75	12.9	113.1																			
	R-09-Z1-B5	120.8	C-22	SILT	CORE	95	80	21.0																				
	R-09-Z1-B5	140.8	C-24	SILTY SAND	CORE	100	94	7.8	108.0																			
	R-09-Z1-B5	171.6	C-28	SANDSTONE	CORE	70	60	10.0	117.3										562.0									
	R-09-Z1-B5	201.4	C-32	SANDSTONE	CORE	88	88	13.6	113.1										231.2									
	R-09-Z1-B5	212.0	C-33	SANDSTONE	CORE	100	80	7.6	138.6											3581.0	314.4							
	R-09-Z1-B5	231.1	C-35	SILTSTONE	CORE	94	75	15.1	106.3											325.0	15.2			56.5				
	R-09-Z1-B5	263.9	C-40	SANDSTONE	CORE	100	89	11.4	115.9										266.3									
	R-09-Z1-B5	312.8	C-46	SANDSTONE	CORE	100	100	11.2	117.6										331.2									
	R-09-Z1-B5	322.6	C-47	SANDSTONE	CORE	63	63	5.4	142.3											2299.0	146.3							
	R-09-Z1-B5	354.0	C-51	SILTSTONE	CORE	94	88	19.6																51.5				
	R-09-Z1-B5	370.6	C-54	SANDSTONE	CORE	94	88	8.7	100.6										288.7									
	R-09-Z1-B5	407.9	C-57	SANDSTONE	CORE	100	90	5.0	143.8											1850.0	214.5							
	R-09-Z1-B5	437.6	C60	GRAVELLY SILTY SAND	CORE	100	100				0:76:24																	
	R-09-Z1-B5	477.3	C65	SILTY SAND	CORE	100	90				0:77:23																	
5	R-09-Z1-B6	20.0	S-5	SANDY lean CLAY	RING		21	20.6	108.6																			
	R-09-Z1-B6	30.0	S-7	lean CLAY	RING		28	20.9	109.1			33	16	17														
	R-09-Z1-B6	40.0	S-9	SANDY lean CLAY	RING		42	18.6	112.3		0:30:70																	
	R-09-Z1-B6	50.0	S-11	SILT	RING		48	22.9	105.6																			
	R-09-Z1-B6	60.0	S-13	SILTY CLAY with SAND	RING		44	26.3	99.9		0:23:77																	
	R-09-Z1-B6	70.0	S-15	SILTY SAND	RING		41	22.8	106.0																			
	R-09-Z1-B6	80.0	S-17	SANDY SILT	RING		53	23.4	103.4		0:43:57																	
	R-09-Z1-B6	90.0	S-19	SILTY SAND	RING		84	16.8	112.7																			
	R-09-Z1-B6	131.2	C-27	CLAYSTONE	CORE	83	83				0:18:82																	
	R-09-Z1-B6	204.6	C-39	SILTSTONE	CORE	93	93	11.4	112.7											319.1								
	R-09-Z1-B6	237.5	C-42	SILTSTONE	CORE	100	100	15.6	110.7										271.5									
	R-09-Z1-B6	238.5	C-42	SILTSTONE	CORE	100	100	17.7	110.5											432.0	40.6			71.7				
	R-09-Z1-B6	267.5	C-45	SILTSTONE	CORE	98	98	12.2	121.7											389.0	7.0			74.1				
	R-09-Z1-B6	279.6	C-47	SILTSTONE	CORE	92	80	12.0	114.3										490.3									
	R-09-Z1-B6	300.4	C-49	SILTSTONE	CORE	100	100	16.6	111.1											863.0	60.2			88.7				
	R-09-Z1-B6	308.4	C-50	SILTSTONE	CORE	100	100	14.8	110.8										588.9						7.49	275	1383	30
	R-09-Z1-B6	333.9	C-53	SILTSTONE	CORE	94	81	16.6	115.1											537.0	40.6			69.4				
	R-09-Z1-B6	376.7	C-60	SILTSTONE	CORE	100	100	14.6	111.4											400.0	8.9			68.8				

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S.NO	Boring #	Depth (ft)	Sample #	Soil or Rock Description	Sample Type	Recovery (%)	Blow Count/ RQD (%)	Field Moisture Content (%)	Field Dry Density (pcf)	Corrected Expansion Index	Grain Size (G:S:F) (%)	Atterberg Limits			Consolidation Undisturbed		Direct Shear Test		UU Triaxial Test	UC Test	Modulus of Elasticity (ksi)	Cerchar Abrasivity Index	Point Load Test	Slake Durability Index	Corrosivity			
												LL	PL	PI	C_{ce}	C_{re}	Ult. Cohesion (psf)	Ult. ϕ (deg)	Undrained Shear Strength (psi)	Uniaxial Compression Strength (psi)			Uniaxial Compression Strength (psi) [=24x corr. point load]		pH	Min. Resistivity (Ω-cm)	Sulfate Content (ppm)	Chloride Content (ppm)
6	R-09-Z1-B7	25.0	S-4	lean CLAY with SAND	RING		50/4"	20.3	108.0		0:24:76	44	17	27														
	R-09-Z1-B7	35.0	S-6	SILTSTONE	RING		50/4"	23.8	102.0			42	15	27														
	R-09-Z1-B7	36.5	C-7	SILTSTONE	CORE	100	100																					
	R-09-Z1-B7	52.5	C-10	SILTSTONE	CORE	100	80	19.0	83.0		0:26:74																	
	R-09-Z1-B7	75.0	C-14	SANDSTONE	CORE	100	100	3.3	98.6		0:75:25																	
	R-09-Z1-B7	101.9	C-19	SILTSTONE	CORE	82	67	12.2	100.9		0:15:85	48	29	19														
	R-09-Z1-B7	144.4	C-25	SANDSTONE	CORE	100	100				0:74:26																	
	R-09-Z1-B7	151.9	C-27	SILTSTONE	CORE	100	100	19.1			0:11:89																	
	R-09-Z1-B7	164.9	C-30	LIMESTONE	CORE	100	100																5448					
	R-09-Z1-B7	173.0	C-32	SANDSTONE	CORE	100	100																864					
	R-09-Z1-B7	192.2	C-36	SILTSTONE	CORE	100	80																4992					
	R-09-Z1-B7	202.0	C-39	SHALE	CORE	100	100	13.6	110.8											178.0				42.0				
	R-09-Z1-B7	210.6	C-41	SILTSTONE	CORE	100	100																1752	94.0				
	R-09-Z1-B7	237.9	C-45	SILTSTONE	CORE	100	100	4.7	112.2											49.5								
	R-09-Z1-B7	248.0	C-47	SANDSTONE	CORE	100	100	12.9	113.4											440.0	44.8		576					
	R-09-Z1-B7	252.5	C-48	SANDSTONE	CORE	60	50	13.2	106.6										17.9									
	R-09-Z1-B7	284.9	C-56	SILTSTONE	CORE	100	100	13.0	107.6											932.0	46.3		528	47.9				
7	R-09-Z1-B8	15.0	S-4	SANDY SILT	SPT		9	23.0			8:22:70																	
	R-09-Z1-B8	25.0	S-6	lean CLAY	SPT		25	31.9				31	20	11														
	R-09-Z1-B8	42.5	S-9	SILTY CLAYEY SAND	P. Pen	22		21.0	110.2		3:52:45						290	29										
	R-09-Z1-B8	52.5	S-11	lean CLAY	P. Pen	100		21.9	109.3																			
	R-09-Z1-B8	80.4	C-17	CLAYSTONE	CORE	97	47	25.7	97.2		0:2:98	47	28	19					75.5									
	R-09-Z1-B8	109.4	C-23	CLAYSTONE	CORE	100	100	23.1	102.5		0:3:97	47	27	20					103.5									
	R-09-Z1-B8	119.8	C-26	SILTSTONE	CORE	100	100	21.4	104.4										161.5									
	R-09-Z1-B8	120.2	C-26	CLAYSTONE	CORE	100	100	15.7			0:4:96	48	26	22												6.18	343	1156	59
	R-09-Z1-B8	133.6	C-28	MUDSTONE	CORE	100	100	23.0	100.2											299.0	7.9			2.0				
	R-09-Z1-B8	148.2	C-31	MUDSTONE	CORE	100	100	21.8	104.9											324.0	10.0			12.9				
	R-09-Z1-B8	159.6	C-33	CLAYSTONE	CORE	100	100	21.5	105.7			47	26	21											6.26	410	720	76
	R-09-Z1-B8	175.4	C-37	MUDSTONE	CORE	100	100	21.7	102.2											289.0	8.8			0.0				
	R-09-Z1-B8	189.6	C-39	SILTSTONE	CORE	93	93	24.2	99.7										122.1									
	R-09-Z1-B8	195.6	C-41	MUDSTONE	CORE	100	100	21.7	101.6											361.0	12.1			56.8				
8	R-09-Z2-B1	15.0	D-3	CH	RING		34	29.1	124.1			64	28	36											7.10	1090	200	226
	R-09-Z2-B1	33.6	C-3	SILTSTONE	CORE	97		30.0	127.1											13.0				0.0				
	R-09-Z2-B1	50.8	C-7	CLAYST/SANDSTONE	CORE	48		24.0	129.5											28.0				2.8				
	R-09-Z2-B1	93.2	C-16	SANDSTONE	CORE	98		20.0	132.3											31.0	8.0			25.6				
	R-09-Z2-B1	115.2	C-22	SILTST/SANDSTONE	CORE	63	13	22.0	126.3											11.0								
	R-09-Z2-B1	121.0	C-23	SILTST/SANDSTONE	CORE	112			125.2											42.0	9.0							
	R-09-Z2-B1	141.0	C-5			67	0															0						
	R-09-Z2-B1	146.2	C-28	SILTST/CLAYSTONE	CORE	173	79	21.0	131.6											52.0	25.0			39.8				
9	R-09-Z2-B2	17.0	C-2	SANDSTONE	CORE	100	100	12.2	120.2		2:53:45																	
	R-09-Z2-B2	38.3	C-6	Poorly graded SAND	CORE	100	100	10.3	122.6																			
	R-09-Z2-B2	55.6	C-10	Silty SAND	CORE	100	100	10.5	125.2		8:79:13																	
	R-09-Z2-B2	77.0	C-14	CLAYSTONE	CORE	100	100	12.7	121.9		0:38:62	45	23	22														
	R-09-Z2-B2	86.3	C-16	SANDSTONE	CORE	100	100	10.1	122.4																			
	R-09-Z2-B2	119.0	C-22	SAND with silt	CORE	100	100	12.5	114.8																			
	R-09-Z2-B2	144.0	C-24	SANDSTONE	CORE	100	100	13.2	118.1		2:78:20								162.9									
	R-09-Z2-B2	165.0	C-29	SANDSTONE	CORE	86	67	16.3	114.4										201.6									
	R-09-Z2-B2	186.5	C33	SANDSTONE	CORE	100	100	17.7	111.6																			
	R-09-Z2-B2	192.8	C-34	SANDSTONE	CORE	92	0	11.7	127.3											101.0	8.8			48.8				
	R-09-Z2-B2	206.0	C-37	SILTSTONE	CORE	90	0	11.4	129.1											248.0	7.2			61.1				
	R-09-Z2-B2	213.0	C-38	SANDSTONE	CORE	90	90	11.2	121.3										181.2									
	R-09-Z2-B2	232.8	C-42	SANDSTONE	CORE	100	95	10.6	127.8											159.8					8.99	1060	99	50

TABLE E-1
SR-710 Tunnel Technical Study
Summary of Laboratory Results

S.NO	Boring #	Depth (ft)	Sample #	Soil or Rock Description	Sample Type	Recovery (%)	Blow Count/ RQD (%)	Field Moisture Content (%)	Field Dry Density (pcf)	Corrected Expansion Index	Grain Size (G:S:F) (%)	Atterberg Limits			Consolidation Undisturbed		Direct Shear Test		UU Triaxial Test	UC Test	Modulus of Elasticity (ksi)	Cerchar Abrasivity Index	Point Load Test	Slake Durability Index	Corrosivity			
												LL	PL	PI	C_{ce}	C_{re}	Ult. Cohesion (psf)	Ult. ϕ (deg)	Undrained Shear Strength (psi)	Uniaxial Compression Strength (psi)			Uniaxial Compression Strength (psi) [=24x corr. point load]		pH	Min. Resistivity (Ω-cm)	Sulfate Content (ppm)	Chloride Content (ppm)
	R-09-Z2-B2	240.6	C-44	SANDSTONE	CORE	63	0	12.3	118.9																			
	R-09-Z2-B2	260.5	C-48	CLAYEY SAND	CORE	48	0	11.0	125.3		3:71:26								190.2									
10	R-09-Z2-B3	15.0	S-4	Silty SAND	SPT		82	9.2	NA		25:60:15																	
	R-09-Z2-B3	25.0	S-8	Silty SAND	SPT		62	10.1	NA		16:66:18																	
	R-09-Z2-B3	45.0	C-16	SILTSTONE	CORE	100	0	17.7	119.0		49:39:12																	
	R-09-Z2-B3	55.0	C-18	SILTSTONE	CORE	100	50	17.4	107.1																			
	R-09-Z2-B3	80.0	C-24	SILTSTONE	CORE	100	35	14.6	114.5																			
	R-09-Z2-B3	105.0	C-29	MUDSTONE	CORE	100	80	21.6	96.4			83	28	55														
	R-09-Z2-B3	150.0	C-41	SILTSTONE	CORE	100	18	14.0	114.4															480				
	R-09-Z2-B3	165.0	C-44	SILTSTONE	CORE	100	8																		98.0			
	R-09-Z2-B3	180.0	C-47	SILTSTONE	CORE	100	18	4.1	140.3															7488				
	R-09-Z2-B3	197.2	C-50	SILTSTONE	CORE	100	25	10.3	124.1											5636.0	271.3				98.0			
	R-09-Z2-B3	215.0	C-55	SILTSTONE	CORE	100	52	10.6	126.7											2812.0	175.5				96.0			
	R-09-Z2-B3	250.9	C-62	SILTSTONE	CORE	100	33	3.1	155.0											4026.0	311.6							
	R-09-Z2-B3	267.0	C-65	SILTSTONE	CORE	100	58																			7.40	740	1633	67
	R-09-Z2-B3	280.0	C-68	SILTSTONE	CORE	100	87	11.9	119.3											2128.0	151.0				98.0			
	R-09-Z2-B3	290.0	C-70	SILTSTONE	CORE	100	30																	4368				
	R-09-Z2-B3	305.0	C-73	SILTSTONE	CORE	100	100	7.8	137.0											3558.0	234.3				98.0			
	R-09-Z2-B3	340.0	C-79	SILTSTONE	CORE	100	60	6.7	136.6											4043.0	150.1			3072				
11	R-09-Z2-B4	10.0	S-3	fat CLAY	SPT		7	30.3				54	25	29														
	R-09-Z2-B4	25.0	S-6	fat CLAY	SPT		5	34.4				51	22	29														
	R-09-Z2-B4	40.0	S-9	fat CLAY with SAND	SPT		12	32.1			6:17:77	62	24	38														
	R-09-Z2-B4	60.0	S-14	SILT	SPT		20	30.8																				
	R-09-Z2-B4	88.5	C-23	Elastic SILT	CORE	105	100	23.1	100.0		0:0:100	60	33	27														
	R-09-Z2-B4	112.5	C-28	Sandy SILT	CORE	105	100	17.3	108.7		2:47:51	NP	NP	NP														
	R-09-Z2-B4	138.4	C-34	SILTSTONE	CORE	110	100	14.6	113.3											201.0	7.9				59.2			
	R-09-Z2-B4	157.0	C-40	SILTSTONE	CORE	119	100	11.0	120.8		4:38:58								184.6									
	R-09-Z2-B4	183.4	C-48	SILTSTONE	CORE	92	92	21.3	106.0										39.8									
	R-09-Z2-B4	185.0	C-49	CLAYSTONE	CORE	125	100			77.0		67	26	41														
	R-09-Z2-B4	208.7	C-55	SILTSTONE	CORE	100	100	8.3	127.0											173.0	3.0							
	R-09-Z2-B4	219.4	C-59	CLAYSTONE	CORE	119	100	14.7	111.6			64	22	42						328.6								
	R-09-Z2-B4	255.8	C-69	SILTSTONE	CORE	114	100	15.2	147.3																51.9			
	R-09-Z2-B4	276.4	C-74	SANDSTONE	CORE	100	100	11.4	114.6											47.0	2.7							
	R-09-Z2-B4	288.9	C-78	MUDSTONE	CORE	135	100	16.0	110.3											252.0	9.8				55.5			
	R-09-Z2-B4	295.0	C-80	SILTSTONE	CORE	110	100	13.3	NA			40	24	16														
	R-09-Z2-B4	314.8	C-85	MUDSTONE	CORE	100	100	16.0	144.7																33.8			
	R-09-Z2-B4	329.0	C-90	MUDSTONE	CORE	114	100	13.3	119.5											579.0	26.4							
	R-09-Z2-B4	357.0	C-98	SILTSTONE	CORE	127	100	14.4	114.5										278.5									
	R-09-Z2-B4	365.0	C-101	SILTSTONE	CORE	122	100	14.2	NA			39	22	17														
	R-09-Z2-B4	384.3	C-106	SANDSTONE	CORE	140	100	14.0	116.7										311.7									
	R-09-Z2-B4	392.3	C-109	MUDSTONE	CORE	100	100	15.3	115.4											67.0	2.8				4.7			
12	R-09-Z2-B5	10.0	S-2	Sandy SILT	SPT		7	19.4																				
	R-09-Z2-B5	15.0	S-3	Sandy SILT	SPT		32	16.8																				
	R-09-Z2-B5	30.0	S-6	Sandy SILT	SPT		9	27.2			0:44:56																	
	R-09-Z2-B5	50.0	S-10	Silty SAND	SPT		18	21.4			3:63:34																	
	R-09-Z2-B5	75.0	S-15	Fat CLAY	SPT		20	21.2				52	22	30														
	R-09-Z2-B5	85.0	S-17	ClayeySILT	SPT		20	21.4																				
	R-09-Z2-B5	105.0	S-21	Lean CLAY	RING			27.1	101.2		0:5:95	47	17	30	0.1	0.015			14.8									
	R-09-Z2-B5	125.0	S-25	Fat CLAY	RING			28.4	94.5			58	29	29					24.4									
	R-09-Z2-B5	148.0	C-28	Fat CLAY	CORE	90	90	39.6	79.8		0:4:96								25.6									
	R-09-Z2-B5	176.6	C-36	SILTSTONE	CORE	100	20	23.3	100.8		0:3:97									114.5								
	R-09-Z2-B5	188.0	C-39	SILTSTONE	CORE	100	83	20.6	106.5											311.0	11.6				69.0			

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S.NO	Boring #	Depth (ft)	Sample #	Soil or Rock Description	Sample Type	Recovery (%)	Blow Count/ RQD (%)	Field Moisture Content (%)	Field Dry Density (pcf)	Corrected Expansion Index	Grain Size (G:S:F) (%)	Atterberg Limits			Consolidation Undisturbed		Direct Shear Test		UU Triaxial Test	UC Test	Modulus of Elasticity (ksi)	Cerchar Abrasivity Index	Point Load Test	Slake Durability Index	Corrosivity			
												LL	PL	PI	C_{ce}	C_{re}	Ult. Cohesion (psf)	Ult. ϕ (deg)	Undrained Shear Strength (psi)	Uniaxial Compression Strength (psi)			Uniaxial Compression Strength (psi) [=24x corr. point load]		pH	Min. Resistivity (Ω-cm)	Sulfate Content (ppm)	Chloride Content (ppm)
	R-09-Z2-B5	203.8	C-43	MUDSTONE	CORE	100	100	22.0	104.6											47.0	1.3			29.0				
	R-09-Z2-B5	217.5	C-47	SILTSTONE	CORE	100	82	23.4	101.5										68.8									
	R-09-Z2-B5	240.5	C-53	MUDSTONE	CORE	100	92	21.1	108.8											194.0	6.4			43.0				
	R-09-Z2-B5	265.0	C-59	SILTSTONE	CORE	111	83	23.6	99.7										69.8									
	R-09-Z2-B5	292.1	C-65	MUDSTONE	CORE	107	100	30.9	87.8											168.0	6.2			46.0				
13	R-09-Z3-B1	10.0	S-1	SILTY SAND	RING		36	13.7	121.6		1:68:31																	
	R-09-Z3-B1	20.0	S-3	SILTY SAND	SPT		30	15.9	116.7		1:56:43	21	20	1														
	R-09-Z3-B1	172.5	C-38	CONGLOMERATE	CORE	75	42																696					
	R-09-Z3-B1	173.8	C-38	CONGLOMERATE	CORE	75	42																9792					
	R-09-Z3-B1	184.0	C-40	CONGLOMERATE	CORE	63	13																2400					
	R-09-Z3-B1	192.5	C-42	DIORITE	CORE	79	30	0.3	164.4											4690.0	357.1							
	R-09-Z3-B1	193.6	C-42	DIORITE	CORE	79	30																16080					
	R-09-Z3-B1	198.9	C-44	CONGLOMERATE	CORE	90	43																6816					
	R-09-Z3-B1	202.5	C-45	CONGLOMERATE	CORE	100	22																3336					
	R-09-Z3-B1	216.8	C-48	CONGLOMERATE	CORE	70	28	7.7			35:55:10																	
	R-09-Z3-B1	236.8	C-52	DIORITE	CORE	88	33																1344					
	R-09-Z3-B1	238.7	C-52	DIORITE	CORE	88	33																2832					
	R-09-Z3-B1	239.9	C-52	DIORITE	CORE	88	33																480					
	R-09-Z3-B1	241.7	C-53	CONGLOMERATE	CORE	53	21																1440					
	R-09-Z3-B1	253.7	C-55	DIORITE	CORE	58	22																2424					
	R-09-Z3-B1	264.1	C-57	CONGLOMERATE	CORE	68	18															4.2	1416					
	R-09-Z3-B1	266.7	C-58	DIORITE	CORE	73	53	0.3	167.5											8045.0	765.8							
	R-09-Z3-B1	270.7	C-58	CONGLOMERATE	CORE	73	53																360					
	R-09-Z3-B1	277.6	C-60	CONGLOMERATE	CORE	53	15	7.9			38:51:11																	
14	R-09-Z3-B2	11.8	S-4	P.G. SAND with SILT and GRAVEL	RING		50/3"	9.8	129.3			NP	NP	NP							\							
	R-09-Z3-B2	15.0	S-5	W.G. SAND with SILT and GRAVEL	SPT		48	9.2			24:68:8																	
	R-09-Z3-B2	31.3	S-9	W.G. SAND with SILT and GRAVEL	RING		50/5"	9.2	132.3		40:54:6																	
	R-09-Z3-B2	40.0	S-11	SILTY SAND	SPT		43	15.3																				
	R-09-Z3-B2	55.0	S-17	W.G. SAND with SILT and GRAVEL	SPT		50/0.5"	10.9			19:74:7																	
	R-09-Z3-B2	64.2	S-20	SILTY SAND	SPT		69	17.9			1:73:26																	
	R-09-Z3-B2	71.5	C-23	SILTY SAND	CORE	97	0	14.7																				
	R-09-Z3-B2	81.5	C-27	P.G. SAND with GRAVEL	CORE	91	0	15.1			23:74:3																	
	R-09-Z3-B2	90.0	S-30	SILTY SAND	SPT		57	15.3			5:75:20																	
	R-09-Z3-B2	100.0	S-34	SILTY SAND	SPT		60	16.8			1:77:22																	
	R-09-Z3-B2	106.5	C-37	SILTY SAND	CORE	100	0	18.4																				
	R-09-Z3-B2	111.5	C-39	SILTY SAND	CORE	100	0	11.5			11:58:31																	
	R-09-Z3-B2	116.5	C-41	CLAYEY SAND	CORE	69	0	13.6				31	17	14														
	R-09-Z3-B2	146.9	C-49	QUARTZITE	CORE	70	10	0.3	159.8														2928					
	R-09-Z3-B2	171.6	C-54	QUARTZITE	CORE	48	0	0.4	155.0														1296					
	R-09-Z3-B2	227.6	C-68	QUARTZITE	CORE	71	20	2.5	156.1														576					
15	R-09-Z3-B3	246.4	C52	DIORITE	CORE	100	0	13.2	141.8		2:64:34	25	14	11											7.10	1090	200	226
	R-09-Z3-B3	254.0	C53	DIORITE	CORE	98	54	3.9	147.3											229.0								
	R-09-Z3-B3	255.0	C53	DIORITE	CORE	100	67		147.3											229.0	200.0							
	R-09-Z3-B3	258.5	C54	DIORITE	CORE	100	0		151.2											35.0								
	R-09-Z3-B3	270.5	C55	FAULT GOUGE	CORE	100	0		146.5											92.0		0						
	R-09-Z3-B3	271.5	C56	DIORITE	CORE	98	0		146.5											92.0	45.0							
	R-09-Z3-B4	15.0	S-3	SILTY SAND	RING		35	17.4	107.1		2:60:38	NP	NP	NP														
	R-09-Z3-B4	40.0	S-8	SILT with SAND	RING		93/9"	23.6	103.8		0:22:78	27	24	3														

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S.NO	Boring #	Depth (ft)	Sample #	Soil or Rock Description	Sample Type	Recovery (%)	Blow Count/ RQD (%)	Field Moisture Content (%)	Field Dry Density (pcf)	Corrected Expansion Index	Grain Size (G:S:F) (%)	Atterberg Limits			Consolidation Undisturbed		Direct Shear Test		UU Triaxial Test	UC Test	Modulus of Elasticity (ksi)	Cerchar Abrasivity Index	Point Load Test	Slake Durability Index	Corrosivity			
												LL	PL	PI	C_{ce}	C_{re}	Ult. Cohesion (psf)	Ult. ϕ (deg)	Undrained Shear Strength (psi)	Uniaxial Compression Strength (psi)			Uniaxial Compression Strength (psi) [=24x corr. point load]		pH	Min. Resistivity (Ω-cm)	Sulfate Content (ppm)	Chloride Content (ppm)
16	R-09-Z3-B4	50.0	S-10	SILTY CLAYEY SAND	RING		78/10"	15.8	118.1		8:50:42	NP	NP	NP														
	R-09-Z3-B4	65.0	S-13	SILTY SAND	SPT		85	23.5			1:51:48																	
	R-09-Z3-B4	75.0	S-15	SILTY SAND	SPT		50/6"	20.7																				
	R-09-Z3-B4	97.0	C-20	SILTY SAND	CORE	50	33	12.0			2:65:33																	
	R-09-Z3-B4	107.5	C-22	SILTY SAND	CORE	80	60	13.4			1:55:44																	
	R-09-Z3-B4	157.5	C-32	P.G. SAND with SILT	CORE	50	20	14.1			9:84:7																	
	R-09-Z3-B4	218.2	C-44	ANDESITE	CORE	86	52	1.2	162.2											406.0	29.0							
	R-09-Z3-B4	221.2	C-45	ANDESITE	CORE	100	60	2.6	254.1											254.0	4.6		144					
	R-09-Z3-B4	236.8	C-48	DIORITE	CORE	100	33																4488					
	R-09-Z3-B4	248.9	C-52	DIORITE	CORE	83	33															2.6	1176					
	R-09-Z3-B4	270.3	C-56	DIORITE	CORE	88	0																2544					
	R-09-Z3-B4	272.6	C-57	DIORITE	CORE	100	76	1.2	90.4											2998.0	358.2		3072					
17	R-09-Z3-B5	15.0	S-3	CLAYEY SAND	SPT		15	17.6	NA			25	11	14														
	R-09-Z3-B5	35.0	S-7	Silty SAND	SPT		26	13.7	NA		1:64:35																	
	R-09-Z3-B5	45.0	S-9	Silty SAND	SPT		24	14.3	NA																			
	R-09-Z3-B5	55.0	S-11	SILT	SPT		79/9"	13.0	NA		0:64:36																	
	R-09-Z3-B5	65.0	S-13	Silty SAND with gravel	SPT		29	15.9	NA		0:50:50																	
	R-09-Z3-B5	75.0	C-16	SANDSTONE	CORE	100	0	13.3	123.4		0:68:32																	
	R-09-Z3-B5	100.0	C-21	SANDSTONE	CORE	100	6	9.0	130.8																			
	R-09-Z3-B5	135.0	C-28	SANDSTONE	CORE	100	8	8.0	136.9		1"62:37																	
	R-09-Z3-B5	155.0	C-32	SANDSTONE	CORE	100	72	6.2	142.3											97.4								
	R-09-Z3-B5	170.0	C-35	SANDSTONE	CORE	100	70				1:73:26																	
	R-09-Z3-B5	200.0	C-41	SANDSTONE	CORE	100	46	5.8	141.5											773.0	45.1							
	R-09-Z3-B5	242.0	C-48	CONGLOMERATE	CORE	100	66	4.8	141.7											54.4								
	R-09-Z3-B5	258.8	C-52	SANDSTONE	CORE	104	64	5.4	135.5											39.1								
	R-09-Z3-B5	270.6	C-55	SILTSTONE	CORE	125	50	9.8	138.9											2812.0	154.0			0.3				
	R-09-Z3-B5	295.3	C-61	SANDSTONE	CORE	100	93	0.9	162.2											5196.0	445.6							
	R-09-Z3-B5	306.5	C-64	MUDSTONE	CORE	113	50	8.5	133.2											41.0	2.0			3.0				
	R-09-Z3-B5	349.1	C-75	MUDSTONE	CORE	123	0	2.8	142.5											361.0	13.4							
	R-09-Z3-B5	349.5	C-76	SANDSTONE	CORE	120	33																		7.10	250	5109	68
	R-09-Z3-B5	370.1	C-79	SANDSTONE	CORE	100	48	6.2	118.8											569.0	6.2							
	R-09-Z3-B5	394.0	C-84	SANDSTONE	CORE	100	24	5.2	135.5											63.2								
18	R-09-Z3-B6	5.0	S-1	SILTY SAND	SPT		11	6.4			4:61:35																	
	R-09-Z3-B6	10.0	S-2	SILTY SAND with GRAV.	RING		88/7"	8.4	127.8		28:56:16																	
	R-09-Z3-B6	173.0	C-27	CONGLOMERATE	CORE	67	7	11.2			16:65:19																	
	R-09-Z3-B6	175.2	C-28	CONGLOMERATE	CORE	67	7																696					
	R-09-Z3-B6	195.7	C-31	SANDSTONE	CORE	98	30															3.9						
	R-09-Z3-B6	198.3	C-32	CONGLOMERATE	CORE	100	29																360					
	R-09-Z3-B6	209.3	C-34	CONGLOMERATE	CORE	90	72	4.2	145.8											1243.0	105.7		1368					
	R-09-Z3-B6	216.4	C-35	CONGLOMERATE	CORE	98	87																312					
	R-09-Z3-B6	218.3	C-35	CONGLOMERATE	CORE	98	87	1.9	148.8											899.0	60.5							
	R-09-Z3-B6	221.5	C-35	CONGLOMERATE	CORE	98	87	3.1	141.8											393.0	31.6		480					
	R-09-Z3-B6	222.5	C-36	CONGLOMERATE	CORE	57	13																504					
	R-09-Z3-B6	227.5	C-37	CONGLOMERATE	CORE	67	32	2.4	152.0											523.0	51.7		744					
	R-09-Z3-B6	254.2	C-43	CONGLOMERATE	CORE	59	19																3144					
	R-09-Z3-B6	257.4	C-44	CONGLOMERATE	CORE	50	32	3.1																66.1				
	R-09-Z3-B6	257.7	C-44	CONGLOMERATE	CORE	50	32	2.0	153.7											770.0	54.5		4176					
	R-09-Z3-B6	284.0	C-49	CONGLOMERATE	CORE	45	19																480					
	R-09-Z3-B6	298.3	C-52	CONGLOMERATE	CORE	46	24																96					
	R-09-Z3-B6	299.0	C-52	SANDSTONE	CORE	46	24	6.1			22:56:22																	
	R-09-Z3-B6	304.5	C-53	SANDSTONE	CORE	100	87	11.7			9:58:33																	
	R-09-Z3-B7	6.0	D-1	GRAVEL with sand	CORE			6.9																				

TABLE E-1
SR-710 Tunnel Technical Study
Summary of Laboratory Results

S.NO	Boring #	Depth (ft)	Sample #	Soil or Rock Description	Sample Type	Recovery (%)	Blow Count/ RQD (%)	Field Moisture Content (%)	Field Dry Density (pcf)	Corrected Expansion Index	Grain Size (G:S:F) (%)	Atterberg Limits			Consolidation Undisturbed		Direct Shear Test		UU Triaxial Test	UC Test	Modulus of Elasticity (ksi)	Cerchar Abrasivity Index	Point Load Test	Slake Durability Index	Corrosivity			
												LL	PL	PI	C_{ce}	C_{re}	Ult. Cohesion (psf)	Ult. ϕ (deg)	Undrained Shear Strength (psi)	Uniaxial Compression Strength (psi)			Uniaxial Compression Strength (psi) [=24x corr. point load]		pH	Min. Resistivity (Ω-cm)	Sulfate Content (ppm)	Chloride Content (ppm)
19	R-09-Z3-B7	21.0	S-2	SILTY Claye SAND	SPT		56	13.3	123.3		0:51:49																	
	R-09-Z3-B7	31.0	C-3	SILTY SAND	CORE			14.0	120.0																			
	R-09-Z3-B7	41.0	C-4	SILTY SAND	CORE			15.9	117.1																			
	R-09-Z3-B7	51.0	S-5	Sandy SILT	SPT	22		14.3	121.4		0:48:52																	
	R-09-Z3-B7	61.0	O-7	Silty SAND				14.8			8:47:45																	
	R-09-Z3-B7	71.0	C-9	SILT	CORE			14.8																				
	R-09-Z3-B7	71.3	C-13	SANDSTONE	CORE	100		13.5			0:24:76	33	16	17														
	R-09-Z3-B7	90.0	C-17	SANDSTONE	CORE			8.5	132.6																			
	R-09-Z3-B7	96.0	C-19	SANDSTONE	CORE			7.0	133.6		0:60:40																	
	R-09-Z3-B7	120.1	S-23	SANDSTONE	SPT		50/3"	5.8	135.8		0:63:37																	
	R-09-Z3-B7	144.3	C-28	SANDSTONE	CORE	100	50	3.9	143.8										151.6									
	R-09-Z3-B7	154.7	C-30	SANDSTONE	CORE	98	76	4.8	141.6											521.0	32.6							
	R-09-Z3-B7	174.2	C-34	SANDSTONE	CORE	100	54	6.3	138.1											82.0	5.6							
	R-09-Z3-B7	186.4	C-37	SANDSTONE	CORE	100	100	6.6	135.1										89.7									
	R-09-Z3-B7	206.5	C-43	SANDSTONE	CORE	100	100	6.1	138.0											93.0	5.4							
	R-09-Z3-B7	220.6	C-47	SANDSTONE	CORE	100	60	1.3	148.1														Invalid Failure					
	R-09-Z3-B7	231.4	C-51	SANDSTONE	CORE	98	62	5.9	143.0											45.0	3.5							
	R-09-Z3-B7	241.6	C-53	MUDSTONE	CORE	94	60	4.4	146.7											397.0	12.3							
	R-09-Z3-B7	251.1	C-56	SANDSTONE	CORE			5.3	144.7										277.6						7.22	770	768	32
	R-09-Z3-B7	260.8	C-59	SANDSTONE	CORE	100	74	4.0	143.8											385.0	31.2			840				
	R-09-Z3-B7	281.5	C-65	SANDSTONE	CORE	98	44	6.8	146.6											66.0	3.0			Invalid Failure				
	R-09-Z3-B7	291.0	C-67	SANDSTONE	CORE			5.2	142.1										312.9									
	R-09-Z3-B7	321.8	C-73	SANDSTONE	CORE	100	78	3.2	149.9											1542.0	100.7							
20	R-09-Z3-B8	10.0	C-3	SANDY SILTY CLAY	RING		78	24.7																				
	R-09-Z3-B8	20.0	C-5	Sandy SILT	SPT		78	22.8	104.0			53	27	26														
	R-09-Z3-B8	29.2	C-7	SILTSTONE	CORE	100	43	24.8	96.3			59	24	35														
	R-09-Z3-B8	52.6	C-12	SANDSTONE	CORE	100	40	21.6	101.5			47	28	19														
	R-09-Z3-B8	88.0	C-20	SILTSTONE	CORE	93	67	12.8	117.0																			
	R-09-Z3-B8	116.2	C-27	SILTSTONE	CORE	93	18	10.2	129.4																			
	R-09-Z3-B8	140.8	C-33	SILTSTONE	CORE	100	77	9.2																	92.2			
	R-09-Z3-B8	156.4	C-37	SANDSTONE	CORE	100	20	7.9															3936					
	R-09-Z3-B8	166.6	C-40	SANDSTONE	CORE	100	10																4176					
	R-09-Z3-B8	174.4	C-42	SILTSTONE	CORE	100	60	6.8	137.4											663.0	40.5							
	R-09-Z3-B8	192.4	C-46	CLAYSTONE	CORE	100	73	10.5																	94.7			
	R-09-Z3-B8	197.0	C-48	SILTSTONE	CORE	100	32	8.1	131.0											2193.0	78.0							
	R-09-Z3-B8	205.4	C-51	SILTSTONE	CORE	100	42	8.1	132.7											774.0	25.9				95.1			
	R-09-Z3-B8	218.0	C-54	CLAYSTONE	CORE																					7.50	1600	5188	64
	R-09-Z3-B8	227.8	C-56	SILTSTONE	CORE	100	83	8.5																	98.0			
	R-09-Z3-B8	235.7	C-58	SILTSTONE	CORE	100	92	5.9	135.1											4898.0	268.5							
	R-09-Z3-B8	256.4	C-63	SILTSTONE	CORE	100	100	6.7	131.6											2641.0	130.6							
	R-09-Z3-B8	265.7	C-65	SILTSTONE	CORE	100	81																6960					
21	R-09-Z3-B9	15.0	S-4	Sand with Silt and Gravel	RING	100		9.0	133.4		41:51:8																	
	R-09-Z3-B9	60.0	S-10	Silty SAND	SPT		46	19.6			0:67:33																	
	R-09-Z3-B9	90.0	S-13	Silty SAND	SPT		47	21.2			0:64:36																	
	R-09-Z3-B9	130.0	S-17	Silty SAND	SPT		80	19.9																				
	R-09-Z3-B9	150.0	S-19	Clayey SAND	SPT		57	14.3			0:55:45	30	20	12														
	R-09-Z3-B9	165.0	C-22	Silty SAND	CORE	100	100	11.0	120.6		5:77:18																	
	R-09-Z3-B9	180.0	C-26	Silty SAND	CORE	100	100	10.8	118.4		5:71:24																	
	R-09-Z3-B9	271.3	C-45	DIORITE	CORE	84	19	2.6	128.8														1008					
	R-09-Z3-B9	292.7	C-50	DIORITE	CORE	100	0	1.0	151.8														1320					
	R-09-Z3-B10	10.0	S-3	Lean CLAY	P. Pen	100		23.2	107.0																			
	R-09-Z3-B10	25.0	S-6	fat CLAY with SAND	SPT		19	24.0			0:22:78	57	24	33														

TABLE E-1
SR-710 Tunnel Technical Study
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S.NO	Boring #	Depth (ft)	Sample #	Soil or Rock Description	Sample Type	Recovery (%)	Blow Count/ RQD (%)	Field Moisture Content (%)	Field Dry Density (pcf)	Corrected Expansion Index	Grain Size (G:S:F) (%)	Atterberg Limits			Consolidation Undisturbed		Direct Shear Test		UU Triaxial Test	UC Test	Modulus of Elasticity (ksi)	Cerchar Abrasivity Index	Point Load Test	Slake Durability Index	Corrosivity			
												LL	PL	PI	C_{ce}	C_{re}	Ult. Cohesion (psf)	Ult. ϕ (deg)	Undrained Shear Strength (psi)	Uniaxial Compression Strength (psi)			Uniaxial Compression Strength (psi) [=24x corr. point load]		pH	Min. Resistivity (Ω-cm)	Sulfate Content (ppm)	Chloride Content (ppm)
22	R-09-Z3-B10	50.0	S-11	Lean CLAY	P. Pen	100		23.7	106.5			47	21	26														
	R-09-Z3-B10	70.7	C-16	CLAYSTONE	CORE	100	100	10.1	127.8		0:18:82	39	22	17														
	R-09-Z3-B10	101.9	C-22	CLAYSTONE	CORE	100	100	15.6	112.1																			
	R-09-Z3-B10	124.2	C-27	CLAYSTONE	CORE	113	93	13.1	115.8.		0:11:89	55	23	32														
	R-09-Z3-B10	152.0	C-35	SANDSTONE	CORE	75	75	11.2	115.8																			
	R-09-Z3-B10	171.0	C-41	SILTSTONE	CORE	100	94	10.3	120.6																			
	R-09-Z3-B10	188.3	C-47	SANDSTONE	CORE	108	63	17.4	110.1																			
	R-09-Z3-B10	225.4	C-59	SANDSTONE	CORE	100	100	12.5	122.8											92.0	4.2							
	R-09-Z3-B10	255.2	C-66	CLAYSTONE	CORE	107	0	16.4	110.2																7.74	226	1942	30
	R-09-Z3-B10	260.0	C-67	CLAYSTONE	CORE	100	72			69.0		43	21	22														
	R-09-Z3-B10	289.5	C-73	SILTSTONE	CORE	117	83	10.6	126.5											851.0	42.1				79.8			
	R-09-Z3-B10	316.4	C-79	SANDSTONE	CORE	106	100	9.2	132.6											246.0	12.2							
	R-09-Z3-B10	331.3	C-83	SILTSTONE	CORE	100	94	12.3	120.9											133.0	7.5				76.3			
	R-09-Z3-B10	340.0	C-85	SILTSTONE	CORE	100	50					44	19	25														
	R-09-Z3-B10	356.7	C-89	SILTSTONE	CORE	100	75	7.9	133.8											225.0	16.3							
23	R-09-Z3-B11	11.0	O-3	SILTY SAND	P. Pen			12.8	113.1		3:66:31																	
	R-09-Z3-B11	23.5	O-5	P.G. SAND with SILT	P. Pen			11.1	107.1			NP	NP	NP														
	R-09-Z3-B11	33.5	O-7	SILTY SAND	P. Pen			14.2	102.4																			
	R-09-Z3-B11	43.5	O-9	P.G. SAND with SILT	P. Pen			21.9	97.8		0:90:10																	
	R-09-Z3-B11	63.5	O-12	W.G. SAND with SILT and GRAVEL	P. Pen			9.5	137.9		29:64:7																	
	R-09-Z3-B11	73.5	O-14	SILTY SAND	P. Pen			21.2	100.5		0:61:39	0	61	39														
	R-09-Z3-B11	81.0	O-16	Sand with SILT	P. Pen			17.5	111.9																			
	R-09-Z3-B11	86.0	S-17	Silty SAND	SPT		28	16.8				31	23	8														
	R-09-Z3-B11	91.0	O-18	Sandy SILT	P. Pen			19.8	100.9			0	44	56														
	R-09-Z3-B11	101.0	O-20	Clayey SAND	P. Pen			9.9	100.9			27	17	10														
	R-09-Z3-B11	116.4	C-24	Silty SAND	CORE	67		11.8			16:66:18	27	25	2														
	R-09-Z3-B11	125.0	C-25	Silty SAND	CORE	100		10.9			4:81:15																	
	R-09-Z3-B11	131.5	C-27	SANDY lean CLAY	CORE	20		25.7			1:35:64	39	18	21														
	R-09-Z3-B11	150.5	C-30	Sand with SILT	CORE	100		14.1			6:86:8																	
	R-09-Z3-B11	171.5	C-35	CLAYSTONE	CORE	100	80	24.9	101.2		0:18:82	60	25	35					29.9							6.86	1240	91	30
	R-09-Z3-B11	184.7	C-37	CLAYSTONE	CORE	110	100	22.0	102.8											58.1								
	R-09-Z3-B11	209.4	C-42	SILTSTONE	CORE	100	100	21.0	112.4											47.0	2.3				0.0			
	R-09-Z3-B11	217.5	C-44	CLAYSTONE	CORE	100	100	21.9	100.7			61	29	32					40.9									
	R-09-Z3-B11	226.4	C-46	MUDSTONE	CORE	110	50	14.7	118.8											38.0	2.2							
	R-09-Z3-B11	245.6	C-49	MUDSTONE	CORE	120	90	12.9	124.3			48	14	34						131.0	3.3				0.1			
	R-09-Z3-B11	263.4	C-54	MUDSTONE	CORE	100	100	14.0	118.5			40	21	19					42.5	12.0	--				22.4			
24	R-09-Z3-B12	25.0	S-5	SILTY SAND	RING		51	24.0	103.7																			
	R-09-Z3-B12	35.0	S-7	Silty SAND	RING		42	29.4	97.3		0:25:75	NP	NP	NP														
	R-09-Z3-B12	45.0	S-9	SILTY SAND	RING		75	24.3	101.8		0:78:22																	
	R-09-Z3-B12	55.0	S-11	P.G. SAND with SILT	RING		89/10"	25.9	101.1																			
	R-09-Z3-B12	75.0	S-15	MUDSTONE	RING		56	20.9	106.4		1:16:83	44	17	27														
	R-09-Z3-B12	101.3	C-21	MUDSTONE	CORE	100	100	17.1	102.8		1:19:80	48	22	26														
	R-09-Z3-B12	109.4	C-23	MUDSTONE	CORE	100	100	22.9	94.6			51	24	27					37.9									
	R-09-Z3-B12	124.8	C-27	MUDSTONE	CORE	100	100	26.6	93.4		0:4:96	61	29	32					66.8									
	R-09-Z3-B12	140.0	C-30	MUDSTONE	CORE	94	94	29.1	88.0		1:4:95								73.4									
	R-09-Z3-B12	164.9	C-34	SHALE	CORE	100	100																			7.76	1320	85	41
	R-09-Z3-B12	178.6	C-38	CLAYSTONE	CORE	92	92	22.8	86.6																			
	R-09-Z3-B12	188.3	C-40	SHALE	CORE	72	50	20.4	93.0											100.2								
	R-09-Z3-B12	190.8	C-41	SHALE	CORE	100	100	22.0	93.6																87.4			
	R-09-Z3-B12	201.5	C-44	SANDSTONE	CORE	100	100	16.3	92.0											48.1								
	R-09-Z3-B12	214.3	C-47	SHALE	CORE	61	61	19.3	105.5											503.0	47.3				84.8			

TABLE E-1
SR-710 Tunnel Technical Study
Summary of Laboratory Results

S.NO	Boring #	Depth (ft)	Sample #	Soil or Rock Description	Sample Type	Recovery (%)	Blow Count/ RQD (%)	Field Moisture Content (%)	Field Dry Density (pcf)	Corrected Expansion Index	Grain Size (G:S:F) (%)	Atterberg Limits			Consolidation		Direct Shear Test		UU Triaxial Test	UC Test	Modulus of Elasticity (ksi)	Cerchar Abrasivity Index	Point Load Test	Slake Durability Index	Corrosivity			
															Undisturbed													
												LL	PL	PI	C_{ce}	C_{re}	Ult. Cohesion (psf)	Ult. ϕ (deg)	Undrained Shear Strength (psi)	Uniaxial Compression Strength (psi)			Uniaxial Compression Strength (psi) [=24x corr. point load]		pH	Min. Resistivity (Ω-cm)	Sulfate Content (ppm)	Chloride Content (ppm)
	R-09-Z3-B12	229.2	C-51	SHALE	CORE	89	62																		7.41	600	798	59
	R-09-Z3-B12	249.4	C-56	SHALE	CORE	76	60	19.7	102.5											232.0	27.2								
	R-09-Z3-B12	267.5	C-61	SHALE	CORE	98	98	11.5	101.2											518.7									
	R-09-Z4-B4	15.0	S-3	SANDY SILTY CLAY	RING		32	18.4	113.0		0:31:69	22	18	4															
	R-09-Z4-B4	25.0	S-5	SILTY SAND	RING		41	21.4	102.5																				
	R-09-Z4-B4	35.0	S-7	SANDY SILTY CLAY	RING		31	19.5	109.6		0:43:57	24	19	5															
	R-09-Z4-B4	50.0	S-10	SILTY SAND with GRAV.	SPT		54	12.3			15:69:16																		
	R-09-Z4-B4	65.0	S-13	SILTY SAND	RING		75	14.3	119.2		1:61:38																		
	R-09-Z4-B4	85.0	S-17	fat CLAY	SPT		42	27.9				56	23	33															
	R-09-Z4-B4	97.5	C-19	CLAYSTONE	CORE	100	100	26.6	95.0		0:1:99	57	29	28					91.8						6.57	1720	21	20
25	R-09-Z4-B4	126.9	C-24	SILTSTONE	CORE	100	100	20.0	101.7			47	33	14						288.6									
	R-09-Z4-B4	139.7	C-26	SILTSTONE	CORE	90	83	17.6	101.9										262.1										
	R-09-Z4-B4	156.7	C-28	SILTSTONE	CORE	100	100	17.4												451.0	19.4			61.0					
	R-09-Z4-B4	185.2	C-33	SILTSTONE	CORE	100	100					52	34	18															
	R-09-Z4-B4	199.0	C-35	SILTSTONE	CORE	100	100	18.3												351.0	15.6			0.6					
	R-09-Z4-B4	221.0	C-38	SILTSTONE	CORE	100	100	20.0	101.4										255.5						4.63	269	3942	60	
	R-09-Z4-B4	234.5	C-40	SILTSTONE	CORE	100	100	13.7												444.0	21.1			12.8					
	R-09-Z4-B4	263.0	C-44	SILTSTONE	CORE	100	100	20.8	102.3										256.2										

Boring No.	R-09-Z1-B4	R-09-Z1-B4	R-09-Z1-B4	R-09-Z1-B4	R-09-Z1-B4	R-09-Z1-B4	R-09-Z1-B4	R-09-Z1-B4
Sample No.	C-1	C-7	C-12	C-17	C-19	C-22	C-26	C-29
Depth (ft.)	13-13.4	21-21.4	30-33.5	45-50	51.5-55	66-66.6	90.3-91.1	105.1-105.7
Sample Type	Small bag	Small bag	Small bag	Core	Core	Core	Core	Core
Soil Identification	Olive clayey sand (SC)	Olive gray well-graded sand with gravel (SW)g	Olive poorly-graded sand (SP)	Olive silty sand (SM)	Olive brown silty sand (SM)	Dark olive brown silt'stone' (ML)	Gray silty sand'stone' (SM)	Gray silty sand'stone' (SM)
Pocket Penetrometer (tons/ft^2)				N/A		2.50	>4.50	>4.50
Weight Soil + Rings / Tube (g)				681.20		746.80	870.30	724.50
Weight of Rings / Tube (g)				0.00		0.00	0.00	0.00
Average Length (in.)				4.2825		5.0920	5.4785	4.9165
Average Diameter (in.)				2.470		2.450	2.373	2.325
Wet. Wt. of Soil + Cont. (g)	810.00	897.40	1165.30	757.70	440.20	853.80	549.30	369.20
Dry Wt. of Soil + Cont. (g)	728.70	808.70	1047.40	639.50	370.90	678.00	496.40	334.90
Weight of Container (g)	108.70	111.10	107.80	77.30	79.20	108.00	78.20	76.10
Container No.								
Wet Density				126.5		118.5	136.8	132.2
Moisture Content (%)	**13.1**	**12.7**	**12.5**	**21.0**	**23.8**	**30.8**	**12.6**	**13.3**
Dry Density (pcf)				**104.5**		**90.6**	**121.5**	**116.8**
Degree of Saturation (%)				92.6		96.7	88.1	80.6

Leighton

MOISTURE & DENSITY of SOILS

ASTM D 2216 & ASTM D 2937

Project Name: SR-710 Tunnel Technical Study
Project No.: 378312.04.09.01
Client Name: CH2M Hill
Tested By: A. Santos Date: 05/28/09

Boring No.	R-09-Z1-B4	R-09-Z1-B4						
Sample No.	C-34	C-40						
Depth (ft.)	132.3-133	164.4-165						
Sample Type	Core	Core						
Soil Identification	Gray silty sand'stone' (SM)	Dark olive elastic silt'stone' (MH)						
Pocket Penetrometer (tons/ft^2)	>4.50	N/A						
Weight Soil + Rings / Tube (g)	542.90	798.50						
Weight of Rings / Tube (g)	0.00	0.00						
Average Length (in.)	3.4545	5.1120						
Average Diameter (in.)	2.390	2.424						
Wet. Wt. of Soil + Cont. (g)	659.00	1445.30						
Dry Wt. of Soil + Cont. (g)	587.10	1245.80						
Weight of Container (g)	76.30	107.90						
Container No.								
Wet Density	133.5	128.9						
Moisture Content (%)	**14.1**	**17.5**						
Dry Density (pcf)	**117.0**	**109.7**						
Degree of Saturation (%)	86.2	88.2						

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MOISTURE & DENSITY of SOILS

ASTM D 2216 & ASTM D 2937

Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Client Name: CH2M Hill

Tested By: A. Santos Date: 05/28/09

MOISTURE CONTENT & UNIT WEIGHT TEST RESULTS

Sample Identification	Depth, ft.	Wet Unit Weight, lb/ft.^{3}	Dry Unit Weight, lb/ft.^{3}	Moisture Content, %
R-09-Z1-B4, C42	171.5-171.9	153.5	135.0	13.7
R-09-Z1-B4, C50	212.5-212.9	142.1	111.8	27.1
R-09-Z1-B4, C65	288.8-289.3	140.3	114.4	22.7

Test Method: ASTM D2216, ASTM D2937

5040 Robert J. Mathews Blvd., El Dorado Hills, CA 95762
Phone: (916) 939-3460 FAX: (916) 939-3507

Boring No.	R-09-Z1-B5	R-09-Z1-B5	R-09-Z1-B5	R-09-Z1-B5	R-09-Z1-B5	R-09-Z1-B5	R-09-Z1-B5	
Sample No.	S3	S5	S7	S9	S11	S13	S15	
Depth (ft.)	15.0	25.0	35.0	45.0	55.0	65.0	75.0	
Sample Type	Drive	Drive	Drive	Drive	Drive	Drive	Drive	
Soil Identification	Dark brown sandy silt s(ML)	Dark brown sandy silty clay s(CL-ML)	Brown sandy lean clay s(CL)	Brown silty sand (SM)	Yellowish brown silty sand (SM)	Light olive silt (ML)	Yellowish brown silty sand (SM)	
Pocket Penetrometer (tons/ft^2)	2.75 / 4.50	>4.50	3.75 / 3.00	1.75 / 3.00	>4.50	>4.50	>4.50	
Weight Soil + Rings / Tube (g)	993.80	1207.90	1016.20	985.40	1207.40	915.90	404.60	
Weight of Rings / Tube (g)	231.55	277.86	231.55	231.55	277.86	231.55	92.62	
Average Length (in.)	4.994	6.012	5.012	4.987	6.005	4.988	2.086	
Average Diameter (in.)	2.406	2.406	2.406	2.406	2.406	2.406	2.406	
Wet. Wt. of Soil + Cont. (g)	678.10	211.70	694.20	505.10	221.60	181.60	240.10	
Dry Wt. of Soil + Cont. (g)	589.10	190.30	599.50	427.40	198.10	147.80	212.50	
Weight of Container (g)	75.80	60.30	76.50	76.80	57.80	36.90	60.70	
Container No.								
Wet Density	127.9	129.6	131.2	126.7	129.7	115.0	125.3	
Moisture Content (%)	**17.3**	**16.5**	**18.1**	**22.2**	**16.7**	**30.5**	**18.2**	
Dry Density (pcf)	**109.0**	**111.3**	**111.1**	**103.7**	**111.1**	**88.1**	**106.0**	
Degree of Saturation (%)	85.7	86.4	94.4	95.6	87.4	90.1	83.3	

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MOISTURE & DENSITY of SOILS

ASTM D 2216 & ASTM D 2937

Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Client Name: CH2M Hill

Tested By: V. Juliano Date: 04/03/09

Boring No.	R-09-Z1-B5	R-09-Z1-B5	R-09-Z1-B5	R-09-Z1-B5	R-09-Z1-B5	R-09-Z1-B5		
Sample No.	C17	C20	C22	C24	C51	C65		
Depth (ft.)	81.5-81.9	108.1-108.5	120.5-121	140.5-141.1	350-350.4	477-477.6		
Sample Type	Core	Core	Core	Core	Core	Core		
Soil Identification	Yellowish brown silty sand (SM)	Yellowish brown silty sand'stone' (SM)	Olive silt (ML)	Light olive silty sand (SM) with greasy contaminant	Olive silt'stone' (ML), density not possible	Light olive silty sand (SM)		
Pocket Penetrometer (tons/ft^2)	N/A	>4.50		>4.50		N/A		
Weight Soil + Rings / Tube (g)	902.50	990.50		991.50		1132.70		
Weight of Rings / Tube (g)	0.00	0.00		0.00		0.00		
Average Length (in.)	3.1890	3.5400		4.9265		3.8270		
Average Diameter (in.)	3.287	3.260		2.895		3.283		
Wet. Wt. of Soil + Cont. (g)	387.20	1100.80	410.90	1099.70	304.80	458.90		
Dry Wt. of Soil + Cont. (g)	338.10	987.70	352.90	1027.60	284.00	417.00		
Weight of Container (g)	77.06	110.50	77.30	108.80	76.20	75.90		
Container No.								
Wet Density	127.0	127.7		116.5		133.2		
Moisture Content (%)	**18.8**	**12.9**	**21.0**	**7.8**	**10.0**	**12.3**		
Dry Density (pcf)	**106.9**	**113.1**		**108.0**		**118.6**		
Degree of Saturation (%)	88.1	71.0		37.8		78.8		

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MOISTURE & DENSITY of SOILS

ASTM D 2216 & ASTM D 2937

Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Client Name: CH2M Hill

Tested By: V. Juliano Date: 05/21/09

Boring No.	R-09-Z1-B6	R-09-Z1-B6	R-09-Z1-B6	R-09-Z1-B6	R-09-Z1-B6	R-09-Z1-B6	R-09-Z1-B6	R-09-Z1-B6
Sample No.	S5	S7	S9	S11	S13	S15	S17	S19
Depth (ft.)	20.0	30.0	40.0	50.0	60.0	70.0	80.0	90.0
Sample Type	Drive	Drive	Drive	Drive	Drive	Drive	Drive	Drive
Soil Identification	Dark yellowish brown sandy lean clay s(CL)	Dark yellowish brown lean clay (CL)	Dark yellowish brown sandy lean clay s(CL)	Light olive brown silt (ML)	Light olive brown silty clay with sand (CL-ML)s (Top: CL-ML, bottom: SP)	Yellowish brown silty sand (SM)	Dark yellowish brown sandy silt s(ML) (Layer of SP in middle)	Yellowish brown silty sand (SM)
Pocket Penetrometer (tons/ft^2)	4.00	2.50 / 4.00	4.50	4.50	2.00 / 4.00	3.50	3.00 / 4.00	>4.50
Weight Soil + Rings / Tube (g)	1009.80	1218.90	1023.80	1203.40	980.80	1005.40	989.40	1218.60
Weight of Rings / Tube (g)	222.00	266.40	222.00	266.40	222.00	222.00	222.00	260.10
Average Length (in.)	5.00	6.00	5.00	6.00	5.00	5.00	5.00	6.064
Average Diameter (in.)	2.416	2.416	2.416	2.416	2.416	2.416	2.416	2.413
Wet. Wt. of Soil + Cont. (g)	390.70	446.50	587.20	354.90	871.70	370.40	894.20	246.10
Dry Wt. of Soil + Cont. (g)	330.70	382.30	506.80	296.10	705.90	308.80	745.20	219.90
Weight of Container (g)	38.84	75.00	75.40	38.88	74.40	39.00	108.40	64.00
Container No.								
Wet Density	130.9	131.9	133.3	129.8	126.1	130.2	127.5	131.7
Moisture Content (%)	**20.6**	**20.9**	**18.6**	**22.9**	**26.3**	**22.8**	**23.4**	**16.8**
Dry Density (pcf)	**108.6**	**109.1**	**112.3**	**105.6**	**99.9**	**106.0**	**103.4**	**112.7**
Degree of Saturation (%)	100.5	103.6	100.5	103.6	103.1	104.4	100.1	91.6

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MOISTURE & DENSITY of SOILS

ASTM D 2216 & ASTM D 2937

Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Client Name: CH2M Hill

Tested By: A. Santos Date: 03/06/09

Boring No.	R-09-Z1-B7	R-09-Z1-B7	R-09-Z1-B7	R-09-Z1-B7	R-09-Z1-B7	R-09-Z1-B7		
Sample No.	S4	S6	C10	C14	C19	C27		
Depth (ft.)	25.0	35.0	51.8-52.6	74.7-75.2	101.3-102.4	151.6-152.2		
Sample Type	Drive	Drive	Core	Core	Core	Core		
Soil Identification	Yellowish brown lean clay with sand (CL)s	Sample missing	Olive silt'stone' with sand (ML)s	Olive silty sand'stone' (SM) with greasy contaminant	Olive silt'stone' with sand (ML)s	Dark olive silt'stone' (ML), density not possible		
Pocket Penetrometer (tons/ft^2)	>4.50		>4.00	>4.00	>4.50			
Weight Soil + Rings / Tube (g)	1003.70		1135.70	773.90	1519.90			
Weight of Rings / Tube (g)	222.00		0.00	0.00	0.00			
Average Length (in.)	5.00		4.256	2.992	5.8675			
Average Diameter (in.)	2.416		3.621	3.509	3.330			
Wet. Wt. of Soil + Cont. (g)	801.90		435.40	433.50	1626.90	467.40		
Dry Wt. of Soil + Cont. (g)	685.10		378.10	422.00	1461.20	404.30		
Weight of Container (g)	109.50		76.20	74.30	107.82	74.50		
Container No.								
Wet Density	129.9		98.7	101.9	113.3			
Moisture Content (%)	**20.3**		**19.0**	**3.3**	**12.2**	**19.1**		
Dry Density (pcf)	**108.0**		**83.0**	**98.6**	**100.9**			
Degree of Saturation (%)	97.7		49.7	12.6	49.4			

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MOISTURE & DENSITY of SOILS

ASTM D 2216 & ASTM D 2937

Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Client Name: CH2M Hill

Tested By: A. Santos Date: 05/05/09

AP Engineering & Testing, Inc.

MOISTURE AND DENSITY TEST RESULTS
ASTM D 2216

Project Name: SR-710 Tunnel Technical Study Tested by: DK Date: 06/03/09
Project Number: 378312.04.09.01 Checked by: AP Date: 06/15/09

Boring No.	Sample No.	Sample Depth	Moisture Content (%)	Dry Density (pcf)
R-09-Z1-B7	S6	35	23.8	102.0

MOISTURE CONTENT & UNIT WEIGHT TEST RESULTS

Sample Identification	Depth, ft.	Wet Unit Weight, lb/ft.^{3}	Dry Unit Weight, lb/ft.^{3}	Moisture Content, %
R-09-Z1-B7, C32	173-173.7	119.6	104.4	14.1
R-09-Z1-B7, C36	192.2-192.5	151.0	147.4	2.4

Test Method: ASTM D2216, ASTM D2937

PROJECT NUMBER:	09-144	May 29, 2009	SR-710 Tunnel Technical Study

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

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MOISTURE CONTENT

ASTM D 2216

Project Name: **SR-710 Tunnel Technical Study**
Project No.: **378312.04.09.01**

Tested By: V. Juliano
Date: 04/03/09
Checked By: J. Ward
Date: 04/08/09

Boring No.	R-09-Z1-B8	R-09-Z1-B8			
Sample No.	S04	S06			
Depth (ft)	15-16.5	25-26.5			
Sample Type	SPT	SPT			
Sample Description	Olive yellow to dark brown sandy silt s(ML)	Dark brown lean clay (CL)			
Wt. wet soil + container (g)	773.50	388.00			
Wt. dry soil + container (g)	649.20	312.60			
Weight of container (g)	108.43	76.12			
Moisture Content (%)	**23.0**	**31.9**			

Boring No.					
Sample No.					
Depth (ft)					
Sample Type					
Sample Description					
Wt. wet soil + container (g)					
Wt. dry soil + container (g)					
Weight of container (g)					
Moisture Content (%)					

Boring No.	R-09-Z1-B8	R-09-Z1-B8	R-09-Z1-B8	R-09-Z1-B8	R-09-Z1-B8			
Sample No.	O11	O13	O15A	S18	C33			
Depth (ft.)	50-55	60-65	70-75	85-86.5	159.25-160			
Sample Type	Drive	Drive	Drive	Drive	Core			
Soil Identification	Olive yellow lean clay (CL)	Sample missing	Sample missing	Sample missing	Dark olive lean clay'stone' (CL)			
Pocket Penetrometer (tons/ft^2)	>4.50 / 4.50				>4.00			
Weight Soil + Rings / Tube (g)	1464.40				814.30			
Weight of Rings / Tube (g)	535.50				0.00			
Average Length (in.)	5.996				5.345			
Average Diameter (in.)	2.375				2.399			
Wet. Wt. of Soil + Cont. (g)	193.30				112.80			
Dry Wt. of Soil + Cont. (g)	169.40				99.35			
Weight of Container (g)	60.40				36.70			
Container No.								
Wet Density	133.2				128.4			
Moisture Content (%)	**21.9**				**21.5**			
Dry Density (pcf)	**109.3**				**105.7**			
Degree of Saturation (%)	109.1				97.5			

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MOISTURE & DENSITY of SOILS

ASTM D 2216 & ASTM D 2937

Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Client Name: CH2M Hill

Tested By: V. Juliano Date: 05/09/09

Boring No.	R-09-Z2-B2	R-09-Z2-B2	R-09-Z2-B2	R-09-Z2-B2	R-09-Z2-B2	R-09-Z2-B2	R-09-Z2-B2	R-09-Z2-B2
Sample No.	C2	C6	C10	C14	C16	C22	C33	C44
Depth (ft.)	17-17.6	38.3-39	55.6-56	77-78	86.3-87	119-119.5	186.5-187	240.6-241.3
Sample Type	Core	Core	Core	Core	Core	Core	Core	Core
Soil Identification	Yellowish brown clayey sand'stone' (SC)	Yellowish brown poorly-graded sand (SP)	Yellowish brown silty sand (SM)	Dark yellowish brown sandy lean clay'stone' s(CL)	Yellowish brown silty sand'stone' (SM)	Brown poorly-graded sand with silt (SP-SM)	Grayish brown silty sand'stone' (SM)	Gray silty sand'stone' (SM)
Pocket Penetrometer (tons/ft^2)	>4.50	3.00	4.00	>4.50	>4.50	3.00	3.50	3.00
Weight Soil + Rings / Tube (g)	539.40	621.00	804.10	850.70	862.70	716.00	941.40	440.50
Weight of Rings / Tube (g)	0.00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
Average Length (in.)	3.2970	3.7285	4.7540	5.1060	5.1510	4.3345	5.5620	2.6765
Average Diameter (in.)	2.425	2.445	2.435	2.425	2.455	2.490	2.500	2.445
Wet. Wt. of Soil + Cont. (g)	616.40	695.60	996.10	958.20	509.60	554.30	1037.60	515.80
Dry Wt. of Soil + Cont. (g)	557.60	637.90	911.60	862.20	469.90	501.20	892.90	467.70
Weight of Container (g)	77.20	75.87	107.70	108.50	77.33	77.39	76.07	75.90
Container No.								
Wet Density	134.9	135.1	138.4	137.4	134.8	129.2	131.4	133.5
Moisture Content (%)	**12.2**	**10.3**	**10.5**	**12.7**	**10.1**	**12.5**	**17.7**	**12.3**
Dry Density (pcf)	**120.2**	**122.6**	**125.2**	**121.9**	**122.4**	**114.8**	**111.6**	**118.9**
Degree of Saturation (%)	82.2	73.8	82.0	89.8	72.4	72.3	93.7	79.4

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MOISTURE & DENSITY of SOILS

ASTM D 2216 & ASTM D 2937

Project Name: SR-710 Tunnel Technical Study
Project No.: 378312.04.09.01
Client Name: CH2M Hill
Tested By: A. Santos Date: 05/19/09

MOISTURE CONTENT & UNIT WEIGHT TEST RESULTS

Sample Identification	Depth, ft.	Wet Unit Weight, lb/ft.^{3}	Dry Unit Weight, lb/ft.^{3}	Moisture Content, %
R-09-Z2-B3, C47	180.2 - 180.7	130.4	114.4	14.0
R-09-Z2-B3, C41	153.1 - 153.5	146.0	140.3	4.1

Test Method: ASTM D2216, ASTM D2937

PROJECT NUMBER:	09-144	June 1, 2009	SR-710 Tunnel Technical Study

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

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AP Engineering & Testing, Inc.

MOISTURE AND DENSITY TEST RESULTS
ASTM D 2216

Project Name: SR-710 Tunnel Technical Study   Tested by: KK   Date: 06/08/09

Project Number: 378312.04.09.01   Checked by: AP   Date: 06/11/09

Boring No.	Sample No.	Sample Depth	Moisture Content (%)	Dry Density (pcf)
R-09-Z2-B3	S-4	15-16.5	9.2	NA
R-09-Z2-B3	S-8	25-26.5	10.1	NA
R-09-Z2-B3	C-16	45-50	17.7	119.0
R-09-Z2-B3	C-18	55-60	17.4	107.1
R-09-Z2-B3	C-24	80-85	14.6	114.5
R-09-Z2-B3	C-29	105-110	21.6	96.4

Boring No.	R-09-Z2-B4	R-09-Z2-B4	R-09-Z2-B4	R-09-Z2-B4	R-09-Z2-B4	R-09-Z2-B4		
Sample No.	S3	S6	S9	S14	C23	C28		
Depth (ft.)	10.0	25.0	40.0	60.0	88.5-89	112.5-113		
Sample Type	SPT	SPT	SPT	SPT	Core	Core		
Soil Identification	Dark olive fat clay (CH)	Olive brown sandy fat clay s(CH)	Olive fat clay with sand (CH)s	Dark olive gray silt (ML)	Dark olive elastic silt (MH)	Olive sandy silt s(ML)		
Pocket Penetrometer (tons/ft^2)					>4.50	4.00		
Weight Soil + Rings / Tube (g)					815.30	925.40		
Weight of Rings / Tube (g)					0.00	0.00		
Average Length (in.)					5.2225	5.5900		
Average Diameter (in.)					2.480	2.510		
Wet. Wt. of Soil + Cont. (g)	528.20	518.20	813.20	487.90	925.60	1372.70		
Dry Wt. of Soil + Cont. (g)	423.20	405.50	642.10	390.90	772.90	1186.30		
Weight of Container (g)	77.10	78.00	108.80	76.20	110.60	108.80		
Container No.								
Wet Density					123.1	127.5		
Moisture Content (%)	**30.3**	**34.4**	**32.1**	**30.8**	**23.1**	**17.3**		
Dry Density (pcf)					**100.0**	**108.7**		
Degree of Saturation (%)					90.9	84.7		

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MOISTURE & DENSITY of SOILS

ASTM D 2216 & ASTM D 2937

Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Client Name: CH2M Hill

Tested By: A. Santos Date: 05/18/09

MOISTURE CONTENT & UNIT WEIGHT TEST RESULTS

Sample Identification	Depth, ft.	Material Type	Dry Unit Weight, lb/ft.^{3}	Moisture Content, %
R-09-Z2-B4, C69	255.5-256	Siltstone	147.3	15.2
R-09-Z2-B4, C85	314.5-315	Siltstone	144.7	16.0

Test Method: ASTM D2216, ASTM D2937

PROJECT NUMBER:	09-144	May 1, 2009

SR-710 Tunnel Technical Study

#378312.04.09.01

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AP Engineering & Testing, Inc.

MOISTURE AND DENSITY TEST RESULTS
ASTM D 2216

Project Name: SR-710 Tunnel Technical Study   Tested by: KK   Date: 06/08/09
Project Number: 378312.04.09.01   Checked by: AP   Date: 06/11/09

Boring No.	Sample No.	Sample Depth	Moisture Content (%)	Dry Density (pcf)
R-09-Z2-B4	C80	295-298.5	13.3	NA
R-09-Z2-B4	C101	365-368.5	14.2	NA

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MOISTURE CONTENT

ASTM D 2216

Project Name: **SR-710 Tunnel Technical Study**
Project No.: **378312.04.09.01**

Tested By: A. Santos
Date: 05/19/09
Checked By: J. Ward
Date: 05/27/09

Boring No.	R-09-Z2-B5	R-09-Z2-B5	R-09-Z2-B5	R-09-Z2-B5	R-09-Z2-B5
Sample No.	S2	S3	S6	S10	S15
Depth (ft)	10	15	30	50	75
Sample Type	SPT	SPT	SPT	SPT	SPT
Sample Description	Dark olive lean clay with sand (CL)s	Olive brown silty sand (SM)	Olive brown sandy silt s(ML)	Olive brown silty sand (SM)	Olive brown lean clay (CL)
Wt. wet soil + container (g)	405.30	590.50	630.10	770.80	611.60
Wt. dry soil + container (g)	351.70	516.50	511.50	653.80	518.10
Weight of container (g)	75.27	76.20	76.10	106.90	77.20
Moisture Content (%)	**19.4**	**16.8**	**27.2**	**21.4**	**21.2**

Boring No.	R-09-Z2-B5	R-09-Z2-B5			
Sample No.	S17	S19			
Depth (ft)	85	95			
Sample Type	SPT	SPT			
Sample Description	Olive brown lean clay (CL)	Sample missing			
Wt. wet soil + container (g)	477.30				
Wt. dry soil + container (g)	406.50				
Weight of container (g)	76.10				
Moisture Content (%)	**21.4**				

Boring No.	R-09-Z3-B1	R-09-Z3-B1	R-09-Z3-B1	R-09-Z3-B1				
Sample No.	S1	S3	C48	C60				
Depth (ft.)	10.0	20.0	216.8	277.6				
Sample Type	Drive	Drive	Core	Core				
Soil Identification	Olive brown silty sand (SM)	Brown silty sand (SM)	Light gray poorly-graded sand with silt and gravel (SP-SM)g	Light gray poorly-graded sand with silt and gravel (SP-SM)g				
Pocket Penetrometer (tons/ft^2)	>4.50	>4.50 / 3.00						
Weight Soil + Rings / Tube (g)	1258.80	1236.40						
Weight of Rings / Tube (g)	259.20	260.07						
Average Length (in.)	6.044	6.034						
Average Diameter (in.)	2.409	2.409	2.416	2.416				
Wet. Wt. of Soil + Cont. (g)	738.80	945.20	1128.40	798.20				
Dry Wt. of Soil + Cont. (g)	659.00	830.70	1055.80	748.10				
Weight of Container (g)	76.20	110.50	110.40	111.00				
Container No.								
Wet Density	138.2	135.2						
Moisture Content (%)	**13.7**	**15.9**	**7.7**	**7.9**				
Dry Density (pcf)	**121.6**	**116.7**						
Degree of Saturation (%)	95.7	96.6						

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MOISTURE & DENSITY of SOILS

ASTM D 2216 & ASTM D 2937

Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Client Name: CH2M Hill

Tested By: V. Juliano Date: 04/27/09

Boring No.	R-09-Z3-B2	R-09-Z3-B2	R-09-Z3-B2	R-09-Z3-B2	R-09-Z3-B2	R-09-Z3-B2	R-09-Z3-B2	R-09-Z3-B2
Sample No.	O4	S5	O9	S11	S17	S20	C23	C27
Depth (ft.)	11.8-12.3	15-16.5	31.3-31.8	40-41.5	55-56	64.2-65.7	71.5-75	81.5-85
Sample Type	Drive	SPT	Drive	SPT	SPT	SPT	Core	Core
Soil Identification	Olive poorly-graded sand with silt and gravel (SP-SM)g	Yellowish brown well-graded sand with silt and gravel (SW-SM)g	Olive well-graded sand with silt and gravel (SW-SM)g	Yellowish brown silty sand (SM)	Yellowish brown well-graded sand with silt and gravel (SW-SM)g	Yellowish brown silty sand (SM)	Olive brown silty sand (SM)	Yellowish brown poorly-graded sand with gravel (SM)g
Pocket Penetrometer (tons/ft^2)	>4.00		>4.00					
Weight Soil + Rings / Tube (g)	1527.10		1526.70					
Weight of Rings / Tube (g)	541.00		527.00					
Average Length (in.)	6.013		5.950					
Average Diameter (in.)	2.367		2.375					
Wet. Wt. of Soil + Cont. (g)	1083.80	923.00	1106.00	704.00	795.30	968.60	346.10	3917.80
Dry Wt. of Soil + Cont. (g)	996.50	852.30	1022.10	621.20	724.30	832.70	311.70	3433.40
Weight of Container (g)	108.50	82.60	107.90	79.10	75.60	74.70	78.10	231.80
Container No.								
Wet Density	142.0		144.5					
Moisture Content (%)	**9.8**	**9.2**	**9.2**	**15.3**	**10.9**	**17.9**	**14.7**	**15.1**
Dry Density (pcf)	**129.3**		**132.3**					
Degree of Saturation (%)	87.3		90.5					

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MOISTURE & DENSITY of SOILS

ASTM D 2216 & ASTM D 2937

Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Client Name: CH2M Hill

Tested By: V. Juliano Date: 05/09/09

Boring No.	R-09-Z3-B2	R-09-Z3-B2	R-09-Z3-B2	R-09-Z3-B2	R-09-Z3-B2			
Sample No.	S30	S34	C37	C39	C41			
Depth (ft.)	90-91.5	100-101.5	106.5-110	111.5-115	116.5-120			
Sample Type	SPT	SPT	Core	Core	Core			
Soil Identification	Yellowish brown silty sand (SM)	Yellowish brown silty sand (SM)	Yellowish brown silty sand (SM)	Reddish brown silty sand (SM)	Yellowish brown clayey sand (SC)			
Pocket Penetrometer (tons/ft^2)								
Weight Soil + Rings / Tube (g)								
Weight of Rings / Tube (g)								
Average Length (in.)								
Average Diameter (in.)								
Wet. Wt. of Soil + Cont. (g)	1047.60	966.80	911.40	596.60	586.50			
Dry Wt. of Soil + Cont. (g)	922.90	843.30	787.00	543.20	525.30			
Weight of Container (g)	108.90	108.40	110.60	77.40	76.80			
Container No.								
Wet Density								
Moisture Content (%)	**15.3**	**16.8**	**18.4**	**11.5**	**13.6**			
Dry Density (pcf)								
Degree of Saturation (%)								

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MOISTURE & DENSITY of SOILS

ASTM D 2216 & ASTM D 2937

Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Client Name: CH2M Hill

Tested By: V. Juliano Date: 05/09/09

MOISTURE CONTENT & UNIT WEIGHT TEST RESULTS

Sample Identification	Depth, ft.	Material Type	Dry Unit Weight, lb/ft.^{3}	Moisture Content, %
Z3-B2, C49	146.75-148	Quartzite	159.8	0.3
Z3-B2, C54	171.4-171.7	Quartzite	155.0	0.4
Z3-B2, C68	227.8-228.1	Quartzite	156.1	2.5

Test Method: ASTM D2216, ASTM D2937

PROJECT NUMBER:	09-144	April 10, 2009	SR-710 Tunnel Technical Study
			#378312.04.09.01

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

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Phone: (916) 939-3460 FAX: (916) 939-3507

Boring No.	R-09-Z3-B4	R-09-Z3-B4	R-09-Z3-B4	R-09-Z3-B4	R-09-Z3-B4	R-09-Z3-B4	R-09-Z3-B4	R-09-Z3-B4
Sample No.	S-3	S-8	S-10	S-13	S-15	C-20	C-22	C-32
Depth (ft.)	15.0	40.0	50.0	65.0	75.0	94-100	105-110	155-160
Sample Type	Drive	Drive	Drive	Drive	Drive	Drive	Drive	Drive
Soil Identification	Yellowish brown silty sand (SM)	Olive silt with sand (ML)s	Yellowish brown silty sand (SM)	Yellowish brown silty sand (SM)	Yellowish brown silty sand (SM)	Brown silty sand (SM)	Yellowish brown silty sand (SM)	Yellowish brown poorly-graded sand with silt (SP-SM)
Pocket Penetrometer (tons/ft^2)	3.75 / 3.75	>4.50	>4.50					
Weight Soil + Rings / Tube (g)	966.50	984.10	1247.30					
Weight of Rings / Tube (g)	213.20	215.30	261.84					
Average Length (in.)	5.008	5.005	6.024					
Average Diameter (in.)	2.409	2.409	2.409					
Wet. Wt. of Soil + Cont. (g)	980.20	844.10	915.90	537.20	157.30	822.90	728.00	692.30
Dry Wt. of Soil + Cont. (g)	851.00	697.50	801.40	448.80	140.90	743.10	650.70	616.10
Weight of Container (g)	107.60	77.40	75.80	72.30	61.50	75.50	75.20	76.60
Container No.								
Wet Density	125.7	128.4	136.7					
Moisture Content (%)	**17.4**	**23.6**	**15.8**	**23.5**	**20.7**	**12.0**	**13.4**	**14.1**
Dry Density (pcf)	**107.1**	**103.8**	**118.1**					
Degree of Saturation (%)	81.8	102.4	99.7					

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MOISTURE & DENSITY of SOILS

ASTM D 2216 & ASTM D 2937

Project Name: SR-710 Tunnel Technical Study
Project No.: 378312.04.09.01
Client Name: CH2M Hill
Tested By: V. Juliano Date: 04/27/09

AP Engineering & Testing, Inc.

MOISTURE AND DENSITY TEST RESULTS
ASTM D 2216

Project Name: SR-710 Tunnel Technical Study Tested by: KK Date: 06/08/09
Project Number: 378312.04.09.01 Checked by: AP Date: 06/11/09

Boring No.	Sample No.	Sample Depth	Moisture Content (%)	Dry Density (pcf)
R-09-Z3-B5	S-3	15-16.5	17.6	NA
R-09-Z3-B5	S-7	35-36.5	13.7	NA
R-09-Z3-B5	S-9	45-46.5	14.3	NA
R-09-Z3-B5	S-11	55-56.5	13.0	NA
R-09-Z3-B5	S-13	65-66.5	15.9	NA
R-09-Z3-B5	C-16	75-80	13.3	123.4
R-09-Z3-B5	C-21	100-105	9.0	130.8
R-09-Z3-B5	C-28	135-140	8.0	136.9
R-09-Z3-B5	C-75	349.1-353.1	8.5	124.1

MOISTURE CONTENT & UNIT WEIGHT TEST RESULTS

Sample Identification	Depth, ft.	Wet Unit Weight, lb/ft.^{3}	Dry Unit Weight, lb/ft.^{3}	Moisture Content, %
R-09-Z3-B5, C55	270.6-271.1	152.6	138.9	9.8

Test Method: ASTM D2216, ASTM D2937

PROJECT NUMBER:	09-144	June 1, 2009

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SR-710 Tunnel Technical Study

378312.04.09.01

Boring No.	R-09-Z3-B6	R-09-Z3-B6	R-09-Z3-B6	R-09-Z3-B6	R-09-Z3-B6			
Sample No.	S1	S2	C27	C52	C53			
Depth (ft.)	5.0	10.0	173.0	299.0	304.5			
Sample Type	Drive	Drive	Core (bag)	Core (bag)	Core (bag)			
Soil Identification	Brown silty sand (SM)	Dark olive silty sand with gravel (SM)g	Light gray silty sand with gravel (SM)g	Light gray silty sand with gravel (SM)g	Light gray silty sand (SM)			
Pocket Penetrometer (tons/ft^2)		>4.00						
Weight Soil + Rings / Tube (g)		1049.80						
Weight of Rings / Tube (g)		215.40						
Average Length (in.)		5.033						
Average Diameter (in.)		2.409						
Wet. Wt. of Soil + Cont. (g)	470.10	1079.70	2167.70	1141.10	1477.50			
Dry Wt. of Soil + Cont. (g)	446.50	1004.60	1971.80	1088.20	1334.50			
Weight of Container (g)	78.00	108.80	217.40	218.30	111.20			
Container No.								
Wet Density		138.6						
Moisture Content (%)	**6.4**	**8.4**	**11.2**	**6.1**	**11.7**			
Dry Density (pcf)		**127.8**						
Degree of Saturation (%)		71.1						

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MOISTURE & DENSITY of SOILS

ASTM D 2216 & ASTM D 2937

Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Client Name: CH2M Hill

Tested By: V. Juliano Date: 04/27/09

Boring No.	R-09-Z3-B7	R-09-Z3-B7	R-09-Z3-B7	R-09-Z3-B7	R-09-Z3-B7	R-09-Z3-B7	R-09-Z3-B7	R-09-Z3-B7
Sample No.	S-2	O-7	O-10	S-12	O-14	O-18	S-23	C-26
Depth (ft.)	6.0	21-23.5	31-33.5	36.0	41-43.5	51-53.5	61.0	71.0
Sample Type	SPT	Drive	Drive	SPT	Drive	Drive	SPT	Core
Soil Identification	Olive poorly-graded gravel with sand (GP)s	Top: Yellowish brown / Bot: Reddish brown silty, clayey sand (SC-SM)	Yellowish brown silty sand with gravel (SM)g	Sample missing	Yellowish brown silty sand with occasional gravel (SM)	Yellowish brown sandy silt s(ML)	Olive brown silty sand (SM)	Olive brown silt (ML)
Pocket Penetrometer (tons/ft^2)		>4.50	>4.50		>4.50	>4.50		
Weight Soil + Rings / Tube (g)		1466.70	1458.50		1493.20	1468.10		
Weight of Rings / Tube (g)		529.50	524.30		544.90	543.50		
Average Length (in.)		5.771	5.826		6.009	5.729		
Average Diameter (in.)		2.375	2.375		2.375	2.375		
Wet. Wt. of Soil + Cont. (g)	864.70	565.80	1040.30		1105.30	583.20	773.20	442.30
Dry Wt. of Soil + Cont. (g)	815.70	508.60	919.80		975.80	519.70	687.30	395.20
Weight of Container (g)	108.30	77.20	108.90		159.90	75.90	108.40	77.70
Container No.								
Wet Density		139.6	137.9		135.7	138.8		
Moisture Content (%)	**6.9**	**13.3**	**14.9**		**15.9**	**14.3**	**14.8**	**14.8**
Dry Density (pcf)		**123.3**	**120.0**		**117.1**	**121.4**		
Degree of Saturation (%)		97.5	99.3		97.6	99.5		

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MOISTURE & DENSITY of SOILS

ASTM D 2216 & ASTM D 2937

Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Client Name: CH2M Hill

Tested By: V. Juliano Date: 04/08/09

Boring No.	R-09-Z3-B7	R-09-Z3-B7	R-09-Z3-B7	R-09-Z3-B7				
Sample No.	S-27	C-32	C-34	C-37				
Depth (ft.)	71.3-71.6	90-90.6	96-96.4	120.1-120.7				
Sample Type	SPT	Core	Core	Core				
Soil Identification	Olive yellow lean clay'stone' with sand (CL)s	Gray silt'stone' (ML)	Gray silty sand'stone' (SM)	Gray silty sand'stone' (SM)				
Pocket Penetrometer (tons/ft^2)		>4.50	>4.50	>4.50				
Weight Soil + Rings / Tube (g)		920.50	691.80	835.80				
Weight of Rings / Tube (g)		0.00	0.00	0.00				
Average Length (in.)		5.0460	3.9905	4.8335				
Average Diameter (in.)		2.480	2.425	2.416				
Wet. Wt. of Soil + Cont. (g)	795.00	1027.50	768.70	911.40				
Dry Wt. of Soil + Cont. (g)	709.30	955.70	723.40	865.30				
Weight of Container (g)	76.50	107.30	77.00	76.10				
Container No.								
Wet Density		143.9	143.0	143.7				
Moisture Content (%)	**13.5**	**8.5**	**7.0**	**5.8**				
Dry Density (pcf)		**132.6**	**133.6**	**135.8**				
Degree of Saturation (%)		84.4	72.4	65.3				

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MOISTURE & DENSITY of SOILS

ASTM D 2216 & ASTM D 2937

Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Client Name: CH2M Hill

Tested By: A. Santos Date: 05/10/09

MOISTURE CONTENT & UNIT WEIGHT TEST RESULTS

Sample Identification	Depth, ft.	Material Type	Dry Unit Weight, lb/ft.^{3}	Moisture Content, %
Z3-B7, C-62	219.7-221.5	Sandstone	148.1	1.3

Test Method: ASTM D2216, ASTM D2937

PROJECT NUMBER:	09-144	April 10, 2009	SR-710 Tunnel Technical Study
			#378312.04.09.01

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Boring No.	R-09-Z3-B8	R-09-Z3-B8	R-09-Z3-B8	R-09-Z3-B8	R-09-Z3-B8	R-09-Z3-B8		
Sample No.	C-3	C-5	C-7	C-12	C-20	C-27		
Depth (ft.)	10-11.5	20-21.5	29.2-30	52.6-53.2	88-88.6	116.2-116.9		
Sample Type	Tube	Tube	Core	Core	Core	Core		
Soil Identification	Olive brown lean clay (CL), disturbed	Olive brown fat clay (CH)	Yellowish brown fat clay'stone' (CH)	Dark yellowish brown silt'stone' (ML)	Dark gray silt'stone' (ML)	Grayish brown silt'stone' (ML)		
Pocket Penetrometer (tons/ft^2)		>4.50	>4.50	>4.50	>4.50	>4.50		
Weight Soil + Rings / Tube (g)		925.40	638.00	795.80	581.20	416.40		
Weight of Rings / Tube (g)		542.50	0.00	0.00	0.00	0.00		
Average Length (in.)		2.585	4.378	5.167	3.818	2.408		
Average Diameter (in.)		2.372	2.425	2.460	2.365	2.425		
Wet. Wt. of Soil + Cont. (g)	260.50	469.10	717.70	872.80	658.10	492.10		
Dry Wt. of Soil + Cont. (g)	224.18	396.10	591.00	731.30	592.00	453.40		
Weight of Container (g)	76.90	75.70	80.30	77.50	77.20	75.80		
Container No.								
Wet Density		127.7	120.2	123.4	132.0	142.6		
Moisture Content (%)	**24.7**	**22.8**	**24.8**	**21.6**	**12.8**	**10.2**		
Dry Density (pcf)		**104.0**	**96.3**	**101.5**	**117.0**	**129.4**		
Degree of Saturation (%)		99.1	89.3	88.4	78.6	91.3		

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MOISTURE & DENSITY of SOILS

ASTM D 2216 & ASTM D 2937

Project Name: SR-710 Tunnel Technical Study
Project No.: 378312.04.9.01
Client Name: CH2M Hill
Tested By: A. Santos Date: 05/19/09

MOISTURE CONTENT & UNIT WEIGHT TEST RESULTS

Sample Identification	Depth, ft.	Wet Unit Weight, lb/ft.^{3}	Dry Unit Weight, lb/ft.^{3}	Moisture Content, %	Material Type
Z3-B8, C37	156.3 - 156.5	146.6	135.9	7.9	sandstone

Test Method: ASTM D2216, ASTM D2937

PROJECT NUMBER:	09-144	May 12, 2009	SR-710 Tunnel Technical Study	

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#378312.04.09.01

Boring No.	R-09-Z3-B9	R-09-Z3-B9	R-09-Z3-B9	R-09-Z3-B9	R-09-Z3-B9	R-09-Z3-B9	R-09-Z3-B9	
Sample No.	S-4	S-10	S-13	S-17	S-19	C-22	C-26	
Depth (ft.)	15.0	60.0	90.0	130.0	150.0	167-168	187.5-187.9	
Sample Type	Drive	Drive	Drive	Drive	Drive	Drive	Drive	
Soil Identification	Light olive brown poorly-graded sand with silt and gravel (SP-SM)g	Dark olive brown silty sand (SM)	Dark olive silty sand (SM)	Olive brown silty sand (SM)	Dark yellowish brown clayey sand (SC)	Olive yellow silty sand (SM)	Olive yellow silty sand (SM)	
Pocket Penetrometer (tons/ft^2)	>4.50					N/A	N/A	
Weight Soil + Rings / Tube (g)	1559.00					766.40	763.70	
Weight of Rings / Tube (g)	543.90					0.00	0.00	
Average Length (in.)	6.0010					4.6635	4.8680	
Average Diameter (in.)	2.375					2.440	2.408	
Wet. Wt. of Soil + Cont. (g)	1146.50	656.30	783.90	953.70	1148.60	1024.80	888.10	
Dry Wt. of Soil + Cont. (g)	1060.80	561.50	660.90	813.10	1018.20	930.90	811.90	
Weight of Container (g)	108.40	77.70	80.30	105.30	109.40	77.13	108.34	
Container No.								
Wet Density	145.5					133.9	131.2	
Moisture Content (%)	**9.0**	**19.6**	**21.2**	**19.9**	**14.3**	**11.0**	**10.8**	
Dry Density (pcf)	**133.4**					**120.6**	**118.4**	
Degree of Saturation (%)	92.3					74.7	69.0	

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MOISTURE & DENSITY of SOILS

ASTM D 2216 & ASTM D 2937

Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Client Name: CH2M Hill

Tested By: A. Santos Date: 05/13/09

MOISTURE CONTENT & UNIT WEIGHT TEST RESULTS

Sample Identification	Depth, ft.	Wet Unit Weight, lb/ft.^{3}	Dry Unit Weight, lb/ft.^{3}	Moisture Content, %	Material Type
Z3-B9, C45	271 - 271.6	132.1	128.8	2.6	diorite

Test Method: ASTM D2216, ASTM D2937

PROJECT NUMBER:	09-144	May 1, 2009	SR-710 Tunnel Technical Study
			#378312.04.09.01

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MOISTURE CONTENT & UNIT WEIGHT TEST RESULTS

Sample Identification	Depth, ft.	Wet Unit Weight, lb/ft.^{3}	Dry Unit Weight, lb/ft.^{3}	Moisture Content, %
R-09-Z3-B9, C50	292.7-293	153.3	151.8	1.0

Test Method: ASTM D2216, ASTM D2937

PROJECT NUMBER:	09-144	June 1, 2009	SR-710 Tunnel Technical Study

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Boring No.	R-09-Z3-B10	R-09-Z3-B10	R-09-Z3-B10	R-09-Z3-B10	R-09-Z3-B10	R-09-Z3-B10	R-09-Z3-B10	R-09-Z3-B10
Sample No.	P-3	S-6	P-11	C-16	C-22	C-27	C-35	C-41
Depth (ft.)	10-11.5	25-26.5	50-51.5	70.7-71.4	101.9-102.6	124.2-124.8	152-152.6	171-171.7
Sample Type	Drive	SPT	Drive	Core	Core	Core	Core	Core
Soil Identification	Dark olive brown lean clay (CL)	Yellowish brown fat clay with sand (CH)s	Dark olive brown lean clay (CL)	Very dark olive lean clay'stone' with sand (CL)s	Dark olive lean clay'stone' (CL)	Dark olive fat clay'stone' (CH)	Grayish brown silty sand'stone' (SM)	Dark olive silt'stone' (ML)
Pocket Penetrometer (tons/ft^2)	>4.50		2.50	>4.50	>4.50	>4.50	>4.50	>4.50
Weight Soil + Rings / Tube (g)	1225.10		1030.40	888.20	854.40	769.40	742.20	664.00
Weight of Rings / Tube (g)	554.90		544.30	0.00	0.00	0.00	0.00	0.00
Average Length (in.)	4.3730		3.1735	5.2795	5.4350	4.8460	4.3720	4.1530
Average Diameter (in.)	2.375		2.375	2.408	2.426	2.425	2.485	2.415
Wet. Wt. of Soil + Cont. (g)	744.80	535.70	559.20	990.70	688.50	965.50	827.30	756.40
Dry Wt. of Soil + Cont. (g)	618.90	453.00	466.50	909.70	606.20	872.20	752.10	693.20
Weight of Container (g)	76.10	107.70	75.30	108.50	78.20	160.70	79.20	79.50
Container No.								
Wet Density	131.8		131.7	140.7	129.6	131.0	133.3	133.0
Moisture Content (%)	**23.2**	**24.0**	**23.7**	**10.1**	**15.6**	**13.1**	**11.2**	**10.3**
Dry Density (pcf)	**107.0**		**106.5**	**127.8**	**112.1**	**115.8**	**119.9**	**120.6**
Degree of Saturation (%)	108.8		109.7	85.6	83.5	77.7	74.4	69.8

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MOISTURE & DENSITY of SOILS

ASTM D 2216 & ASTM D 2937

Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Client Name: CH2M Hill

Tested By: A. Santos Date: 05/13/09

Boring No.	R-09-Z3-B10	R-09-Z3-B10						
Sample No.	C-47	C-66						
Depth (ft.)	188.3-189	255.2-255.8						
Sample Type	Core	Core						
Soil Identification	Dark olive silt'stone' (ML)	Dark olive lean clay'stone' (CL)						
Pocket Penetrometer (tons/ft^2)	>4.50	>4.50						
Weight Soil + Rings / Tube (g)	780.00	798.30						
Weight of Rings / Tube (g)	0.00	0.00						
Average Length (in.)	5.0600	5.1345						
Average Diameter (in.)	2.405	2.425						
Wet. Wt. of Soil + Cont. (g)	529.20	1276.70						
Dry Wt. of Soil + Cont. (g)	461.90	1112.30						
Weight of Container (g)	76.20	108.50						
Container No.								
Wet Density	129.3	128.2						
Moisture Content (%)	**17.4**	**16.4**						
Dry Density (pcf)	**110.1**	**110.2**						
Degree of Saturation (%)	88.6	83.5						

Leighton

MOISTURE & DENSITY of SOILS

ASTM D 2216 & ASTM D 2937

Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Client Name: CH2M Hill

Tested By: A. Santos Date: 05/13/09

Boring No.	R-09-Z3-B11	R-09-Z3-B11	R-09-Z3-B11	R-09-Z3-B11	R-09-Z3-B11	R-09-Z3-B11		
Sample No.	O-3	O-5	O-7	O-9	O-12	O-14		
Depth (ft.)	11.5-16	21-26	31-36	41-46	61-66	71-76		
Sample Type	Drive	Drive	Drive	Drive	Drive	Drive		
Soil Identification	Olive silty sand (SM)	Olive brown poorly-graded sand with silt and gravel (SP-SM)g	Olive silty sand (SM)	Olive poorly-graded sand with silt (SP-SM)	Olive well-graded sand with silt and gravel (SW-SM)g	Olive silty sand (SM)		
Pocket Penetrometer (tons/ft^2)	>4.50	N/A	4.25 / 4.00	0.75 / 1.50	N/A	2.25		
Weight Soil + Rings / Tube (g)	1426.00	1302.60	1351.90	1333.40	1530.30	1347.30		
Weight of Rings / Tube (g)	535.50	525.80	535.50	535.50	544.90	535.50		
Average Length (in.)	6.003	5.617	6.001	5.758	5.615	5.735		
Average Diameter (in.)	2.375	2.375	2.375	2.375	2.375	2.375		
Wet. Wt. of Soil + Cont. (g)	600.40	852.60	231.70	502.90	1091.20	445.80		
Dry Wt. of Soil + Cont. (g)	540.40	775.50	210.25	426.20	1006.30	381.80		
Weight of Container (g)	72.50	77.90	59.70	75.30	108.20	79.40		
Container No.								
Wet Density	127.6	118.9	117.0	119.2	150.9	121.7		
Moisture Content (%)	**12.8**	**11.1**	**14.2**	**21.9**	**9.5**	**21.2**		
Dry Density (pcf)	**113.1**	**107.1**	**102.4**	**97.8**	**137.9**	**100.5**		
Degree of Saturation (%)	70.5	52.0	59.5	81.5	114.7	84.3		

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MOISTURE & DENSITY of SOILS

ASTM D 2216 & ASTM D 2937

Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Client Name: CH2M Hill

Tested By: V. Juliano Date: 04/03/09

Boring No.	R-09-Z3-B11	R-09-Z3-B11	R-09-Z3-B11	R-09-Z3-B11	R-09-Z3-B11	R-09-Z3-B11	R-09-Z3-B11	R-09-Z3-B11
Sample No.	O-16	S-17	O-18	O-20	C-24	C-25	C-27	C-30
Depth (ft.)	81-86	86.0	91-96	101-102	116.4-116.9	125-125.5	131.5-132	150.5-151
Sample Type	Drive	SPT	Drive	Drive	Core	Core	Core	Core
Soil Identification	Olive brown poorly-graded sand with silt (SP-SM)	Olive brown silty sand (SM)	Yellowish brown sandy silt s(ML)	Dark olive brown clayey sand (SC)	Olive yellow silty sand with gravel (SM)g	Olive yellow silty sand (SM)	Dark olive brown sandy lean clay s(CL)	Olive brown well-graded sand with silt (SW-SM)
Pocket Penetrometer (tons/ft^2)	>4.50		3.50	>4.50				
Weight Soil + Rings / Tube (g)	1418.40		1389.50	1527.70				
Weight of Rings / Tube (g)	526.40		546.00	529.30				
Average Length (in.)	5.836		6.001	6.005				
Average Diameter (in.)	2.375		2.375	2.375				
Wet. Wt. of Soil + Cont. (g)	966.70	714.30	951.20	1104.60	952.50	912.20	853.30	827.10
Dry Wt. of Soil + Cont. (g)	834.30	623.60	812.30	1015.00	859.80	830.20	700.70	734.20
Weight of Container (g)	75.80	82.70	111.20	109.30	75.90	76.70	107.10	75.10
Container No.								
Wet Density	131.4		120.9	143.0				
Moisture Content (%)	**17.5**	**16.8**	**19.8**	**9.9**	**11.8**	**10.9**	**25.7**	**14.1**
Dry Density (pcf)	**111.9**		**100.9**	**130.1**				
Degree of Saturation (%)	93.1		79.7	90.4				

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MOISTURE & DENSITY of SOILS

ASTM D 2216 & ASTM D 2937

Project Name: SR-710 Tunnel Technical Study
Project No.: 378312.04.09.01
Client Name: CH2M Hill
Tested By: A. Santos Date: 05/13/09

MOISTURE CONTENT & UNIT WEIGHT TEST RESULTS

Sample Identification	Depth, ft.	Wet Unit Weight, lb/ft.^{3}	Dry Unit Weight, lb/ft.^{3}	Moisture Content, %	Material Type
Z3-B12, C41	190.8-191.3	114.1	93.6	22.0	Shale

Test Method: ASTM D2216, ASTM D2937

PROJECT NUMBER:	09-144	April 2, 2009	SR-710 Tunnel Technical Study	

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

5040 Robert J. Mathews Blvd., El Dorado Hills, CA 95762
Phone: (916) 939-3460 FAX: (916) 939-3507

#378312.04.09.01

Boring No.	R-09-Z3-B12	R-09-Z3-B12	R-09-Z3-B12	R-09-Z3-B12	R-09-Z3-B12	R-09-Z3-B12	R-09-Z3-B12	
Sample No.	S5	S7	S9	S11	S15	C21	C38	
Depth (ft.)	25.0	35.0	45.0	55.0	75.0	101-101.5	178.3-178.9	
Sample Type	Drive	Drive	Drive	Drive	Drive	Core	Core	
Soil Identification	Yellowish brown silty sand (SM)	Yellowish brown silt with sand (ML)s	Dark grayish brown silty sand (SM)	Dark grayish brown poorly-graded sand with silt (SP-SM)	Olive brown lean clay with sand (CL)s	Olive lean clay with sand (CL)s	Olive lean clay (CL)	
Pocket Penetrometer (tons/ft^2)	4.00	2.00	2.00	2.00 / 3.50	>4.50	>4.50	N/A	
Weight Soil + Rings / Tube (g)	796.30	979.50	786.70	790.40	1194.90	1542.40	326.70	
Weight of Rings / Tube (g)	177.60	222.00	177.60	177.60	266.40	0.00	0.00	
Average Length (in.)	4.00	5.00	4.00	4.00	6.00	5.918	Calculated volume = 191.8 cc	
Average Diameter (in.)	2.416	2.416	2.416	2.416	2.416	3.241		
Wet. Wt. of Soil + Cont. (g)	330.40	829.60	289.50	333.50	383.30	1648.20	403.80	
Dry Wt. of Soil + Cont. (g)	274.10	665.70	240.60	273.00	326.40	1423.00	343.20	
Weight of Container (g)	39.13	108.00	39.10	39.61	53.70	106.80	77.10	
Container No.								
Wet Density	128.5	125.9	126.5	127.3	128.6	120.3	106.3	
Moisture Content (%)	**24.0**	**29.4**	**24.3**	**25.9**	**20.9**	**17.1**	**22.8**	
Dry Density (pcf)	**103.7**	**97.3**	**101.8**	**101.1**	**106.4**	**102.8**	**86.6**	
Degree of Saturation (%)	103.4	108.3	100.0	104.9	96.4	72.2	65.0	

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MOISTURE & DENSITY of SOILS

ASTM D 2216 & ASTM D 2937

Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Client Name: CH2M Hill

Tested By: A. Santos Date: 03/06/09

MOISTURE CONTENT & UNIT WEIGHT TEST RESULTS

Sample Identification	Depth, ft.	Wet Unit Weight, lb/ft.^{3}	Dry Unit Weight, lb/ft.^{3}	Moisture Content, %	Material Type
Z3-B12, C41	190.8-191.3	114.1	93.6	22.0	Shale

Test Method: ASTM D2216, ASTM D2937

PROJECT NUMBER:	09-144	April 2, 2009	SR-710 Tunnel Technical Study
			#378312.04.09.01

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

5040 Robert J. Mathews Blvd., El Dorado Hills, CA 95762
Phone: (916) 939-3460 FAX: (916) 939-3507

Boring No.	R-09-Z4-B4	R-09-Z4-B4	R-09-Z4-B4	R-09-Z4-B4	R-09-Z4-B4	R-09-Z4-B4		
Sample No.	S-3	S-5	S-7	S-10	S-13	S-17		
Depth (ft.)	15.0	25.0	35.0	50.0	65.0	85.0		
Sample Type	Drive	Drive	Drive	SPT	Drive	SPT		
Soil Identification	Yellowish brown sandy silty clay s(CL-ML)	Yellowish brown silty sand (SM)	Yellowish brown sandy silty clay s(CL-ML)	Yellowish brown silty sand with gravel (SM)g	Brown silty sand (SM)	Yellowish brown fat clay (CH)		
Pocket Penetrometer (tons/ft^2)	3.50 / 3.50	>4.50	4.00 / 4.00		>4.50			
Weight Soil + Rings / Tube (g)	1224.70	952.70	1204.50		1023.20			
Weight of Rings / Tube (g)	260.40	207.42	260.04		207.38			
Average Length (in.)	6.024	5.005	6.025		5.004			
Average Diameter (in.)	2.409	2.409	2.409		2.409			
Wet. Wt. of Soil + Cont. (g)	573.50	189.40	892.70	740.20	693.30	392.30		
Dry Wt. of Soil + Cont. (g)	496.00	162.50	764.60	667.60	616.70	322.90		
Weight of Container (g)	75.90	37.00	108.60	77.60	80.10	74.20		
Container No.								
Wet Density	133.8	124.5	131.0		136.3			
Moisture Content (%)	**18.4**	**21.4**	**19.5**	**12.3**	**14.3**	**27.9**		
Dry Density (pcf)	**113.0**	**102.5**	**109.6**		**119.2**			
Degree of Saturation (%)	101.2	89.8	98.0		93.2			

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MOISTURE & DENSITY of SOILS

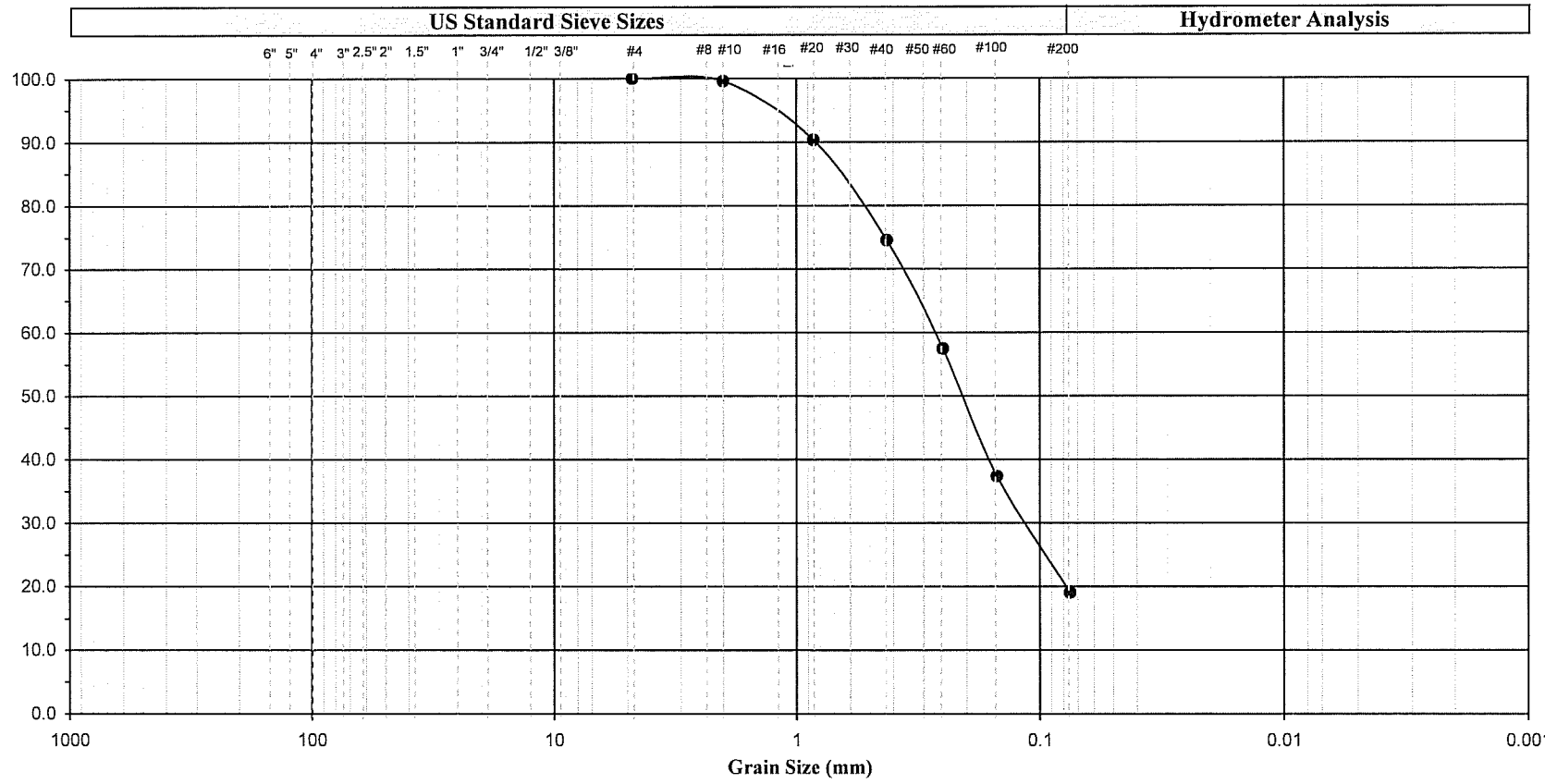
ASTM D 2216 & ASTM D 2937

Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Client Name: CH2M Hill

Tested By: V. Juliano Date: 04/27/09



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

Symbol	Boring Number	Sample Number	Depth (ft)	Depth (m)	Soil Color	Soil Description	U.S.C.S.
●	Z1-B2	Run 20	88.6~89.7		Yellowish brown	Silty sand	SM
Remark							

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

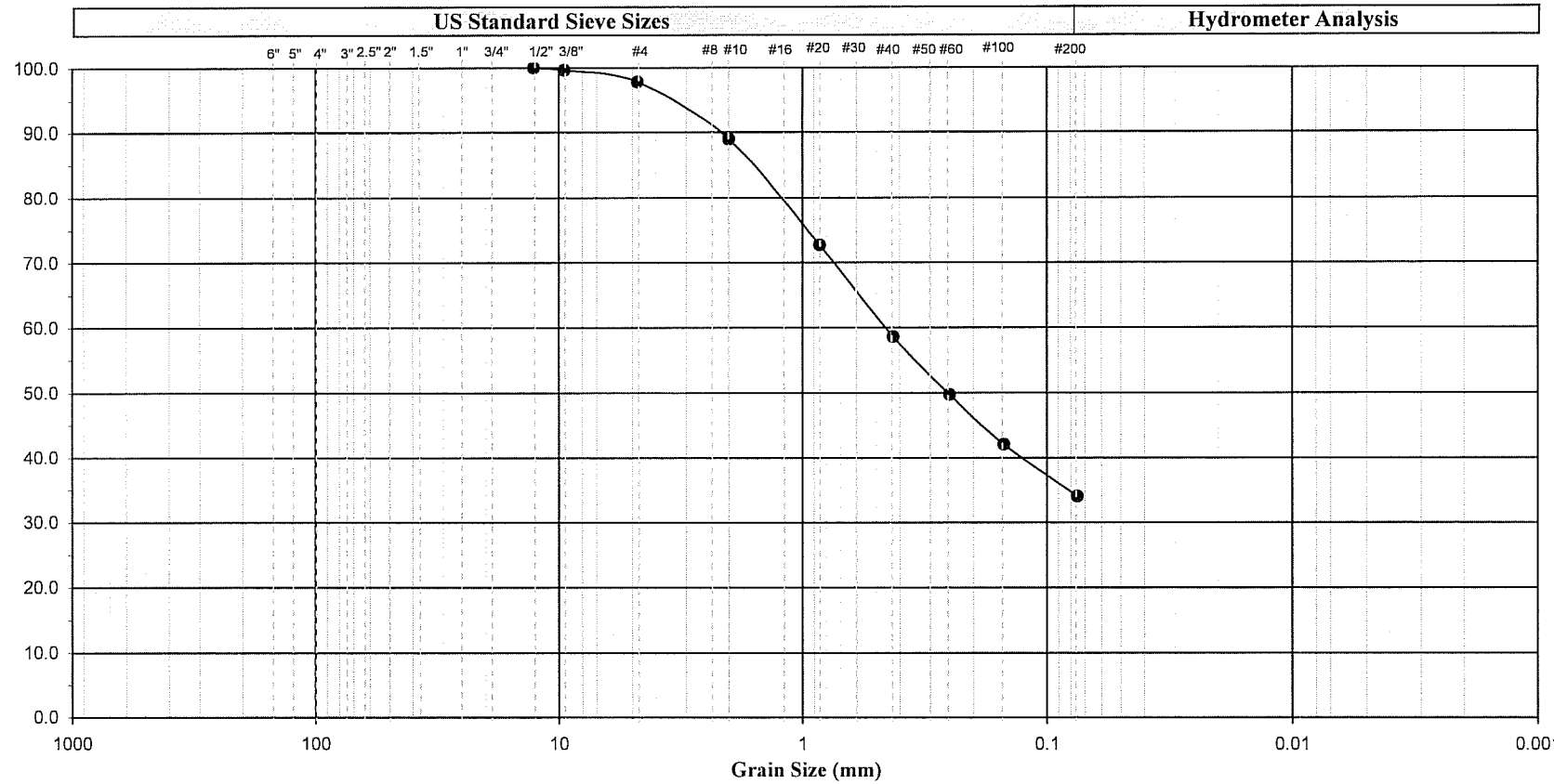
CH2MHill/SR-710 Tunnel Site Investigation T.O.4

Project No. : *08-169*

Date : *04/20/09*

GRAIN SIZE ANALYSIS
(ASTM D-422-63)

Figure No. :



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

Symbol	Boring Number	Sample Number	Depth (ft)	Depth (m)	Soil Color	Soil Description	U.S.C.S.
●	Z3-B3	C-28	246.4		White with light gray	Clayey sand	SC
Remark	excluded 1 piece 1.75" gravel						

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

CH2MHill/SR-710 Tunnel Site Investigation T.O.4

Project No. : 08-169 Date : 03/23/09

GRAIN SIZE ANALYSIS
(ASTM D-422-63)

Figure No. :

Leighton

PARTICLE-SIZE ANALYSIS of SOILS
ASTM D 422

Project Name: SR-710 Tunnel Technical Study
Project No.: 378312.04.09.01
Exploration No.: R-09-Z1-B4
Sample No.: C-1
Soil Identification: Olive clayey sand (SC)

Tested By: A. Santos Date: 05/20/09
Checked By: J. Ward Date: 06/01/09
Depth (feet): 13-13.4

		Moisture Content of Total Air - Dry Soil	
Container No.:	923	Wt. of Air-Dry Soil + Cont. (g)	0.00
Wt. of Air-Dried Soil + Cont.(g)	728.70	Wt. of Dry Soil + Cont. (g)	0.00
Wt. of Container (g)	108.70	Wt. of Container No._____ (g)	1.00
Dry Wt. of Soil (g)	620.00	Moisture Content (%)	0.00

After Wet Sieve	Container No.	923
	Wt. of Dry Soil + Container (g)	487.80
	Wt. of Container (g)	108.70
	Dry Wt. of Soil Retained on # 200 Sieve (g)	379.10

U. S. Sieve Size (in.)	U. S. Sieve Size (mm.)	Cumulative Weight Dry Soil Retained (g)	Percent Passing (%)
6"	152.400		
3"	75.000		
1 1/2	37.500		
3/4"	19.000		
3/8"	9.500	0.00	100.0
#4	4.750	4.10	99.3
#8	2.360	23.90	96.1
#16	1.180	79.80	87.1
#30	0.600	149.70	75.9
#50	0.300	225.00	63.7
#100	0.150	310.10	50.0
#200	0.075	374.80	39.5
PAN			

GRAVEL: **1 %**
SAND: **59 %**
FINES: **40 %**
GROUP SYMBOL: **SC**

Cu = D60/D10 = _____
Cc = $(D30)^2/(D60*D10)$ = _____

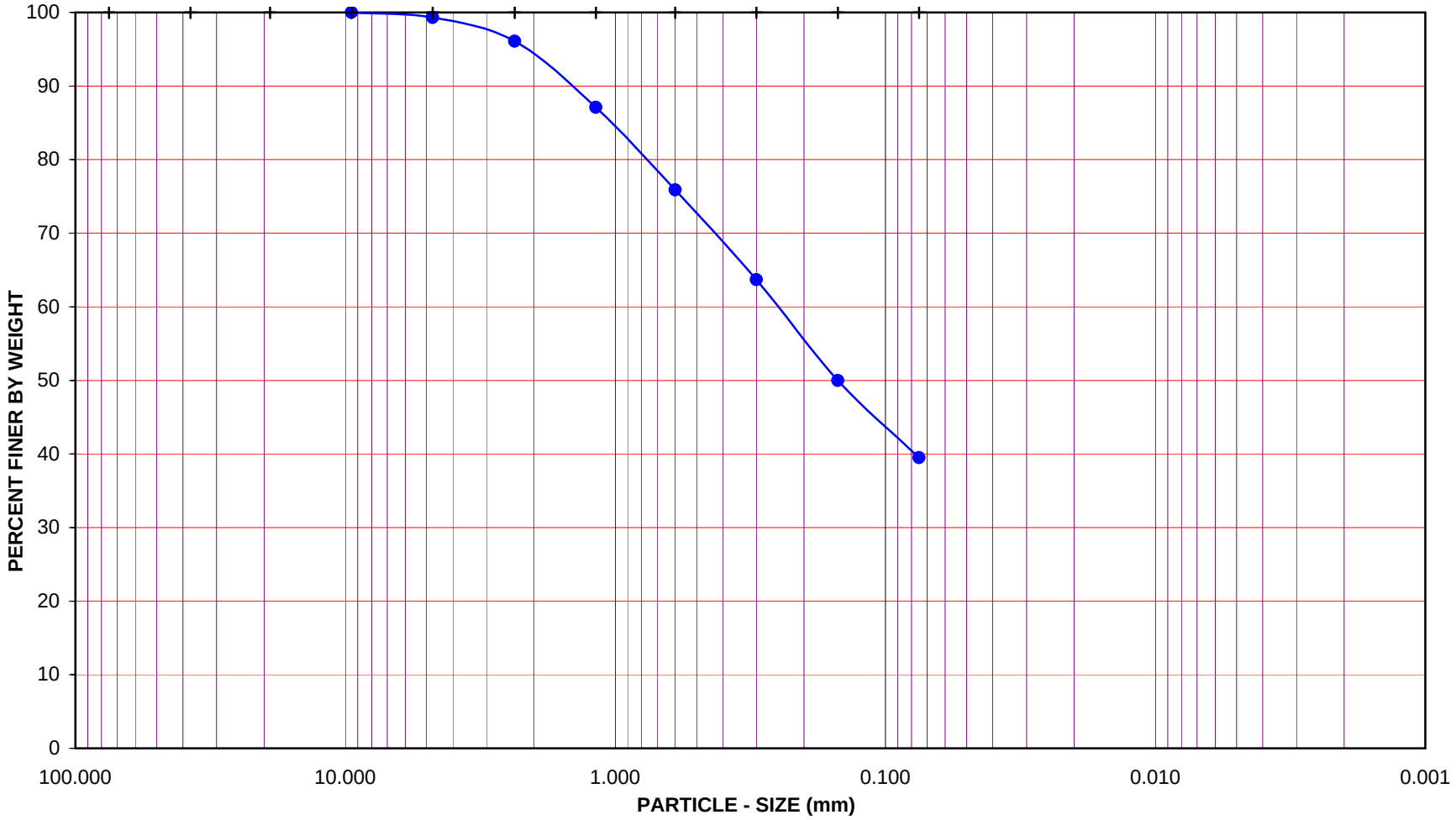
Remarks:

GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY

U.S. STANDARD SIEVE OPENING: 3.0" 1 1/2" 3/4" 3/8"

U.S. STANDARD SIEVE NUMBER: #4 #8 #16 #30 #50 #100 #200

HYDROMETER



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z1-B4 Sample No.: C-1

Depth (feet): 13-13.4 Soil Type : SC

Soil Identification: Olive clayey sand (SC)

GR:SA:FI : (%) 1 : 59 : 40

Leighton

PARTICLE - SIZE DISTRIBUTION ASTM D 422

Jun-09

Leighton

PARTICLE-SIZE ANALYSIS of SOILS
ASTM D 422

Project Name: SR-710 Tunnel Technical Study
Project No.: 378312.04.09.01
Exploration No.: R-09-Z1-B4
Sample No.: C-7
Soil Identification: Olive gray well-graded sand with gravel (SW)g

Tested By: A. Santos Date: 05/20/09
Checked By: J. Ward Date: 06/01/09
Depth (feet): 21-21.4

		Moisture Content of Total Air - Dry Soil	
Container No.:	11	Wt. of Air-Dry Soil + Cont. (g)	0.00
Wt. of Air-Dried Soil + Cont.(g)	808.70	Wt. of Dry Soil + Cont. (g)	0.00
Wt. of Container (g)	111.10	Wt. of Container No._____ (g)	1.00
Dry Wt. of Soil (g)	697.60	Moisture Content (%)	0.00

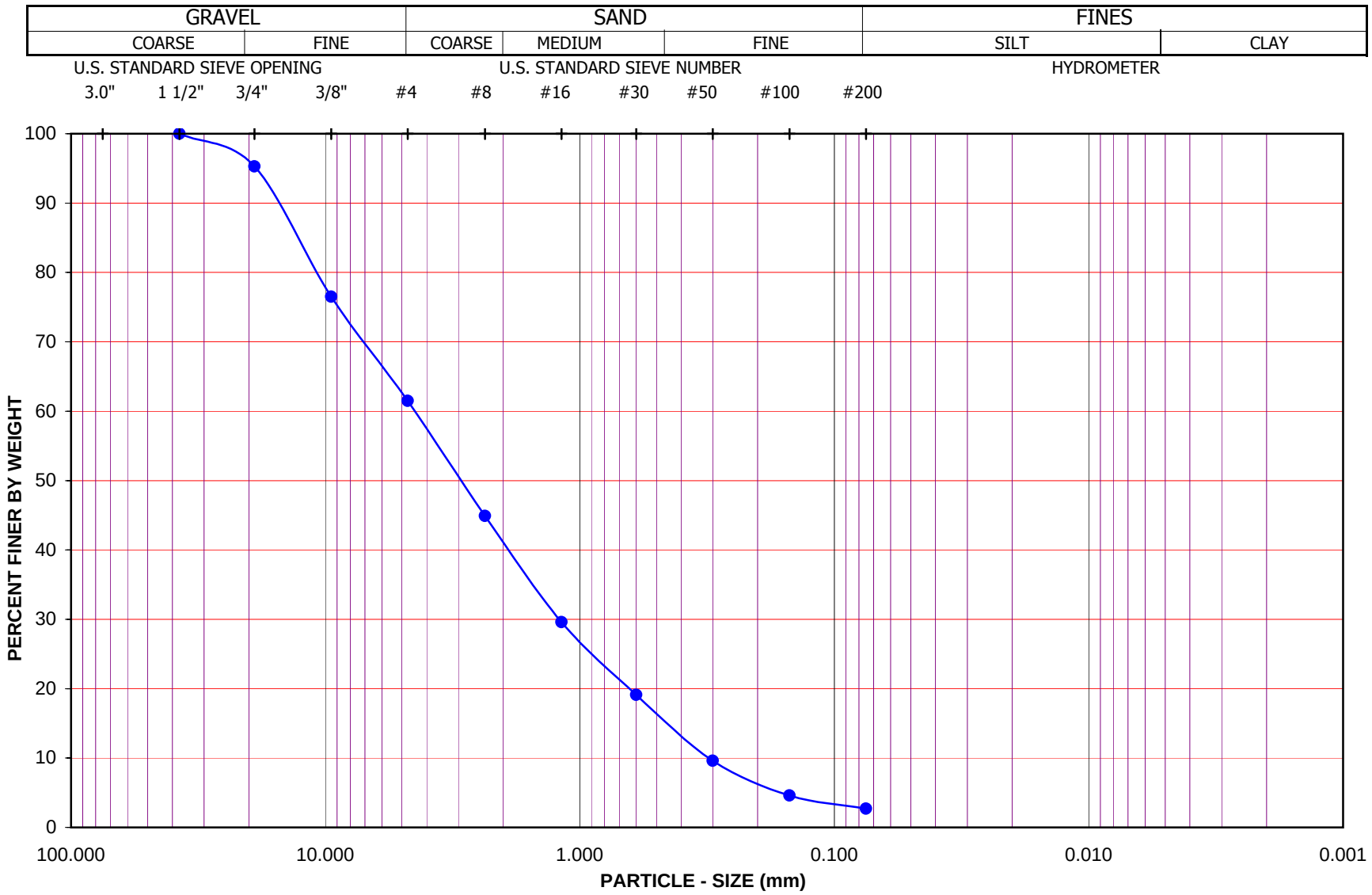
After Wet Sieve	Container No.	11
	Wt. of Dry Soil + Container (g)	792.10
	Wt. of Container (g)	111.10
	Dry Wt. of Soil Retained on # 200 Sieve (g)	681.00

U. S. Sieve Size (in.)	U. S. Sieve Size (mm.)	Cumulative Weight Dry Soil Retained (g)	Percent Passing (%)
6"	152.400		
3"	75.000		
1 1/2	37.500	0.00	100.0
3/4"	19.000	32.80	95.3
3/8"	9.500	163.60	76.5
#4	4.750	268.60	61.5
#8	2.360	384.20	44.9
#16	1.180	491.00	29.6
#30	0.600	564.10	19.1
#50	0.300	630.80	9.6
#100	0.150	665.40	4.6
#200	0.075	678.50	2.7
PAN			

GRAVEL: **39 %**
SAND: **58 %**
FINES: **3 %**
GROUP SYMBOL: **(SW)g**

Cu = D60/D10 = 14.33
Cc = $(D30)^2/(D60*D10)$ = 1.08

Remarks: Insufficient sample mass available to meet the ASTM specification for this material



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z1-B4 Sample No.: C-7

Depth (feet): 21-21.4 Soil Type : (SW)g

Soil Identification: Olive gray well-graded sand with gravel (SW)g

GR:SA:FI : (%) 39 : 58 : 3

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PARTICLE - SIZE DISTRIBUTION ASTM D 422

Jun-09

SA R-09-Z1-B4, C-7 @ 21-21.4

Leighton

PARTICLE-SIZE ANALYSIS of SOILS
ASTM D 422

Project Name: SR-710 Tunnel Technical Study
Project No.: 378312.04.09.01
Exploration No.: R-09-Z1-B4
Sample No.: C-17
Soil Identification: Olive silty sand (SM)

Tested By: A. Santos Date: 05/29/09
Checked By: J. Ward Date: 06/01/09
Depth (feet): 45-50

		Moisture Content of Total Air - Dry Soil	
Container No.:	724	Wt. of Air-Dry Soil + Cont. (g)	0.00
Wt. of Air-Dried Soil + Cont.(g)	639.50	Wt. of Dry Soil + Cont. (g)	0.00
Wt. of Container (g)	77.30	Wt. of Container No._____ (g)	1.00
Dry Wt. of Soil (g)	562.20	Moisture Content (%)	0.00

After Wet Sieve	Container No.	724
	Wt. of Dry Soil + Container (g)	523.40
	Wt. of Container (g)	77.30
	Dry Wt. of Soil Retained on # 200 Sieve (g)	446.10

U. S. Sieve Size (in.)	U. S. Sieve Size (mm.)	Cumulative Weight Dry Soil Retained (g)	Percent Passing (%)
6"	152.400		
3"	75.000		
1 1/2	37.500		
3/4"	19.000		
3/8"	9.500	0.00	100.0
#4	4.750	0.90	99.8
#8	2.360	3.50	99.4
#16	1.180	8.90	98.4
#30	0.600	22.60	96.0
#50	0.300	99.60	82.3
#100	0.150	305.10	45.7
#200	0.075	433.90	22.8
PAN			

GRAVEL: **0 %**
SAND: **77 %**
FINES: **23 %**
GROUP SYMBOL: **SM**

Cu = D60/D10 = _____
Cc = $(D30)^2/(D60*D10)$ = _____

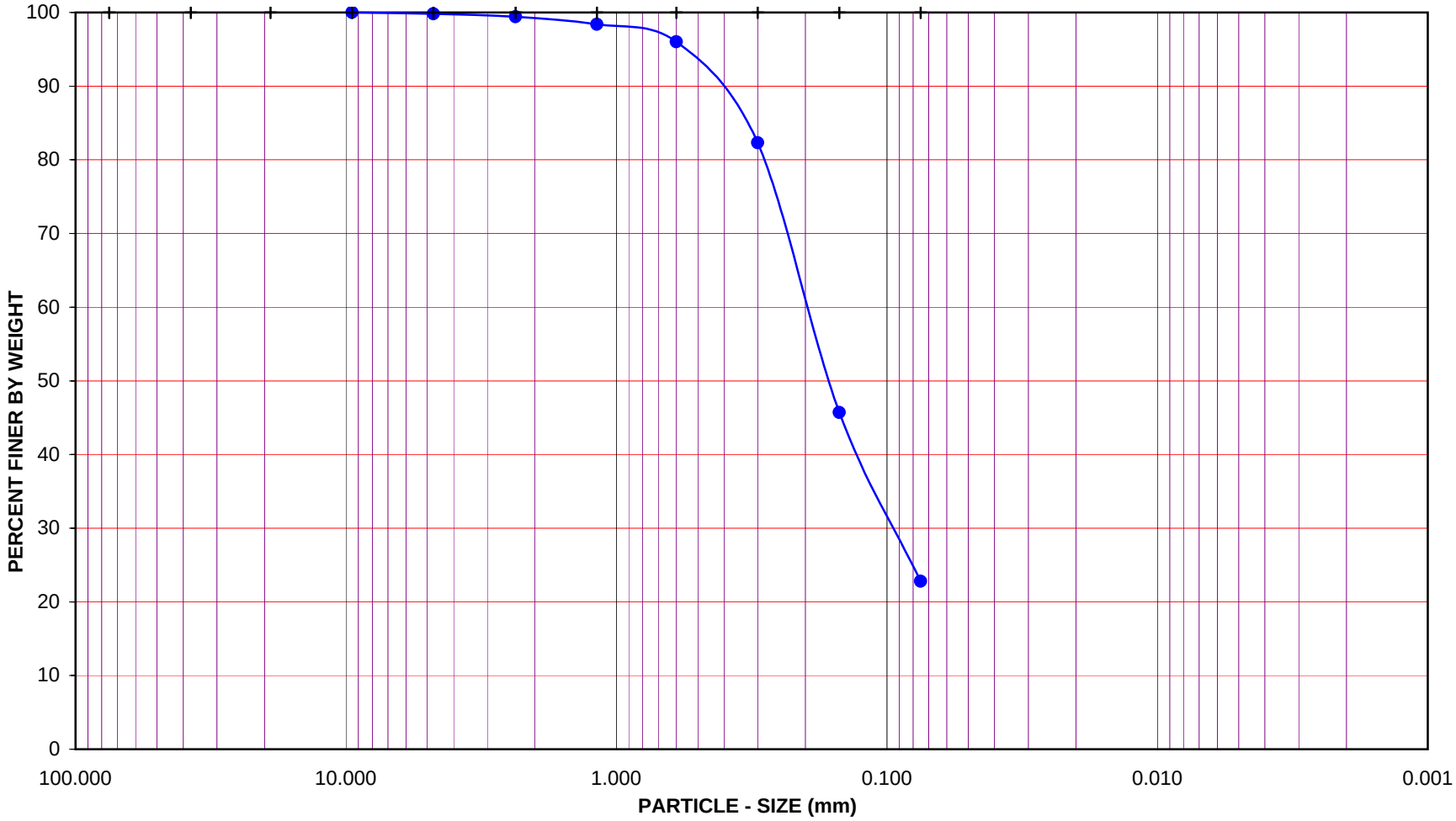
Remarks:

GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY

U.S. STANDARD SIEVE OPENING: 3.0" 1 1/2" 3/4" 3/8"

U.S. STANDARD SIEVE NUMBER: #4 #8 #16 #30 #50 #100 #200

HYDROMETER



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z1-B4 Sample No.: C-17

Depth (feet): 45-50 Soil Type : SM

Soil Identification: Olive silty sand (SM)

GR:SA:FI : (%) 0 : 77 : 23

Leighton

PARTICLE - SIZE DISTRIBUTION ASTM D 422

Jun-09

SA R-09-Z1-B4, C-17 @ 45-50

Leighton

PARTICLE-SIZE ANALYSIS OF SOILS

ASTM D 422

Project Name: SR-710 Tunnel Technical Study | Tested By : V. Juliano | Date: 06/01/09

Project No. : 378312.04.09.01 | Data Input By: J. Ward | Date: 06/06/09

Exploration No.: R-09-Z1-B4

Sample No.: C-22 | Depth (feet) : 66-66.6

Soil Identification: Yellowish brown fat clay'stone (CH)

				Moisture Content of Total Air-Dry Soil	Moisture Content of Air-Dry Soil Passing #10	After Hydrometer & Wet Sieve ret. in #200 Sieve
% Gravel	**0**	**Soil Type**				
% Sand	**3**	**CH**				
% Fines	**97**					
Specific Gravity (Assumed)	2.70	Wt.of Air-Dry Soil + Cont.(g)		0.00	0.00	
Correction for Specific Gravity	0.99	Dry Wt. of Soil + Cont. (g)		0.00	0.00	80.76
Wt.of Air-Dry Soil + Cont. (g)	687.30	Wt. of Container No.___ (g)		1.00	1.00	78.47
Wt. of Container	107.60	Moisture Content (%)		0.00	0.00	
Dry Wt. of Soil (g)	579.70	Wt. of Dry Soil (g)				2.29

Coarse Sieve

U.S. Sieve	Cumulative Wt. Of Dry Soil Retained (g)	% Passing
3"	0.00	100.0
1½"	0.00	100.0
3/4"	0.00	100.0
3/8"	0.00	100.0
No. 4	0.00	100.0
No. 10	0.00	100.0
Pan		

Sieve after Hydrometer & Wet Sieve

U.S. Sieve Size	Cumulative Wt. Of Dry Soil Retained (g)	% Passing	% Total Sample
No. 10	0.00	100.0	100.0
No. 16	0.03	100.0	100.0
No. 30	0.07	99.9	99.9
No. 50	0.11	99.8	99.8
No. 100	0.36	99.4	99.4
No. 200	2.19	96.6	96.6
Pan			

Hydrometer Wt. of Air-Dry Soil (g) 65.14 Wt. of Dry Soil (g) 65.14

Deflocculant 125 cc of 4% Solution

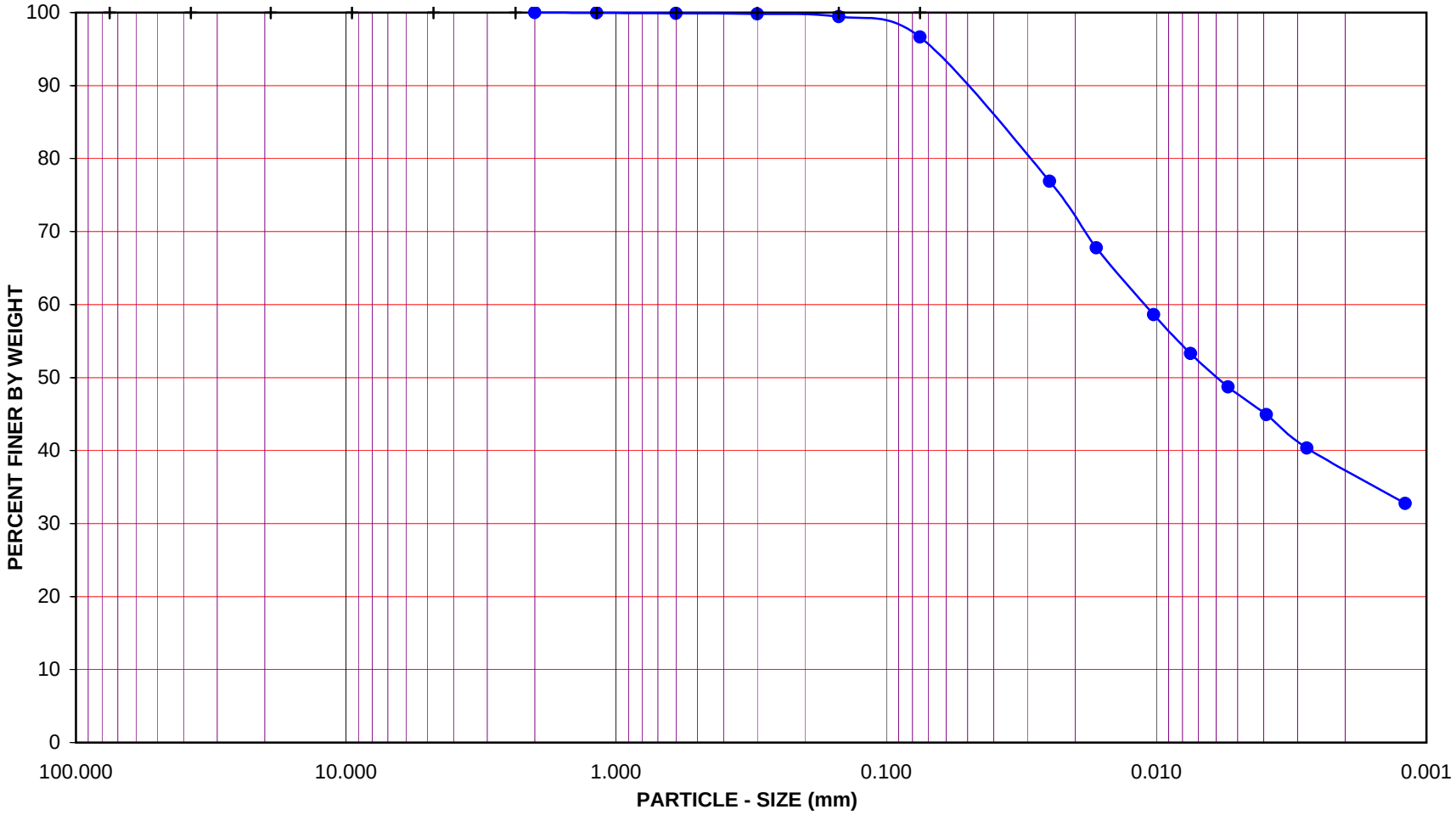
Date	Time	Elapsed Time (min)	Water Temperature (°C)	Composite Correction 152H	Actual Hydrometer Readings	% Total Sample (%)	Soil Particle Diameter (mm)
02-Jun-09	9:08	0		6.5			
	9:10	2	21.6	6.5	57.0	76.9	0.0248
	9:13	5	21.7	6.5	51.0	67.8	0.0167
	9:23	15	21.5	6.5	45.0	58.6	0.0102
	9:38	30	21.6	6.5	41.5	53.3	0.0075
	10:08	60	21.6	6.5	38.5	48.7	0.0054
	11:08	120	21.7	6.5	36.0	44.9	0.0039
	13:18	250	21.8	6.5	33.0	40.4	0.0028
03-Jun-09	9:08	1440	21.5	6.5	28.0	32.7	0.0012

GRAVEL		SAND			FINES	
COARSE	FINE	CRSE	MEDIUM	FINE	SILT	CLAY

U.S. STANDARD SIEVE OPENING: 3.0" 1 1/2" 3/4" 3/8"

U.S. STANDARD SIEVE NUMBER: #4 #8 #16 #30 #50 #100 #200

HYDROMETER



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z1-B4 Sample No.: C-22

Depth (feet) : 66-66.6 Soil Type : CH

Soil Identification: Yellowish brown fat clay'stone (CH)

GR:SA:FI : (%) 0 : 3 : 97

Leighton

PARTICLE - SIZE DISTRIBUTION ASTM D 422

Jun-09

Leighton

PARTICLE-SIZE ANALYSIS of SOILS
ASTM D 422

Project Name: SR-710 Tunnel Technical Study
Project No.: 378312.04.09.01
Exploration No.: R-09-Z1-B4
Sample No.: C-34
Soil Identification: Gray silty sand'stone' (SM)

Tested By: A. Santos Date: 05/29/09
Checked By: J. Ward Date: 06/01/09
Depth (feet): 132.3-133

		Moisture Content of Total Air - Dry Soil	
Container No.:	738	Wt. of Air-Dry Soil + Cont. (g)	0.00
Wt. of Air-Dried Soil + Cont.(g)	587.10	Wt. of Dry Soil + Cont. (g)	0.00
Wt. of Container (g)	76.30	Wt. of Container No._____ (g)	1.00
Dry Wt. of Soil (g)	510.80	Moisture Content (%)	0.00

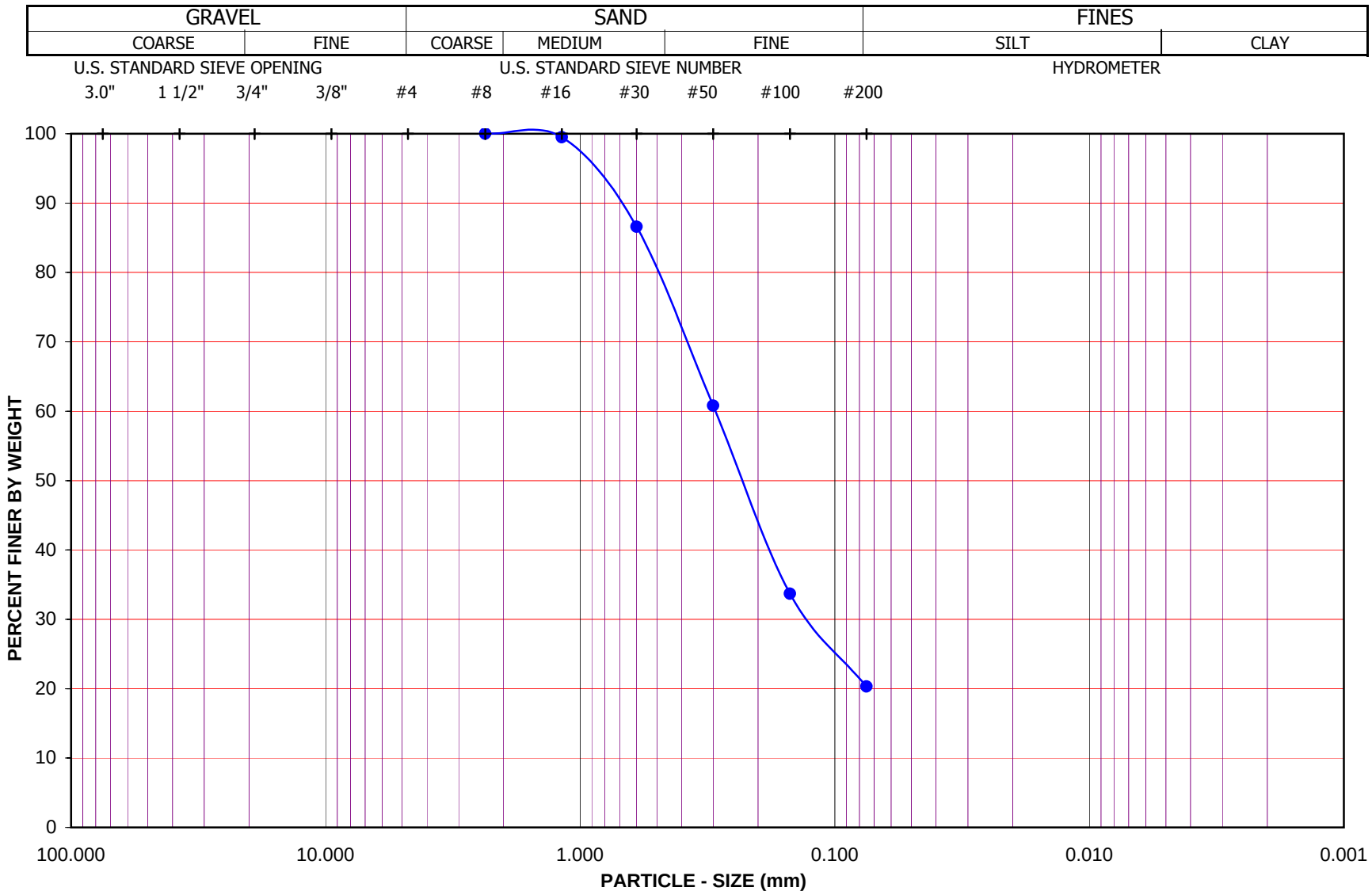
After Wet Sieve	Container No.	738
	Wt. of Dry Soil + Container (g)	495.70
	Wt. of Container (g)	76.30
	Dry Wt. of Soil Retained on # 200 Sieve (g)	419.40

U. S. Sieve Size (in.)	U. S. Sieve Size (mm.)	Cumulative Weight Dry Soil Retained (g)	Percent Passing (%)
6"	152.400		
3"	75.000		
1 1/2	37.500		
3/4"	19.000		
3/8"	9.500		
#4	4.750		
#8	2.360	0.00	100.0
#16	1.180	2.50	99.5
#30	0.600	68.70	86.6
#50	0.300	200.20	60.8
#100	0.150	338.80	33.7
#200	0.075	407.30	20.3
PAN			

GRAVEL: **0 %**
SAND: **80 %**
FINES: **20 %**
GROUP SYMBOL: **SM**

Cu = D60/D10 = _____
Cc = $(D30)^2/(D60*D10)$ = _____

Remarks:



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z1-B4 Sample No.: C-34

Depth (feet): 132.3-133 Soil Type : SM

Soil Identification: Gray silty sand'stone' (SM)

GR:SA:FI : (%) 0 : 80 : 20

Leighton

PARTICLE - SIZE DISTRIBUTION ASTM D 422

Jun-09

SA R-09-Z1-B4, C-34 @ 132.3-133

Leighton

PARTICLE-SIZE ANALYSIS OF SOILS

ASTM D 422

Project Name: SR-710 Tunnel Technical Study | Tested By : V. Juliano | Date: 04/06/09

Project No. : 378312.04.09.01 | Data Input By: J. Ward | Date: 04/28/09

Exploration No.: R-09-Z1-B5

Sample No.: S3 | Depth (feet) : 15.0

Soil Identification: Dark brown sandy silt s(ML)

% Gravel	**0**	**Soil Type**	
% Sand	**43**	**s(ML)**	
% Fines	**57**		

			Moisture Content of Total Air-Dry Soil	Moisture Content of Air-Dry Soil Passing #10	After Hydrometer & Wet Sieve ret. in #200 Sieve
Specific Gravity (Assumed)	2.70	Wt.of Air-Dry Soil + Cont.(g)	0.00	0.00	
Correction for Specific Gravity	0.99	Dry Wt. of Soil + Cont. (g)	0.00	0.00	106.65
Wt.of Air-Dry Soil + Cont. (g)	589.10	Wt. of Container No.___ (g)	1.00	1.00	76.15
Wt. of Container	75.80	Moisture Content (%)	0.00	0.00	
Dry Wt. of Soil (g)	513.30	Wt. of Dry Soil (g)			30.50

Coarse Sieve

U.S. Sieve	Cumulative Wt. Of Dry Soil Retained (g)	% Passing
3"	0.00	100.0
1½"	0.00	100.0
3/4"	0.00	100.0
3/8"	0.00	100.0
No. 4	0.00	100.0
No. 10	0.00	100.0
Pan		

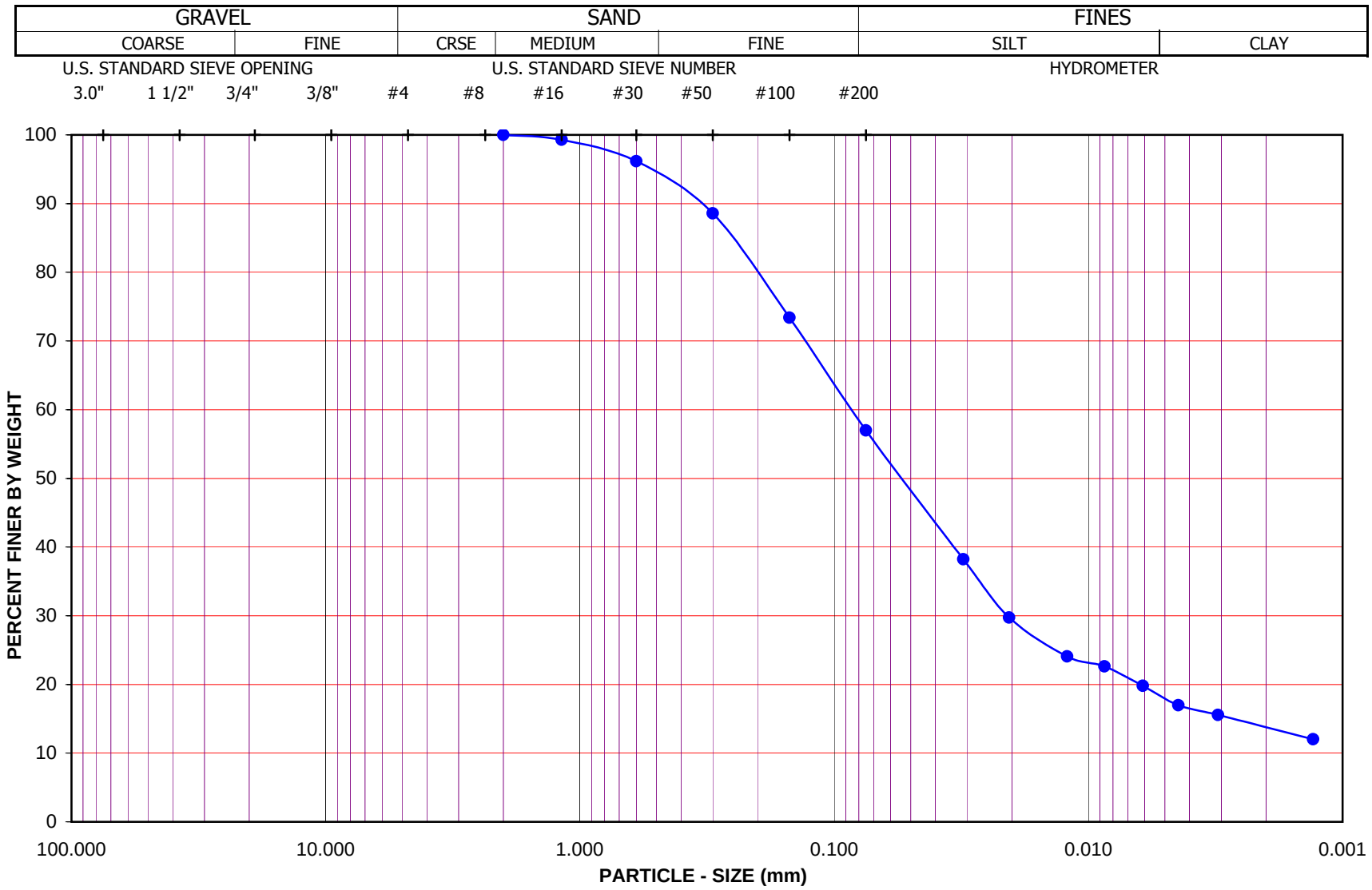
Sieve after Hydrometer & Wet Sieve

U.S. Sieve Size	Cumulative Wt. Of Dry Soil Retained (g)	% Passing	% Total Sample
No. 10	0.00	100.0	100.0
No. 16	0.49	99.3	99.3
No. 30	2.69	96.2	96.2
No. 50	8.02	88.6	88.6
No. 100	18.66	73.4	73.4
No. 200	30.15	57.0	57.0
Pan			

Hydrometer Wt. of Air-Dry Soil (g) 70.09 Wt. of Dry Soil (g) 70.09

Deflocculant 125 cc of 4% Solution

Date	Time	Elapsed Time (min)	Water Temperature (°C)	Composite Correction 152H	Actual Hydrometer Readings	% Total Sample (%)	Soil Particle Diameter (mm)
07-Apr-09	8:24	0		6.0			
	8:26	2	21.4	6.0	33.0	38.2	0.0310
	8:29	5	21.4	6.0	27.0	29.7	0.0205
	8:39	15	21.5	6.0	23.0	24.1	0.0121
	8:54	30	21.7	6.0	22.0	22.6	0.0086
	9:24	60	22.0	6.0	20.0	19.8	0.0061
	10:24	120	21.9	6.0	18.0	17.0	0.0044
	12:34	250	21.8	6.0	17.0	15.6	0.0031
08-Apr-09	8:24	1440	21.7	6.0	14.5	12.0	0.0013



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z1-B5 Sample No.: S3

Depth (feet) : 15.0 Soil Type : s(ML)

Soil Identification: Dark brown sandy silt s(ML)

GR:SA:FI : (%) 0 : 43 : 57

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PARTICLE - SIZE DISTRIBUTION ASTM D 422

Apr-09

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PARTICLE-SIZE ANALYSIS OF SOILS

ASTM D 422

Project Name: SR-710 Tunnel Technical Study | Tested By : V. Juliano | Date: 04/06/09

Project No. : 378312.04.09.01 | Data Input By: J. Ward | Date: 04/28/09

Exploration No.: R-09-Z1-B5

Sample No.: S7 | Depth (feet) : 35.0

Soil Identification: Brown sandy lean clay s(CL)

% Gravel	**0**	**Soil Type**	Moisture Content of Total Air-Dry Soil	Moisture Content of Air-Dry Soil Passing #10	After Hydrometer & Wet Sieve ret. in #200 Sieve
% Sand	**42**	**s(CL)**			
% Fines	**58**				

Specific Gravity (Assumed)	2.70	Wt.of Air-Dry Soil + Cont.(g)	0.00	0.00	
Correction for Specific Gravity	0.99	Dry Wt. of Soil + Cont. (g)	0.00	0.00	102.46
Wt.of Air-Dry Soil + Cont. (g)	599.50	Wt. of Container No.___ (g)	1.00	1.00	72.53
Wt. of Container	76.50	Moisture Content (%)	0.00	0.00	
Dry Wt. of Soil (g)	523.00	Wt. of Dry Soil (g)			29.93

Coarse Sieve

U.S. Sieve	Cumulative Wt. Of Dry Soil Retained (g)	% Passing
3"	0.00	100.0
1½"	0.00	100.0
3/4"	0.00	100.0
3/8"	0.00	100.0
No. 4	0.00	100.0
No. 10	0.00	100.0
Pan		

Sieve after Hydrometer & Wet Sieve

U.S. Sieve Size	Cumulative Wt. Of Dry Soil Retained (g)	% Passing	% Total Sample
No. 10	0.00	100.0	100.0
No. 16	0.31	99.6	99.6
No. 30	2.11	97.0	97.0
No. 50	7.49	89.3	89.3
No. 100	18.61	73.4	73.4
No. 200	29.67	57.6	57.6
Pan			

Hydrometer Wt. of Air-Dry Soil (g) 70.04 Wt. of Dry Soil (g) 70.04

Deflocculant 125 cc of 4% Solution

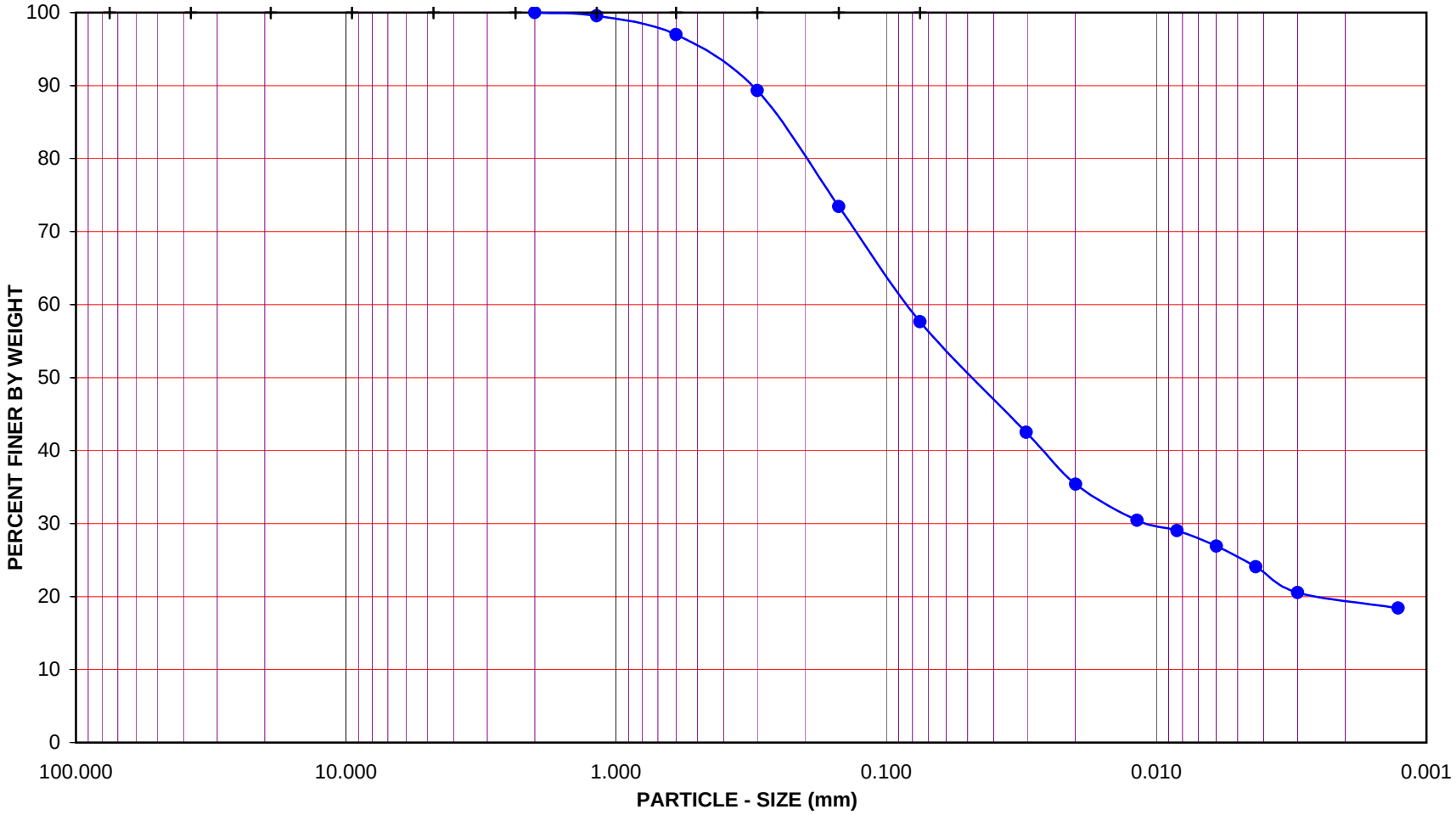
Date	Time	Elapsed Time (min)	Water Temperature (°C)	Composite Correction 152H	Actual Hydrometer Readings	% Total Sample (%)	Soil Particle Diameter (mm)
07-Apr-09	8:16	0		6.0			
	8:18	2	21.3	6.0	36.0	42.5	0.0303
	8:21	5	21.4	6.0	31.0	35.4	0.0199
	8:31	15	21.4	6.0	27.5	30.5	0.0118
	8:46	30	21.6	6.0	26.5	29.0	0.0084
	9:16	60	21.9	6.0	25.0	26.9	0.0060
	10:16	120	21.8	6.0	23.0	24.1	0.0043
	12:30	254	21.8	6.0	20.5	20.5	0.0030
08-Apr-09	8:16	1440	21.7	6.0	19.0	18.4	0.0013

GRAVEL		SAND			FINES	
COARSE	FINE	CRSE	MEDIUM	FINE	SILT	CLAY

U.S. STANDARD SIEVE OPENING: 3.0" 1 1/2" 3/4" 3/8"

U.S. STANDARD SIEVE NUMBER: #4 #8 #16 #30 #50 #100 #200

HYDROMETER



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z1-B5 Sample No.: S7

Depth (feet) : 35.0 Soil Type : s(CL)

Soil Identification: Brown sandy lean clay s(CL)

GR:SA:FI : (%) 0 : 42 : 58

Leighton

PARTICLE - SIZE DISTRIBUTION ASTM D 422

Apr-09

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PARTICLE-SIZE ANALYSIS of SOILS
ASTM D 422

Project Name: SR-710 Tunnel Technical Study
Project No.: 378312.04.09.01
Exploration No.: R-09-Z1-B5
Sample No.: S9
Soil Identification: Brown silty sand (SM)

Tested By: V. Juliano Date: 04/06/09
Checked By: J. Ward Date: 04/28/09
Depth (feet): 45.0

		Moisture Content of Total Air - Dry Soil	
Container No.:	746	Wt. of Air-Dry Soil + Cont. (g)	0.00
Wt. of Air-Dried Soil + Cont.(g)	427.40	Wt. of Dry Soil + Cont. (g)	0.00
Wt. of Container (g)	76.80	Wt. of Container No._____ (g)	1.00
Dry Wt. of Soil (g)	350.60	Moisture Content (%)	0.00

After Wet Sieve	Container No.	746
	Wt. of Dry Soil + Container (g)	269.35
	Wt. of Container (g)	76.80
	Dry Wt. of Soil Retained on # 200 Sieve (g)	192.55

U. S. Sieve Size (in.)	U. S. Sieve Size (mm.)	Cumulative Weight Dry Soil Retained (g)	Percent Passing (%)
6"	152.400		
3"	75.000		
1 1/2	37.500		
3/4"	19.000		
3/8"	9.500		
#4	4.750	0.00	100.0
#8	2.360	4.37	98.8
#16	1.180	12.12	96.5
#30	0.600	28.33	91.9
#50	0.300	62.82	82.1
#100	0.150	130.70	62.7
#200	0.075	191.39	45.4
PAN			

GRAVEL: **0 %**
SAND: **55 %**
FINES: **45 %**
GROUP SYMBOL: **SM**

Cu = D60/D10 = _____
Cc = $(D30)^2/(D60*D10)$ = _____

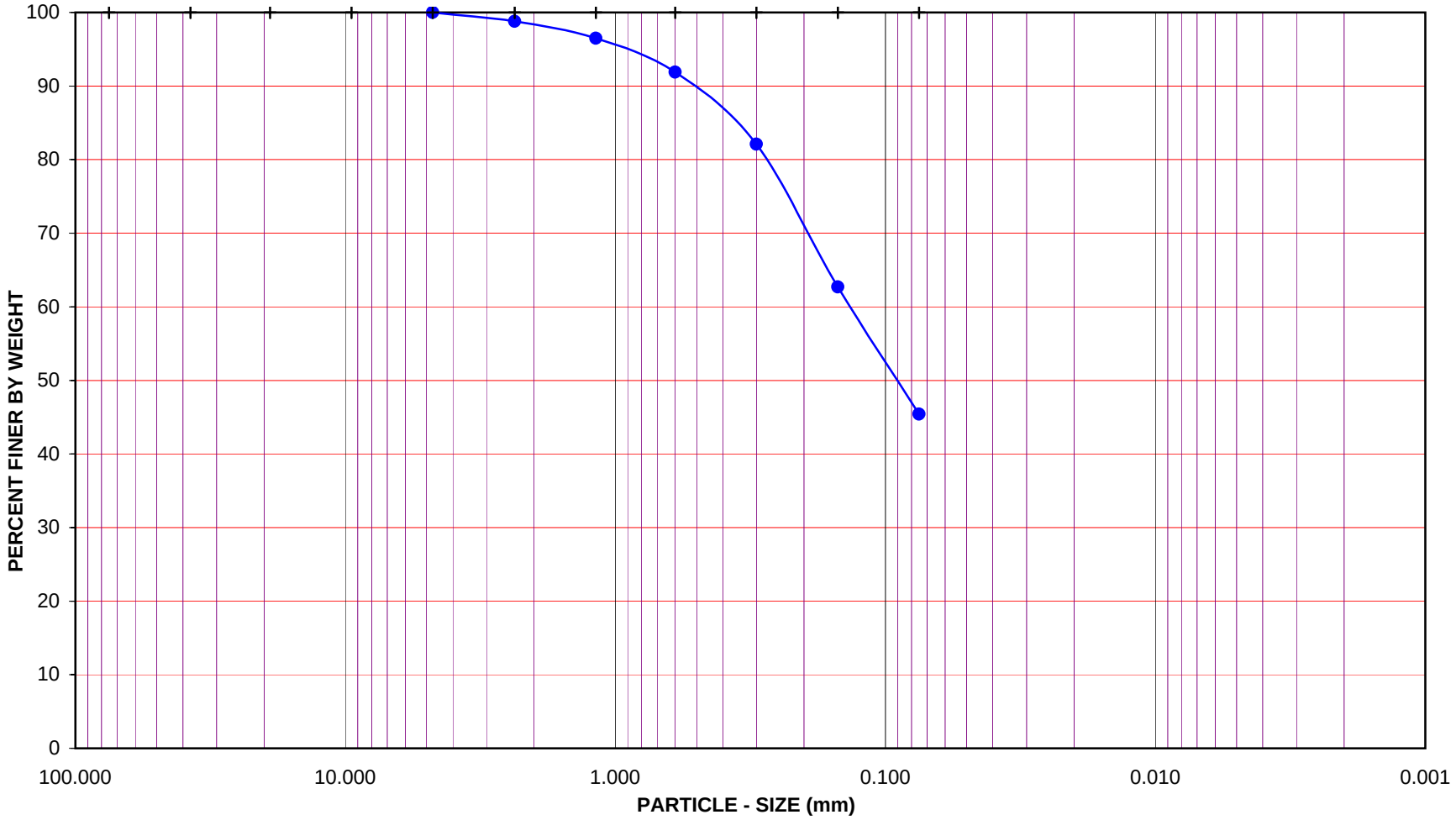
Remarks:

GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY

U.S. STANDARD SIEVE OPENING: 3.0" 1 1/2" 3/4" 3/8"

U.S. STANDARD SIEVE NUMBER: #4 #8 #16 #30 #50 #100 #200

HYDROMETER



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z1-B5 Sample No.: S9

Depth (feet): 45.0 Soil Type : SM

Soil Identification: Brown silty sand (SM)

GR:SA:FI : (%) 0 : 55 : 45

Leighton

PARTICLE - SIZE DISTRIBUTION ASTM D 422

Apr-09

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PARTICLE-SIZE ANALYSIS of SOILS
ASTM D 422

Project Name: SR-710 Tunnel Technical Study
Project No.: 378312.04.09.01
Exploration No.: R-09-Z1-B5
Sample No.: C60
Soil Identification: Gray silty sand (SM)

Tested By: A. Santos Date: 05/14/09
Checked By: J. Ward Date: 05/21/09
Depth (feet): 437.3-438.0

		Moisture Content of Total Air - Dry Soil	
Container No.:	903	Wt. of Air-Dry Soil + Cont. (g)	0.00
Wt. of Air-Dried Soil + Cont.(g)	805.70	Wt. of Dry Soil + Cont. (g)	0.00
Wt. of Container (g)	110.50	Wt. of Container No._____ (g)	1.00
Dry Wt. of Soil (g)	695.20	Moisture Content (%)	0.00

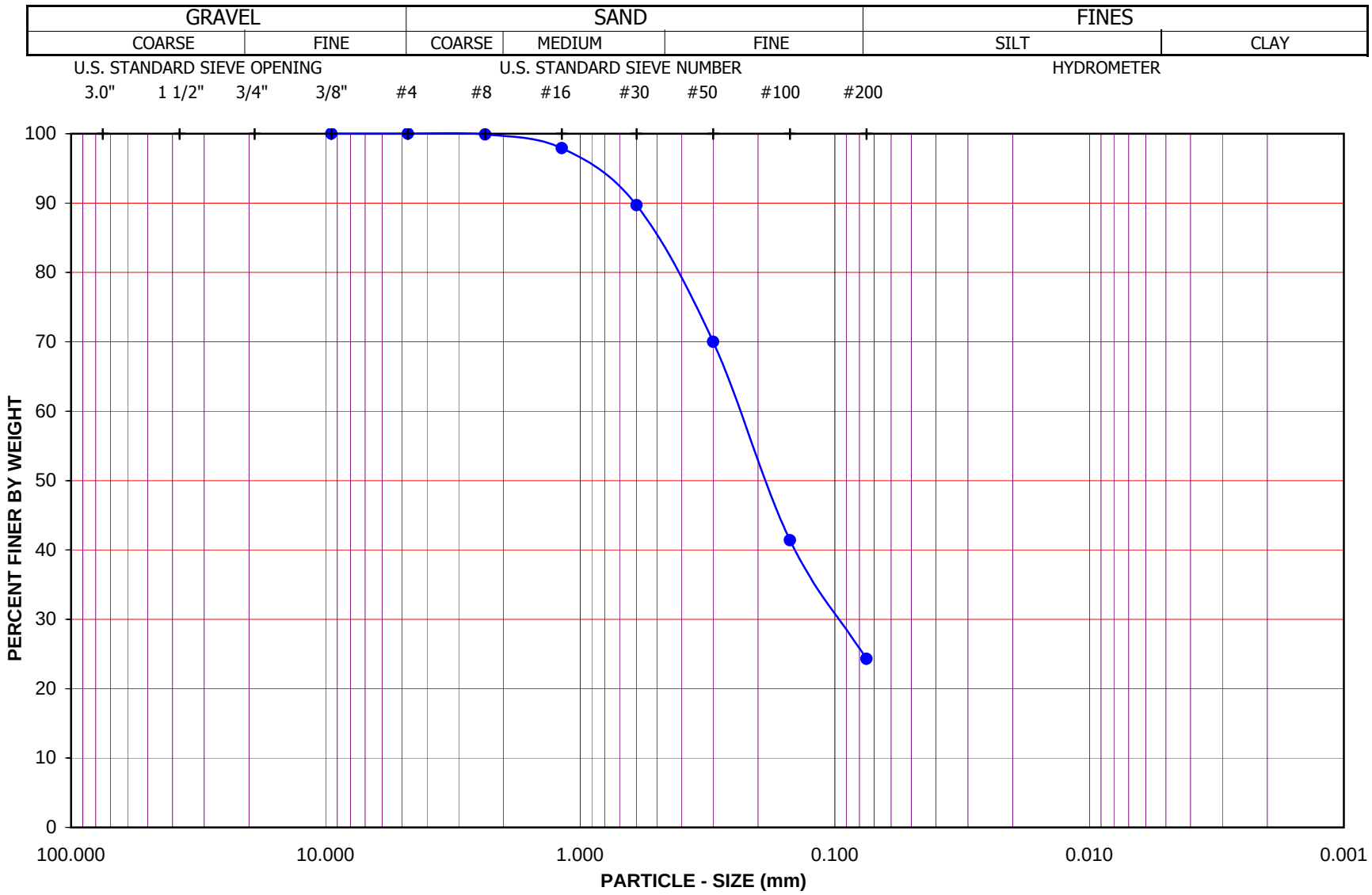
After Wet Sieve	Container No.	903
	Wt. of Dry Soil + Container (g)	647.20
	Wt. of Container (g)	110.50
	Dry Wt. of Soil Retained on # 200 Sieve (g)	536.70

U. S. Sieve Size (in.)	U. S. Sieve Size (mm.)	Cumulative Weight Dry Soil Retained (g)	Percent Passing (%)
6"	152.400		
3"	75.000		
1 1/2	37.500		
3/4"	19.000		
3/8"	9.500	0.00	100.0
#4	4.750	0.20	100.0
#8	2.360	0.70	99.9
#16	1.180	14.70	97.9
#30	0.600	71.40	89.7
#50	0.300	208.40	70.0
#100	0.150	407.10	41.4
#200	0.075	526.10	24.3
PAN			

GRAVEL: **0 %**
SAND: **76 %**
FINES: **24 %**
GROUP SYMBOL: **SM**

Cu = D60/D10 = _____
Cc = $(D30)^2/(D60*D10)$ = _____

Remarks:



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z1-B5 Sample No.: C60

Depth (feet): 437.3-438.0 Soil Type : SM

Soil Identification: Gray silty sand (SM)

GR:SA:FI : (%) 0 : 76 : 24

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PARTICLE - SIZE DISTRIBUTION ASTM D 422

May-09

Leighton

PARTICLE-SIZE ANALYSIS of SOILS
ASTM D 422

Project Name: SR-710 Tunnel Technical Study
Project No.: 378312.04.09.01
Exploration No.: R-09-Z1-B5
Sample No.: C65
Soil Identification: Light olive silty sand (SM)

Tested By: V. Juliano Date: 05/06/09
Checked By: J. Ward Date: 05/12/09
Depth (feet): 477-477.6

		Moisture Content of Total Air - Dry Soil	
Container No.:	790	Wt. of Air-Dry Soil + Cont. (g)	0.00
Wt. of Air-Dried Soil + Cont.(g)	417.00	Wt. of Dry Soil + Cont. (g)	0.00
Wt. of Container (g)	75.90	Wt. of Container No._____ (g)	1.00
Dry Wt. of Soil (g)	341.10	Moisture Content (%)	0.00

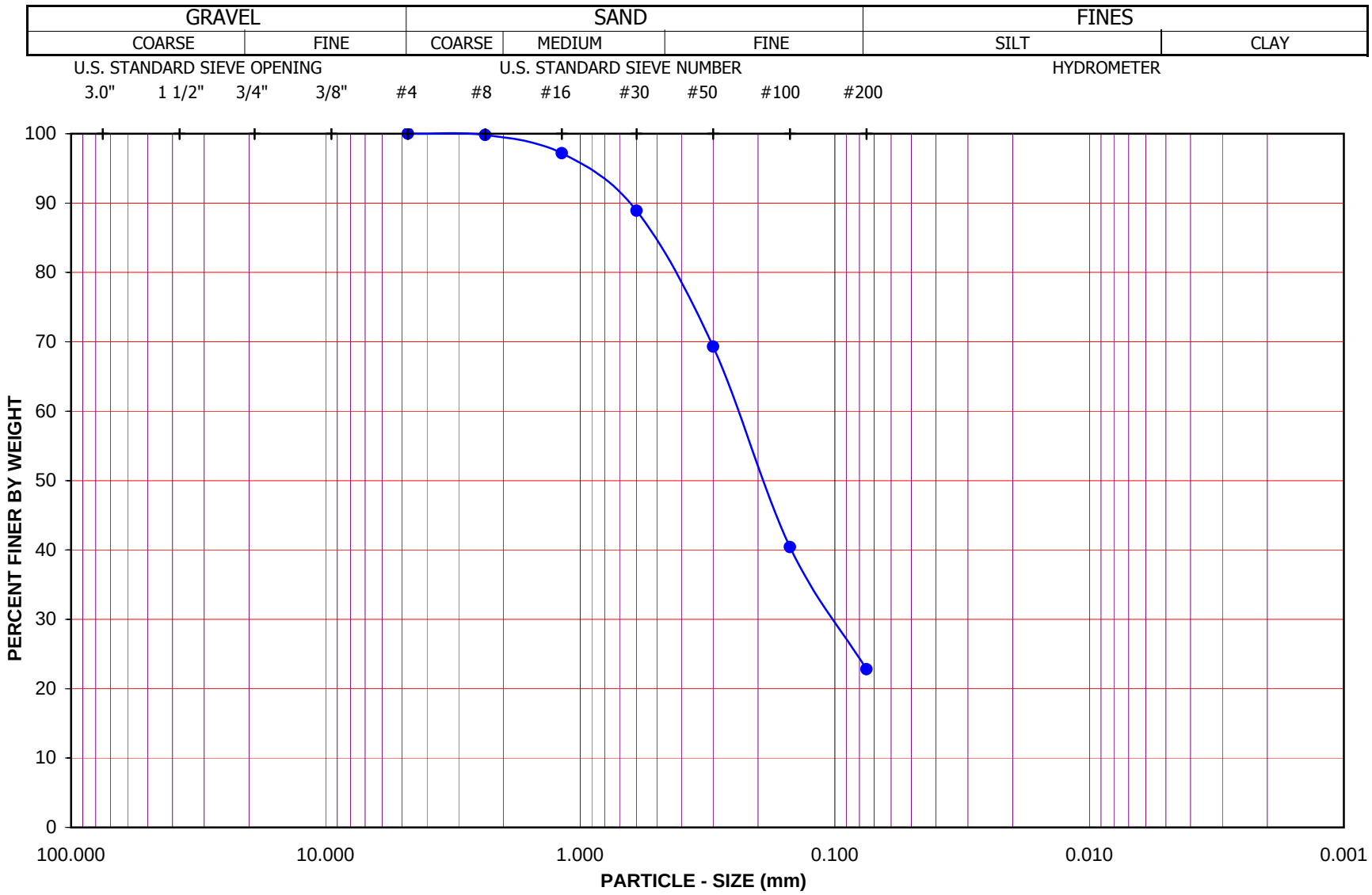
After Wet Sieve	Container No.	790
	Wt. of Dry Soil + Container (g)	346.80
	Wt. of Container (g)	75.90
	Dry Wt. of Soil Retained on # 200 Sieve (g)	270.90

U. S. Sieve Size (in.)	U. S. Sieve Size (mm.)	Cumulative Weight Dry Soil Retained (g)	Percent Passing (%)
6"	152.400		
3"	75.000		
1 1/2	37.500		
3/4"	19.000		
3/8"	9.500		
#4	4.750	0.00	100.0
#8	2.360	0.60	99.8
#16	1.180	9.50	97.2
#30	0.600	38.00	88.9
#50	0.300	104.60	69.3
#100	0.150	203.40	40.4
#200	0.075	263.30	22.8
PAN			

GRAVEL: **0 %**
SAND: **77 %**
FINES: **23 %**
GROUP SYMBOL: **SM**

Cu = D60/D10 = _____
Cc = $(D30)^2/(D60*D10)$ = _____

Remarks:



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z1-B5 Sample No.: C65

Depth (feet): 477-477.6 Soil Type : SM

Soil Identification: Light olive silty sand (SM)

GR:SA:FI : (%) 0 : 77 : 23

Leighton

PARTICLE - SIZE DISTRIBUTION ASTM D 422

May-09

SA R-09-Z1-B5, R49 @ 477-477.6

Leighton

PARTICLE-SIZE ANALYSIS OF SOILS

ASTM D 422

Project Name: SR-710 Tunnel Technical Study | Tested By : A. Santos | Date: 03/10/09

Project No. : 378312.04.09.01 | Data Input By: J. Ward | Date: 03/26/09

Exploration No.: R-09-Z1-B6

Sample No.: S9 | Depth (feet) : 40.0

Soil Identification: Dark yellowish brown sandy lean clay s(CL)

% Gravel	**0**	**Soil Type**
% Sand	**30**	**s(CL)**
% Fines	**70**	

			Moisture Content of Total Air-Dry Soil	Moisture Content of Air-Dry Soil Passing #10	After Hydrometer & Wet Sieve ret. in #200 Sieve
Specific Gravity (Assumed)	2.70	Wt.of Air-Dry Soil + Cont.(g)	0.00	0.00	
Correction for Specific Gravity	0.99	Dry Wt. of Soil + Cont. (g)	0.00	0.00	91.25
Wt.of Air-Dry Soil + Cont. (g)	506.80	Wt. of Container No.___ (g)	1.00	1.00	75.40
Wt. of Container	75.40	Moisture Content (%)	0.00	0.00	
Dry Wt. of Soil (g)	431.40	Wt. of Dry Soil (g)			15.85

Coarse Sieve

U.S. Sieve	Cumulative Wt. Of Dry Soil Retained (g)	% Passing
3"	0.00	100.0
1½"	0.00	100.0
3/4"	0.00	100.0
3/8"	0.00	100.0
No. 4	0.00	100.0
No. 10	0.04	100.0
Pan		

Sieve after Hydrometer & Wet Sieve

U.S. Sieve Size	Cumulative Wt. Of Dry Soil Retained (g)	% Passing	% Total Sample
No. 10	0.00	100.0	100.0
No. 16	0.01	100.0	100.0
No. 30	0.10	99.8	99.8
No. 50	0.92	98.2	98.2
No. 100	6.10	88.1	88.1
No. 200	15.32	70.1	70.1
Pan			

Hydrometer Wt. of Air-Dry Soil (g) 51.20 Wt. of Dry Soil (g) 51.20

Deflocculant 125 cc of 4% Solution

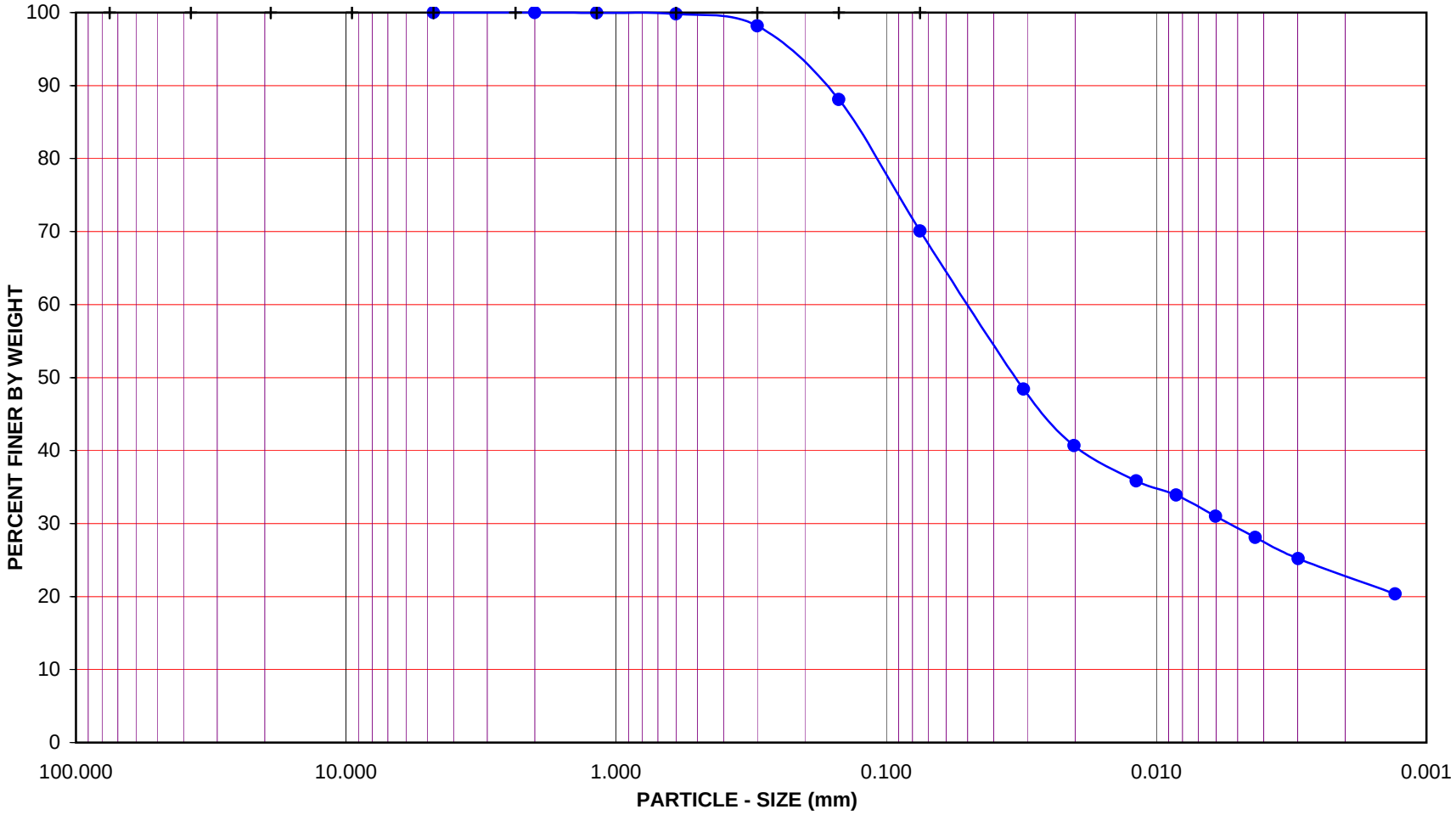
Date	Time	Elapsed Time (min)	Water Temperature (°C)	Composite Correction 152H	Actual Hydrometer Readings	% Total Sample (%)	Soil Particle Diameter (mm)
12-Mar-09	9:32	0		8.0			
	9:34	2	21.0	8.0	33.0	48.4	0.0310
	9:37	5	21.0	8.0	29.0	40.7	0.0201
	9:47	15	21.0	8.0	26.5	35.8	0.0119
	10:02	30	21.1	8.0	25.5	33.9	0.0084
	10:32	60	21.3	8.0	24.0	31.0	0.0060
	11:32	120	21.8	8.0	22.5	28.1	0.0043
	13:42	250	22.5	8.0	21.0	25.2	0.0030
13-Mar-09	9:32	1440	19.8	8.0	18.5	20.3	0.0013

GRAVEL		SAND			FINES	
COARSE	FINE	CRSE	MEDIUM	FINE	SILT	CLAY

U.S. STANDARD SIEVE OPENING: 3.0" 1 1/2" 3/4" 3/8"

U.S. STANDARD SIEVE NUMBER: #4 #8 #16 #30 #50 #100 #200

HYDROMETER



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z1-B6 Sample No.: S9

Depth (feet) : 40.0 Soil Type : s(CL)

Soil Identification: Dark yellowish brown sandy lean clay s(CL)

GR:SA:FI : (%) 0 : 30 : 70

Leighton

PARTICLE - SIZE DISTRIBUTION ASTM D 422

Mar-09

Leighton

PARTICLE-SIZE ANALYSIS OF SOILS

ASTM D 422

Project Name: SR-710 Tunnel Technical Study | Tested By : A. Santos | Date: 03/10/09

Project No. : 378312.04.09.01 | Data Input By: J. Ward | Date: 03/26/09

Exploration No.: R-09-Z1-B6

Sample No.: S17 | Depth (feet) : 80.0

Soil Identification: Dark yellowish brown sandy silt s(ML)

				Moisture Content of Total Air-Dry Soil	Moisture Content of Air-Dry Soil Passing #10	After Hydrometer & Wet Sieve ret. in #200 Sieve
% Gravel	**0**	**Soil Type**				
% Sand	**43**	**s(ML)**				
% Fines	**57**					
Specific Gravity (Assumed)	2.70	Wt.of Air-Dry Soil + Cont.(g)		0.00	0.00	
Correction for Specific Gravity	0.99	Dry Wt. of Soil + Cont. (g)		0.00	0.00	127.15
Wt.of Air-Dry Soil + Cont. (g)	745.20	Wt. of Container No.___ (g)		1.00	1.00	82.66
Wt. of Container	108.40	Moisture Content (%)		0.00	0.00	
Dry Wt. of Soil (g)	636.80	Wt. of Dry Soil (g)				44.49

Coarse Sieve

U.S. Sieve	Cumulative Wt. Of Dry Soil Retained (g)	% Passing
3"	0.00	100.0
1½"	0.00	100.0
3/4"	0.00	100.0
3/8"	0.00	100.0
No. 4	0.00	100.0
No. 10	0.22	100.0
Pan		

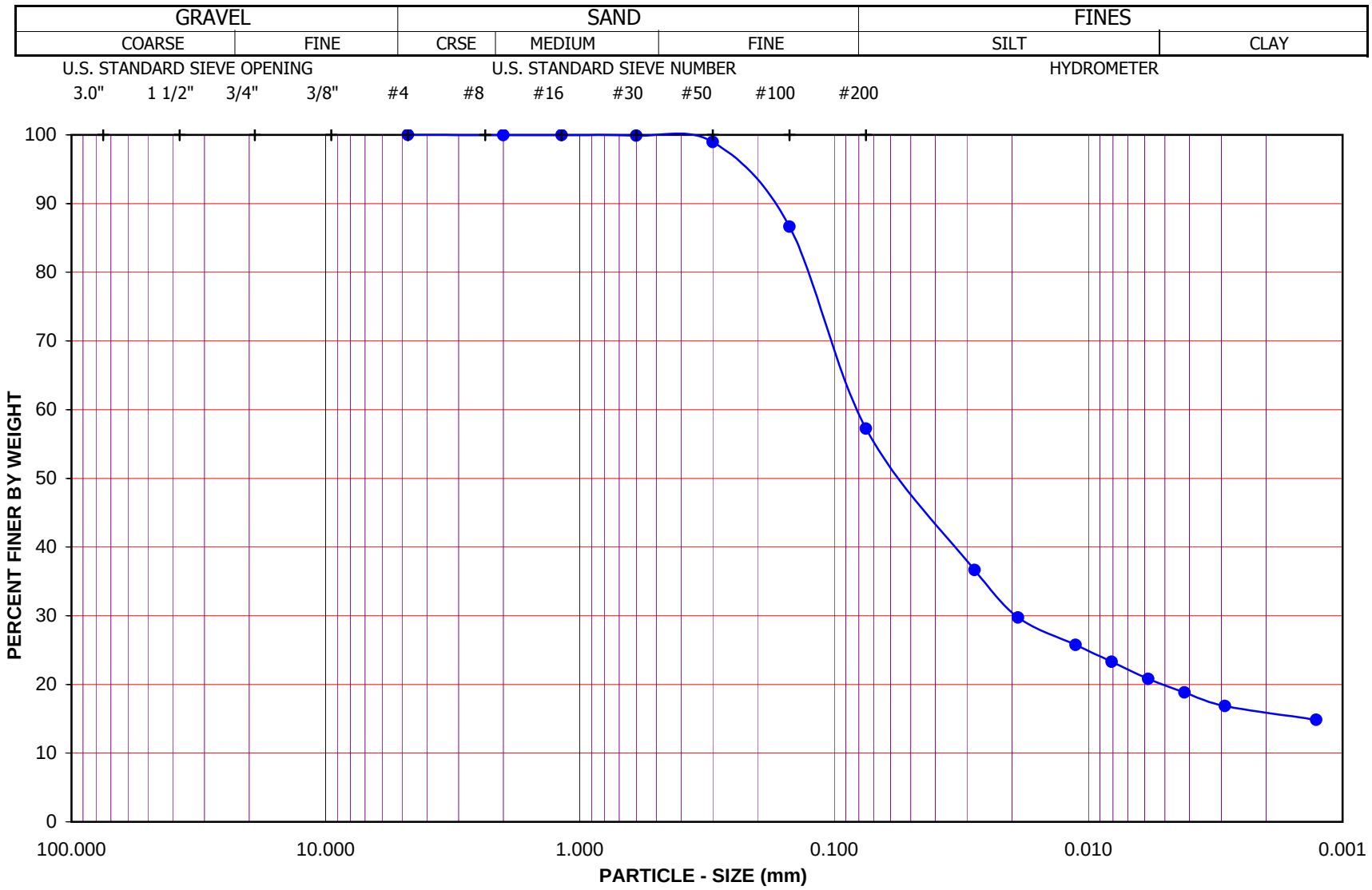
Sieve after Hydrometer & Wet Sieve

U.S. Sieve Size	Cumulative Wt. Of Dry Soil Retained (g)	% Passing	% Total Sample
No. 10	0.00	100.0	100.0
No. 16	0.00	100.0	100.0
No. 30	0.06	99.9	99.9
No. 50	0.99	99.0	99.0
No. 100	13.34	86.7	86.6
No. 200	42.78	57.2	57.2
Pan			

Hydrometer Wt. of Air-Dry Soil (g) 100.06 Wt. of Dry Soil (g) 100.06

Deflocculant 125 cc of 4% Solution

Date	Time	Elapsed Time (min)	Water Temperature (°C)	Composite Correction 152H	Actual Hydrometer Readings	% Total Sample (%)	Soil Particle Diameter (mm)
12-Mar-09	9:40	0		8.0			
	9:42	2	21.0	8.0	45.0	36.7	0.0280
	9:45	5	21.0	8.0	38.0	29.7	0.0189
	9:55	15	21.0	8.0	34.0	25.8	0.0112
	10:10	30	21.2	8.0	31.5	23.3	0.0081
	10:40	60	21.4	8.0	29.0	20.8	0.0058
	11:40	120	21.8	8.0	27.0	18.8	0.0042
	13:50	250	22.7	8.0	25.0	16.8	0.0029
13-Mar-09	9:40	1440	19.9	8.0	23.0	14.9	0.0013



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z1-B6 Sample No.: S17

Depth (feet) : 80.0 Soil Type : s(ML)

Soil Identification: Dark yellowish brown sandy silt s(ML)

GR:SA:FI : (%) 0 : 43 : 57

Leighton

PARTICLE - SIZE DISTRIBUTION ASTM D 422

Mar-09

Leighton

PARTICLE-SIZE ANALYSIS OF SOILS

ASTM D 422

Project Name: SR-710 Tunnel Technical Study | Tested By : V. Juliano | Date: 05/12/09

Project No. : 378312.04.09.01 | Data Input By: J. Ward | Date: 05/14/09

Exploration No.: R-09-Z1-B6

Sample No.: C27 | Depth (feet) : 130.8-131.5

Soil Identification: Dark olive lean clay'stone' with sand (CL)s

% Gravel	**0**	**Soil Type**	Moisture Content of Total Air-Dry Soil	Moisture Content of Air-Dry Soil Passing #10	After Hydrometer & Wet Sieve ret. in #200 Sieve
% Sand	**18**	**(CL)s**			
% Fines	**82**				
Specific Gravity (Assumed)	2.70	Wt.of Air-Dry Soil + Cont.(g)	0.00	0.00	
Correction for Specific Gravity	0.99	Dry Wt. of Soil + Cont. (g)	0.00	0.00	N/A
Wt.of Air-Dry Soil + Cont. (g)	737.30	Wt. of Container No.___ (g)	1.00	1.00	N/A
Wt. of Container	108.80	Moisture Content (%)	0.00	0.00	
Dry Wt. of Soil (g)	628.50	Wt. of Dry Soil (g)			N/A

Coarse Sieve

U.S. Sieve	Cumulative Wt. Of Dry Soil Retained (g)	% Passing
3"	0.00	100.0
1½"	0.00	100.0
3/4"	0.00	100.0
3/8"	0.00	100.0
No. 4	0.00	100.0
No. 10	0.00	100.0
Pan		

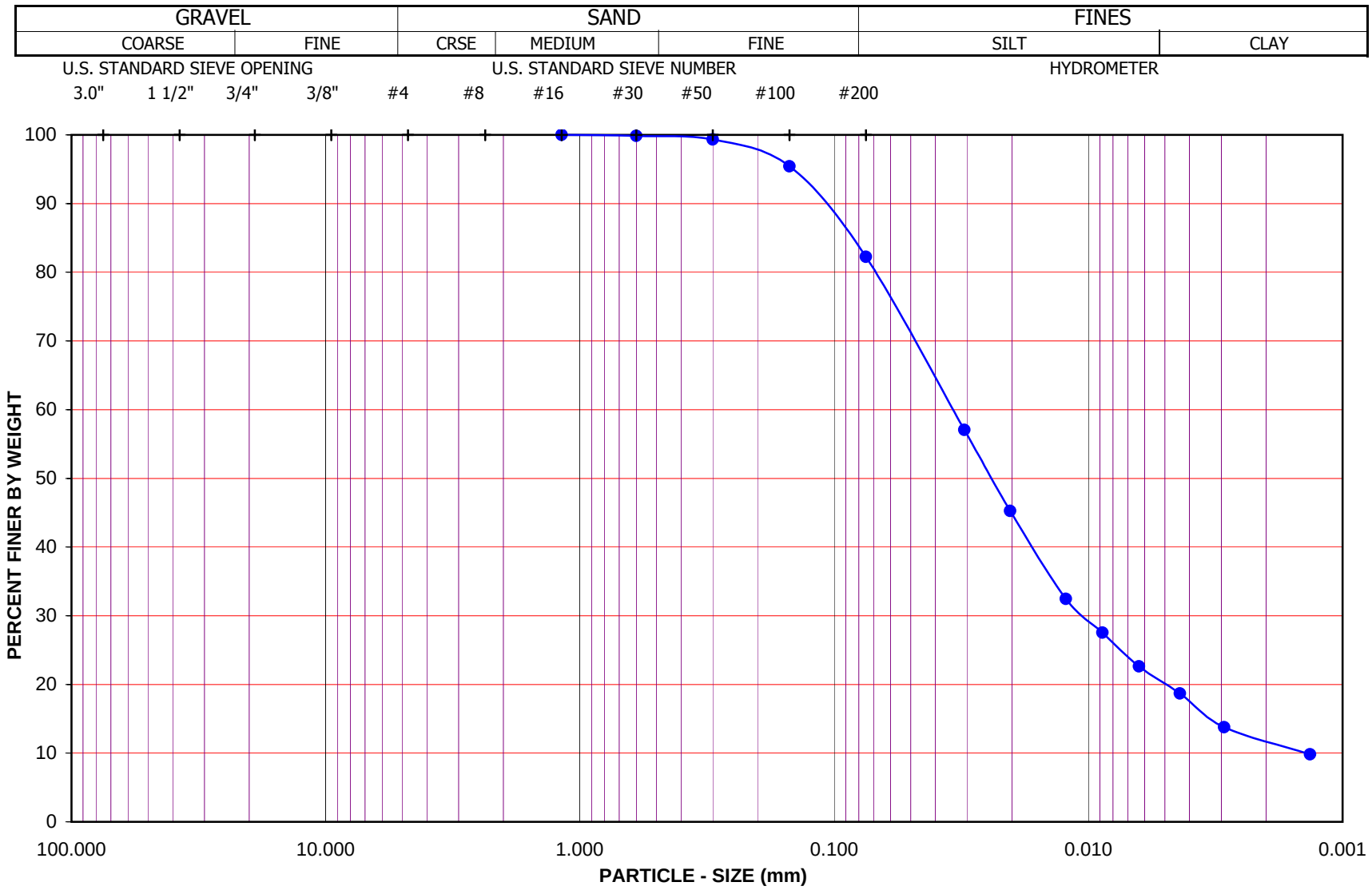
Sieve after Hydrometer & Wet Sieve

U.S. Sieve Size	Cumulative Wt. Of Dry Soil Retained (g)	% Passing	% Total Sample
No. 10	0.00	100.0	100.0
No. 16	0.00	100.0	100.0
No. 30	0.07	99.9	99.9
No. 50	0.33	99.3	99.3
No. 100	2.31	95.4	95.4
No. 200	8.96	82.2	82.2
Pan			

Hydrometer Wt. of Air-Dry Soil (g) 50.42 Wt. of Dry Soil (g) 50.42

Deflocculant 125 cc of 4% Solution

Date	Time	Elapsed Time (min)	Water Temperature (°C)	Composite Correction 152H	Actual Hydrometer Readings	% Total Sample (%)	Soil Particle Diameter (mm)
13-May-09	8:35	0		5.0			
	8:37	2	21.8	5.0	34.0	57.1	0.0307
	8:40	5	21.8	5.0	28.0	45.3	0.0203
	8:50	15	21.5	5.0	21.5	32.5	0.0123
	9:05	30	21.7	5.0	19.0	27.5	0.0088
	9:35	60	21.5	5.0	16.5	22.6	0.0063
	10:44	129	21.5	5.0	14.5	18.7	0.0044
	13:30	295	21.5	5.0	12.0	13.8	0.0029
14-May-09	8:35	1440	21.7	5.0	10.0	9.8	0.0013



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z1-B6 Sample No.: C27

Depth (feet) : 130.8-131.5 Soil Type : (CL)s

Soil Identification: Dark olive lean clay'stone' with sand (CL)s

GR:SA:FI : (%) 0 : 18 : 82

Leighton

PARTICLE - SIZE DISTRIBUTION ASTM D 422

May-09

Leighton

PARTICLE-SIZE ANALYSIS of SOILS
ASTM D 422

Project Name: SR-710 Tunnel Technical Study Tested By: A. Santos Date: 03/09/09

Project No.: 378312.04.09.01 Checked By: J. Ward Date: 04/08/09

Exploration No.: R-09-Z1-B6 Depth (feet): 60.0

Sample No.: S13

Soil Identification: Light olive brown silty clay with sand (CL-ML)s

Note: Top of sample is (CL-ML), bottom is (SP)

		Moisture Content of Total Air - Dry Soil	
Container No.:	P44	Wt. of Air-Dry Soil + Cont. (g)	0.00
Wt. of Air-Dried Soil + Cont.(g)	705.90	Wt. of Dry Soil + Cont. (g)	0.00
Wt. of Container (g)	74.40	Wt. of Container No._____ (g)	1.00
Dry Wt. of Soil (g)	631.50	Moisture Content (%)	0.00

After Wet Sieve	Container No.	P44
	Wt. of Dry Soil + Container (g)	228.40
	Wt. of Container (g)	74.40
	Dry Wt. of Soil Retained on # 200 Sieve (g)	154.00

U. S. Sieve Size (in.)	U. S. Sieve Size (mm.)	Cumulative Weight Dry Soil Retained (g)	Percent Passing (%)
6"	152.400		
3"	75.000		
1 1/2	37.500		
3/4"	19.000		
3/8"	9.500		
#4	4.750		
#8	2.360	0.00	100.0
#16	1.180	0.30	100.0
#30	0.600	0.81	99.9
#50	0.300	6.22	99.0
#100	0.150	54.58	91.4
#200	0.075	143.03	77.4
PAN			

GRAVEL: **0 %**

SAND: **23 %**

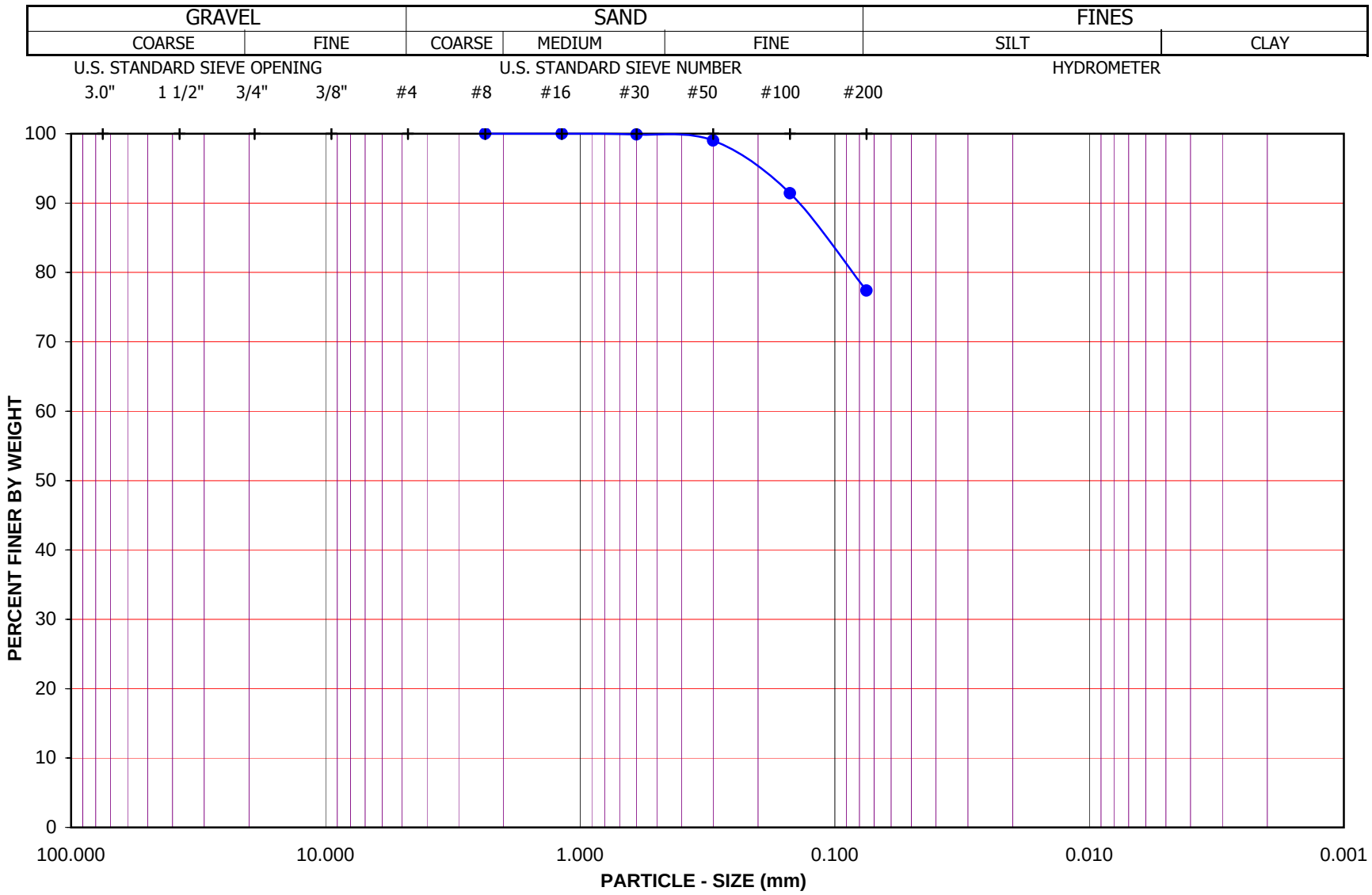
FINES: **77 %**

GROUP SYMBOL: **(CL-ML)s**

Cu = D60/D10 = _____

Cc = $(D30)^2/(D60*D10)$ = _____

Remarks:



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z1-B6 Sample No.: S13

Depth (feet): 60.0 Soil Type : (CL-ML)s

Soil Identification: Light olive brown silty clay with sand (CL-ML)s

GR:SA:FI : (%) 0 : 23 : 77

Leighton

PARTICLE - SIZE DISTRIBUTION ASTM D 422

Apr-09

Leighton

PARTICLE-SIZE ANALYSIS OF SOILS

ASTM D 422

Project Name: SR-710 Tunnel Technical Study | Tested By : A. Santos | Date: 03/10/09

Project No. : 378312.04.09.01 | Data Input By: J. Ward | Date: 04/08/09

Exploration No.: R-09-Z1-B7

Sample No.: S4 | Depth (feet) : 25.0

Soil Identification: Yellowish brown lean clay with sand (CL)s

% Gravel	**0**	**Soil Type**	Moisture Content of Total Air-Dry Soil	Moisture Content of Air-Dry Soil Passing #10	After Hydrometer & Wet Sieve ret. in #200 Sieve
% Sand	**24**	**(CL)s**			
% Fines	**76**				
Specific Gravity (Assumed)	2.70	Wt.of Air-Dry Soil + Cont.(g)	0.00	0.00	
Correction for Specific Gravity	0.99	Dry Wt. of Soil + Cont. (g)	0.00	0.00	87.01
Wt.of Air-Dry Soil + Cont. (g)	688.90	Wt. of Container No.___ (g)	1.00	1.00	73.60
Wt. of Container	109.31	Moisture Content (%)	0.00	0.00	
Dry Wt. of Soil (g)	579.59	Wt. of Dry Soil (g)			13.41

Coarse Sieve

U.S. Sieve	Cumulative Wt. Of Dry Soil Retained (g)	% Passing
3"	0.00	100.0
1½"	0.00	100.0
3/4"	0.00	100.0
3/8"	0.00	100.0
No. 4	0.52	99.9
No. 10	1.31	99.8
Pan		

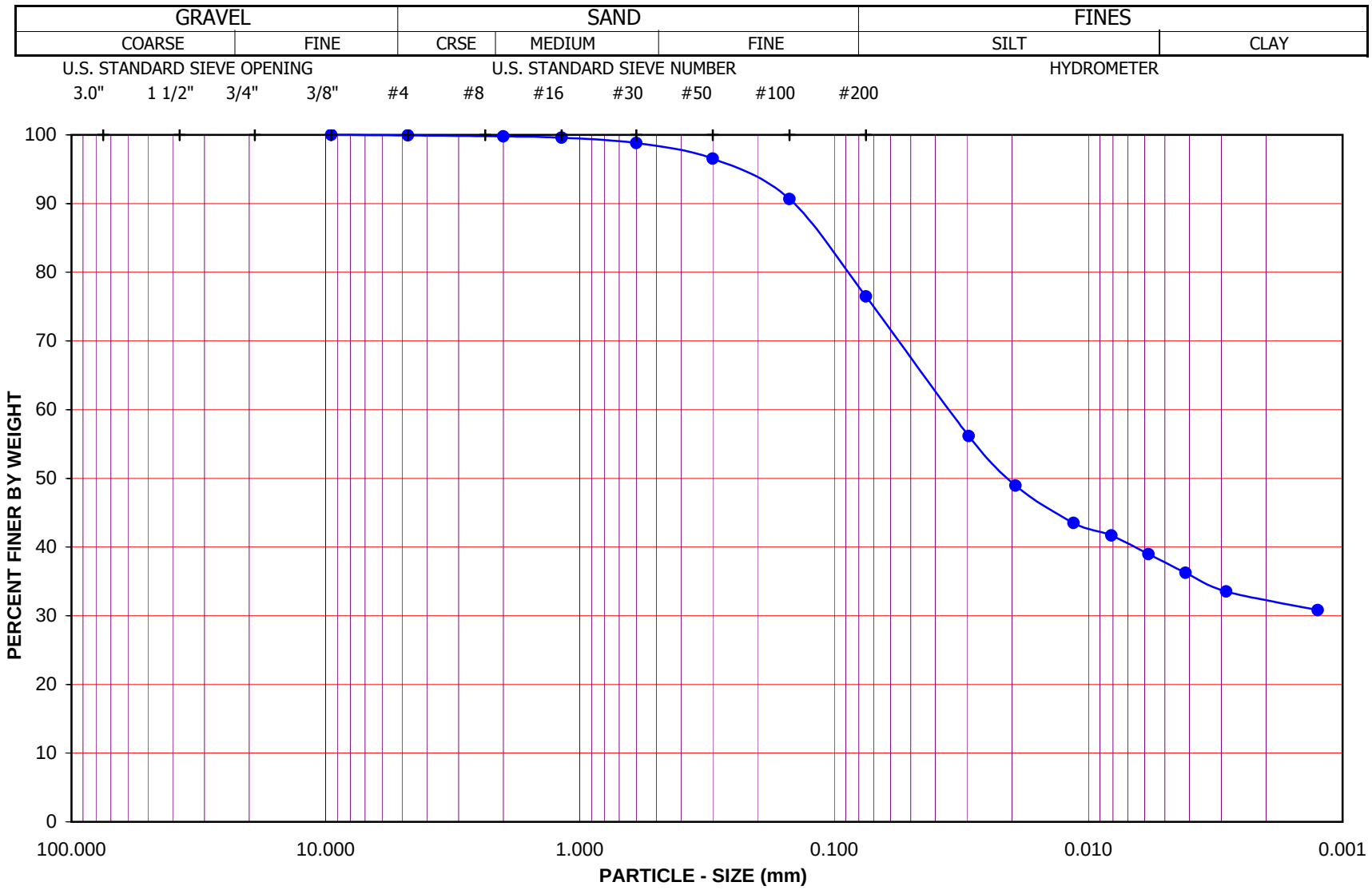
Sieve after Hydrometer & Wet Sieve

U.S. Sieve Size	Cumulative Wt. Of Dry Soil Retained (g)	% Passing	% Total Sample
No. 10	0.00	100.0	99.8
No. 16	0.10	99.8	99.6
No. 30	0.53	99.0	98.8
No. 50	1.77	96.8	96.5
No. 100	4.99	90.9	90.7
No. 200	12.75	76.7	76.5
Pan			

Hydrometer Wt. of Air-Dry Soil (g) 54.62 Wt. of Dry Soil (g) 54.62

Deflocculant 125 cc of 4% Solution

Date	Time	Elapsed Time (min)	Water Temperature (°C)	Composite Correction 152H	Actual Hydrometer Readings	% Total Sample (%)	Soil Particle Diameter (mm)
12-Mar-09	9:44	0		8.0			
	9:46	2	21.0	8.0	39.0	56.2	0.0295
	9:49	5	21.0	8.0	35.0	48.9	0.0193
	9:59	15	21.1	8.0	32.0	43.5	0.0114
	10:14	30	21.2	8.0	31.0	41.7	0.0081
	10:44	60	21.4	8.0	29.5	39.0	0.0058
	11:44	120	21.9	8.0	28.0	36.2	0.0041
	13:54	250	22.7	8.0	26.5	33.5	0.0029
13-Mar-09	9:44	1440	19.9	8.0	25.0	30.8	0.0013



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z1-B7 Sample No.: S4

Depth (feet) : 25.0 Soil Type : (CL)s

Soil Identification: Yellowish brown lean clay with sand (CL)s

GR:SA:FI : (%) 0 : 24 : 76

Leighton

PARTICLE - SIZE DISTRIBUTION ASTM D 422

Apr-09

Leighton

PARTICLE-SIZE ANALYSIS OF SOILS

ASTM D 422

Project Name: SR-710 Tunnel Technical Study | Tested By : V. Juliano | Date: 05/06/09

Project No. : 378312.04.09.01 | Data Input By: J. Ward | Date: 05/14/09

Exploration No.: R-09-Z1-B7

Sample No.: C10 | Depth (feet) : 51.8-52.6

Soil Identification: Olive silt'stone' with sand (ML)s

% Gravel	**0**	**Soil Type**	Moisture Content of Total Air-Dry Soil	Moisture Content of Air-Dry Soil Passing #10	After Hydrometer & Wet Sieve ret. in #200 Sieve
% Sand	**26**	**(ML)s**			
% Fines	**74**				
Specific Gravity (Assumed)	2.70	Wt.of Air-Dry Soil + Cont.(g)	0.00	0.00	
Correction for Specific Gravity	0.99	Dry Wt. of Soil + Cont. (g)	0.00	0.00	95.59
Wt.of Air-Dry Soil + Cont. (g)	378.10	Wt. of Container No.___ (g)	1.00	1.00	77.03
Wt. of Container	76.20	Moisture Content (%)	0.00	0.00	
Dry Wt. of Soil (g)	301.90	Wt. of Dry Soil (g)			18.56

Coarse Sieve

U.S. Sieve	Cumulative Wt. Of Dry Soil Retained (g)	% Passing
3"	0.00	100.0
1½"	0.00	100.0
3/4"	0.00	100.0
3/8"	0.00	100.0
No. 4	0.00	100.0
No. 10	0.00	100.0
Pan		

Sieve after Hydrometer & Wet Sieve

U.S. Sieve Size	Cumulative Wt. Of Dry Soil Retained (g)	% Passing	% Total Sample
No. 10	0.00	100.0	100.0
No. 16	0.00	100.0	100.0
No. 30	0.04	99.9	99.9
No. 50	0.14	99.7	99.7
No. 100	1.66	97.0	97.0
No. 200	14.23	74.2	74.2
Pan			

Hydrometer Wt. of Air-Dry Soil (g) 55.25 Wt. of Dry Soil (g) 55.25

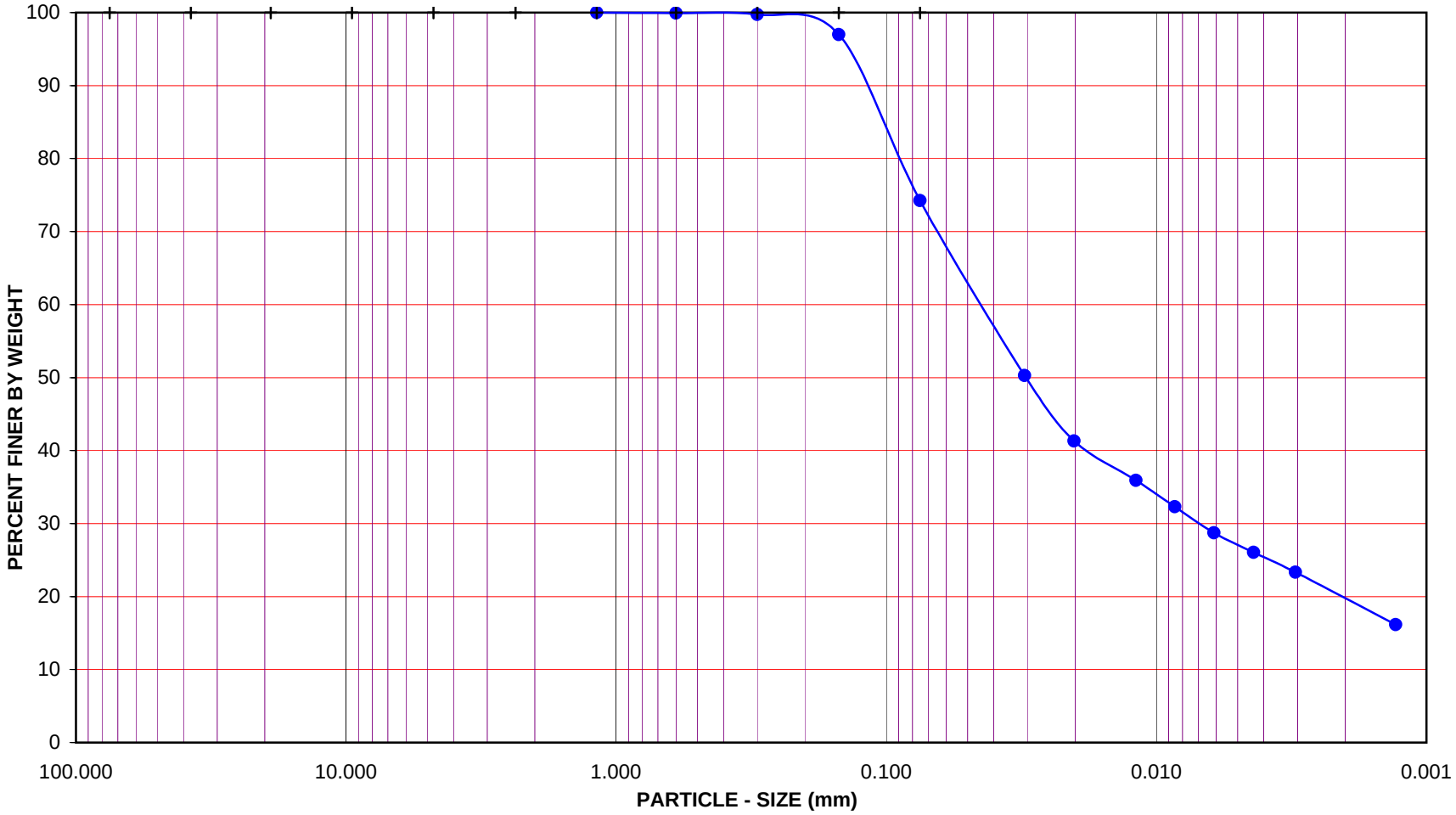
Deflocculant 125 cc of 4% Solution

Date	Time	Elapsed Time (min)	Water Temperature (°C)	Composite Correction 152H	Actual Hydrometer Readings	% Total Sample (%)	Soil Particle Diameter (mm)
08-May-09	8:19	0		6.0			
	8:21	2	21.3	6.0	34.0	50.3	0.0307
	8:24	5	21.3	6.0	29.0	41.3	0.0201
	8:34	15	21.2	6.0	26.0	35.9	0.0119
	8:49	30	21.3	6.0	24.0	32.3	0.0085
	9:19	60	21.2	6.0	22.0	28.7	0.0061
	10:19	120	21.5	6.0	20.5	26.0	0.0044
	12:29	250	21.5	6.0	19.0	23.3	0.0031
09-May-09	8:19	1440	21.1	6.0	15.0	16.2	0.0013

GRAVEL		SAND			FINES	
COARSE	FINE	CRSE	MEDIUM	FINE	SILT	CLAY

U.S. STANDARD SIEVE OPENING — U.S. STANDARD SIEVE NUMBER — HYDROMETER

3.0" 1 1/2" 3/4" 3/8" #4 #8 #16 #30 #50 #100 #200



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z1-B7 Sample No.: C10

Depth (feet) : 51.8-52.6 Soil Type : (ML)s

Soil Identification: Olive silt'stone' with sand (ML)s

GR:SA:FI : (%) 0 : 26 : 74

Leighton

PARTICLE - SIZE DISTRIBUTION ASTM D 422

May-09

Leighton

PARTICLE-SIZE ANALYSIS OF SOILS

ASTM D 422

Project Name: SR-710 Tunnel Technical Study | Tested By : V. Juliano | Date: 05/06/09

Project No. : 378312.04.09.01 | Data Input By: J. Ward | Date: 05/14/09

Exploration No.: R-09-Z1-B7

Sample No.: C14 | Depth (feet) : 74.7-75.2

Soil Identification: Olive silty sand'stone' (SM) with greasy contaminant

	% Gravel	**0**	**Soil Type**	Moisture Content of Total Air-Dry Soil	Moisture Content of Air-Dry Soil Passing #10	After Hydrometer & Wet Sieve ret. in #200 Sieve
	% Sand	**75**	**SM**			
	% Fines	**25**				
Specific Gravity (Assumed)	2.70	Wt.of Air-Dry Soil + Cont.(g)		0.00	0.00	
Correction for Specific Gravity	0.99	Dry Wt. of Soil + Cont. (g)		0.00	0.00	119.40
Wt.of Air-Dry Soil + Cont. (g)	422.00	Wt. of Container No.___ (g)		1.00	1.00	76.17
Wt. of Container	74.30	Moisture Content (%)		0.00	0.00	
Dry Wt. of Soil (g)	347.70	Wt. of Dry Soil (g)				43.23

Coarse Sieve

U.S. Sieve	Cumulative Wt. Of Dry Soil Retained (g)	% Passing
3"	0.00	100.0
1½"	0.00	100.0
3/4"	0.00	100.0
3/8"	0.00	100.0
No. 4	0.00	100.0
No. 10	0.00	100.0
Pan		

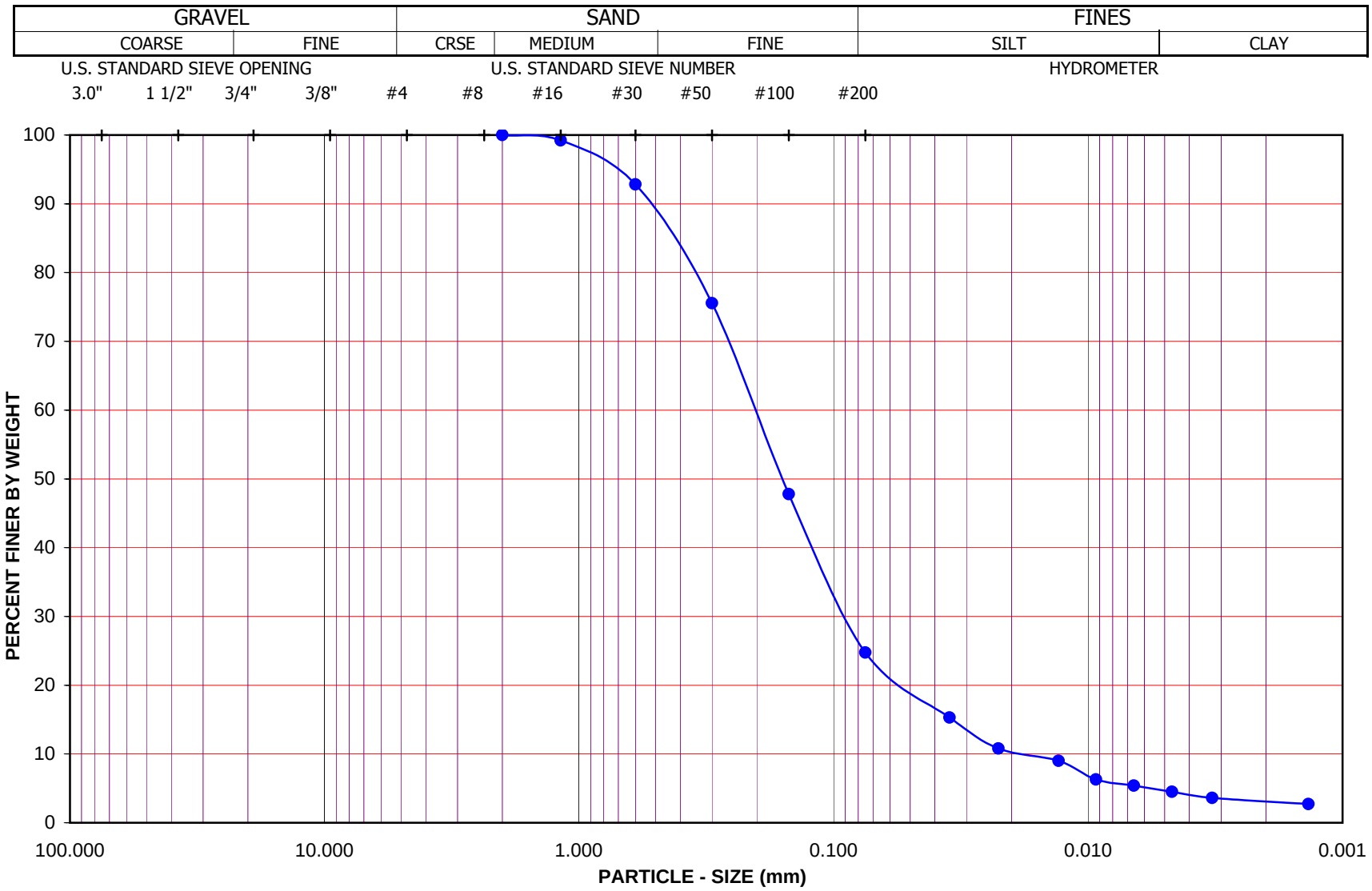
Sieve after Hydrometer & Wet Sieve

U.S. Sieve Size	Cumulative Wt. Of Dry Soil Retained (g)	% Passing	% Total Sample
No. 10	0.00	100.0	100.0
No. 16	0.44	99.2	99.2
No. 30	3.95	92.8	92.8
No. 50	13.47	75.6	75.6
No. 100	28.79	47.8	47.8
No. 200	41.48	24.7	24.7
Pan			

Hydrometer Wt. of Air-Dry Soil (g) 55.12 Wt. of Dry Soil (g) 55.12

Deflocculant 125 cc of 4% Solution

Date	Time	Elapsed Time (min)	Water Temperature (°C)	Composite Correction 152H	Actual Hydrometer Readings	% Total Sample (%)	Soil Particle Diameter (mm)
08-May-09	8:39	0		6.0			
	8:41	2	21.4	6.0	14.5	15.3	0.0350
	8:44	5	21.4	6.0	12.0	10.8	0.0225
	8:54	15	21.1	6.0	11.0	9.0	0.0131
	9:09	30	21.4	6.0	9.5	6.3	0.0093
	9:39	60	21.4	6.0	9.0	5.4	0.0066
	10:39	120	21.4	6.0	8.5	4.5	0.0047
	12:49	250	21.5	6.0	8.0	3.6	0.0033
09-May-09	8:39	1440	21.1	6.0	7.5	2.7	0.0014



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z1-B7 Sample No.: C14

Depth (feet) : 74.7-75.2 Soil Type : SM

Soil Identification: Olive silty sand'stone' (SM)

GR:SA:FI : (%) 0 : 75 : 25

Leighton

PARTICLE - SIZE DISTRIBUTION ASTM D 422

May-09

Leighton

PARTICLE-SIZE ANALYSIS OF SOILS

ASTM D 422

Project Name: SR-710 Tunnel Technical Study | Tested By : V. Juliano | Date: 05/14/09

Project No. : 378312.04.09.01 | Data Input By: J. Ward | Date: 05/29/09

Exploration No.: R-09-Z1-B7

Sample No.: C19 | Depth (feet) : 101.3-102.4

Soil Identification: Olive silt'stone' with sand (ML)s

% Gravel	**0**	**Soil Type**	Moisture Content of Total Air-Dry Soil	Moisture Content of Air-Dry Soil Passing #10	After Hydrometer & Wet Sieve ret. in #200 Sieve
% Sand	**15**	**(ML)s**			
% Fines	**85**				

Specific Gravity (Assumed)	2.70	Wt.of Air-Dry Soil + Cont.(g)	0.00	0.00	
Correction for Specific Gravity	0.99	Dry Wt. of Soil + Cont. (g)	0.00	0.00	N/A
Wt.of Air-Dry Soil + Cont. (g)	490.20	Wt. of Container No.___ (g)	1.00	1.00	N/A
Wt. of Container	0.00	Moisture Content (%)	0.00	0.00	
Dry Wt. of Soil (g)	490.20	Wt. of Dry Soil (g)			N/A

Coarse Sieve

U.S. Sieve	Cumulative Wt. Of Dry Soil Retained (g)	% Passing
3"	0.00	100.0
1½"	0.00	100.0
3/4"	0.00	100.0
3/8"	0.00	100.0
No. 4	0.07	100.0
No. 10	6.88	98.6
Pan		

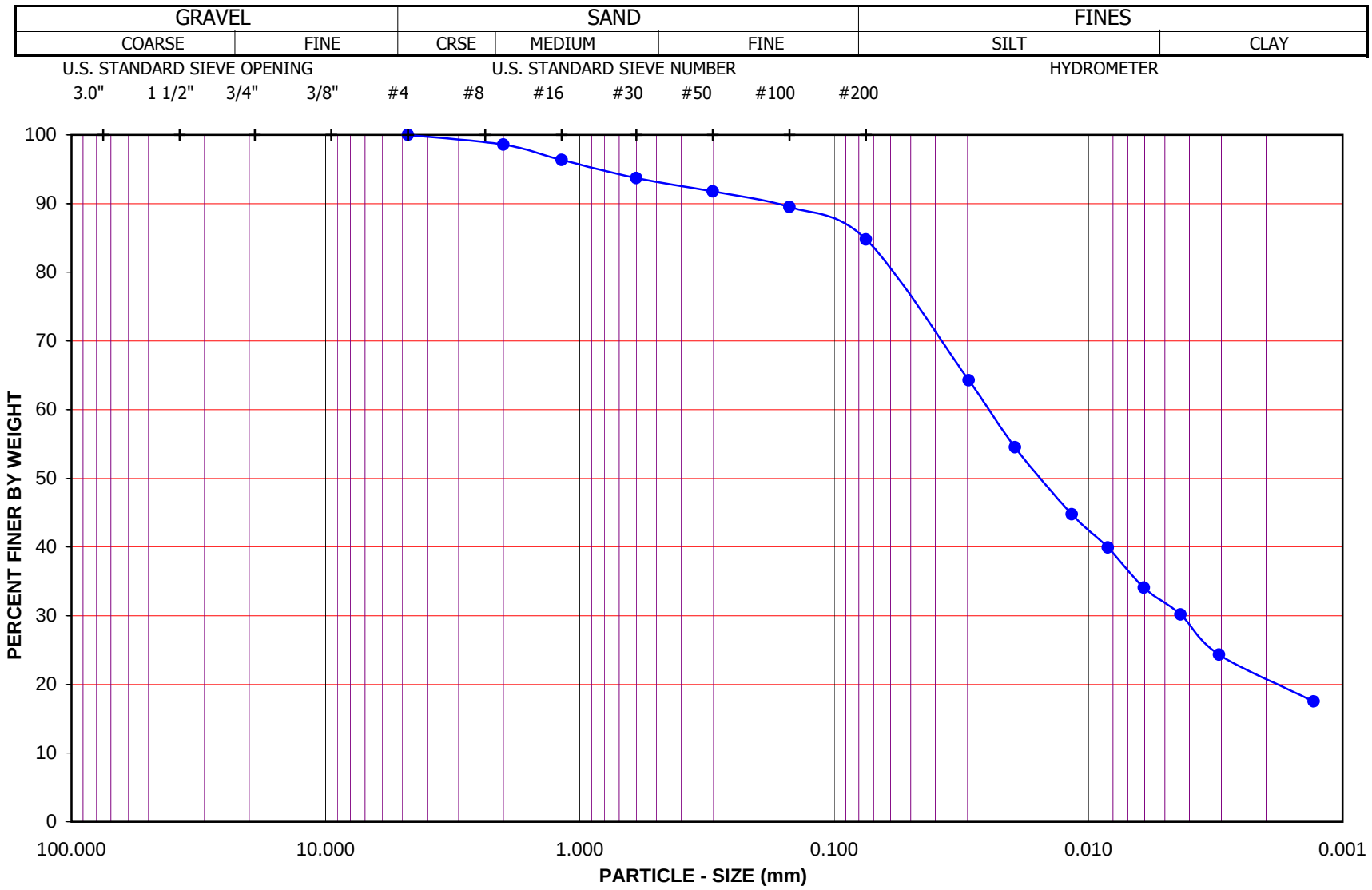
Sieve after Hydrometer & Wet Sieve

U.S. Sieve Size	Cumulative Wt. Of Dry Soil Retained (g)	% Passing	% Total Sample
No. 10	0.00	100.0	98.6
No. 16	1.14	97.7	96.4
No. 30	2.49	95.0	93.7
No. 50	3.48	93.1	91.8
No. 100	4.63	90.8	89.5
No. 200	7.04	86.0	84.8
Pan			

Hydrometer Wt. of Air-Dry Soil (g) 50.23 Wt. of Dry Soil (g) 50.23

Deflocculant 125 cc of 4% Solution

Date	Time	Elapsed Time (min)	Water Temperature (°C)	Composite Correction 152H	Actual Hydrometer Readings	% Total Sample (%)	Soil Particle Diameter (mm)
18-May-09	10:23	0		6.0			
	10:25	2	21.5	6.0	39.0	64.3	0.0295
	10:28	5	21.5	6.0	34.0	54.5	0.0194
	10:38	15	21.6	6.0	29.0	44.8	0.0116
	10:53	30	21.5	6.0	26.5	39.9	0.0084
	11:23	60	21.6	6.0	23.5	34.1	0.0061
	12:23	120	21.5	6.0	21.5	30.2	0.0043
	14:33	250	21.7	6.0	18.5	24.3	0.0031
19-May-09	10:23	1440	21.2	6.0	15.0	17.5	0.0013



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z1-B7 Sample No.: C19

Depth (feet) : 101.3-102.4 Soil Type : (ML)s

Soil Identification: Olive silt'stone' with sand (ML)s

GR:SA:FI : (%) 0 : 15 : 85

Leighton

PARTICLE - SIZE DISTRIBUTION ASTM D 422

May-09

Leighton

PARTICLE-SIZE ANALYSIS of SOILS
ASTM D 422

Project Name: SR-710 Tunnel Technical Study
Project No.: 378312.04.09.01
Exploration No.: R-09-Z1-B7
Sample No.: C25
Soil Identification: Very dark olive brown silty sand (SM) with greasy contaminant

Tested By: V. Juliano Date: 04/28/09
Checked By: J. Ward Date: 05/12/09
Depth (feet): 144-144.8

		Moisture Content of Total Air - Dry Soil	
Container No.:	9554	Wt. of Air-Dry Soil + Cont. (g)	0.00
Wt. of Air-Dried Soil + Cont.(g)	903.70	Wt. of Dry Soil + Cont. (g)	0.00
Wt. of Container (g)	108.20	Wt. of Container No._____ (g)	1.00
Dry Wt. of Soil (g)	795.50	Moisture Content (%)	0.00

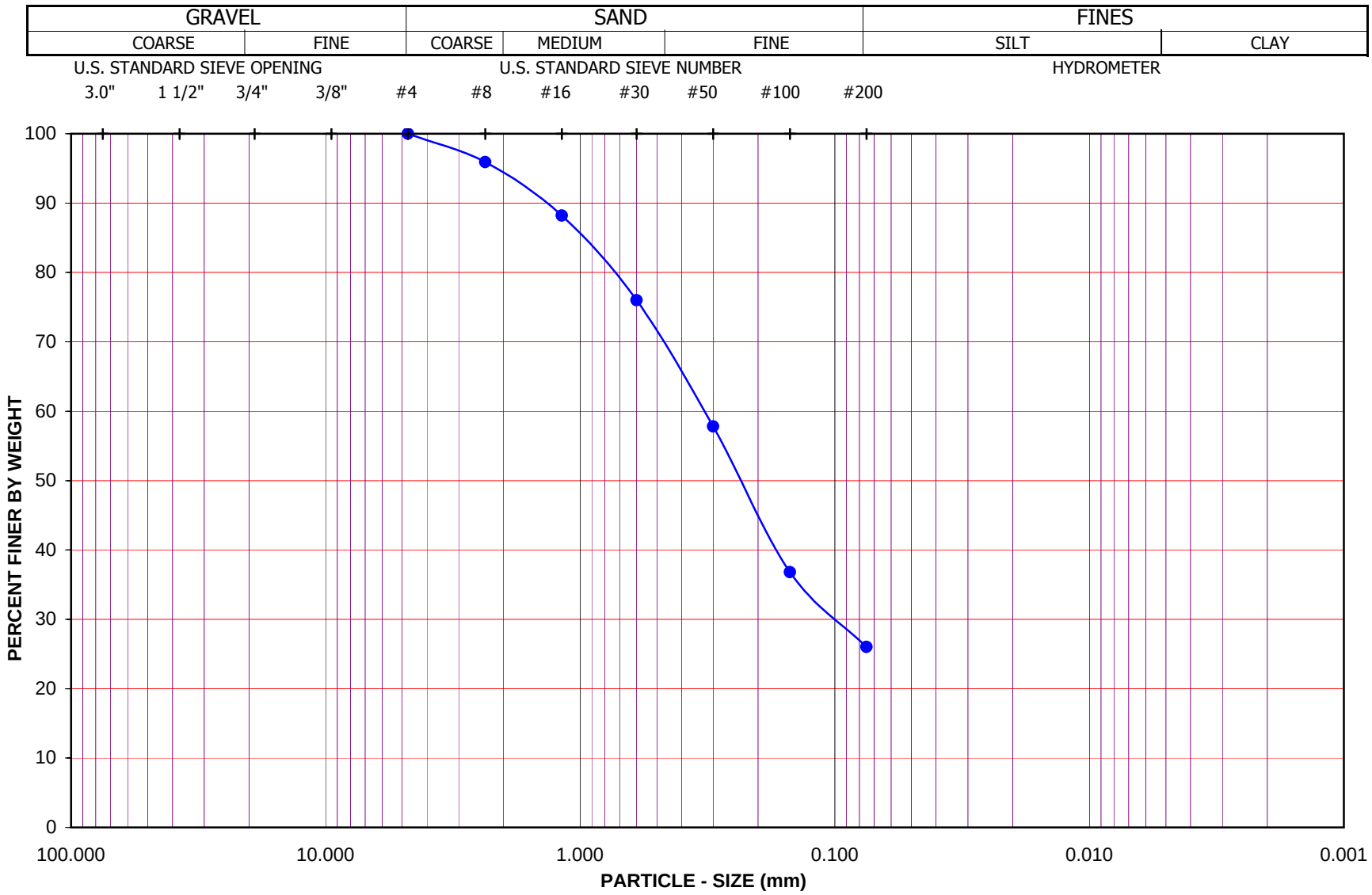
After Wet Sieve	Container No.	9554
	Wt. of Dry Soil + Container (g)	699.20
	Wt. of Container (g)	108.20
	Dry Wt. of Soil Retained on # 200 Sieve (g)	591.00

U. S. Sieve Size (in.)	U. S. Sieve Size (mm.)	Cumulative Weight Dry Soil Retained (g)	Percent Passing (%)
6"	152.400		
3"	75.000		
1 1/2	37.500		
3/4"	19.000		
3/8"	9.500		
#4	4.750	0.00	100.0
#8	2.360	32.77	95.9
#16	1.180	93.79	88.2
#30	0.600	191.20	76.0
#50	0.300	336.00	57.8
#100	0.150	502.70	36.8
#200	0.075	588.30	26.0
PAN			

GRAVEL: **0 %**
SAND: **74 %**
FINES: **26 %**
GROUP SYMBOL: **SM**

Cu = D60/D10 = _____
Cc = $(D30)^2/(D60*D10)$ = _____

Remarks:



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z1-B7 Sample No.: C25

Depth (feet): 144-144.8 Soil Type : SM

Soil Identification: Very dark olive brown silty sand (SM)

GR:SA:FI : (%) 0 : 74 : 26

Leighton

PARTICLE - SIZE DISTRIBUTION ASTM D 422

May-09

Leighton

PARTICLE-SIZE ANALYSIS OF SOILS

ASTM D 422

Project Name: SR-710 Tunnel Technical Study | Tested By : V. Juliano | Date: 05/06/09

Project No. : 378312.04.09.01 | Data Input By: J. Ward | Date: 05/14/09

Exploration No.: R-09-Z1-B7

Sample No.: C27 | Depth (feet) : 151.6-152.2

Soil Identification: Dark olive silt'stone' (ML)

% Gravel	**0**	**Soil Type**	Moisture Content of Total Air-Dry Soil	Moisture Content of Air-Dry Soil Passing #10	After Hydrometer & Wet Sieve ret. in #200 Sieve
% Sand	**11**	**ML**			
% Fines	**89**				
Specific Gravity (Assumed)	2.70	Wt.of Air-Dry Soil + Cont.(g)	0.00	0.00	
Correction for Specific Gravity	0.99	Dry Wt. of Soil + Cont. (g)	0.00	0.00	85.91
Wt.of Air-Dry Soil + Cont. (g)	404.30	Wt. of Container No.___ (g)	1.00	1.00	77.27
Wt. of Container	74.50	Moisture Content (%)	0.00	0.00	
Dry Wt. of Soil (g)	329.80	Wt. of Dry Soil (g)			8.64

Coarse Sieve

U.S. Sieve	Cumulative Wt. Of Dry Soil Retained (g)	% Passing
3"	0.00	100.0
1½"	0.00	100.0
3/4"	0.00	100.0
3/8"	0.00	100.0
No. 4	0.00	100.0
No. 10	0.00	100.0
Pan		

Sieve after Hydrometer & Wet Sieve

U.S. Sieve Size	Cumulative Wt. Of Dry Soil Retained (g)	% Passing	% Total Sample
No. 10	0.00	100.0	100.0
No. 16	0.00	100.0	100.0
No. 30	0.02	100.0	100.0
No. 50	0.06	99.9	99.9
No. 100	0.80	98.6	98.6
No. 200	6.36	88.5	88.5
Pan			

Hydrometer Wt. of Air-Dry Soil (g) 55.38 Wt. of Dry Soil (g) 55.38

Deflocculant 125 cc of 4% Solution

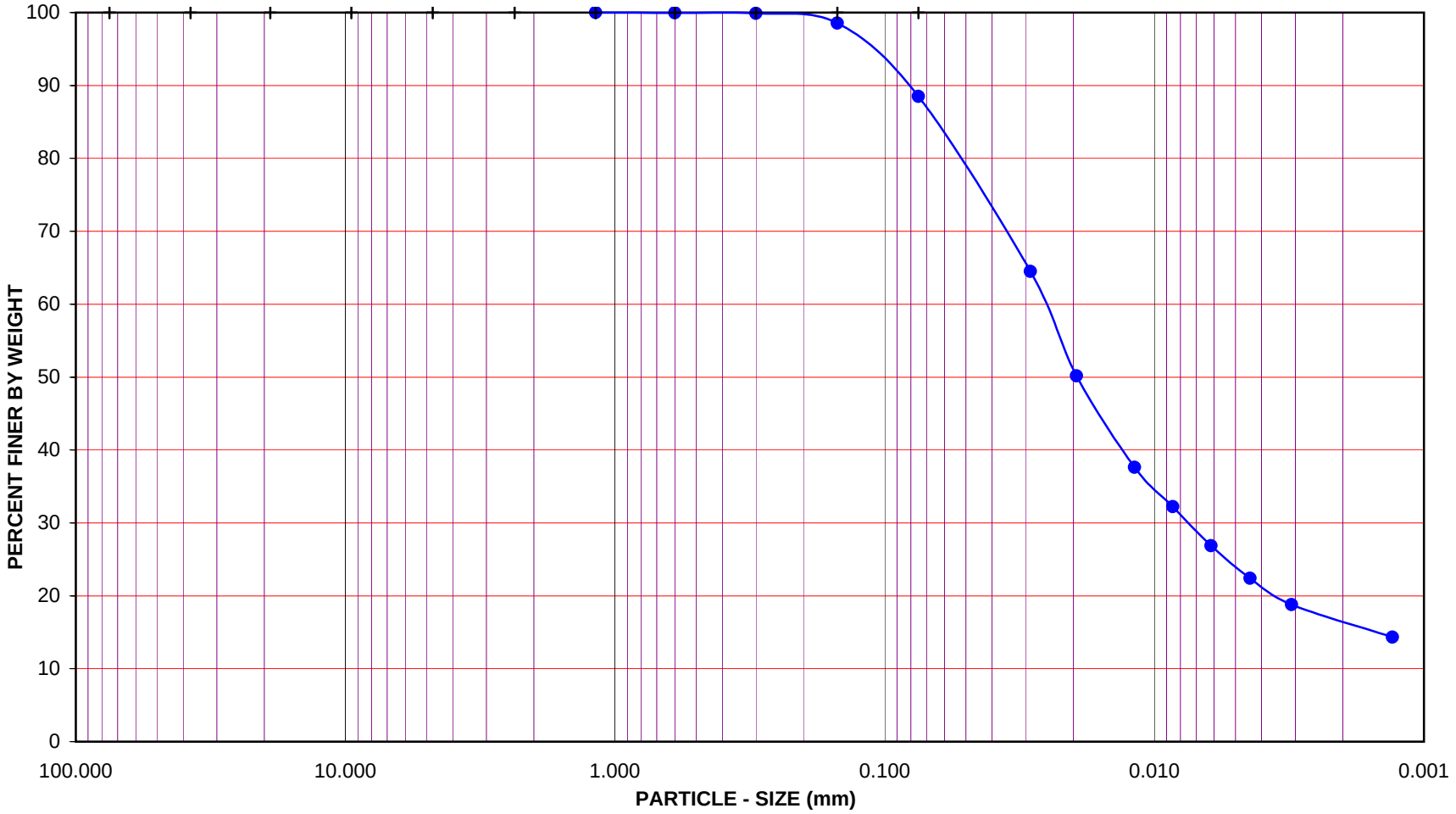
Date	Time	Elapsed Time (min)	Water Temperature (°C)	Composite Correction 152H	Actual Hydrometer Readings	% Total Sample (%)	Soil Particle Diameter (mm)
08-May-09	8:35	0		6.0			
	8:37	2	21.2	6.0	42.0	64.5	0.0288
	8:40	5	21.4	6.0	34.0	50.2	0.0194
	8:50	15	21.2	6.0	27.0	37.6	0.0118
	9:05	30	21.4	6.0	24.0	32.2	0.0085
	9:35	60	21.5	6.0	21.0	26.9	0.0062
	10:35	120	21.4	6.0	18.5	22.4	0.0044
	12:45	250	21.5	6.0	16.5	18.8	0.0031
09-May-09	8:35	1440	21.1	6.0	14.0	14.3	0.0013

GRAVEL		SAND			FINES	
COARSE	FINE	CRSE	MEDIUM	FINE	SILT	CLAY

U.S. STANDARD SIEVE OPENING: 3.0" 1 1/2" 3/4" 3/8"

U.S. STANDARD SIEVE NUMBER: #4 #8 #16 #30 #50 #100 #200

HYDROMETER



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z1-B7 Sample No.: C27

Depth (feet) : 151.6-152.2 Soil Type : ML

Soil Identification: Dark olive silt'stone' (ML)

GR:SA:FI : (%) 0 : 11 : 89

Leighton

PARTICLE - SIZE DISTRIBUTION ASTM D 422

May-09

Leighton

PARTICLE-SIZE ANALYSIS of SOILS
ASTM D 422

Project Name: SR-710 Tunnel Technical Study
Project No.: 378312.04.09.01
Exploration No.: R-09-Z1-B8
Sample No.: S09
Soil Identification: Olive brown silty, clayey sand (SC-SM)

Tested By: S. Felter Date: 04/06/09
Checked By: J. Ward Date: 04/08/09
Depth (feet): 40-45

		Moisture Content of Total Air - Dry Soil	
Container No.:	VI	Wt. of Air-Dry Soil + Cont. (g)	0.00
Wt. of Air-Dried Soil + Cont.(g)	806.60	Wt. of Dry Soil + Cont. (g)	0.00
Wt. of Container (g)	220.10	Wt. of Container No._____ (g)	1.00
Dry Wt. of Soil (g)	586.50	Moisture Content (%)	0.00

After Wet Sieve	Container No.	VI
	Wt. of Dry Soil + Container (g)	552.10
	Wt. of Container (g)	220.10
	Dry Wt. of Soil Retained on # 200 Sieve (g)	332.00

U. S. Sieve Size (in.)	U. S. Sieve Size (mm.)	Cumulative Weight Dry Soil Retained (g)	Percent Passing (%)
6"	152.400		
3"	75.000		
1 1/2	37.500		
3/4"	19.000	0.00	100.0
3/8"	9.500	2.00	99.7
#4	4.750	20.10	96.6
#8	2.360	34.60	94.1
#16	1.180	53.50	90.9
#30	0.600	85.50	85.4
#50	0.300	159.90	72.7
#100	0.150	246.60	58.0
#200	0.075	324.50	44.7
PAN			

GRAVEL: **3 %**
SAND: **52 %**
FINES: **45 %**
GROUP SYMBOL: **SC-SM**

Cu = D60/D10 = _____
Cc = $(D30)^2/(D60*D10)$ = _____

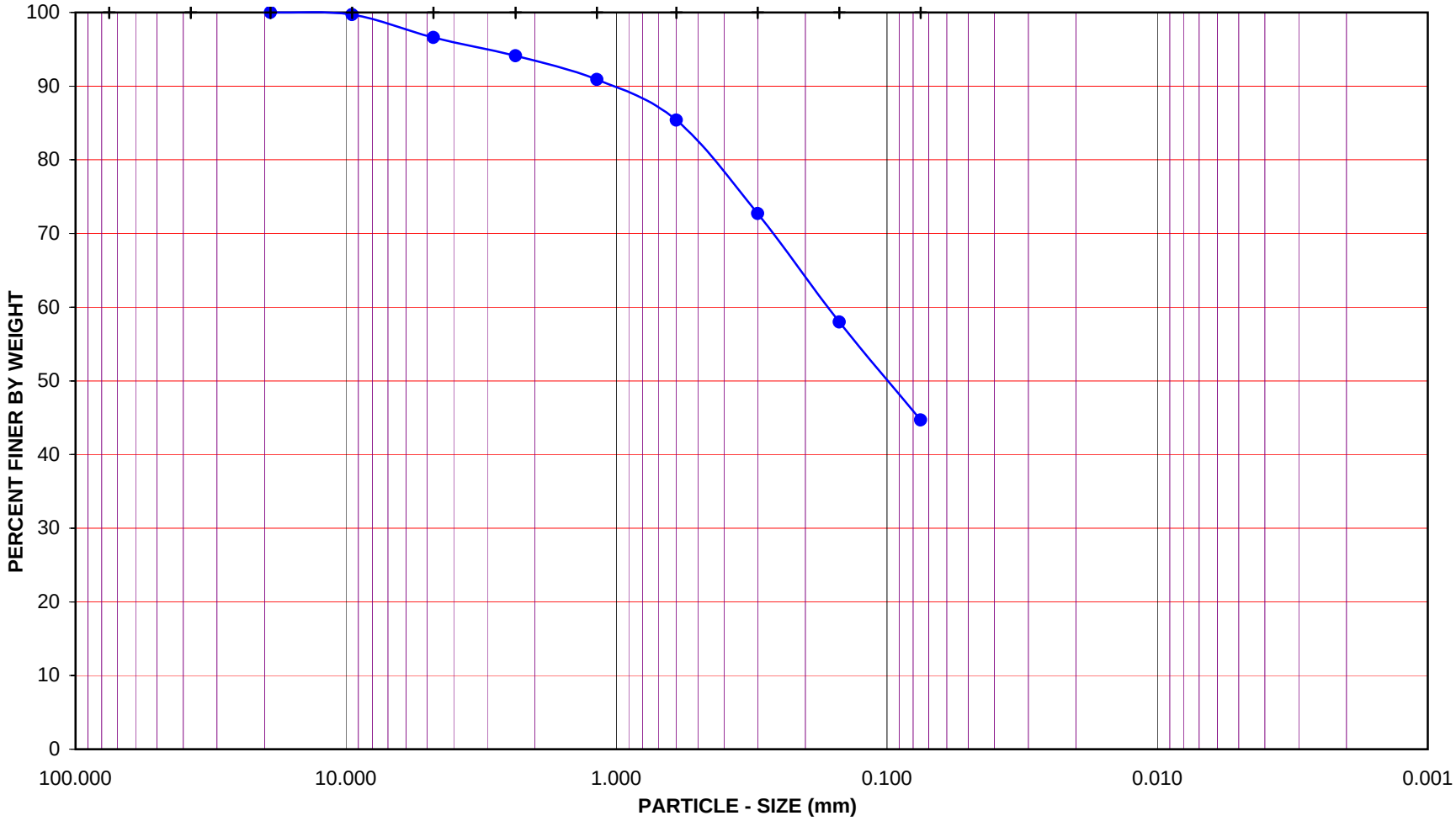
Remarks:

GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY

U.S. STANDARD SIEVE OPENING: 3.0" | 1 1/2" | 3/4" | 3/8"

U.S. STANDARD SIEVE NUMBER: #4 | #8 | #16 | #30 | #50 | #100 | #200

HYDROMETER



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z1-B8 Sample No.: S09

Depth (feet): 40-45 Soil Type : SC-SM

Soil Identification: Olive brown silty, clayey sand (SC-SM)

GR:SA:FI : (%) 3 : 52 : 45

Leighton

PARTICLE - SIZE DISTRIBUTION ASTM D 422

Apr-09

Leighton

PARTICLE-SIZE ANALYSIS of SOILS
ASTM D 422

Project Name: SR-710 Tunnel Technical Study
Project No.: 378312.04.09.01
Exploration No.: R-09-Z1-B8
Sample No.: S04
Soil Identification: Olive yellow to dark brown sandy silt s(ML)

Tested By: V. Juliano Date: 04/06/09
Checked By: J. Ward Date: 04/08/09
Depth (feet): 15-16.5

		Moisture Content of Total Air - Dry Soil	
Container No.:	936	Wt. of Air-Dry Soil + Cont. (g)	0.00
Wt. of Air-Dried Soil + Cont.(g)	649.20	Wt. of Dry Soil + Cont. (g)	0.00
Wt. of Container (g)	108.43	Wt. of Container No._____ (g)	1.00
Dry Wt. of Soil (g)	540.77	Moisture Content (%)	0.00

After Wet Sieve	Container No.	936
	Wt. of Dry Soil + Container (g)	271.30
	Wt. of Container (g)	108.43
	Dry Wt. of Soil Retained on # 200 Sieve (g)	162.87

U. S. Sieve Size (in.)	U. S. Sieve Size (mm.)	Cumulative Weight Dry Soil Retained (g)	Percent Passing (%)
6"	152.400		
3"	75.000		
1 1/2	37.500	0.00	100.0
3/4"	19.000	14.30	97.4
3/8"	9.500	28.67	94.7
#4	4.750	41.11	92.4
#8	2.360	52.32	90.3
#16	1.180	65.39	87.9
#30	0.600	79.31	85.3
#50	0.300	98.23	81.8
#100	0.150	126.46	76.6
#200	0.075	161.50	70.1
PAN			

GRAVEL: **8 %**
SAND: **22 %**
FINES: **70 %**
GROUP SYMBOL: **s(ML)**

Cu = D60/D10 = _____
Cc = $(D30)^2/(D60*D10)$ = _____

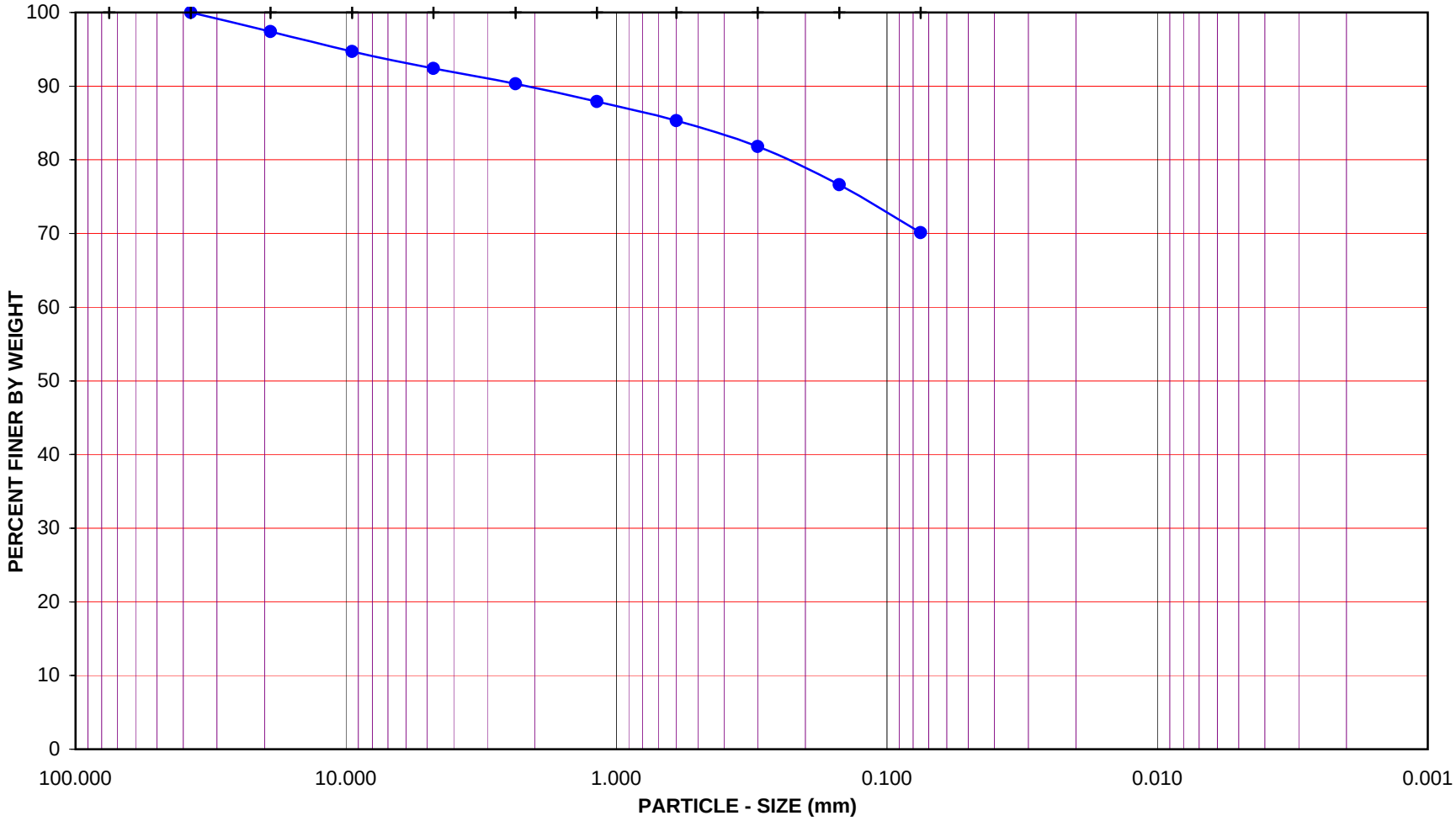
Remarks:

GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY

U.S. STANDARD SIEVE OPENING: 3.0" | 1 1/2" | 3/4" | 3/8"

U.S. STANDARD SIEVE NUMBER: #4 | #8 | #16 | #30 | #50 | #100 | #200

HYDROMETER



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z1-B8 Sample No.: S04

Depth (feet): 15-16.5 Soil Type : s(ML)

Soil Identification: Olive yellow to dark brown sandy silt s(ML)

GR:SA:FI : (%) 8 : 22 : 70

Leighton

PARTICLE - SIZE DISTRIBUTION ASTM D 422

Apr-09

Leighton

PARTICLE-SIZE ANALYSIS OF SOILS

ASTM D 422

Project Name: SR-710 Tunnel Technical Study | Tested By : V. Juliano | Date: 05/11/09

Project No. : 378312.04.09.01 | Data Input By: J. Ward | Date: 05/14/09

Exploration No.: R-09-Z1-B8

Sample No.: C17 | Depth (feet) : 80-80.75

Soil Identification: Dark olive silt'stone' (ML)

% Gravel	**0**	**Soil Type**	
% Sand	**2**	**ML**	
% Fines	**98**		

			Moisture Content of Total Air-Dry Soil	Moisture Content of Air-Dry Soil Passing #10	After Hydrometer & Wet Sieve ret. in #200 Sieve
Specific Gravity (Assumed)	2.70	Wt.of Air-Dry Soil + Cont.(g)	0.00	0.00	
Correction for Specific Gravity	0.99	Dry Wt. of Soil + Cont. (g)	0.00	0.00	78.85
Wt.of Air-Dry Soil + Cont. (g)	631.00	Wt. of Container No.___ (g)	1.00	1.00	77.27
Wt. of Container	77.00	Moisture Content (%)	0.00	0.00	
Dry Wt. of Soil (g)	554.00	Wt. of Dry Soil (g)			1.58

Coarse Sieve

U.S. Sieve	Cumulative Wt. Of Dry Soil Retained (g)	% Passing
3"	0.00	100.0
1½"	0.00	100.0
3/4"	0.00	100.0
3/8"	0.00	100.0
No. 4	0.00	100.0
No. 10	0.00	100.0
Pan		

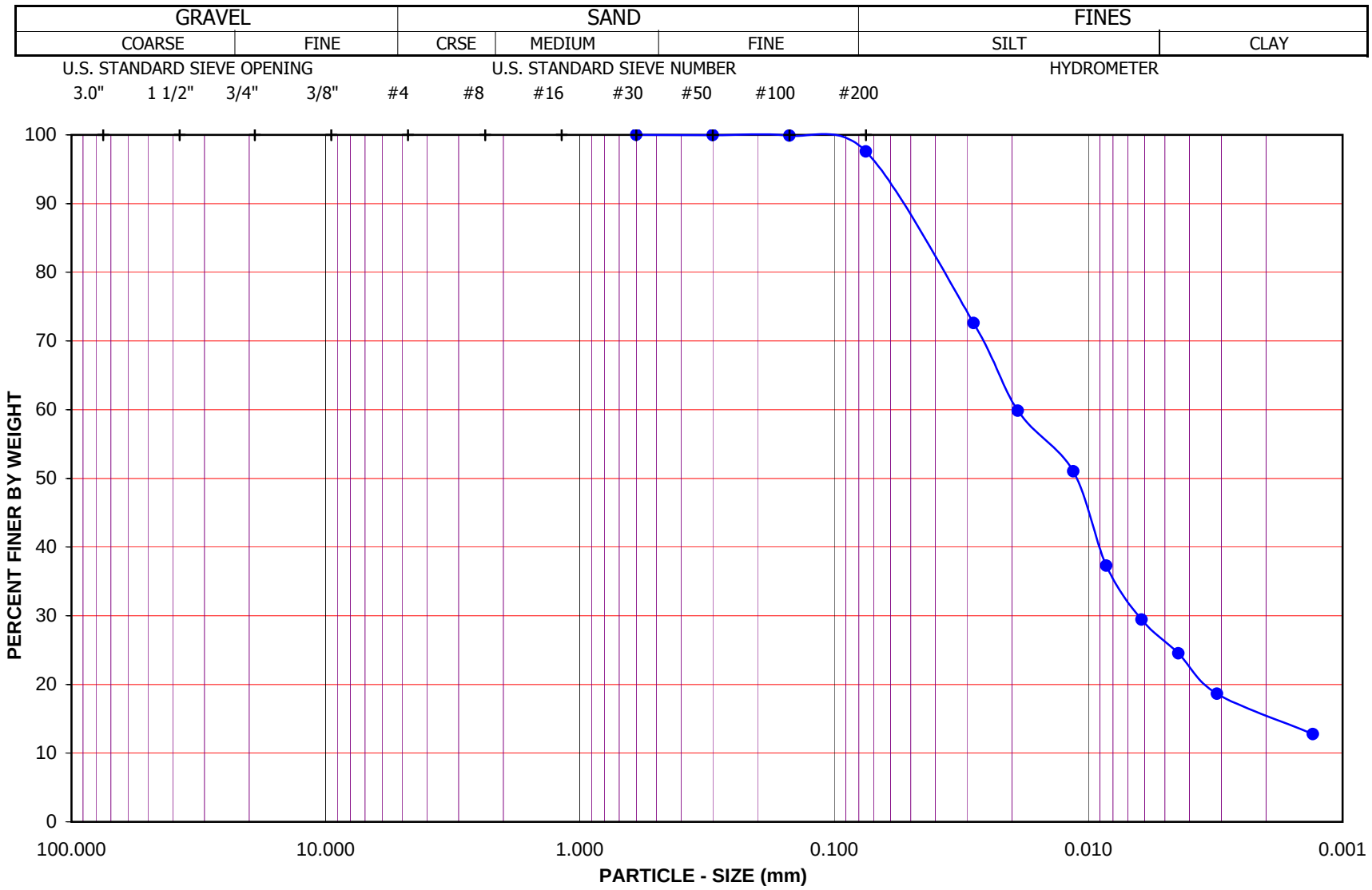
Sieve after Hydrometer & Wet Sieve

U.S. Sieve Size	Cumulative Wt. Of Dry Soil Retained (g)	% Passing	% Total Sample
No. 10	0.00	100.0	100.0
No. 16	0.00	100.0	100.0
No. 30	0.00	100.0	100.0
No. 50	0.02	100.0	100.0
No. 100	0.05	99.9	99.9
No. 200	1.22	97.6	97.6
Pan			

Hydrometer Wt. of Air-Dry Soil (g) 50.55 Wt. of Dry Soil (g) 50.55

Deflocculant 125 cc of 4% Solution

Date	Time	Elapsed Time (min)	Water Temperature (°C)	Composite Correction 152H	Actual Hydrometer Readings	% Total Sample (%)	Soil Particle Diameter (mm)
12-May-09	7:48	0		5.5			
	7:50	2	22.1	5.5	42.5	72.6	0.0283
	7:53	5	22.1	5.5	36.0	59.9	0.0189
	8:03	15	21.7	5.5	31.5	51.0	0.0115
	8:18	30	21.9	5.5	24.5	37.3	0.0085
	8:48	60	21.8	5.5	20.5	29.4	0.0062
	9:48	120	21.8	5.5	18.0	24.5	0.0044
	11:58	250	21.7	5.5	15.0	18.6	0.0031
13-May-09	7:48	1440	22.0	5.5	12.0	12.8	0.0013



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z1-B8 Sample No.: C17

Depth (feet) : 80-80.75 Soil Type : ML

Soil Identification: Dark olive silt'stone' (ML)

GR:SA:FI : (%) 0 : 2 : 98

Leighton

PARTICLE - SIZE DISTRIBUTION ASTM D 422

May-09

Leighton

PARTICLE-SIZE ANALYSIS OF SOILS

ASTM D 422

Project Name: SR-710 Tunnel Technical Study | Tested By : V. Juliano | Date: 05/11/09

Project No. : 378312.04.09.01 | Data Input By: J. Ward | Date: 05/14/09

Exploration No.: R-09-Z1-B8

Sample No.: C23 | Depth (feet) : 109-109.7

Soil Identification: Dark olive lean clay'stone' (CL)

% Gravel	**0**	**Soil Type**
% Sand	**3**	**CL**
% Fines	**97**	

			Moisture Content of Total Air-Dry Soil	Moisture Content of Air-Dry Soil Passing #10	After Hydrometer & Wet Sieve ret. in #200 Sieve
Specific Gravity (Assumed)	2.70	Wt.of Air-Dry Soil + Cont.(g)	0.00	0.00	
Correction for Specific Gravity	0.99	Dry Wt. of Soil + Cont. (g)	0.00	0.00	77.75
Wt.of Air-Dry Soil + Cont. (g)	748.50	Wt. of Container No.___ (g)	1.00	1.00	76.15
Wt. of Container	75.20	Moisture Content (%)	0.00	0.00	
Dry Wt. of Soil (g)	673.30	Wt. of Dry Soil (g)			1.60

Coarse Sieve

U.S. Sieve	Cumulative Wt. Of Dry Soil Retained (g)	% Passing
3"	0.00	100.0
1½"	0.00	100.0
3/4"	0.00	100.0
3/8"	0.00	100.0
No. 4	0.00	100.0
No. 10	0.00	100.0
Pan		

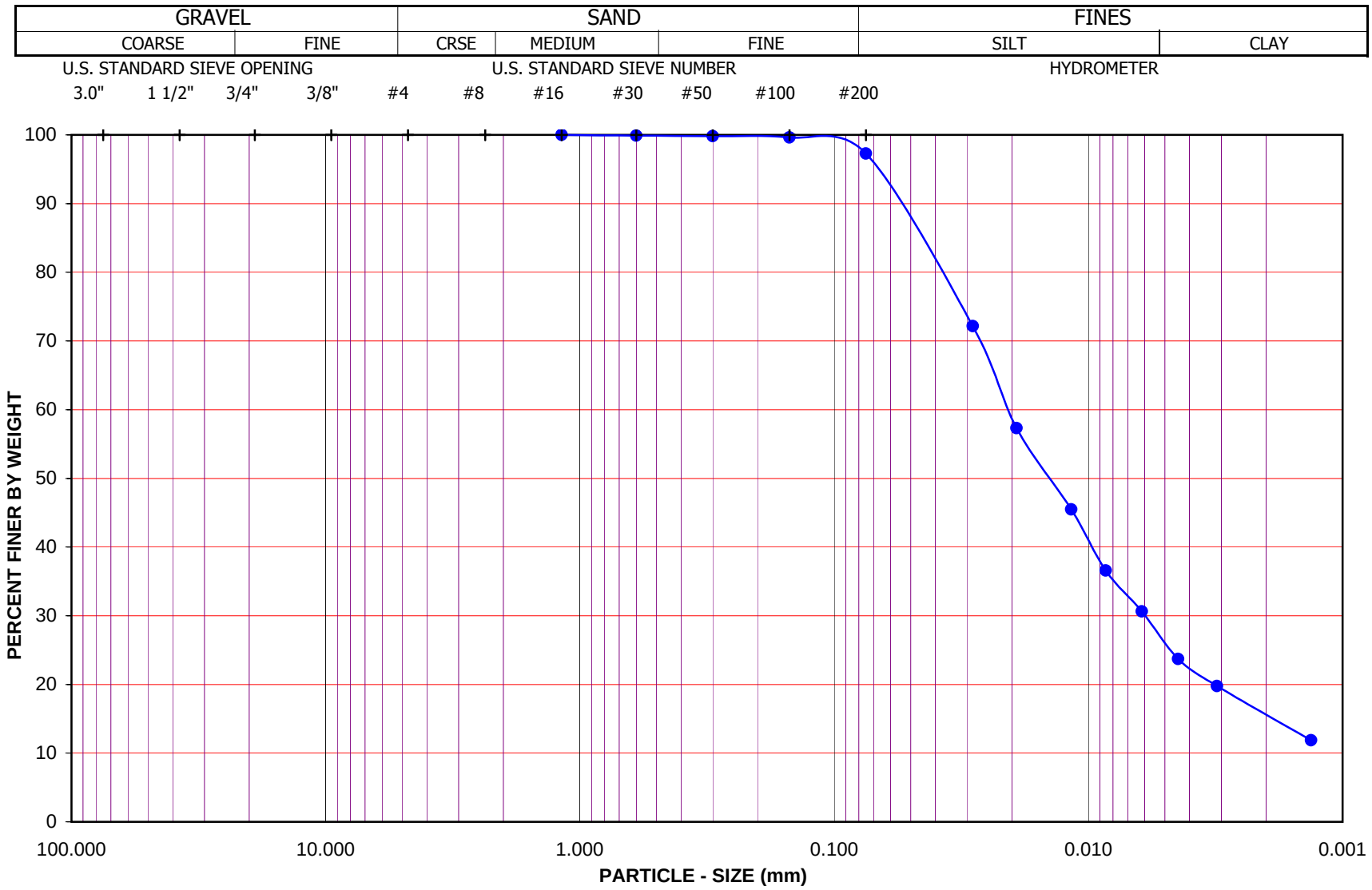
Sieve after Hydrometer & Wet Sieve

U.S. Sieve Size	Cumulative Wt. Of Dry Soil Retained (g)	% Passing	% Total Sample
No. 10	0.00	100.0	100.0
No. 16	0.00	100.0	100.0
No. 30	0.05	99.9	99.9
No. 50	0.10	99.8	99.8
No. 100	0.18	99.6	99.6
No. 200	1.37	97.3	97.3
Pan			

Hydrometer Wt. of Air-Dry Soil (g) 50.18 Wt. of Dry Soil (g) 50.18

Deflocculant 125 cc of 4% Solution

Date	Time	Elapsed Time (min)	Water Temperature (°C)	Composite Correction 152H	Actual Hydrometer Readings	% Total Sample (%)	Soil Particle Diameter (mm)
12-May-09	7:44	0		5.5			
	7:46	2	22.1	5.5	42.0	72.2	0.0284
	7:49	5	22.1	5.5	34.5	57.3	0.0192
	7:59	15	21.8	5.5	28.5	45.5	0.0117
	8:14	30	21.8	5.5	24.0	36.6	0.0085
	8:44	60	21.8	5.5	21.0	30.6	0.0062
	9:44	120	21.7	5.5	17.5	23.7	0.0044
	11:54	250	21.5	5.5	15.5	19.8	0.0031
13-May-09	7:44	1440	21.9	5.5	11.5	11.9	0.0013



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z1-B8 Sample No.: C23

Depth (feet) : 109-109.7 Soil Type : CL

Soil Identification: Dark olive lean clay'stone' (CL)

GR:SA:FI : (%) 0 : 3 : 97

Leighton

PARTICLE - SIZE DISTRIBUTION ASTM D 422

May-09

SA & Hyd R-09-Z1-B8, C23 @ 109-109.7

Leighton

PARTICLE-SIZE ANALYSIS OF SOILS

ASTM D 422

Project Name: SR-710 Tunnel Technical Study | Tested By : V. Juliano | Date: 05/11/09

Project No. : 378312.04.09.01 | Data Input By: J. Ward | Date: 05/14/09

Exploration No.: R-09-Z1-B8

Sample No.: C26 | Depth (feet) : 120-120.4

Soil Identification: Dark olive lean clay'stone' (CL)

				Moisture Content of Total Air-Dry Soil	Moisture Content of Air-Dry Soil Passing #10	After Hydrometer & Wet Sieve ret. in #200 Sieve
% Gravel	**0**	**Soil Type**				
% Sand	**4**	**CL**				
% Fines	**96**					
Specific Gravity (Assumed)	2.70	Wt.of Air-Dry Soil + Cont.(g)		0.00	0.00	
Correction for Specific Gravity	0.99	Dry Wt. of Soil + Cont. (g)		0.00	0.00	79.08
Wt.of Air-Dry Soil + Cont. (g)	742.90	Wt. of Container No.___ (g)		1.00	1.00	76.85
Wt. of Container	72.90	Moisture Content (%)		0.00	0.00	
Dry Wt. of Soil (g)	670.00	Wt. of Dry Soil (g)				2.23

Coarse Sieve

U.S. Sieve	Cumulative Wt. Of Dry Soil Retained (g)	% Passing
3"	0.00	100.0
1½"	0.00	100.0
3/4"	0.00	100.0
3/8"	0.00	100.0
No. 4	0.00	100.0
No. 10	0.00	100.0
Pan		

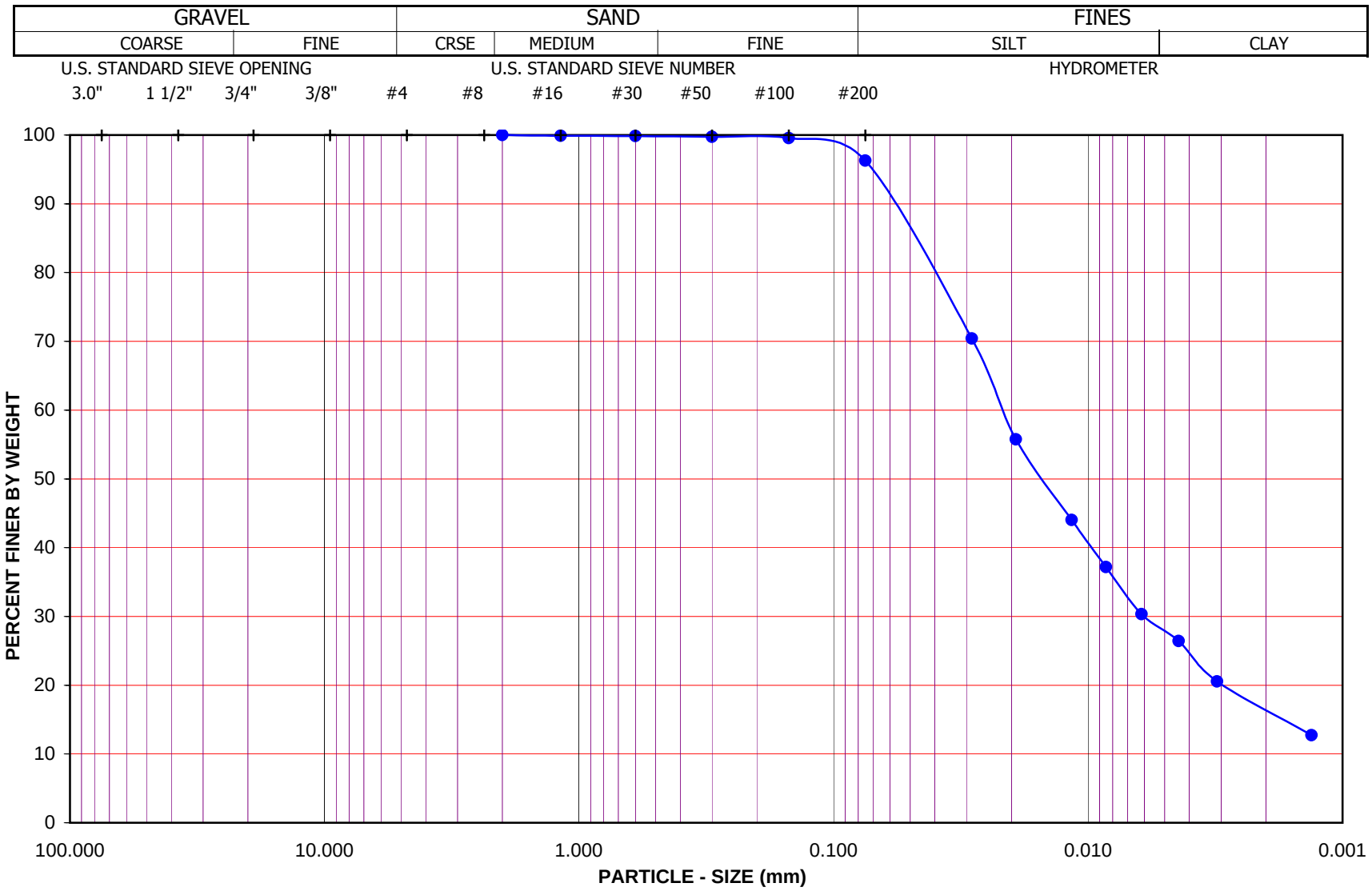
Sieve after Hydrometer & Wet Sieve

U.S. Sieve Size	Cumulative Wt. Of Dry Soil Retained (g)	% Passing	% Total Sample
No. 10	0.00	100.0	100.0
No. 16	0.05	99.9	99.9
No. 30	0.08	99.8	99.8
No. 50	0.14	99.7	99.7
No. 100	0.22	99.6	99.6
No. 200	1.89	96.3	96.3
Pan			

Hydrometer Wt. of Air-Dry Soil (g) 50.71 Wt. of Dry Soil (g) 50.71

Deflocculant 125 cc of 4% Solution

Date	Time	Elapsed Time (min)	Water Temperature (°C)	Composite Correction 152H	Actual Hydrometer Readings	% Total Sample (%)	Soil Particle Diameter (mm)
12-May-09	7:40	0		5.5			
	7:42	2	22.1	5.5	41.5	70.4	0.0286
	7:45	5	22.1	5.5	34.0	55.8	0.0192
	7:55	15	22.1	5.5	28.0	44.0	0.0116
	8:10	30	21.8	5.5	24.5	37.2	0.0085
	8:40	60	21.7	5.5	21.0	30.3	0.0062
	9:40	120	21.7	5.5	19.0	26.4	0.0044
	11:50	250	21.4	5.5	16.0	20.5	0.0031
13-May-09	7:40	1440	21.9	5.5	12.0	12.7	0.0013



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z1-B8 Sample No.: C26

Depth (feet) : 120-120.4 Soil Type : CL

Soil Identification: Dark olive lean clay'stone' (CL)

GR:SA:FI : (%) 0 : 4 : 96

Leighton

PARTICLE - SIZE DISTRIBUTION ASTM D 422

May-09

Leighton

PARTICLE-SIZE ANALYSIS of SOILS
ASTM D 422

Project Name: SR-710 Tunnel Technical Study
Project No.: 378312.04.09.01
Exploration No.: R-09-Z2-B2
Sample No.: C2
Soil Identification: Yellowish brown clayey sand'stone' (SC)

Tested By: A. Santos Date: 05/20/09
Checked By: J. Ward Date: 05/27/09
Depth (feet): 17-17.6

		Moisture Content of Total Air - Dry Soil	
Container No.:	724	Wt. of Air-Dry Soil + Cont. (g)	0.00
Wt. of Air-Dried Soil + Cont.(g)	557.60	Wt. of Dry Soil + Cont. (g)	0.00
Wt. of Container (g)	77.20	Wt. of Container No._____ (g)	1.00
Dry Wt. of Soil (g)	480.40	Moisture Content (%)	0.00

After Wet Sieve	Container No.	724
	Wt. of Dry Soil + Container (g)	347.50
	Wt. of Container (g)	77.20
	Dry Wt. of Soil Retained on # 200 Sieve (g)	270.30

U. S. Sieve Size (in.)	U. S. Sieve Size (mm.)	Cumulative Weight Dry Soil Retained (g)	Percent Passing (%)
6"	152.400		
3"	75.000		
1 1/2	37.500		
3/4"	19.000		
3/8"	9.500	0.00	100.0
#4	4.750	10.20	97.9
#8	2.360	28.60	94.0
#16	1.180	65.10	86.4
#30	0.600	109.20	77.3
#50	0.300	155.50	67.6
#100	0.150	207.50	56.8
#200	0.075	264.30	45.0
PAN			

GRAVEL: **2 %**
SAND: **53 %**
FINES: **45 %**
GROUP SYMBOL: **SC**

Cu = D60/D10 = _____
Cc = $(D30)^2/(D60*D10)$ = _____

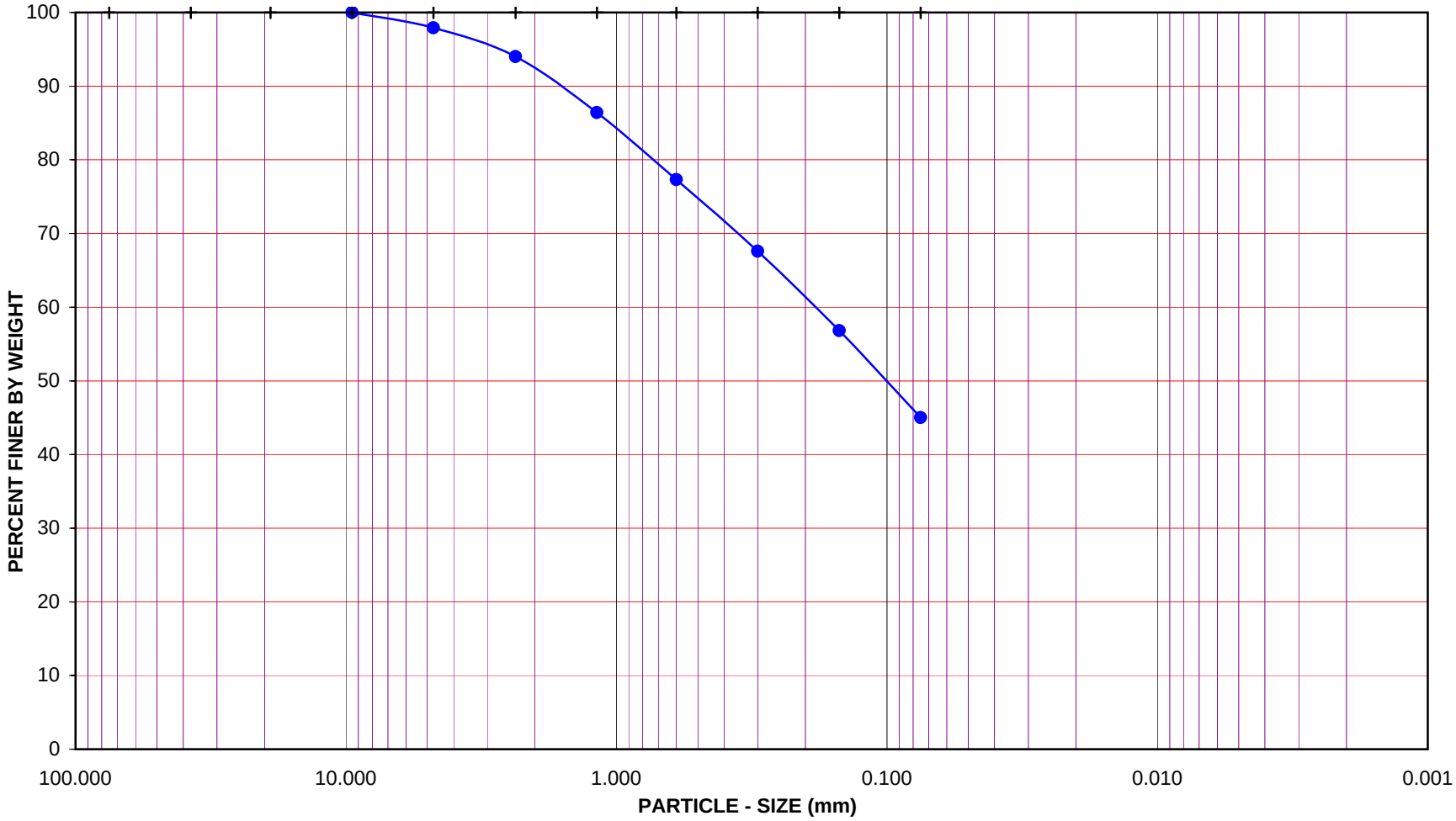
Remarks:

GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY

U.S. STANDARD SIEVE OPENING: 3.0" | 1 1/2" | 3/4" | 3/8"

U.S. STANDARD SIEVE NUMBER: #4 | #8 | #16 | #30 | #50 | #100 | #200

HYDROMETER



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z2-B2 Sample No.: C2

Depth (feet): 17-17.6 Soil Type : SC

Soil Identification: Yellowish brown clayey sand'stone' (SC)

GR:SA:FI : (%) 2 : 53 : 45

Leighton

PARTICLE - SIZE DISTRIBUTION ASTM D 422

May-09

Leighton

PARTICLE-SIZE ANALYSIS of SOILS
ASTM D 422

Project Name: SR-710 Tunnel Technical Study
Project No.: 378312.04.09.01
Exploration No.: R-09-Z2-B2
Sample No.: C10
Soil Identification: Yellowish brown silty sand (SM)

Tested By: A. Santos Date: 05/20/09
Checked By: J. Ward Date: 05/27/09
Depth (feet): 55.6-56

		Moisture Content of Total Air - Dry Soil	
Container No.:	A 15	Wt. of Air-Dry Soil + Cont. (g)	0.00
Wt. of Air-Dried Soil + Cont.(g)	911.60	Wt. of Dry Soil + Cont. (g)	0.00
Wt. of Container (g)	107.70	Wt. of Container No._____ (g)	1.00
Dry Wt. of Soil (g)	803.90	Moisture Content (%)	0.00

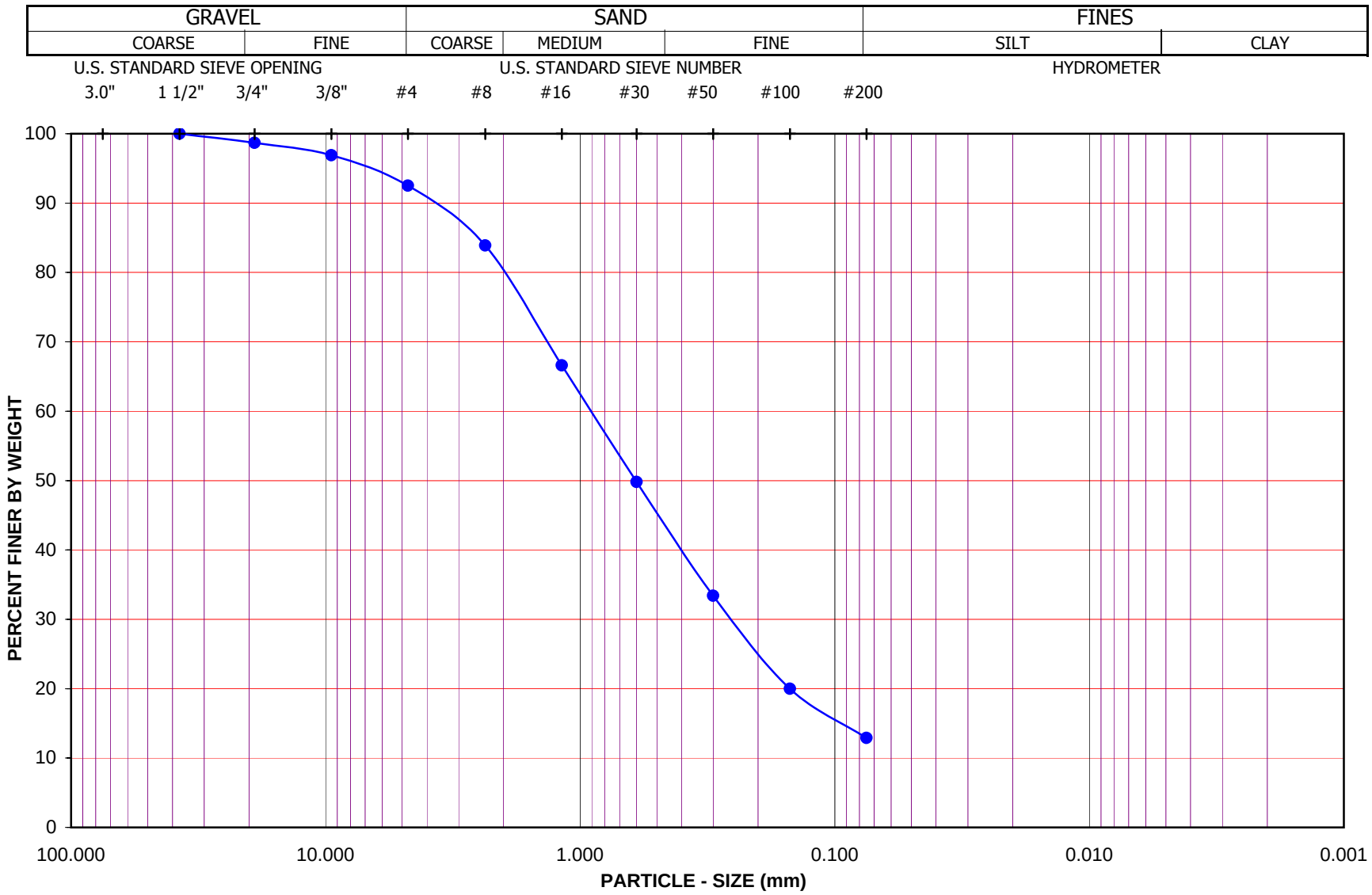
After Wet Sieve	Container No.	A 15
	Wt. of Dry Soil + Container (g)	812.20
	Wt. of Container (g)	107.70
	Dry Wt. of Soil Retained on # 200 Sieve (g)	704.50

U. S. Sieve Size (in.)	U. S. Sieve Size (mm.)	Cumulative Weight Dry Soil Retained (g)	Percent Passing (%)
6"	152.400		
3"	75.000		
1 1/2	37.500	0.00	100.0
3/4"	19.000	10.20	98.7
3/8"	9.500	25.00	96.9
#4	4.750	60.30	92.5
#8	2.360	129.10	83.9
#16	1.180	268.80	66.6
#30	0.600	403.50	49.8
#50	0.300	535.30	33.4
#100	0.150	643.10	20.0
#200	0.075	699.90	12.9
PAN			

GRAVEL: **8 %**
SAND: **79 %**
FINES: **13 %**
GROUP SYMBOL: **SM**

Cu = D60/D10 = _____
Cc = $(D30)^2/(D60*D10)$ = _____

Remarks:



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z2-B2 Sample No.: C10

Depth (feet): 55.6-56 Soil Type : SM

Soil Identification: Yellowish brown silty sand (SM)

GR:SA:FI : (%) 8 : 79 : 13

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PARTICLE - SIZE DISTRIBUTION ASTM D 422

May-09

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PARTICLE-SIZE ANALYSIS of SOILS
ASTM D 422

Project Name: SR-710 Tunnel Technical Study
Project No.: 378312.04.09.01
Exploration No.: R-09-Z2-B2
Sample No.: C24
Soil Identification: Olive brown silty sand (SM)

Tested By: A. Santos Date: 05/21/09
Checked By: J. Ward Date: 05/27/09
Depth (feet): 144-144.5

		Moisture Content of Total Air - Dry Soil	
Container No.:	9554	Wt. of Air-Dry Soil + Cont. (g)	0.00
Wt. of Air-Dried Soil + Cont.(g)	883.70	Wt. of Dry Soil + Cont. (g)	0.00
Wt. of Container (g)	108.32	Wt. of Container No._____ (g)	1.00
Dry Wt. of Soil (g)	775.38	Moisture Content (%)	0.00

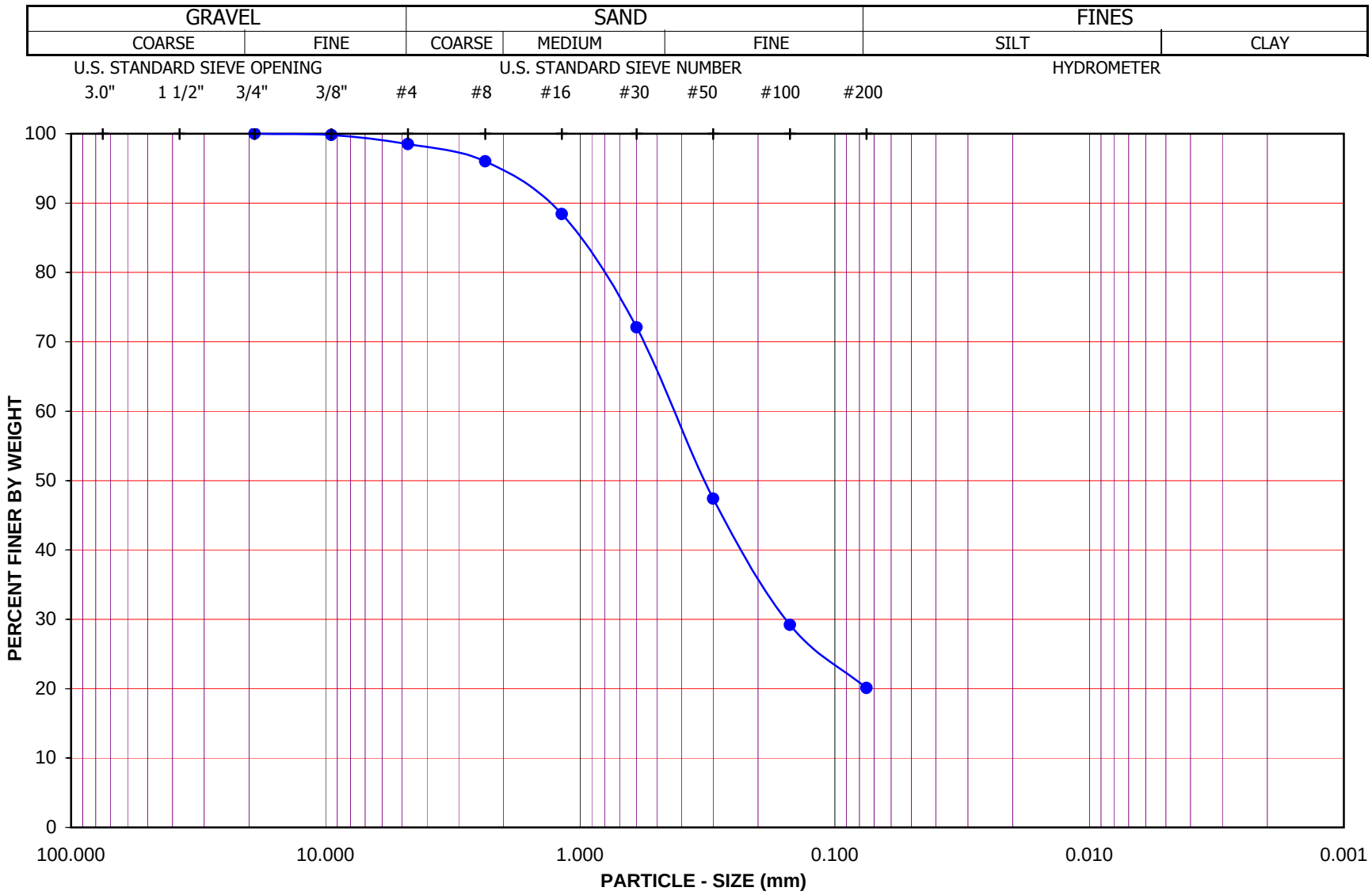
After Wet Sieve	Container No.	9554
	Wt. of Dry Soil + Container (g)	733.50
	Wt. of Container (g)	108.32
	Dry Wt. of Soil Retained on # 200 Sieve (g)	625.18

U. S. Sieve Size (in.)	U. S. Sieve Size (mm.)	Cumulative Weight Dry Soil Retained (g)	Percent Passing (%)
6"	152.400		
3"	75.000		
1 1/2	37.500		
3/4"	19.000	0.00	100.0
3/8"	9.500	1.60	99.8
#4	4.750	11.60	98.5
#8	2.360	31.00	96.0
#16	1.180	90.10	88.4
#30	0.600	216.70	72.1
#50	0.300	408.00	47.4
#100	0.150	548.90	29.2
#200	0.075	619.50	20.1
PAN			

GRAVEL: **2 %**
SAND: **78 %**
FINES: **20 %**
GROUP SYMBOL: **SM**

Cu = D60/D10 = _____
Cc = $(D30)^2/(D60*D10)$ = _____

Remarks:



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z2-B2 Sample No.: C24

Depth (feet): 144-144.5 Soil Type : SM

Soil Identification: Olive brown silty sand (SM)

GR:SA:FI : (%) 2 : 78 : 20

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PARTICLE - SIZE DISTRIBUTION ASTM D 422

May-09

SA R-09-Z2-B2, C24 @ 144-144.5

Leighton

PARTICLE-SIZE ANALYSIS of SOILS
ASTM D 422

Project Name: SR-710 Tunnel Technical Study
Project No.: 378312.04.09.01
Exploration No.: R-09-Z2-B2
Sample No.: C48
Soil Identification: Dark grayish brown clayey sand (SC)

Tested By: A. Santos Date: 05/21/09
Checked By: J. Ward Date: 05/27/09
Depth (feet): 260.5-261.1

		Moisture Content of Total Air - Dry Soil	
Container No.:	944	Wt. of Air-Dry Soil + Cont. (g)	0.00
Wt. of Air-Dried Soil + Cont.(g)	1022.80	Wt. of Dry Soil + Cont. (g)	0.00
Wt. of Container (g)	109.40	Wt. of Container No._____ (g)	1.00
Dry Wt. of Soil (g)	913.40	Moisture Content (%)	0.00

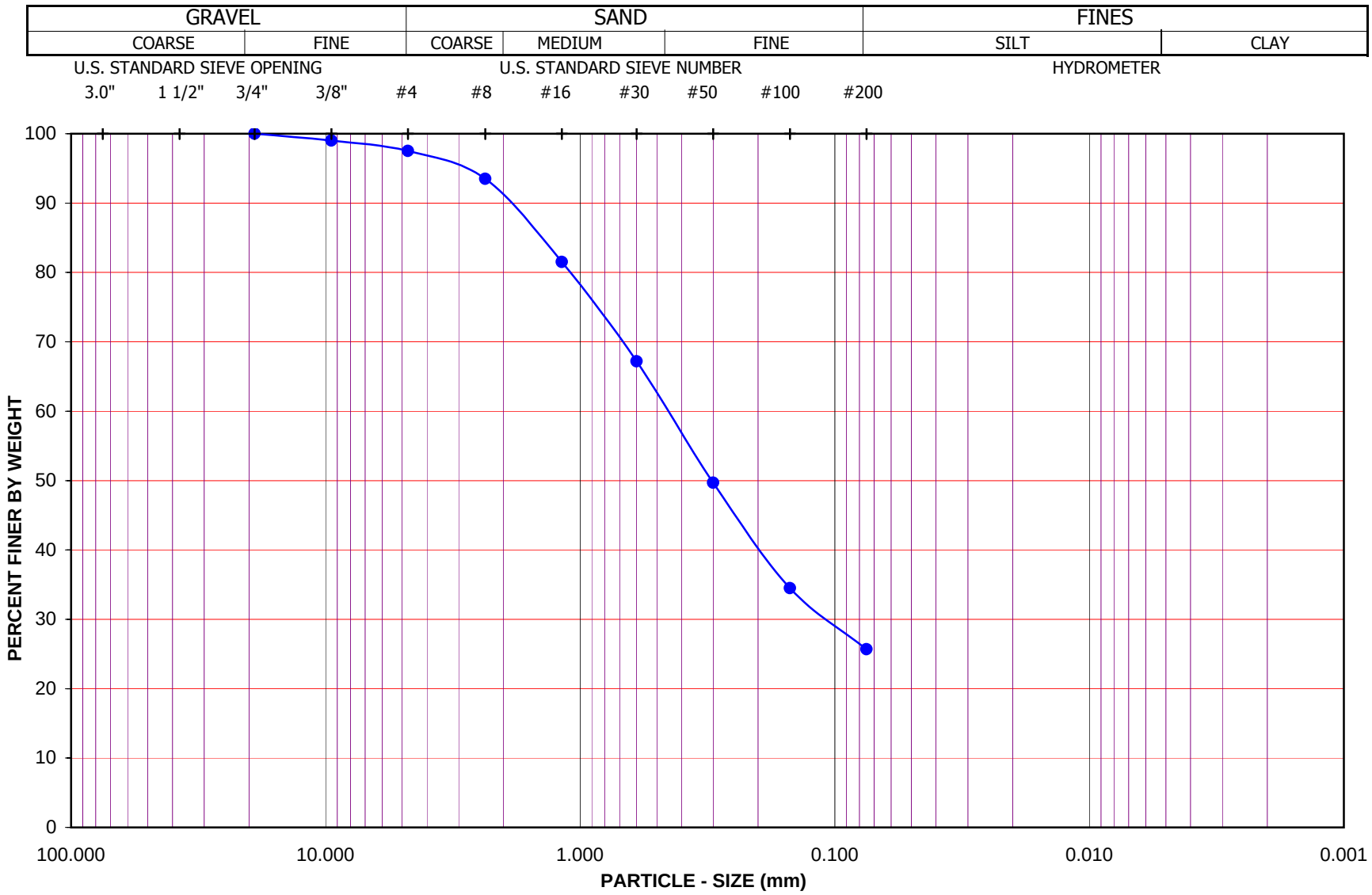
After Wet Sieve	Container No.	944
	Wt. of Dry Soil + Container (g)	796.70
	Wt. of Container (g)	109.40
	Dry Wt. of Soil Retained on # 200 Sieve (g)	687.30

U. S. Sieve Size (in.)	U. S. Sieve Size (mm.)	Cumulative Weight Dry Soil Retained (g)	Percent Passing (%)
6"	152.400		
3"	75.000		
1 1/2	37.500		
3/4"	19.000	0.00	100.0
3/8"	9.500	8.80	99.0
#4	4.750	22.40	97.5
#8	2.360	59.10	93.5
#16	1.180	168.70	81.5
#30	0.600	300.00	67.2
#50	0.300	459.40	49.7
#100	0.150	598.70	34.5
#200	0.075	678.20	25.7
PAN			

GRAVEL: **3 %**
SAND: **71 %**
FINES: **26 %**
GROUP SYMBOL: **SC**

Cu = D60/D10 = _____
Cc = $(D30)^2/(D60*D10)$ = _____

Remarks:



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z2-B2 Sample No.: C48

Depth (feet): 260.5-261.1 Soil Type : SC

Soil Identification: Dark grayish brown clayey sand (SC)

GR:SA:FI : (%) 3 : 71 : 26

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PARTICLE - SIZE DISTRIBUTION ASTM D 422

May-09

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PARTICLE-SIZE ANALYSIS OF SOILS

ASTM D 422

Project Name: SR-710 Tunnel Technical Study | Tested By : V. Juliano | Date: 05/28/09

Project No. : 378312.04.09.01 | Data Input By: J. Ward | Date: 06/05/09

Exploration No.: R-09-Z2-B2

Sample No.: C14 | Depth (feet) : 77-78

Soil Identification: Dark yellowish brown sandy lean clay'stone' s(CL)

% Gravel	**0**	**Soil Type**	
% Sand	**38**	**s(CL)**	
% Fines	**62**		

			Moisture Content of Total Air-Dry Soil	Moisture Content of Air-Dry Soil Passing #10	After Hydrometer & Wet Sieve ret. in #200 Sieve
Specific Gravity (Assumed)	2.70	Wt.of Air-Dry Soil + Cont.(g)	0.00	0.00	
Correction for Specific Gravity	0.99	Dry Wt. of Soil + Cont. (g)	0.00	0.00	99.48
Wt.of Air-Dry Soil + Cont. (g)	862.20	Wt. of Container No.___ (g)	1.00	1.00	78.22
Wt. of Container	107.60	Moisture Content (%)	0.00	0.00	
Dry Wt. of Soil (g)	754.60	Wt. of Dry Soil (g)			21.26

Coarse Sieve

U.S. Sieve	Cumulative Wt. Of Dry Soil Retained (g)	% Passing
3"	0.00	100.0
1½"	0.00	100.0
3/4"	0.00	100.0
3/8"	0.00	100.0
No. 4	0.00	100.0
No. 10	0.00	100.0
Pan		

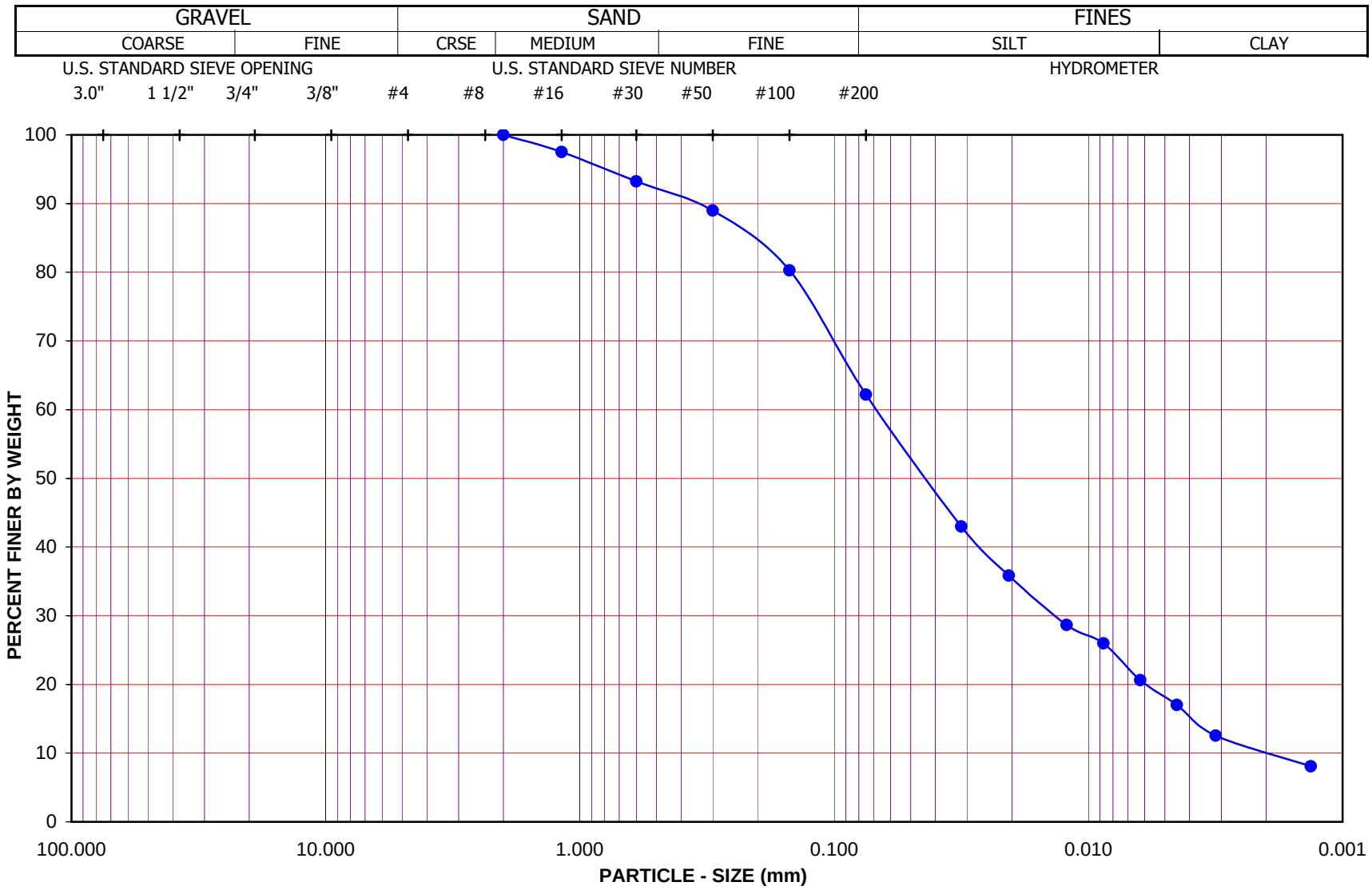
Sieve after Hydrometer & Wet Sieve

U.S. Sieve Size	Cumulative Wt. Of Dry Soil Retained (g)	% Passing	% Total Sample
No. 10	0.00	100.0	100.0
No. 16	1.38	97.5	97.5
No. 30	3.76	93.2	93.2
No. 50	6.09	89.0	89.0
No. 100	10.92	80.3	80.3
No. 200	20.94	62.2	62.2
Pan			

Hydrometer Wt. of Air-Dry Soil (g) 55.37 Wt. of Dry Soil (g) 55.37

Deflocculant 125 cc of 4% Solution

Date	Time	Elapsed Time (min)	Water Temperature (°C)	Composite Correction 152H	Actual Hydrometer Readings	% Total Sample (%)	Soil Particle Diameter (mm)
02-Jun-09	9:04	0		6.5			
	9:06	2	21.6	6.5	30.5	43.0	0.0316
	9:09	5	21.6	6.5	26.5	35.8	0.0205
	9:19	15	21.6	6.5	22.5	28.7	0.0122
	9:34	30	21.5	6.5	21.0	26.0	0.0087
	10:04	60	21.5	6.5	18.0	20.6	0.0063
	11:04	120	21.7	6.5	16.0	17.0	0.0045
	13:14	250	21.8	6.5	13.5	12.5	0.0032
03-Jun-09	9:04	1440	21.5	6.5	11.0	8.1	0.0013



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z2-B2 Sample No.: C14

Depth (feet) : 77-78 Soil Type : s(CL)

Soil Identification: Dark yellowish brown sandy lean clay'stone' s(CL)

GR:SA:FI : (%) 0 : 38 : 62

Leighton

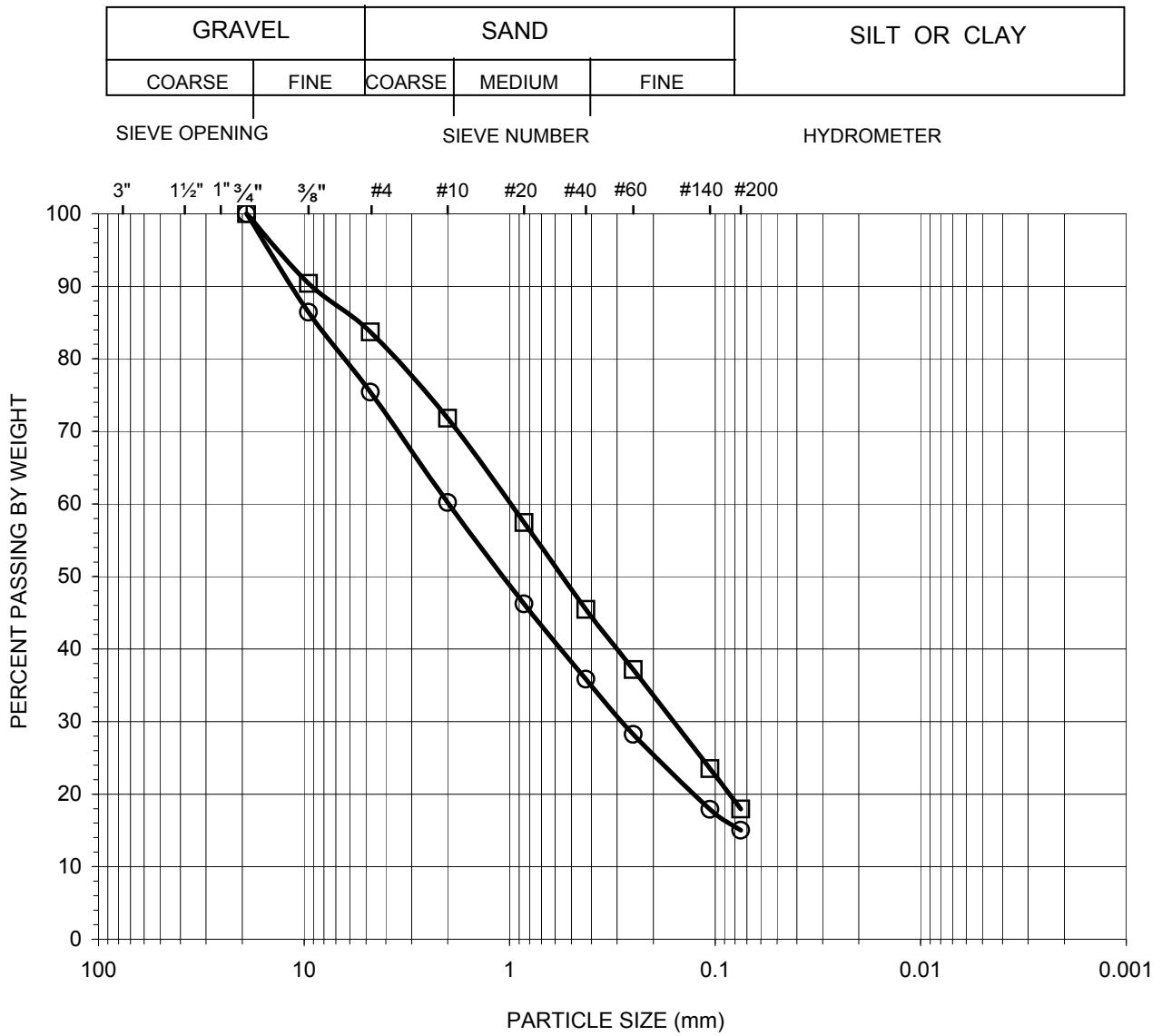
PARTICLE - SIZE DISTRIBUTION ASTM D 422

Jun-09

AP Engineering & Testing, Inc.

GRAIN SIZE DISTRIBUTION CURVE
ASTM D 422

Project Name: SR-710 Tunnel Technical Study Tested by: DK Date: 06/02/09
Project Number: 378312.04.09.01 Checked by: AP Date: 06/11/09

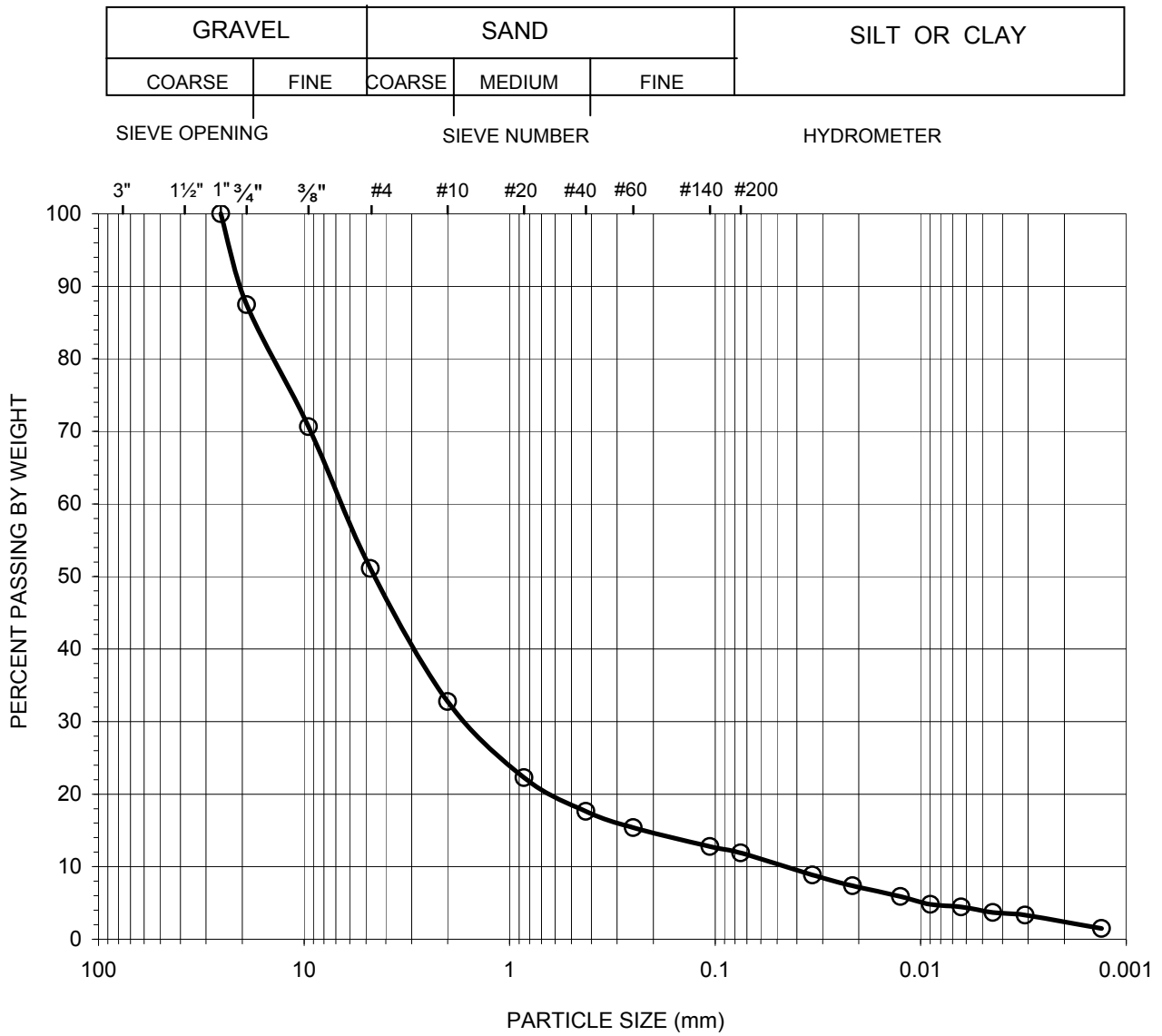


Symbol	Boring No.	Sample No.	Sample Date	Percent			Atterberg Limits LL:PL:PI	Soil Type U.S.C.S
				Gravel	Sand	Fines		
○	R-09-Z2-B3	S-4	15-16.5	24.58	60.38	15.03	N/A	SM
□	R-09-Z2-B3	S-8	25-26.5	16.31	65.77	17.92	N/A	SM

AP Engineering & Testing, Inc.

GRAIN SIZE DISTRIBUTION CURVE
ASTM D 422

Project Name: SR-710 Tunnel Technical Study Tested by: DK Date: 06/02/09
Project Number: 378312.04.09.01 Checked by: AP Date: 06/11/09



Symbol	Boring No.	Sample No.	Depth (feet)	Percent			Atterberg Limits LL:PL:PI	Soil Type U.S.C.S
				Gravel	Sand	Fines		
○	R-09-Z2-B3	C-16	45-50	48.90	39.19	11.91	N/A	

Note: Sample is siltstone and too hard to breakdown to small grain size.

Leighton

PARTICLE-SIZE ANALYSIS OF SOILS

ASTM D 422

Project Name: SR-710 Tunnel Technical Study | Tested By : V. Juliano | Date: 05/20/09

Project No. : 378312.04.09.01 | Data Input By: J. Ward | Date: 05/27/09

Exploration No.: R-09-Z2-B4

Sample No.: C23 | Depth (feet) : 88.5-89

Soil Identification: Dark olive elastic silt (MH)

% Gravel	**0**	**Soil Type**	Moisture Content of Total Air-Dry Soil	Moisture Content of Air-Dry Soil Passing #10	After Hydrometer & Wet Sieve ret. in #200 Sieve
% Sand	**0**	**MH**			
% Fines	**100**				

Specific Gravity (Assumed)	2.70	Wt.of Air-Dry Soil + Cont.(g)	0.00	0.00	
Correction for Specific Gravity	0.99	Dry Wt. of Soil + Cont. (g)	0.00	0.00	N/A
Wt.of Air-Dry Soil + Cont. (g)	772.90	Wt. of Container No.___ (g)	1.00	1.00	N/A
Wt. of Container	110.05	Moisture Content (%)	0.00	0.00	
Dry Wt. of Soil (g)	662.85	Wt. of Dry Soil (g)			N/A

Coarse Sieve

U.S. Sieve	Cumulative Wt. Of Dry Soil Retained (g)	% Passing
3"	0.00	100.0
1½"	0.00	100.0
3/4"	0.00	100.0
3/8"	0.00	100.0
No. 4	0.00	100.0
No. 10	0.00	100.0
Pan		

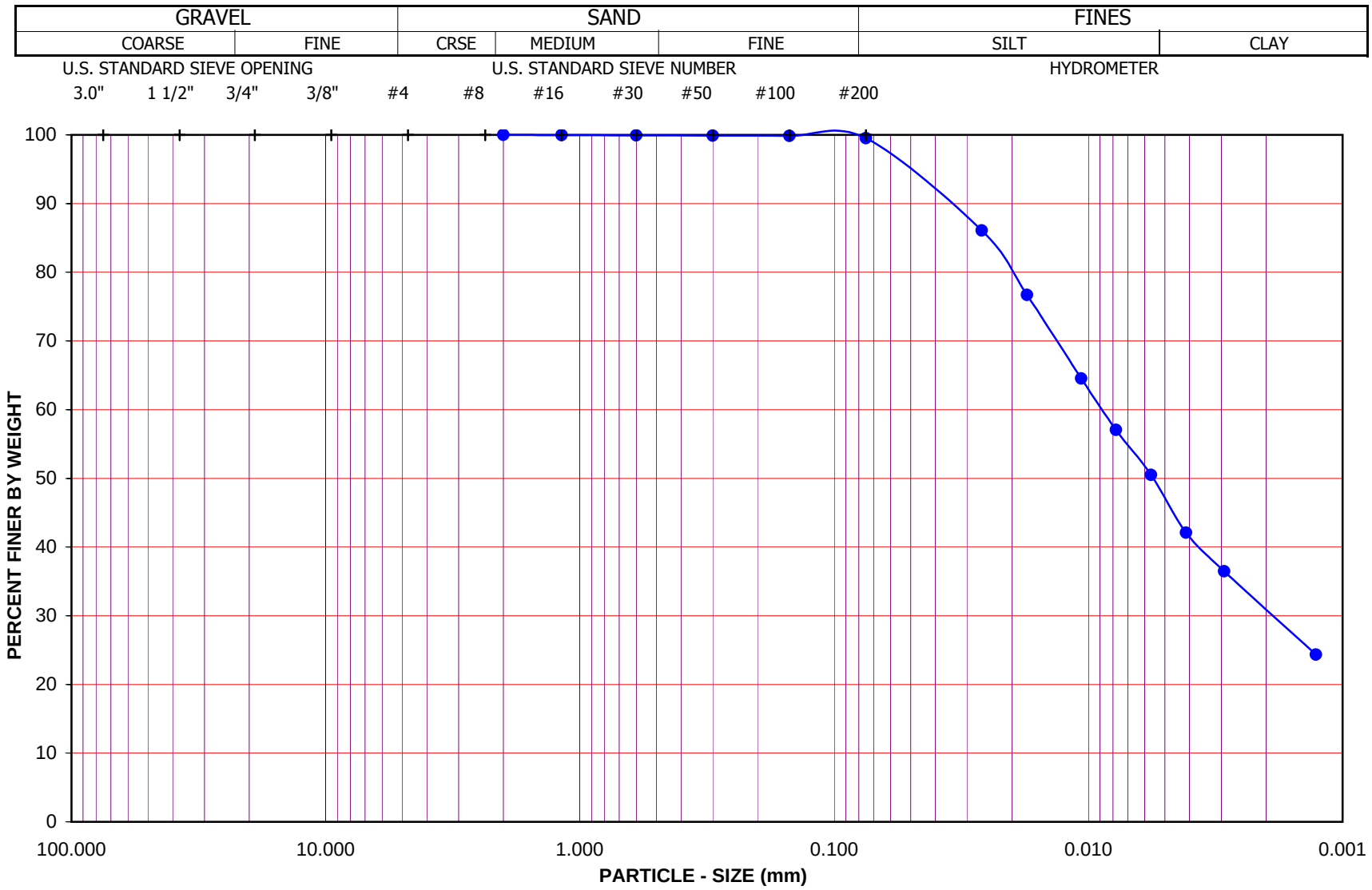
Sieve after Hydrometer & Wet Sieve

U.S. Sieve Size	Cumulative Wt. Of Dry Soil Retained (g)	% Passing	% Total Sample
No. 10	0.00	100.0	100.0
No. 16	0.01	100.0	100.0
No. 30	0.04	99.9	99.9
No. 50	0.06	99.9	99.9
No. 100	0.07	99.9	99.9
No. 200	0.26	99.5	99.5
Pan			

Hydrometer Wt. of Air-Dry Soil (g) 53.02 Wt. of Dry Soil (g) 53.02

Deflocculant 125 cc of 4% Solution

Date	Time	Elapsed Time (min)	Water Temperature (°C)	Composite Correction 152H	Actual Hydrometer Readings	% Total Sample (%)	Soil Particle Diameter (mm)
21-May-09	10:34	0		6.0			
	10:36	2	21.4	6.0	52.0	86.1	0.0262
	10:39	5	21.4	6.0	47.0	76.7	0.0174
	10:49	15	21.5	6.0	40.5	64.5	0.0107
	11:04	30	21.5	6.0	36.5	57.1	0.0078
	11:34	60	21.5	6.0	33.0	50.5	0.0057
	12:34	120	21.4	6.0	28.5	42.1	0.0041
	14:44	250	21.4	6.0	25.5	36.5	0.0029
22-May-09	10:34	1440	21.3	6.0	19.0	24.3	0.0013



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z2-B4 Sample No.: C23

Depth (feet) : 88.5-89 Soil Type : MH

Soil Identification: Dark olive elastic silt (MH)

GR:SA:FI : (%) 0 : 0 : 100

Leighton

PARTICLE - SIZE DISTRIBUTION ASTM D 422

May-09

Leighton

PARTICLE-SIZE ANALYSIS OF SOILS

ASTM D 422

Project Name: SR-710 Tunnel Technical Study | Tested By : V. Juliano | Date: 05/19/09

Project No. : 378312.04.09.01 | Data Input By: J. Ward | Date: 05/27/09

Exploration No.: R-09-Z2-B4

Sample No.: C28 | Depth (feet) : 112.5-113

Soil Identification: Olive sandy silt s(ML)

% Gravel	2	Soil Type
% Sand	47	s(ML)
% Fines	51	

			Moisture Content of Total Air-Dry Soil	Moisture Content of Air-Dry Soil Passing #10	After Hydrometer & Wet Sieve ret. in #200 Sieve
Specific Gravity (Assumed)	2.70	Wt.of Air-Dry Soil + Cont.(g)	0.00	0.00	
Correction for Specific Gravity	0.99	Dry Wt. of Soil + Cont. (g)	0.00	0.00	117.01
Wt.of Air-Dry Soil + Cont. (g)	1186.30	Wt. of Container No.___ (g)	1.00	1.00	77.48
Wt. of Container	108.00	Moisture Content (%)	0.00	0.00	
Dry Wt. of Soil (g)	1078.30	Wt. of Dry Soil (g)			39.53

Coarse Sieve

U.S. Sieve	Cumulative Wt. Of Dry Soil Retained (g)	% Passing
3"	0.00	100.0
1½"	0.00	100.0
3/4"	0.00	100.0
3/8"	6.57	99.4
No. 4	25.87	97.6
No. 10	54.07	95.0
Pan		

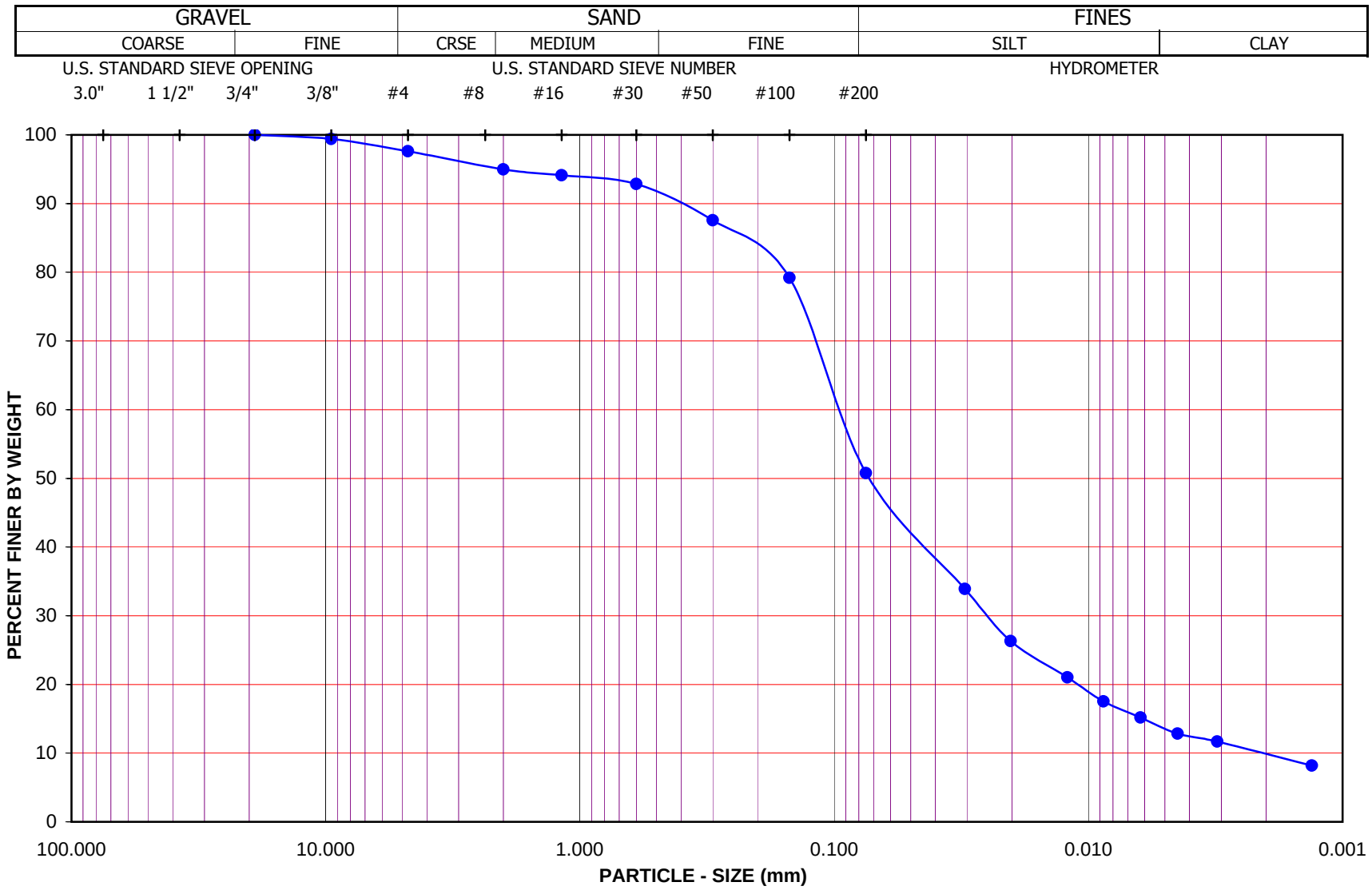
Sieve after Hydrometer & Wet Sieve

U.S. Sieve Size	Cumulative Wt. Of Dry Soil Retained (g)	% Passing	% Total Sample
No. 10	0.00	100.0	95.0
No. 16	0.75	99.1	94.1
No. 30	1.82	97.7	92.8
No. 50	6.29	92.2	87.6
No. 100	13.39	83.4	79.2
No. 200	37.54	53.4	50.8
Pan			

Hydrometer Wt. of Air-Dry Soil (g) 80.62 Wt. of Dry Soil (g) 80.62

Deflocculant 125 cc of 4% Solution

Date	Time	Elapsed Time (min)	Water Temperature (°C)	Composite Correction 152H	Actual Hydrometer Readings	% Total Sample (%)	Soil Particle Diameter (mm)
21-May-09	10:38	0		6.0			
	10:40	2	21.4	6.0	35.0	33.9	0.0306
	10:43	5	21.5	6.0	28.5	26.3	0.0202
	10:53	15	21.6	6.0	24.0	21.0	0.0121
	11:08	30	21.4	6.0	21.0	17.5	0.0087
	11:38	60	21.5	6.0	19.0	15.2	0.0062
	12:38	120	21.4	6.0	17.0	12.9	0.0045
	14:48	250	21.4	6.0	16.0	11.7	0.0031
22-May-09	10:38	1440	21.3	6.0	13.0	8.2	0.0013



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z2-B4 Sample No.: C28

Depth (feet) : 112.5-113 Soil Type : s(ML)

Soil Identification: Olive sandy silt s(ML)

GR:SA:FI : (%) 2 : 47 : 51

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PARTICLE - SIZE DISTRIBUTION ASTM D 422

May-09

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PARTICLE-SIZE ANALYSIS OF SOILS

ASTM D 422

Project Name: SR-710 Tunnel Technical Study | Tested By : V. Juliano | Date: 05/19/09

Project No. : 378312.04.09.01 | Data Input By: J. Ward | Date: 05/28/09

Exploration No.: R-09-Z2-B4

Sample No.: C40 | Depth (feet) : 157-158

Soil Identification: Dark olive sandy silt'stone' s(ML)

				Moisture Content of Total Air-Dry Soil	Moisture Content of Air-Dry Soil Passing #10	After Hydrometer & Wet Sieve ret. in #200 Sieve
% Gravel	**4**	**Soil Type**				
% Sand	**38**	**s(ML)**				
% Fines	**58**					
Specific Gravity (Assumed)	2.70	Wt.of Air-Dry Soil + Cont.(g)		0.00	0.00	
Correction for Specific Gravity	0.99	Dry Wt. of Soil + Cont. (g)		0.00	0.00	98.68
Wt.of Air-Dry Soil + Cont. (g)	894.40	Wt. of Container No.___ (g)		1.00	1.00	75.77
Wt. of Container	106.40	Moisture Content (%)		0.00	0.00	
Dry Wt. of Soil (g)	788.00	Wt. of Dry Soil (g)				22.91

Coarse Sieve

U.S. Sieve	Cumulative Wt. Of Dry Soil Retained (g)	% Passing
3"	0.00	100.0
1½"	0.00	100.0
3/4"	0.00	100.0
3/8"	3.62	99.5
No. 4	35.04	95.6
No. 10	75.21	90.5
Pan		

Sieve after Hydrometer & Wet Sieve

U.S. Sieve Size	Cumulative Wt. Of Dry Soil Retained (g)	% Passing	% Total Sample
No. 10	0.00	100.0	90.5
No. 16	0.68	98.9	89.4
No. 30	1.84	97.0	87.7
No. 50	3.77	93.8	84.8
No. 100	6.47	89.3	80.8
No. 200	21.48	64.6	58.4
Pan			

Hydrometer Wt. of Air-Dry Soil (g) 60.66 Wt. of Dry Soil (g) 60.66

Deflocculant 125 cc of 4% Solution

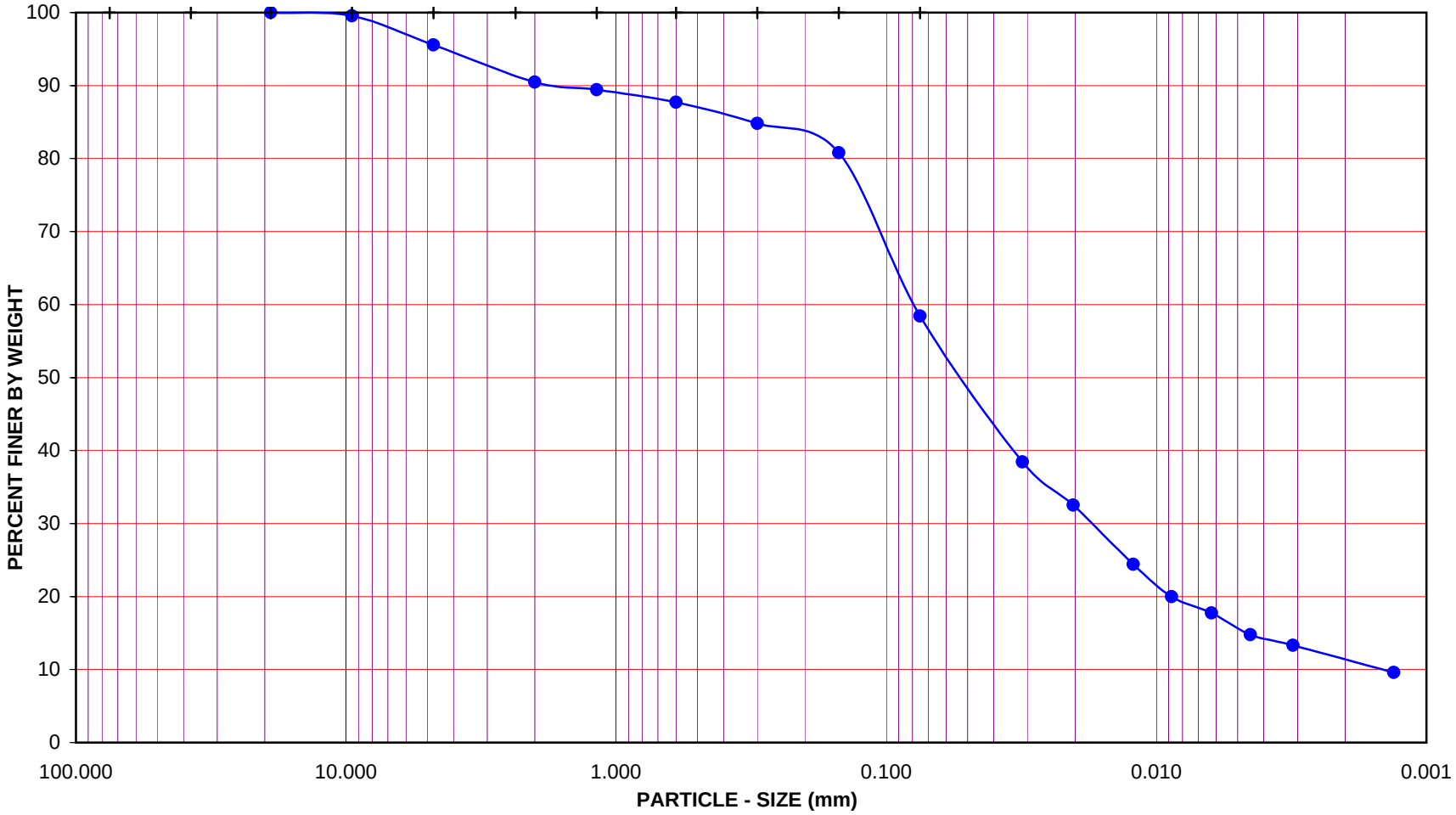
Date	Time	Elapsed Time (min)	Water Temperature (°C)	Composite Correction 152H	Actual Hydrometer Readings	% Total Sample (%)	Soil Particle Diameter (mm)
21-May-09	10:30	0		6.0			
	10:32	2	21.4	6.0	32.0	38.5	0.0313
	10:35	5	21.4	6.0	28.0	32.5	0.0203
	10:45	15	21.5	6.0	22.5	24.4	0.0122
	11:00	30	21.5	6.0	19.5	20.0	0.0088
	11:30	60	21.5	6.0	18.0	17.8	0.0063
	12:30	120	21.4	6.0	16.0	14.8	0.0045
	14:40	250	21.4	6.0	15.0	13.3	0.0031
22-May-09	10:30	1440	21.3	6.0	12.5	9.6	0.0013

GRAVEL		SAND			FINES	
COARSE	FINE	CRSE	MEDIUM	FINE	SILT	CLAY

U.S. STANDARD SIEVE OPENING: 3.0" 1 1/2" 3/4" 3/8"

U.S. STANDARD SIEVE NUMBER: #4 #8 #16 #30 #50 #100 #200

HYDROMETER



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z2-B4 Sample No.: C40

Depth (feet) : 157-158 Soil Type : s(ML)

Soil Identification: Dark olive sandy silt'stone' s(ML)

GR:SA:FI : (%) 4 : 38 : 58

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PARTICLE - SIZE DISTRIBUTION ASTM D 422

May-09

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PARTICLE-SIZE ANALYSIS OF SOILS

ASTM D 422

Project Name: SR-710 Tunnel Technical Study | Tested By : V. Juliano | Date: 05/17/09

Project No. : 378312.04.09.01 | Data Input By: J. Ward | Date: 05/27/09

Exploration No.: R-09-Z2-B4

Sample No.: S9 | Depth (feet) : 40.0

Soil Identification: Olive fat clay with sand (CH)s

% Gravel	**6**	**Soil Type**
% Sand	**17**	**(CH)s**
% Fines	**77**	

			Moisture Content of Total Air-Dry Soil	Moisture Content of Air-Dry Soil Passing #10	After Hydrometer & Wet Sieve ret. in #200 Sieve
Specific Gravity (Assumed)	2.70	Wt.of Air-Dry Soil + Cont.(g)	0.00	0.00	
Correction for Specific Gravity	0.99	Dry Wt. of Soil + Cont. (g)	0.00	0.00	N/A
Wt.of Air-Dry Soil + Cont. (g)	642.10	Wt. of Container No.___ (g)	1.00	1.00	N/A
Wt. of Container	108.70	Moisture Content (%)	0.00	0.00	
Dry Wt. of Soil (g)	533.40	Wt. of Dry Soil (g)			N/A

Coarse Sieve

U.S. Sieve	Cumulative Wt. Of Dry Soil Retained (g)	% Passing
3"	0.00	100.0
1½"	0.00	100.0
3/4"	12.27	97.7
3/8"	27.16	94.9
No. 4	32.91	93.8
No. 10	41.31	92.3
Pan		

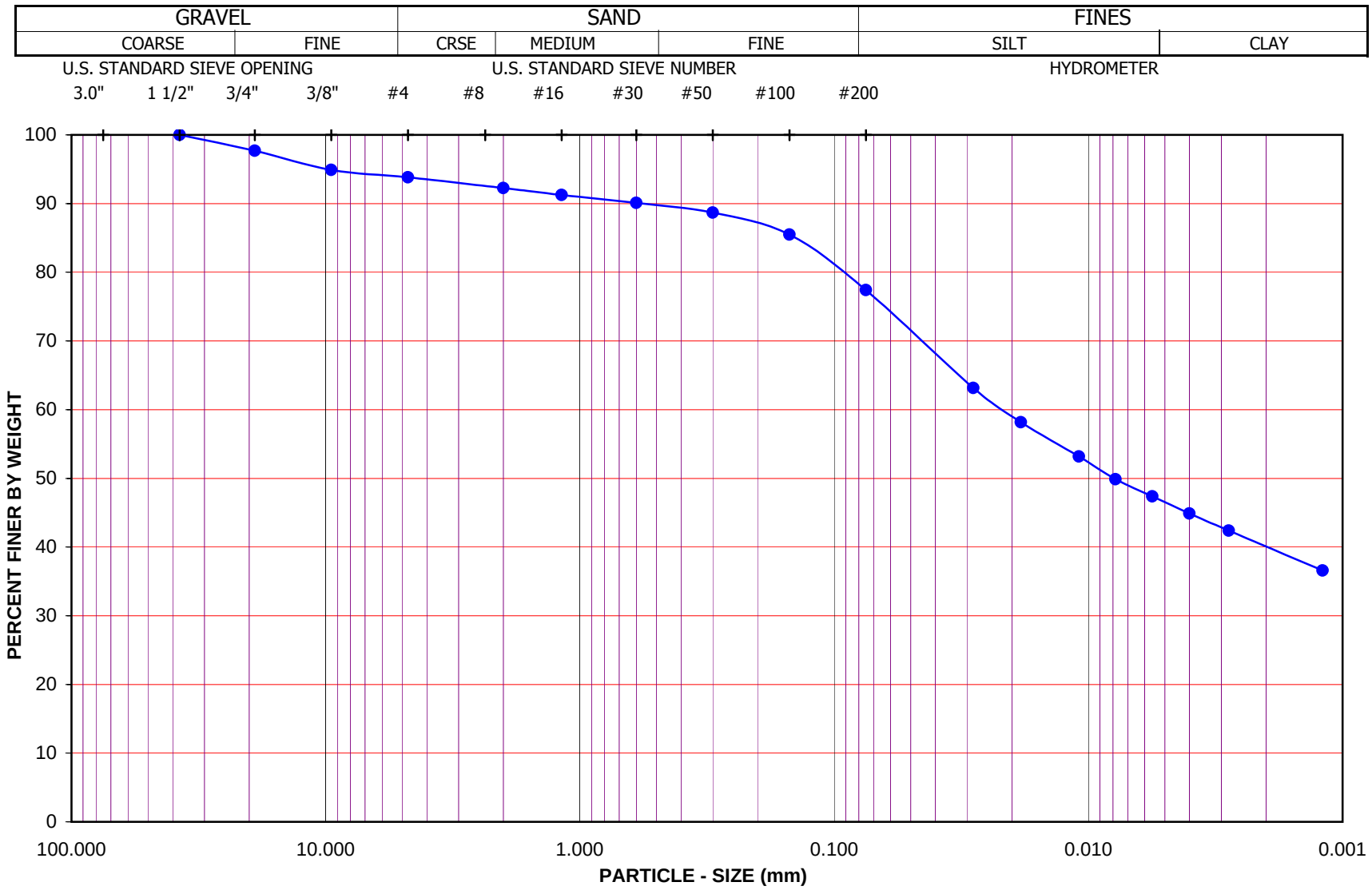
Sieve after Hydrometer & Wet Sieve

U.S. Sieve Size	Cumulative Wt. Of Dry Soil Retained (g)	% Passing	% Total Sample
No. 10	0.00	100.0	92.3
No. 16	0.59	98.9	91.3
No. 30	1.29	97.7	90.1
No. 50	2.14	96.1	88.7
No. 100	4.03	92.7	85.5
No. 200	8.85	83.9	77.4
Pan			

Hydrometer Wt. of Air-Dry Soil (g) 55.05 Wt. of Dry Soil (g) 55.05

Deflocculant 125 cc of 4% Solution

Date	Time	Elapsed Time (min)	Water Temperature (°C)	Composite Correction 152H	Actual Hydrometer Readings	% Total Sample (%)	Soil Particle Diameter (mm)
18-May-09	10:31	0		6.0			
	10:33	2	21.6	6.0	44.0	63.2	0.0283
	10:36	5	21.6	6.0	41.0	58.2	0.0184
	10:46	15	21.4	6.0	38.0	53.2	0.0109
	11:01	30	21.6	6.0	36.0	49.9	0.0078
	11:31	60	21.7	6.0	34.5	47.4	0.0056
	12:31	120	21.5	6.0	33.0	44.9	0.0040
	14:41	250	21.7	6.0	31.5	42.4	0.0028
19-May-09	10:31	1440	21.3	6.0	28.0	36.6	0.0012



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z2-B4 Sample No.: S9

Depth (feet) : 40.0 Soil Type : (CH)s

Soil Identification: Olive fat clay with sand (CH)s

GR:SA:FI : (%) 6 : 17 : 77

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PARTICLE - SIZE DISTRIBUTION ASTM D 422

May-09

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PARTICLE-SIZE ANALYSIS of SOILS
ASTM D 422

Project Name: SR-710 Tunnel Technical Study
Project No.: 378312.04.09.01
Exploration No.: R-09-Z2-B5
Sample No.: S6
Soil Identification: Olive brown sandy silt s(ML)

Tested By: A. Santos Date: 05/20/09
Checked By: J. Ward Date: 05/27/09
Depth (feet): 30.0

		Moisture Content of Total Air - Dry Soil	
Container No.:	780	Wt. of Air-Dry Soil + Cont. (g)	0.00
Wt. of Air-Dried Soil + Cont.(g)	511.50	Wt. of Dry Soil + Cont. (g)	0.00
Wt. of Container (g)	76.10	Wt. of Container No._____ (g)	1.00
Dry Wt. of Soil (g)	435.40	Moisture Content (%)	0.00

After Wet Sieve	Container No.	780
	Wt. of Dry Soil + Container (g)	278.50
	Wt. of Container (g)	76.10
	Dry Wt. of Soil Retained on # 200 Sieve (g)	202.40

U. S. Sieve Size (in.)	U. S. Sieve Size (mm.)	Cumulative Weight Dry Soil Retained (g)	Percent Passing (%)
6"	152.400		
3"	75.000		
1 1/2	37.500		
3/4"	19.000		
3/8"	9.500		
#4	4.750	0.00	100.0
#8	2.360	0.90	99.8
#16	1.180	2.80	99.4
#30	0.600	18.30	95.8
#50	0.300	63.40	85.4
#100	0.150	131.70	69.8
#200	0.075	191.60	56.0
PAN			

GRAVEL: **0 %**
SAND: **44 %**
FINES: **56 %**
GROUP SYMBOL: **s(ML)**

Cu = D60/D10 = _____
Cc = $(D30)^2/(D60*D10)$ = _____

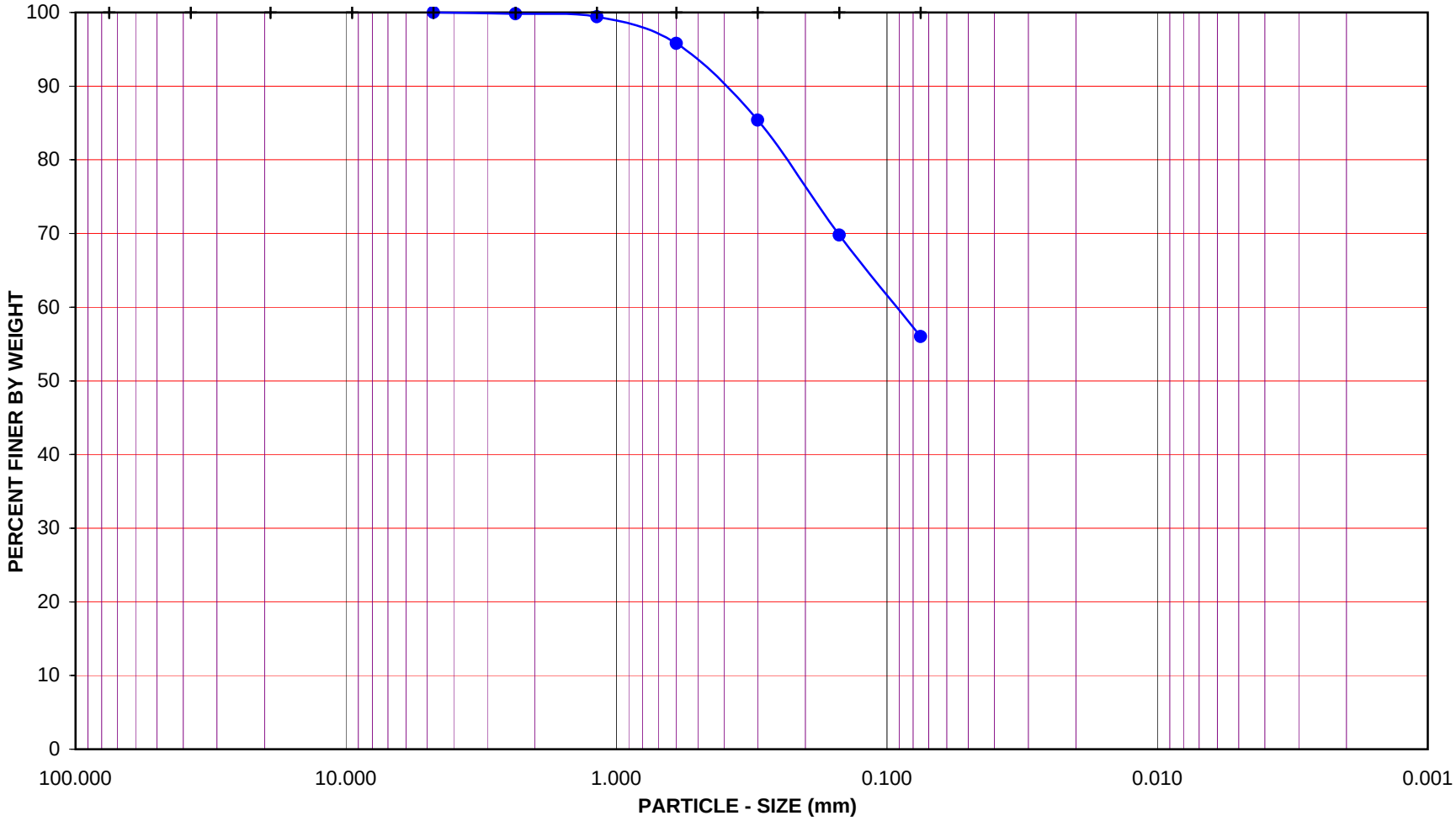
Remarks:

GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY

U.S. STANDARD SIEVE OPENING: 3.0" 1 1/2" 3/4" 3/8"

U.S. STANDARD SIEVE NUMBER: #4 #8 #16 #30 #50 #100 #200

HYDROMETER



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z2-B5 Sample No.: S6

Depth (feet): 30.0 Soil Type : s(ML)

Soil Identification: Olive brown sandy silt s(ML)

GR:SA:FI : (%) 0 : 44 : 56

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PARTICLE - SIZE DISTRIBUTION ASTM D 422

May-09

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PARTICLE-SIZE ANALYSIS of SOILS
ASTM D 422

Project Name: SR-710 Tunnel Technical Study
Project No.: 378312.04.09.01
Exploration No.: R-09-Z2-B5
Sample No.: S10
Soil Identification: Olive brown silty sand (SM)

Tested By: A. Santos Date: 05/20/09
Checked By: J. Ward Date: 05/27/09
Depth (feet): 50.0

		Moisture Content of Total Air - Dry Soil	
Container No.:	912	Wt. of Air-Dry Soil + Cont. (g)	0.00
Wt. of Air-Dried Soil + Cont.(g)	653.80	Wt. of Dry Soil + Cont. (g)	0.00
Wt. of Container (g)	106.90	Wt. of Container No._____ (g)	1.00
Dry Wt. of Soil (g)	546.90	Moisture Content (%)	0.00

After Wet Sieve	Container No.	912
	Wt. of Dry Soil + Container (g)	477.70
	Wt. of Container (g)	106.90
	Dry Wt. of Soil Retained on # 200 Sieve (g)	370.80

U. S. Sieve Size (in.)	U. S. Sieve Size (mm.)	Cumulative Weight Dry Soil Retained (g)	Percent Passing (%)
6"	152.400		
3"	75.000		
1 1/2	37.500		
3/4"	19.000	0.00	100.0
3/8"	9.500	9.10	98.3
#4	4.750	14.30	97.4
#8	2.360	18.10	96.7
#16	1.180	24.50	95.5
#30	0.600	39.90	92.7
#50	0.300	107.30	80.4
#100	0.150	266.80	51.2
#200	0.075	362.80	33.7
PAN			

GRAVEL: **3 %**
SAND: **63 %**
FINES: **34 %**
GROUP SYMBOL: **SM**

Cu = D60/D10 = _____
Cc = $(D30)^2/(D60*D10)$ = _____

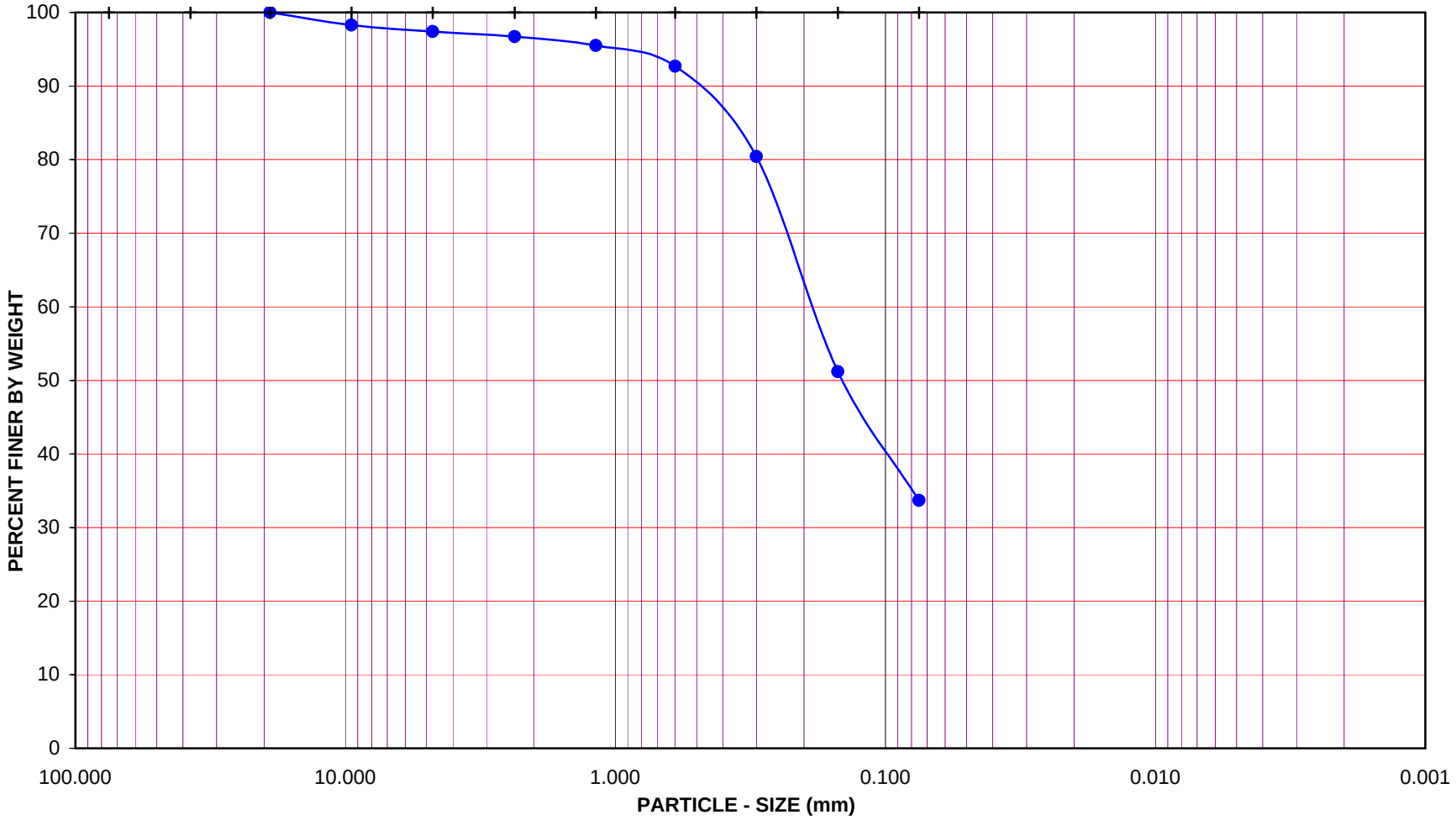
Remarks:

GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY

U.S. STANDARD SIEVE OPENING: 3.0" 1 1/2" 3/4" 3/8"

U.S. STANDARD SIEVE NUMBER: #4 #8 #16 #30 #50 #100 #200

HYDROMETER



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z2-B5 Sample No.: S10

Depth (feet): 50.0 Soil Type : SM

Soil Identification: Olive brown silty sand (SM)

GR:SA:FI : (%) 3 : 63 : 34

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PARTICLE - SIZE DISTRIBUTION ASTM D 422

May-09

SA R-09-Z2-B5, S10 @ 50

Leighton

PARTICLE-SIZE ANALYSIS OF SOILS

ASTM D 422

Project Name: SR-710 Tunnel Technical Study | Tested By : V. Juliano | Date: 05/28/09

Project No. : 378312.04.09.01 | Data Input By: J. Ward | Date: 06/06/09

Exploration No.: R-09-Z2-B5

Sample No.: C28 | Depth (feet) : 148-148.6

Soil Identification: Yellowish brown fat clay (CH)

% Gravel	**0**	**Soil Type**	
% Sand	**4**	**CH**	
% Fines	**96**		

			Moisture Content of Total Air-Dry Soil	Moisture Content of Air-Dry Soil Passing #10	After Hydrometer & Wet Sieve ret. in #200 Sieve
Specific Gravity (Assumed)	2.70	Wt.of Air-Dry Soil + Cont.(g)	0.00	0.00	
Correction for Specific Gravity	0.99	Dry Wt. of Soil + Cont. (g)	0.00	0.00	78.55
Wt.of Air-Dry Soil + Cont. (g)	552.00	Wt. of Container No.___ (g)	1.00	1.00	76.29
Wt. of Container	109.00	Moisture Content (%)	0.00	0.00	
Dry Wt. of Soil (g)	443.00	Wt. of Dry Soil (g)			2.26

Coarse Sieve

U.S. Sieve	Cumulative Wt. Of Dry Soil Retained (g)	% Passing
3"	0.00	100.0
1½"	0.00	100.0
3/4"	0.00	100.0
3/8"	0.00	100.0
No. 4	0.00	100.0
No. 10	0.00	100.0
Pan		

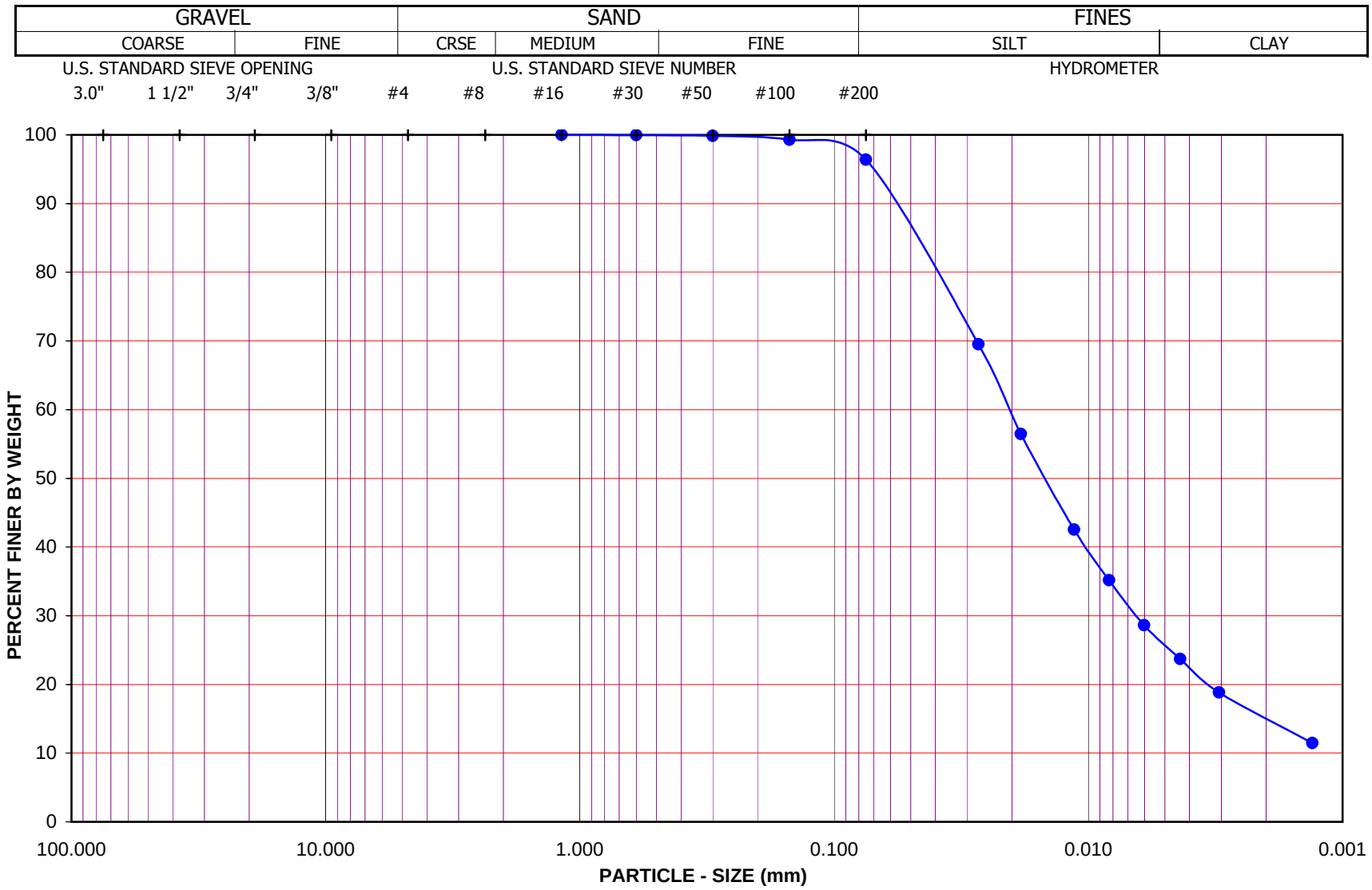
Sieve after Hydrometer & Wet Sieve

U.S. Sieve Size	Cumulative Wt. Of Dry Soil Retained (g)	% Passing	% Total Sample
No. 10	0.00	100.0	100.0
No. 16	0.00	100.0	100.0
No. 30	0.03	100.0	100.0
No. 50	0.09	99.9	99.9
No. 100	0.44	99.3	99.3
No. 200	2.18	96.4	96.4
Pan			

Hydrometer Wt. of Air-Dry Soil (g) 60.63 Wt. of Dry Soil (g) 60.63

Deflocculant 125 cc of 4% Solution

Date	Time	Elapsed Time (min)	Water Temperature (°C)	Composite Correction 152H	Actual Hydrometer Readings	% Total Sample (%)	Soil Particle Diameter (mm)
02-Jun-09	9:00	0		6.5			
	9:02	2	21.6	6.5	49.0	69.5	0.0271
	9:05	5	21.6	6.5	41.0	56.4	0.0184
	9:15	15	21.7	6.5	32.5	42.5	0.0114
	9:30	30	21.4	6.5	28.0	35.2	0.0083
	10:00	60	21.5	6.5	24.0	28.6	0.0060
	11:00	120	21.6	6.5	21.0	23.7	0.0044
	13:10	250	21.8	6.5	18.0	18.8	0.0031
03-Jun-09	9:00	1440	21.5	6.5	13.5	11.5	0.0013



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z2-B5 Sample No.: C28

Depth (feet) : 148-148.6 Soil Type : CH

Soil Identification: Yellowish brown fat clay (CH)

GR:SA:FI : (%) 0 : 4 : 96

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PARTICLE - SIZE DISTRIBUTION ASTM D 422

Jun-09

SA & Hyd R-09-Z2-B5, C28 @ 148-148.6

Leighton

PARTICLE-SIZE ANALYSIS OF SOILS

ASTM D 422

Project Name: SR-710 Tunnel Technical Study | Tested By : V. Juliano | Date: 05/28/09

Project No. : 378312.04.09.01 | Data Input By: J. Ward | Date: 06/06/09

Exploration No.: R-09-Z2-B5

Sample No.: C36 | Depth (feet) : 176.6-177.2

Soil Identification: Very dark olive silt'stone' (ML)

% Gravel	**0**	**Soil Type**
% Sand	**3**	**ML**
% Fines	**97**	

			Moisture Content of Total Air-Dry Soil	Moisture Content of Air-Dry Soil Passing #10	After Hydrometer & Wet Sieve ret. in #200 Sieve
Specific Gravity (Assumed)	2.70	Wt.of Air-Dry Soil + Cont.(g)	0.00	0.00	
Correction for Specific Gravity	0.99	Dry Wt. of Soil + Cont. (g)	0.00	0.00	78.08
Wt.of Air-Dry Soil + Cont. (g)	772.90	Wt. of Container No.___ (g)	1.00	1.00	76.20
Wt. of Container	110.10	Moisture Content (%)	0.00	0.00	
Dry Wt. of Soil (g)	662.80	Wt. of Dry Soil (g)			1.88

Coarse Sieve

U.S. Sieve	Cumulative Wt. Of Dry Soil Retained (g)	% Passing
3"	0.00	100.0
1½"	0.00	100.0
3/4"	0.00	100.0
3/8"	0.00	100.0
No. 4	0.00	100.0
No. 10	0.00	100.0
Pan		

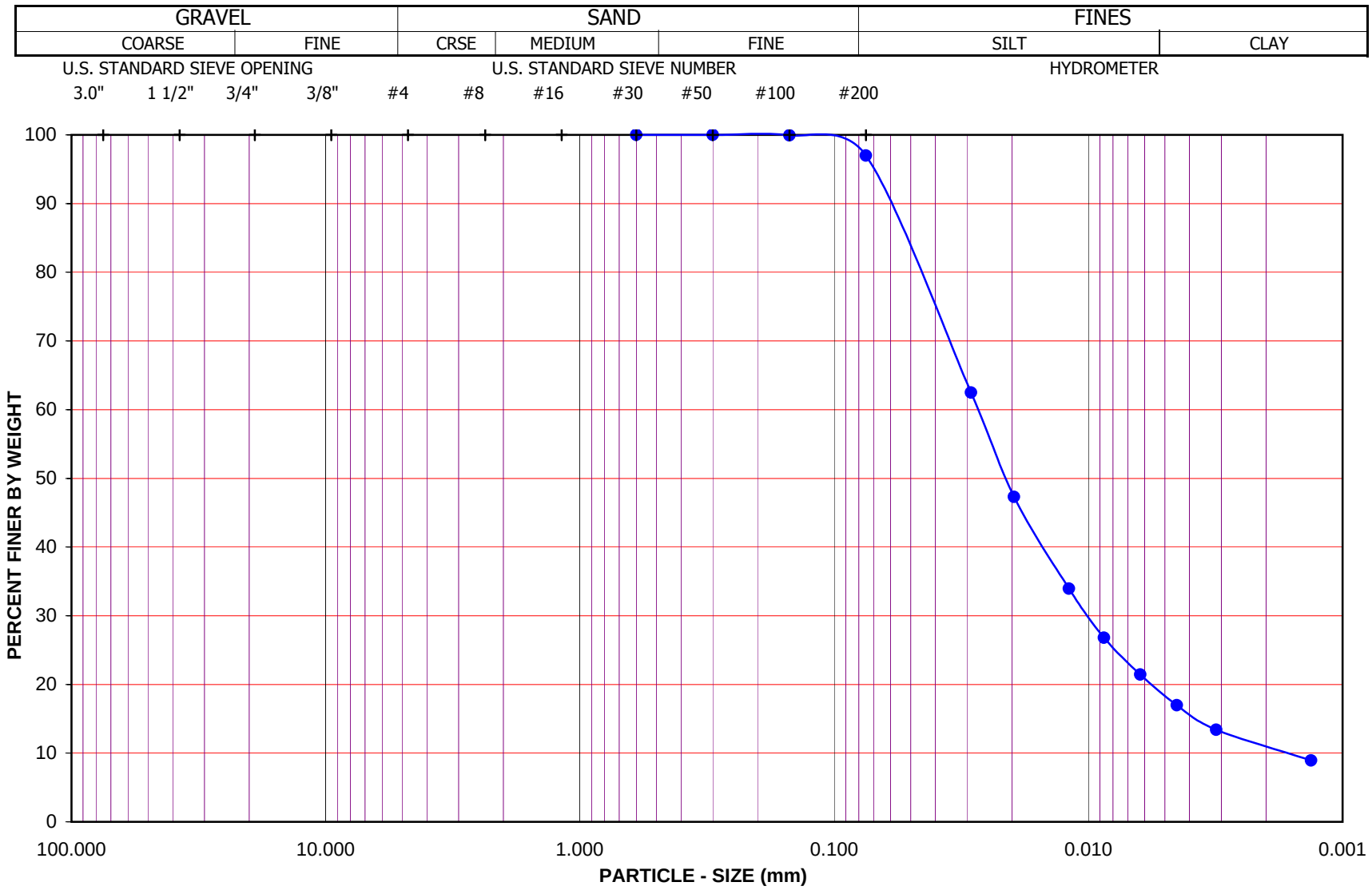
Sieve after Hydrometer & Wet Sieve

U.S. Sieve Size	Cumulative Wt. Of Dry Soil Retained (g)	% Passing	% Total Sample
No. 10	0.00	100.0	100.0
No. 16	0.00	100.0	100.0
No. 30	0.00	100.0	100.0
No. 50	0.01	100.0	100.0
No. 100	0.05	99.9	99.9
No. 200	1.68	97.0	97.0
Pan			

Hydrometer Wt. of Air-Dry Soil (g) 55.56 Wt. of Dry Soil (g) 55.56

Deflocculant 125 cc of 4% Solution

Date	Time	Elapsed Time (min)	Water Temperature (°C)	Composite Correction 152H	Actual Hydrometer Readings	% Total Sample (%)	Soil Particle Diameter (mm)
02-Jun-09	9:12	0		6.5			
	9:14	2	21.7	6.5	41.5	62.5	0.0289
	9:17	5	21.6	6.5	33.0	47.3	0.0196
	9:27	15	21.4	6.5	25.5	33.9	0.0119
	9:42	30	21.6	6.5	21.5	26.8	0.0087
	10:12	60	21.6	6.5	18.5	21.4	0.0062
	11:12	120	21.5	6.5	16.0	17.0	0.0045
	13:22	250	21.8	6.5	14.0	13.4	0.0031
03-Jun-09	9:12	1440	21.5	6.5	11.5	8.9	0.0013



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z2-B5 Sample No.: C36

Depth (feet) : 176.6-177.2 Soil Type : ML

Soil Identification: Very dark olive silt'stone' (ML)

GR:SA:FI : (%) 0 : 3 : 97

Leighton

PARTICLE - SIZE DISTRIBUTION ASTM D 422

Jun-09

Leighton

PARTICLE-SIZE ANALYSIS OF SOILS

ASTM D 422

Project Name: SR-710 Tunnel Technical Study | Tested By : V. Juliano | Date: 05/22/09

Project No. : 378312.04.09.01 | Data Input By: J. Ward | Date: 05/27/09

Exploration No.: R-09-Z2-B5

Sample No.: S21 | Depth (feet) : 105.0

Soil Identification: Olive brown lean clay (CL)

% Gravel	**0**	**Soil Type**
% Sand	**5**	**CL**
% Fines	**95**	

			Moisture Content of Total Air-Dry Soil	Moisture Content of Air-Dry Soil Passing #10	After Hydrometer & Wet Sieve ret. in #200 Sieve
Specific Gravity (Assumed)	2.70	Wt.of Air-Dry Soil + Cont.(g)	0.00	0.00	
Correction for Specific Gravity	0.99	Dry Wt. of Soil + Cont. (g)	0.00	0.00	78.31
Wt.of Air-Dry Soil + Cont. (g)	358.10	Wt. of Container No.___ (g)	1.00	1.00	75.47
Wt. of Container	75.18	Moisture Content (%)	0.00	0.00	
Dry Wt. of Soil (g)	282.92	Wt. of Dry Soil (g)			2.84

Coarse Sieve

U.S. Sieve	Cumulative Wt. Of Dry Soil Retained (g)	% Passing
3"	0.00	100.0
1½"	0.00	100.0
3/4"	0.00	100.0
3/8"	0.00	100.0
No. 4	0.00	100.0
No. 10	0.00	100.0
Pan		

Sieve after Hydrometer & Wet Sieve

U.S. Sieve Size	Cumulative Wt. Of Dry Soil Retained (g)	% Passing	% Total Sample
No. 10	0.00	100.0	100.0
No. 16	0.06	99.9	99.9
No. 30	0.14	99.7	99.7
No. 50	0.24	99.6	99.6
No. 100	0.59	98.9	98.9
No. 200	2.79	95.0	95.0
Pan			

Hydrometer Wt. of Air-Dry Soil (g) 55.43 Wt. of Dry Soil (g) 55.43

Deflocculant 125 cc of 4% Solution

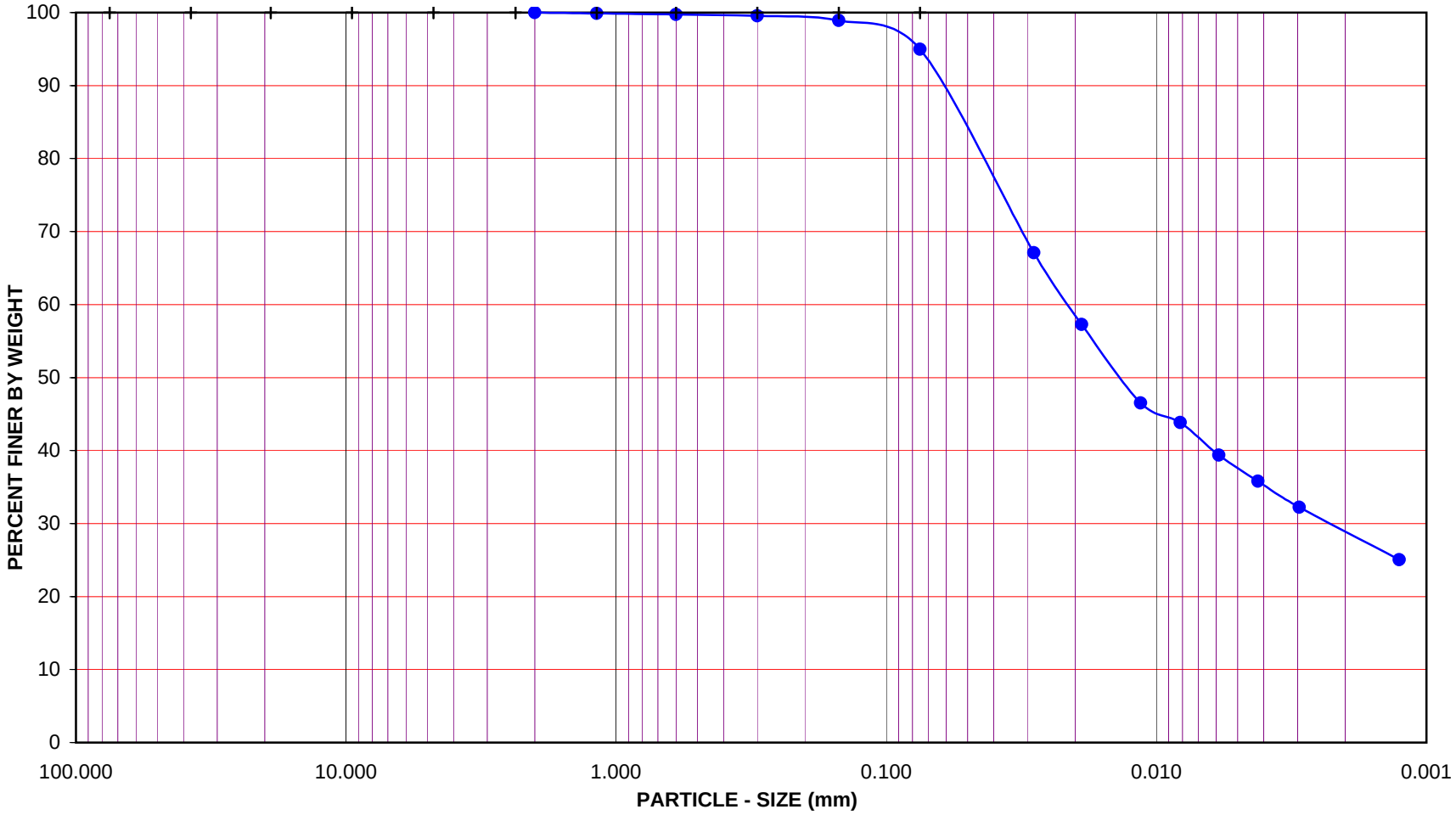
Date	Time	Elapsed Time (min)	Water Temperature (°C)	Composite Correction 152H	Actual Hydrometer Readings	% Total Sample (%)	Soil Particle Diameter (mm)
26-May-09	8:00	0		6.0			
	8:02	2	21.6	6.0	43.5	67.1	0.0284
	8:05	5	21.6	6.0	38.0	57.3	0.0189
	8:15	15	21.3	6.0	32.0	46.5	0.0114
	8:30	30	21.4	6.0	30.5	43.8	0.0082
	9:00	60	21.5	6.0	28.0	39.4	0.0059
	10:00	120	21.0	6.0	26.0	35.8	0.0042
	12:10	250	21.2	6.0	24.0	32.2	0.0030
27-May-09	8:00	1440	21.4	6.0	20.0	25.1	0.0013

GRAVEL		SAND			FINES	
COARSE	FINE	CRSE	MEDIUM	FINE	SILT	CLAY

U.S. STANDARD SIEVE OPENING: 3.0" 1 1/2" 3/4" 3/8"

U.S. STANDARD SIEVE NUMBER: #4 #8 #16 #30 #50 #100 #200

HYDROMETER



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z2-B5 Sample No.: S21

Depth (feet) : 105.0 Soil Type : CL

Soil Identification: Olive brown lean clay (CL)

GR:SA:FI : (%) 0 : 5 : 95

Leighton

PARTICLE - SIZE DISTRIBUTION ASTM D 422

May-09

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PARTICLE-SIZE ANALYSIS of SOILS
ASTM D 422

Project Name: SR-710 Tunnel Technical Study
Project No.: 378312.04.09.01
Exploration No.: R-09-Z3-B1
Sample No.: S1
Soil Identification: Olive brown silty sand (SM)

Tested By: V. Juliano Date: 04/28/09
Checked By: J. Ward Date: 05/07/09
Depth (feet): 10.0

		Moisture Content of Total Air - Dry Soil	
Container No.:	786	Wt. of Air-Dry Soil + Cont. (g)	0.00
Wt. of Air-Dried Soil + Cont.(g)	659.00	Wt. of Dry Soil + Cont. (g)	0.00
Wt. of Container (g)	76.20	Wt. of Container No._____ (g)	1.00
Dry Wt. of Soil (g)	582.80	Moisture Content (%)	0.00

After Wet Sieve	Container No.	786
	Wt. of Dry Soil + Container (g)	482.70
	Wt. of Container (g)	76.20
	Dry Wt. of Soil Retained on # 200 Sieve (g)	406.50

U. S. Sieve Size (in.)	U. S. Sieve Size (mm.)	Cumulative Weight Dry Soil Retained (g)	Percent Passing (%)
6"	152.400		
3"	75.000		
1 1/2	37.500		
3/4"	19.000		
3/8"	9.500	0.00	100.0
#4	4.750	6.20	98.9
#8	2.360	29.80	94.9
#16	1.180	81.90	85.9
#30	0.600	150.10	74.2
#50	0.300	238.50	59.1
#100	0.150	334.70	42.6
#200	0.075	403.10	30.8
PAN			

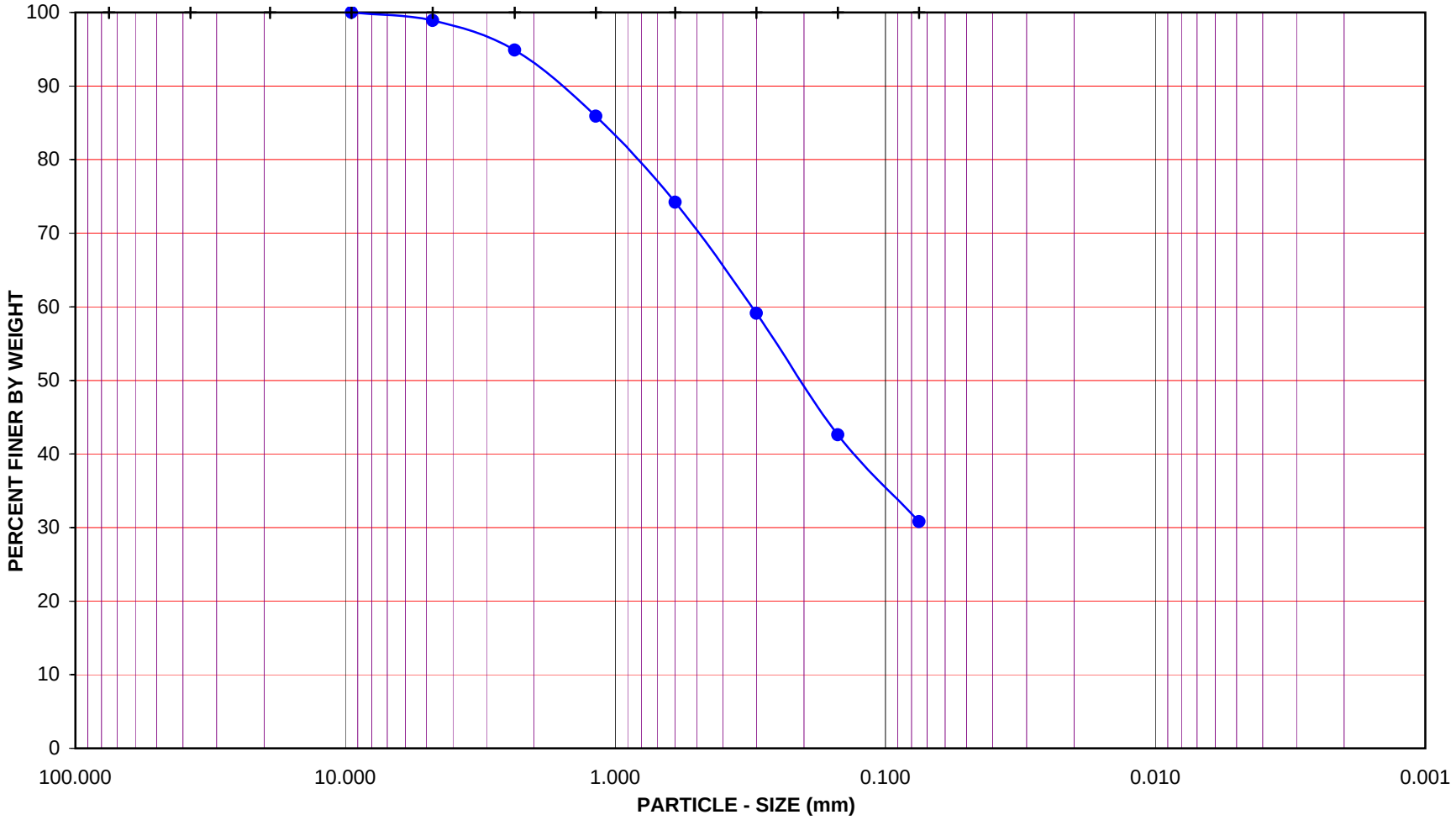
GRAVEL: **1 %**
SAND: **68 %**
FINES: **31 %**
GROUP SYMBOL: **SM**

Cu = D60/D10 = _____
Cc = $(D30)^2/(D60*D10)$ = _____

Remarks:

GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY

U.S. STANDARD SIEVE OPENING: 3.0" | 1 1/2" | 3/4" | 3/8"
U.S. STANDARD SIEVE NUMBER: #4 | #8 | #16 | #30 | #50 | #100 | #200
HYDROMETER



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z3-B1 Sample No.: S1

Depth (feet): 10.0 Soil Type : SM

Soil Identification: Olive brown silty sand (SM)

GR:SA:FI : (%) 1 : 68 : 31

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PARTICLE - SIZE DISTRIBUTION ASTM D 422

May-09

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PARTICLE-SIZE ANALYSIS of SOILS
ASTM D 422

Project Name: SR-710 Tunnel Technical Study
Project No.: 378312.04.09.01
Exploration No.: R-09-Z3-B1
Sample No.: S3
Soil Identification: Brown silty sand (SM)

Tested By: V. Juliano Date: 04/28/09
Checked By: J. Ward Date: 05/07/09
Depth (feet): 20.0

Calculation of Dry Weights	Whole Sample	Sample Passing #10	Moisture Contents	Whole Sample	Sample passing #4
Container No.:	969	784	Wt. of Air-Dry Soil + Cont.(g)	0.00	0.00
Wt. Air-Dried Soil + Cont.(g)	830.70	388.00	Wt. of Dry Soil + Cont. (g)	0.00	0.00
Wt. of Container (g)	110.50	77.00	Wt. of Container No._____(g)	1.00	1.00
Dry Wt. of Soil (g)	720.20	311.00	Moisture Content (%)	0.00	0.00

Passing #10 Material After Wet Sieve		
	Container No.	784
	Wt. of Dry Soil + Container (g)	246.90
	Wt. of Container (g)	77.00
	Dry Wt. of Soil Retained on # 200 Sieve (g)	169.90

U. S. Sieve Size		Cumulative Weight of Dry Soil Retained (g)		Percent Passing (%)
	(mm.)	Whole Sample	Sample Passing #4	
6"	152.400			
3"	75.000			
1 1/2	37.500			
3/4"	19.000			
3/8"	9.500	0.00		100.0
#4	4.750	4.00		99.4
#10	2.000	61.10		91.5
#16	1.180		25.10	84.1
#30	0.600		57.60	74.6
#50	0.300		91.20	64.7
#100	0.150		126.80	54.2
#200	0.075		166.50	42.5
PAN				

GRAVEL: **1 %**
SAND: **56 %**
FINES: **43 %**
GROUP SYMBOL **SM**

Cu = D60/D10 = _____
Cc = $(D30)^2/(D60*D10)$ = _____

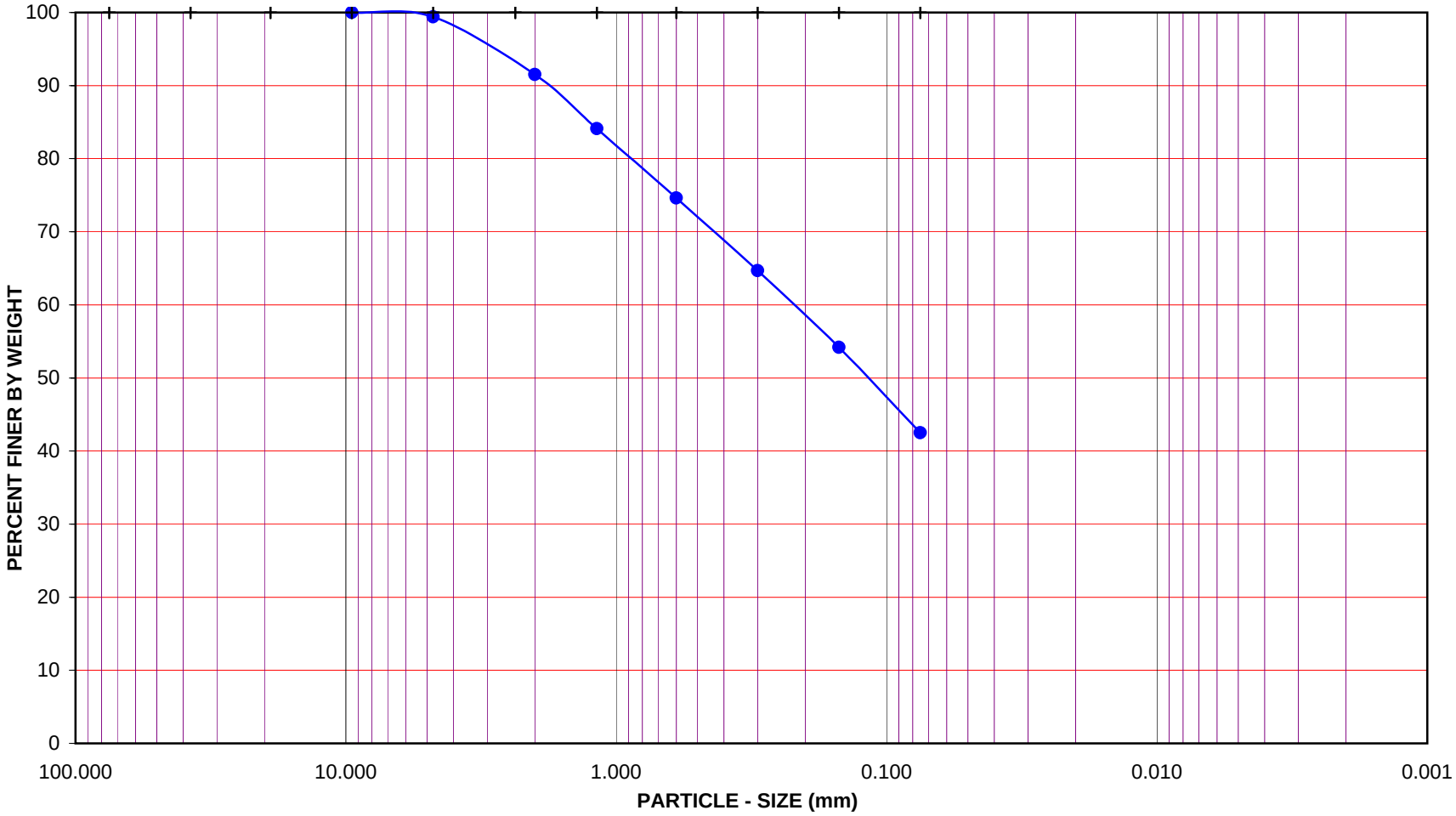
Remarks: _____

GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY

U.S. STANDARD SIEVE OPENING: 3.0" 1 1/2" 3/4" 3/8"

U.S. STANDARD SIEVE NUMBER: #4 #8 #16 #30 #50 #100 #200

HYDROMETER



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z3-B1 Sample No.: S3

Depth (feet): 20.0 Soil Type : SM

Soil Identification: Brown silty sand (SM)

GR:SA:FI : (%) 1 : 56 : 43

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PARTICLE - SIZE DISTRIBUTION ASTM D 422

May-09

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PARTICLE-SIZE ANALYSIS OF SOILS

ASTM D 422

Project Name: SR-710 Tunnel Technical Study | Tested By : V. Juliano | Date: 04/28/09

Project No. : 378312.04.09.01 | Data Input By: J. Ward | Date: 05/07/09

Exploration No.: R-09-Z3-B1

Sample No.: C48 | Depth (feet) : 216.8

Soil Identification: Light gray poorly-graded sand with silt and gravel (SP-SM)g

				Moisture Content of Total Air-Dry Soil	Moisture Content of Air-Dry Soil Passing #10	After Hydrometer & Wet Sieve ret. in #200 Sieve
% Gravel	**35**	**Soil Type**				
% Sand	**55**	**(SP-SM)g**				
% Fines	**10**					
Specific Gravity (Assumed)	2.70	Wt.of Air-Dry Soil + Cont.(g)		0.00	0.00	
Correction for Specific Gravity	0.99	Dry Wt. of Soil + Cont. (g)		0.00	0.00	152.39
Wt.of Air-Dry Soil + Cont. (g)	1055.80	Wt. of Container No.___ (g)		1.00	1.00	77.34
Wt. of Container	110.40	Moisture Content (%)		0.00	0.00	
Dry Wt. of Soil (g)	945.40	Wt. of Dry Soil (g)				75.05

Coarse Sieve

U.S. Sieve	Cumulative Wt. Of Dry Soil Retained (g)	% Passing
3"	0.00	100.0
1½"	0.00	100.0
3/4"	27.30	97.1
3/8"	219.90	76.7
No. 4	333.20	64.8
No. 10	485.00	48.7
Pan		

Sieve after Hydrometer & Wet Sieve

U.S. Sieve Size	Cumulative Wt. Of Dry Soil Retained (g)	% Passing	% Total Sample
No. 10	0.00	100.0	48.7
No. 16	10.32	89.1	43.4
No. 30	28.79	69.7	33.9
No. 50	46.37	51.2	24.9
No. 100	62.94	33.7	16.4
No. 200	74.83	21.2	10.3
Pan			

Hydrometer Wt. of Air-Dry Soil (g) 94.93 Wt. of Dry Soil (g) 94.93

Deflocculant 125 cc of 4% Solution

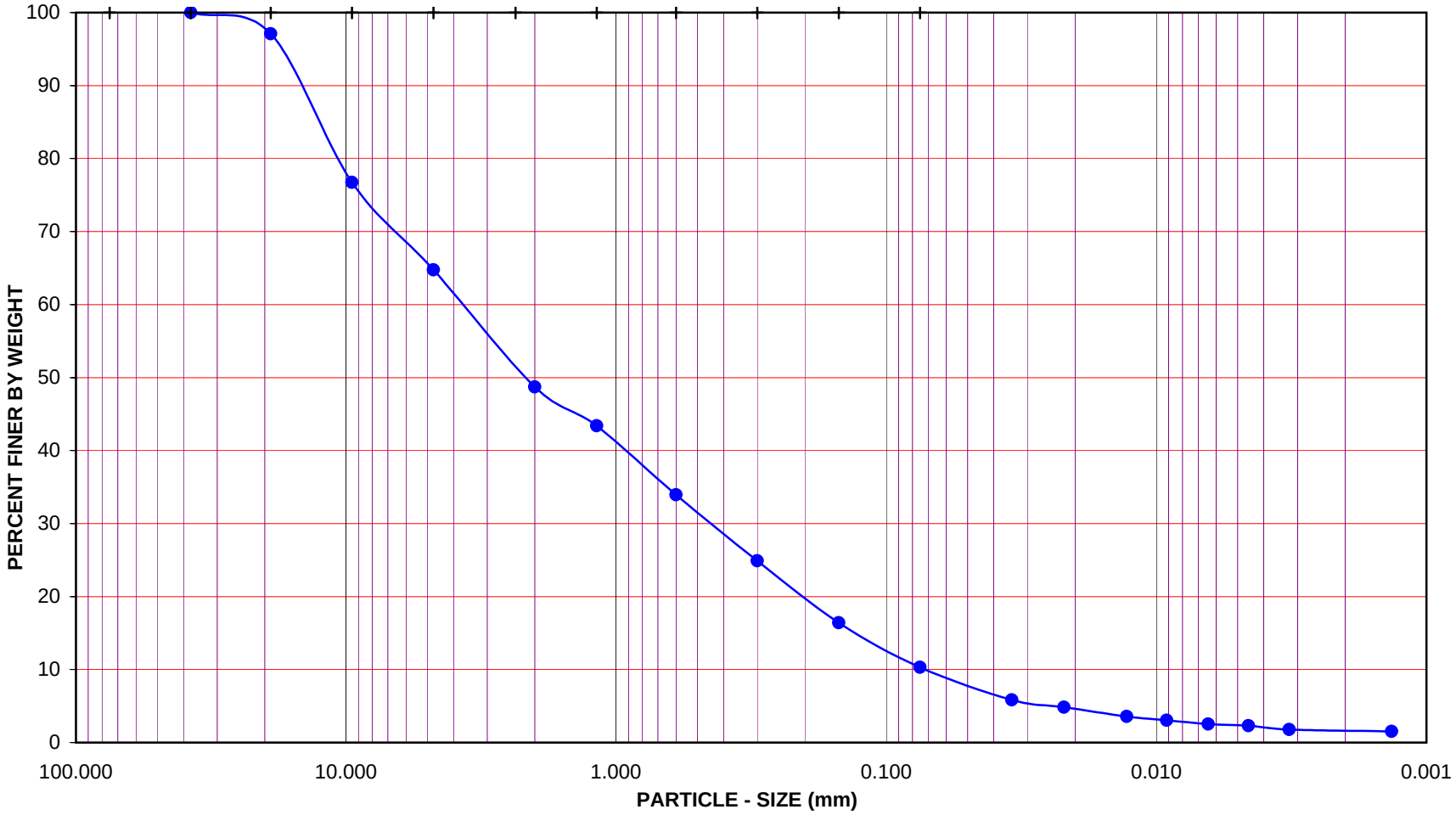
Date	Time	Elapsed Time (min)	Water Temperature (°C)	Composite Correction 152H	Actual Hydrometer Readings	% Total Sample (%)	Soil Particle Diameter (mm)
30-Apr-09	9:00	0		6.5			
	9:02	2	21.7	6.5	18.0	5.9	0.0342
	9:05	5	21.7	6.5	16.0	4.8	0.0220
	9:15	15	21.8	6.5	13.5	3.6	0.0129
	9:30	30	21.9	6.5	12.5	3.1	0.0092
	10:00	60	22.1	6.5	11.5	2.5	0.0064
	11:00	120	22.0	6.5	11.0	2.3	0.0046
	13:10	250	21.7	6.5	10.0	1.8	0.0032
01-May-09	9:00	1440	21.9	6.5	9.5	1.5	0.0013

GRAVEL		SAND			FINES	
COARSE	FINE	CRSE	MEDIUM	FINE	SILT	CLAY

U.S. STANDARD SIEVE OPENING: 3.0" 1 1/2" 3/4" 3/8"

U.S. STANDARD SIEVE NUMBER: #4 #8 #16 #30 #50 #100 #200

HYDROMETER



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z3-B1 Sample No.: C48

Depth (feet) : 216.8 Soil Type : (SP-SM)g

Soil Identification: Light gray poorly-graded sand with silt and gravel (SP-SM)g

GR:SA:FI : (%) 35 : 55 : 10

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PARTICLE - SIZE DISTRIBUTION ASTM D 422

May-09

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PARTICLE-SIZE ANALYSIS OF SOILS

ASTM D 422

Project Name: SR-710 Tunnel Technical Study | Tested By : V. Juliano | Date: 04/28/09

Project No. : 378312.04.09.01 | Data Input By: J. Ward | Date: 05/07/09

Exploration No.: R-09-Z3-B1

Sample No.: C60 | Depth (feet) : 277.6

Soil Identification: Light gray poorly-graded sand with silt and gravel (SP-SM)g

				Moisture Content of Total Air-Dry Soil	Moisture Content of Air-Dry Soil Passing #10	After Hydrometer & Wet Sieve ret. in #200 Sieve
% Gravel	**38**	**Soil Type**				
% Sand	**51**	**(SP-SM)g**				
% Fines	**11**					
Specific Gravity (Assumed)	2.70	Wt.of Air-Dry Soil + Cont.(g)		0.00	0.00	
Correction for Specific Gravity	0.99	Dry Wt. of Soil + Cont. (g)		0.00	0.00	143.04
Wt.of Air-Dry Soil + Cont. (g)	748.10	Wt. of Container No.___ (g)		1.00	1.00	79.43
Wt. of Container	111.00	Moisture Content (%)		0.00	0.00	
Dry Wt. of Soil (g)	637.10	Wt. of Dry Soil (g)				63.61

Coarse Sieve

U.S. Sieve	Cumulative Wt. Of Dry Soil Retained (g)	% Passing
3"	0.00	100.0
1½"	0.00	100.0
3/4"	73.10	88.5
3/8"	163.30	74.4
No. 4	241.50	62.1
No. 10	317.50	50.2
Pan		

Sieve after Hydrometer & Wet Sieve

U.S. Sieve Size	Cumulative Wt. Of Dry Soil Retained (g)	% Passing	% Total Sample
No. 10	0.00	100.0	50.2
No. 16	7.40	90.8	45.5
No. 30	22.12	72.4	36.3
No. 50	37.50	53.2	26.7
No. 100	53.98	32.6	16.4
No. 200	63.31	21.0	10.5
Pan			

Hydrometer Wt. of Air-Dry Soil (g) 80.10 Wt. of Dry Soil (g) 80.10

Deflocculant 125 cc of 4% Solution

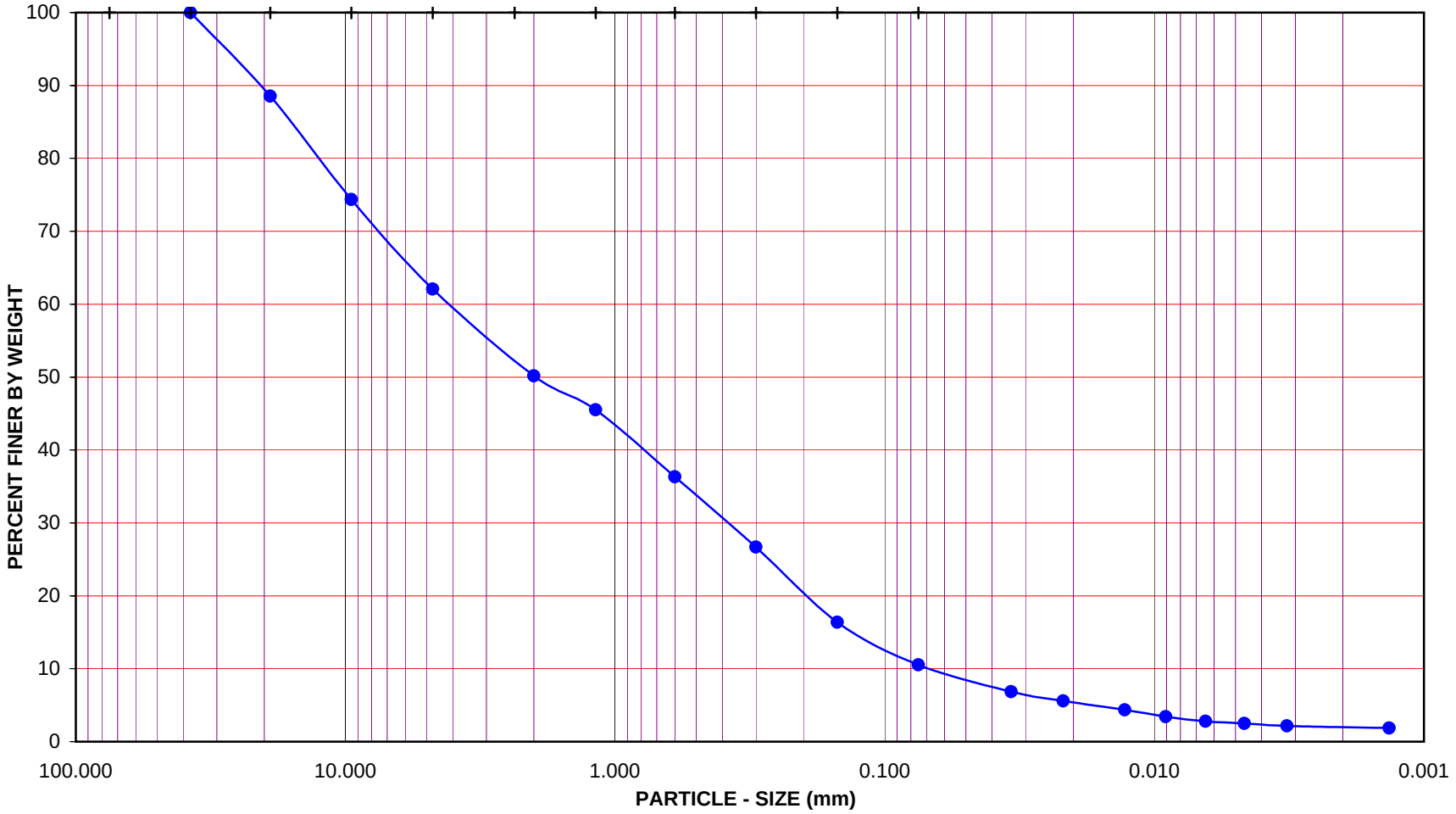
Date	Time	Elapsed Time (min)	Water Temperature (°C)	Composite Correction 152H	Actual Hydrometer Readings	% Total Sample (%)	Soil Particle Diameter (mm)
30-Apr-09	10:22	0		6.5			
	10:24	2	22.4	6.5	17.5	6.8	0.0340
	10:27	5	22.3	6.5	15.5	5.6	0.0218
	10:37	15	21.9	6.5	13.5	4.3	0.0129
	10:52	30	22.1	6.5	12.0	3.4	0.0091
	11:22	60	22.0	6.5	11.0	2.8	0.0065
	12:22	120	21.9	6.5	10.5	2.5	0.0046
	14:32	250	21.8	6.5	10.0	2.2	0.0032
01-May-09	10:22	1440	21.5	6.5	9.5	1.9	0.0013

GRAVEL		SAND			FINES	
COARSE	FINE	CRSE	MEDIUM	FINE	SILT	CLAY

U.S. STANDARD SIEVE OPENING: 3.0" 1 1/2" 3/4" 3/8"

U.S. STANDARD SIEVE NUMBER: #4 #8 #16 #30 #50 #100 #200

HYDROMETER



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z3-B1 Sample No.: C60

Depth (feet) : 277.6 Soil Type : (SP-SM)g

Soil Identification: Light gray poorly-graded sand with silt and gravel (SP-SM)g

GR:SA:FI : (%) 38 : 51 : 11

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PARTICLE - SIZE DISTRIBUTION ASTM D 422

May-09

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PARTICLE-SIZE ANALYSIS of SOILS
ASTM D 422

Project Name: SR-710 Tunnel Technical Study
Project No.: 378312.04.09.01
Exploration No.: R-09-Z3-B2
Sample No.: S5
Soil Identification: Yellowish brown well-graded sand with silt and gravel (SW-SM)g

Tested By: V. Juliano Date: 05/11/09
Checked By: J. Ward Date: 05/15/09
Depth (feet): 15-16.5

		Moisture Content of Total Air - Dry Soil	
Container No.:	538	Wt. of Air-Dry Soil + Cont. (g)	0.00
Wt. of Air-Dried Soil + Cont.(g)	852.30	Wt. of Dry Soil + Cont. (g)	0.00
Wt. of Container (g)	82.60	Wt. of Container No._____ (g)	1.00
Dry Wt. of Soil (g)	769.70	Moisture Content (%)	0.00

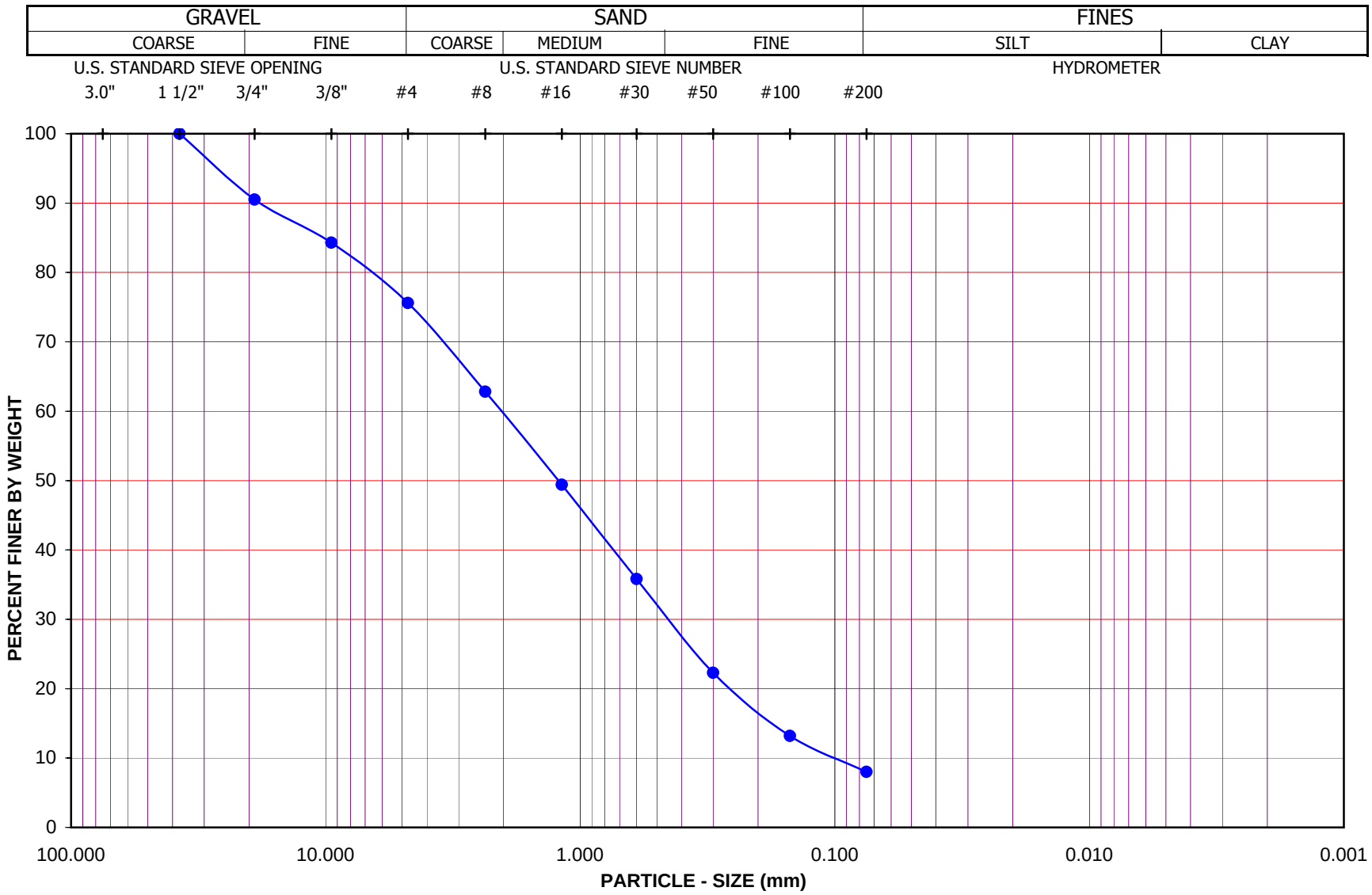
After Wet Sieve	Container No.	538
	Wt. of Dry Soil + Container (g)	795.80
	Wt. of Container (g)	82.60
	Dry Wt. of Soil Retained on # 200 Sieve (g)	713.20

U. S. Sieve Size (in.)	U. S. Sieve Size (mm.)	Cumulative Weight Dry Soil Retained (g)	Percent Passing (%)
6"	152.400		
3"	75.000		
1 1/2	37.500	0.00	100.0
3/4"	19.000	73.20	90.5
3/8"	9.500	120.70	84.3
#4	4.750	188.00	75.6
#8	2.360	286.50	62.8
#16	1.180	389.50	49.4
#30	0.600	494.00	35.8
#50	0.300	597.90	22.3
#100	0.150	667.90	13.2
#200	0.075	708.00	8.0
PAN			

GRAVEL: **24 %**
SAND: **68 %**
FINES: **8 %**
GROUP SYMBOL: **(SW-SM)g**

Cu = D60/D10 = 20.00
Cc = $(D30)^2/(D60*D10)$ = 0.97

Remarks: Insufficient sample mass available to meet the ASTM specification for this material



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z3-B2 Sample No.: S5

Depth (feet): 15-16.5 Soil Type : (SW-SM)g

Soil Identification: Yellowish brown well-graded sand with silt and gravel (SW-SM)g

GR:SA:FI : (%) 24 : 68 : 8

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PARTICLE - SIZE DISTRIBUTION ASTM D 422

May-09

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PARTICLE-SIZE ANALYSIS of SOILS
ASTM D 422

Project Name: SR-710 Tunnel Technical Study
Project No.: 378312.04.09.01
Exploration No.: R-09-Z3-B2
Sample No.: S9
Soil Identification: Olive well-graded sand with silt and gravel (SW-SM)g

Tested By: V. Juliano Date: 05/11/09
Checked By: J. Ward Date: 05/15/09
Depth (feet): 31.3-31.8

		Moisture Content of Total Air - Dry Soil	
Container No.:	952	Wt. of Air-Dry Soil + Cont. (g)	0.00
Wt. of Air-Dried Soil + Cont.(g)	1022.10	Wt. of Dry Soil + Cont. (g)	0.00
Wt. of Container (g)	107.90	Wt. of Container No._____ (g)	1.00
Dry Wt. of Soil (g)	914.20	Moisture Content (%)	0.00

After Wet Sieve	Container No.	952
	Wt. of Dry Soil + Container (g)	973.70
	Wt. of Container (g)	107.90
	Dry Wt. of Soil Retained on # 200 Sieve (g)	865.80

U. S. Sieve Size (in.)	U. S. Sieve Size (mm.)	Cumulative Weight Dry Soil Retained (g)	Percent Passing (%)
6"	152.400		
3"	75.000		
1 1/2	37.500	0.00	100.0
3/4"	19.000	183.80	79.9
3/8"	9.500	280.90	69.3
#4	4.750	366.10	60.0
#8	2.360	468.20	48.8
#16	1.180	585.30	36.0
#30	0.600	683.10	25.3
#50	0.300	759.40	16.9
#100	0.150	820.70	10.2
#200	0.075	861.20	5.8
PAN			

GRAVEL: **40 %**
SAND: **54 %**
FINES: **6 %**
GROUP SYMBOL: **(SW-SM)g**

Cu = D60/D10 = 33.93
Cc = $(D30)^2/(D60*D10)$ = 1.04

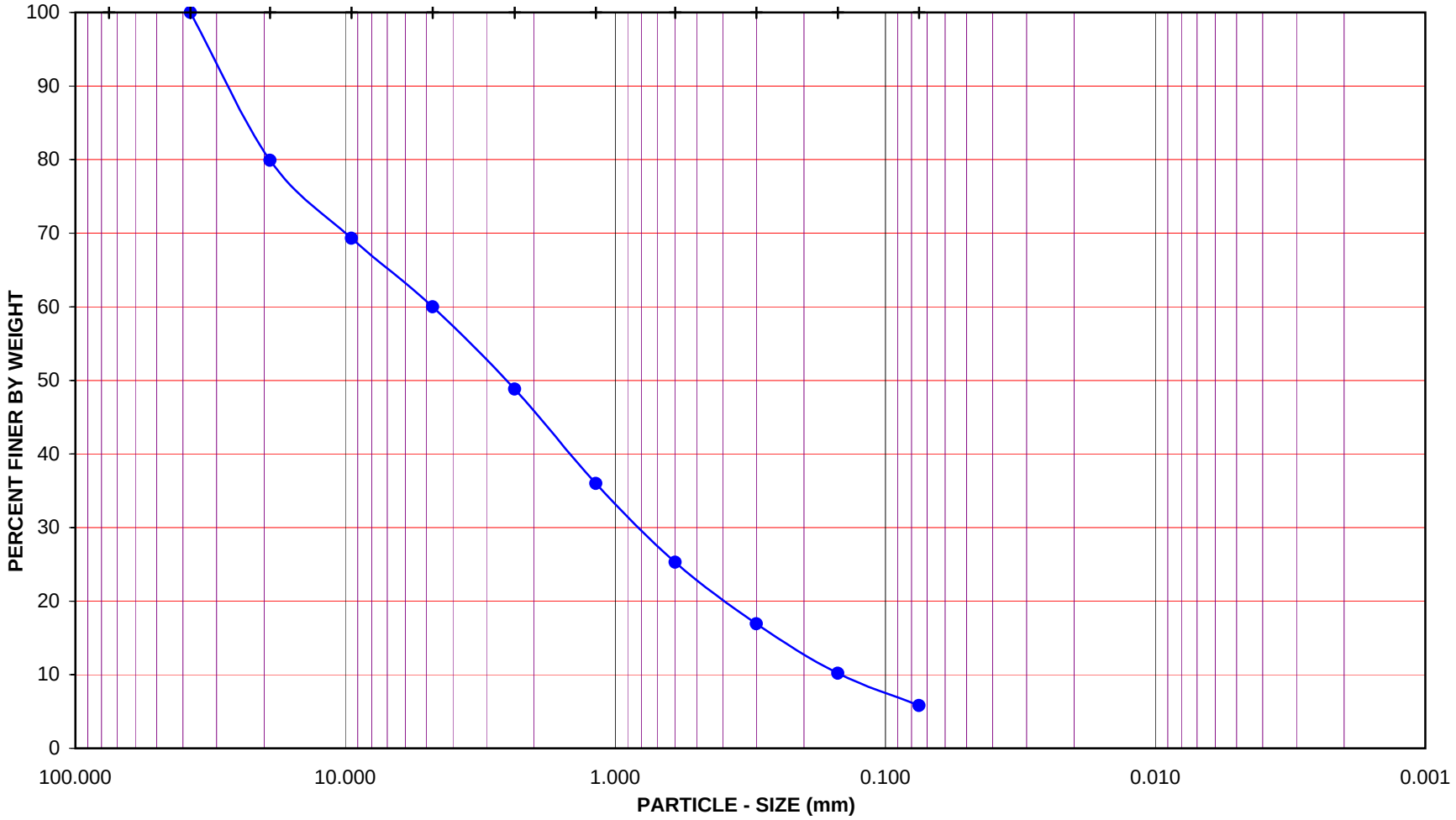
Remarks: Insufficient sample mass available to meet the ASTM specification for this material

GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY

U.S. STANDARD SIEVE OPENING: 3.0" 1 1/2" 3/4" 3/8"

U.S. STANDARD SIEVE NUMBER: #4 #8 #16 #30 #50 #100 #200

HYDROMETER



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z3-B2 Sample No.: S9

Depth (feet): 31.3-31.8 Soil Type : (SW-SM)g

Soil Identification: Olive well-graded sand with silt and gravel (SW-SM)g

GR:SA:FI : (%) 40 : 54 : 6

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PARTICLE - SIZE DISTRIBUTION ASTM D 422

May-09

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PARTICLE-SIZE ANALYSIS of SOILS
ASTM D 422

Project Name: SR-710 Tunnel Technical Study
Project No.: 378312.04.09.01
Exploration No.: R-09-Z3-B2
Sample No.: S17
Soil Identification: Yellowish brown well-graded sand with silt and gravel (SW-SM)g

Tested By: V. Juliano Date: 05/11/09
Checked By: J. Ward Date: 05/15/09
Depth (feet): 55-56

		Moisture Content of Total Air - Dry Soil	
Container No.:	752	Wt. of Air-Dry Soil + Cont. (g)	0.00
Wt. of Air-Dried Soil + Cont.(g)	724.30	Wt. of Dry Soil + Cont. (g)	0.00
Wt. of Container (g)	75.60	Wt. of Container No._____ (g)	1.00
Dry Wt. of Soil (g)	648.70	Moisture Content (%)	0.00

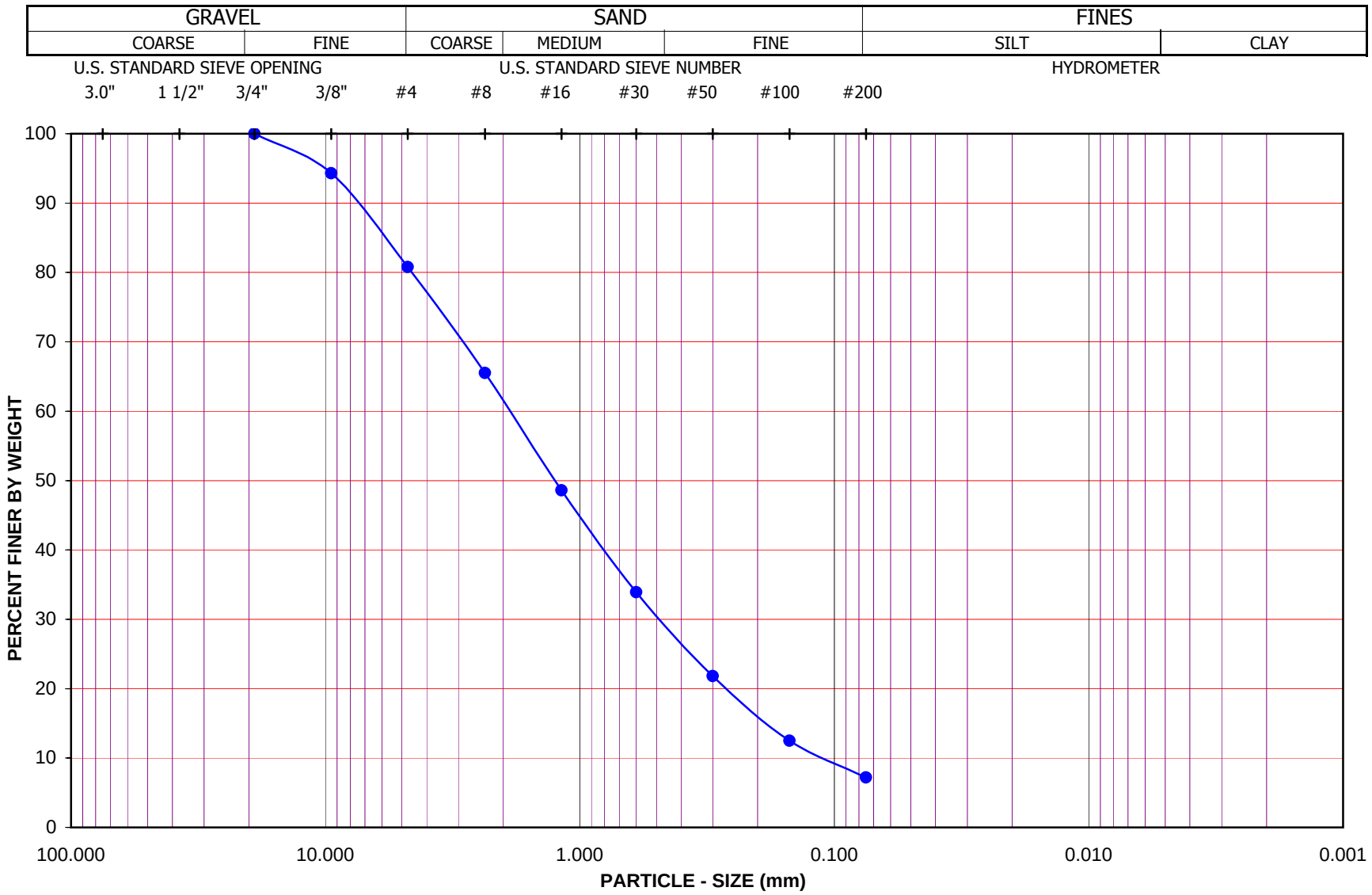
After Wet Sieve	Container No.	752
	Wt. of Dry Soil + Container (g)	682.70
	Wt. of Container (g)	75.60
	Dry Wt. of Soil Retained on # 200 Sieve (g)	607.10

U. S. Sieve Size (in.)	U. S. Sieve Size (mm.)	Cumulative Weight Dry Soil Retained (g)	Percent Passing (%)
6"	152.400		
3"	75.000		
1 1/2	37.500		
3/4"	19.000	0.00	100.0
3/8"	9.500	37.30	94.3
#4	4.750	124.40	80.8
#8	2.360	224.00	65.5
#16	1.180	333.50	48.6
#30	0.600	428.50	33.9
#50	0.300	507.30	21.8
#100	0.150	567.70	12.5
#200	0.075	602.30	7.2
PAN			

GRAVEL: **19 %**
SAND: **74 %**
FINES: **7 %**
GROUP SYMBOL: **(SW-SM)g**

Cu = D60/D10 = 16.36
Cc = $(D30)^2/(D60*D10)$ = 1.26

Remarks: Insufficient sample mass available to meet the ASTM specification for this material



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z3-B2 Sample No.: S17

Depth (feet): 55-56 Soil Type : (SW-SM)g

Soil Identification: Yellowish brown well-graded sand with silt and gravel (SW-SM)g

GR:SA:FI : (%) 19 : 74 : 7

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PARTICLE - SIZE DISTRIBUTION ASTM D 422

May-09

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PARTICLE-SIZE ANALYSIS of SOILS
ASTM D 422

Project Name: SR-710 Tunnel Technical Study
Project No.: 378312.04.09.01
Exploration No.: R-09-Z3-B2
Sample No.: S20
Soil Identification: Yellowish brown silty sand (SM)

Tested By: V. Juliano Date: 05/11/09
Checked By: J. Ward Date: 05/15/09
Depth (feet): 64.2-65.7

		Moisture Content of Total Air - Dry Soil	
Container No.:	NG-18	Wt. of Air-Dry Soil + Cont. (g)	0.00
Wt. of Air-Dried Soil + Cont.(g)	832.70	Wt. of Dry Soil + Cont. (g)	0.00
Wt. of Container (g)	74.70	Wt. of Container No._____ (g)	1.00
Dry Wt. of Soil (g)	758.00	Moisture Content (%)	0.00

After Wet Sieve	Container No.	NG-18
	Wt. of Dry Soil + Container (g)	650.60
	Wt. of Container (g)	74.70
	Dry Wt. of Soil Retained on # 200 Sieve (g)	575.90

U. S. Sieve Size (in.)	U. S. Sieve Size (mm.)	Cumulative Weight Dry Soil Retained (g)	Percent Passing (%)
6"	152.400		
3"	75.000		
1 1/2	37.500		
3/4"	19.000		
3/8"	9.500	0.00	100.0
#4	4.750	6.70	99.1
#8	2.360	19.70	97.4
#16	1.180	63.10	91.7
#30	0.600	150.90	80.1
#50	0.300	280.00	63.1
#100	0.150	440.30	41.9
#200	0.075	562.50	25.8
PAN			

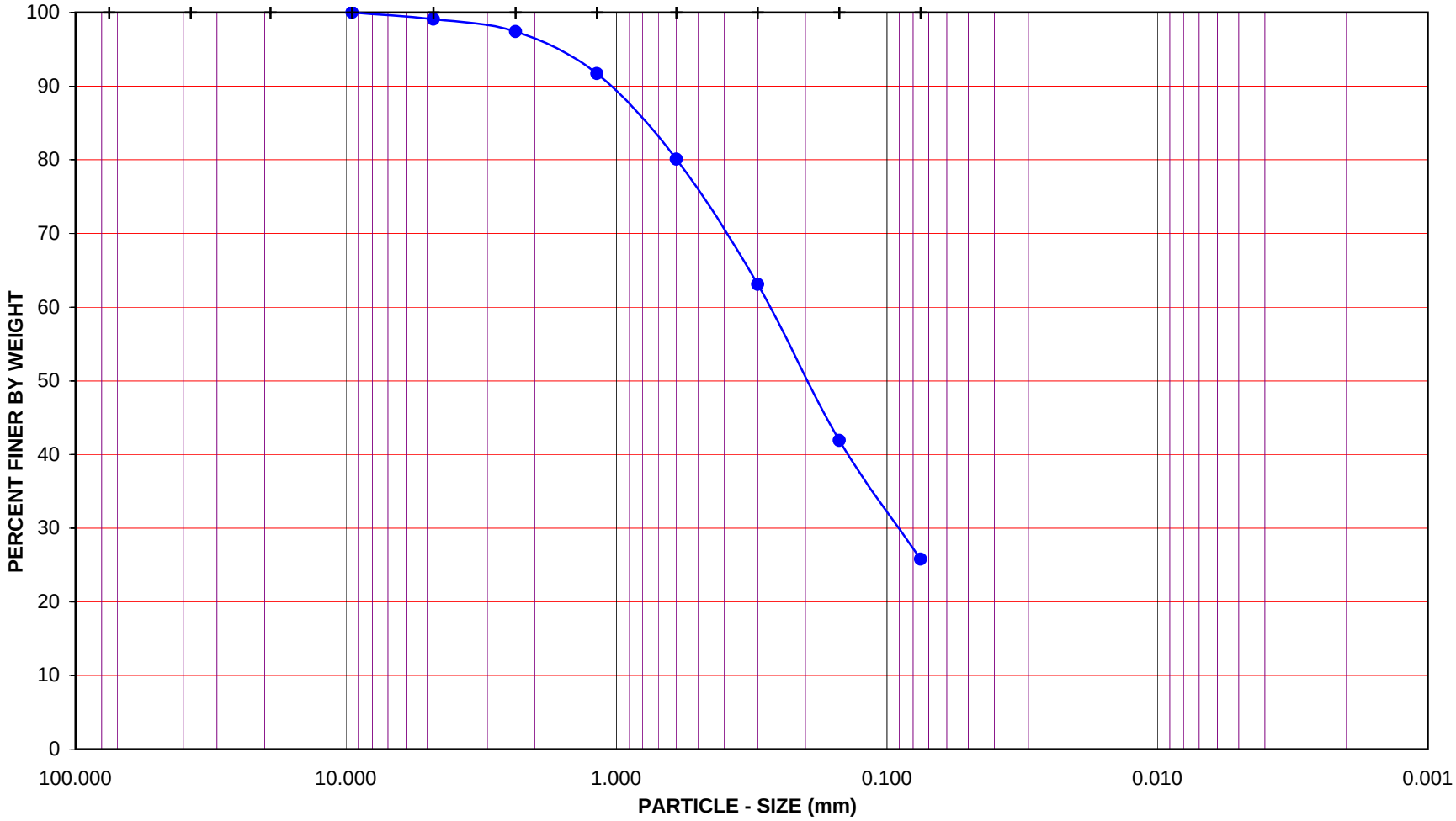
GRAVEL: **1 %**
SAND: **73 %**
FINES: **26 %**
GROUP SYMBOL: **SM**

Cu = D60/D10 = _____
Cc = $(D30)^2/(D60*D10)$ = _____

Remarks:

GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY

U.S. STANDARD SIEVE OPENING: 3.0" | 1 1/2" | 3/4" | 3/8"
U.S. STANDARD SIEVE NUMBER: #4 | #8 | #16 | #30 | #50 | #100 | #200
HYDROMETER



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z3-B2 Sample No.: S20

Depth (feet): 64.2-65.7 Soil Type : SM

Soil Identification: Yellowish brown silty sand (SM)

GR:SA:FI : (%) 1 : 73 : 26

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PARTICLE - SIZE DISTRIBUTION ASTM D 422

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PARTICLE-SIZE ANALYSIS of SOILS
ASTM D 422

Project Name: SR-710 Tunnel Technical Study
Project No.: 378312.04.09.01
Exploration No.: R-09-Z3-B2
Sample No.: C27
Soil Identification: Yellowish brown poorly-graded sand with gravel (SP)g

Tested By: V. Juliano Date: 05/11/09
Checked By: J. Ward Date: 05/15/09
Depth (feet): 81.5-85

Calculation of Dry Weights	Whole Sample	Sample Passing #4	Moisture Contents	Whole Sample	Sample passing #4
Container No.:	MK-25	746	Wt. of Air-Dry Soil + Cont.(g)	0.00	0.00
Wt. Air-Dried Soil + Cont.(g)	3433.40	736.40	Wt. of Dry Soil + Cont. (g)	0.00	0.00
Wt. of Container (g)	231.80	76.80	Wt. of Container No._____(g)	1.00	1.00
Dry Wt. of Soil (g)	3201.60	659.60	Moisture Content (%)	0.00	0.00

Passing #4 Material After Wet Sieve		
	Container No.	746
	Wt. of Dry Soil + Container (g)	711.10
	Wt. of Container (g)	76.80
	Dry Wt. of Soil Retained on # 200 Sieve (g)	634.30

U. S. Sieve Size		Cumulative Weight of Dry Soil Retained (g)		Percent Passing (%)
	(mm.)	Whole Sample	Sample Passing #4	
6"	152.400			
3"	75.000	0.00		100.0
1 1/2	37.500	242.90		92.4
3/4"	19.000	403.80		87.4
3/8"	9.500	562.80		82.4
#4	4.750	722.70		77.4
#8	2.360		49.70	71.6
#16	1.180		145.10	60.4
#30	0.600		319.60	39.9
#50	0.300		511.60	17.4
#100	0.150		600.50	6.9
#200	0.075		631.50	3.3
PAN				

GRAVEL: **23 %**
SAND: **74 %**
FINES: **3 %**
GROUP SYMBOL **(SP)g**

Cu = D60/D10 = 6.00
Cc = $(D30)^2/(D60*D10)$ = 0.81

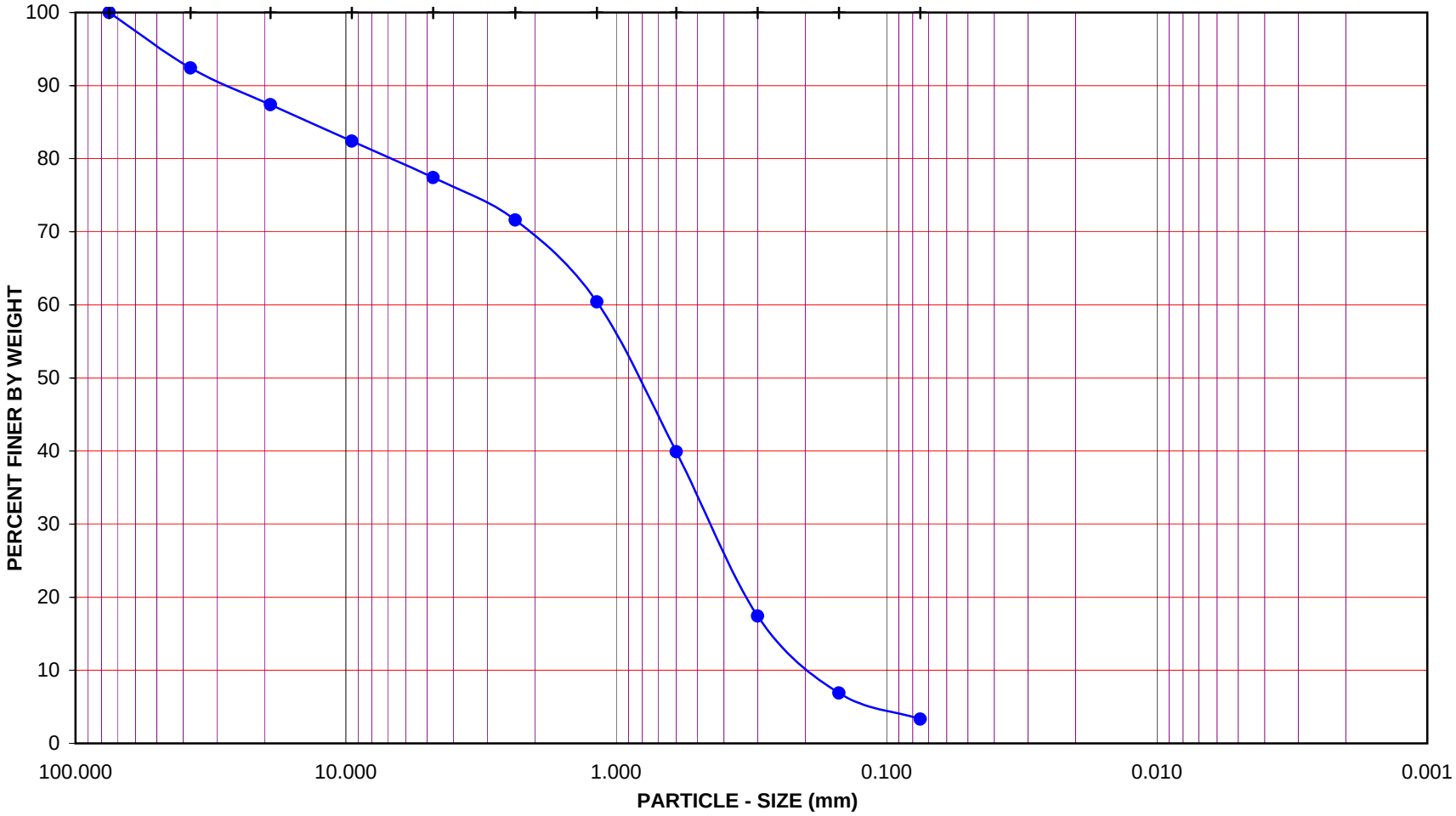
Remarks: Insufficient sample mass available to meet the ASTM specification for this material

GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY

U.S. STANDARD SIEVE OPENING: 3.0" 1 1/2" 3/4" 3/8"

U.S. STANDARD SIEVE NUMBER: #4 #8 #16 #30 #50 #100 #200

HYDROMETER



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z3-B2 Sample No.: C27

Depth (feet): 81.5-85 Soil Type : (SP)g

Soil Identification: Yellowish brown poorly-graded sand with gravel (SP)g

GR:SA:FI : (%) 23 : 74 : 3

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PARTICLE - SIZE DISTRIBUTION ASTM D 422

May-09

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PARTICLE-SIZE ANALYSIS of SOILS
ASTM D 422

Project Name: SR-710 Tunnel Technical Study
Project No.: 378312.04.09.01
Exploration No.: R-09-Z3-B2
Sample No.: S30
Soil Identification: Yellowish brown silty sand (SM)

Tested By: V. Juliano Date: 05/11/09
Checked By: J. Ward Date: 05/15/09
Depth (feet): 90-91.5

		Moisture Content of Total Air - Dry Soil	
Container No.:	935	Wt. of Air-Dry Soil + Cont. (g)	0.00
Wt. of Air-Dried Soil + Cont.(g)	922.90	Wt. of Dry Soil + Cont. (g)	0.00
Wt. of Container (g)	108.90	Wt. of Container No._____ (g)	1.00
Dry Wt. of Soil (g)	814.00	Moisture Content (%)	0.00

After Wet Sieve	Container No.	935
	Wt. of Dry Soil + Container (g)	768.20
	Wt. of Container (g)	108.90
	Dry Wt. of Soil Retained on # 200 Sieve (g)	659.30

U. S. Sieve Size (in.)	U. S. Sieve Size (mm.)	Cumulative Weight Dry Soil Retained (g)	Percent Passing (%)
6"	152.400		
3"	75.000		
1 1/2	37.500		
3/4"	19.000	0.00	100.0
3/8"	9.500	7.50	99.1
#4	4.750	37.80	95.4
#8	2.360	91.20	88.8
#16	1.180	189.10	76.8
#30	0.600	335.70	58.8
#50	0.300	462.90	43.1
#100	0.150	565.30	30.6
#200	0.075	648.30	20.4
PAN			

GRAVEL: **5 %**
SAND: **75 %**
FINES: **20 %**
GROUP SYMBOL: **SM**

Cu = D60/D10 = _____
Cc = $(D30)^2/(D60*D10)$ = _____

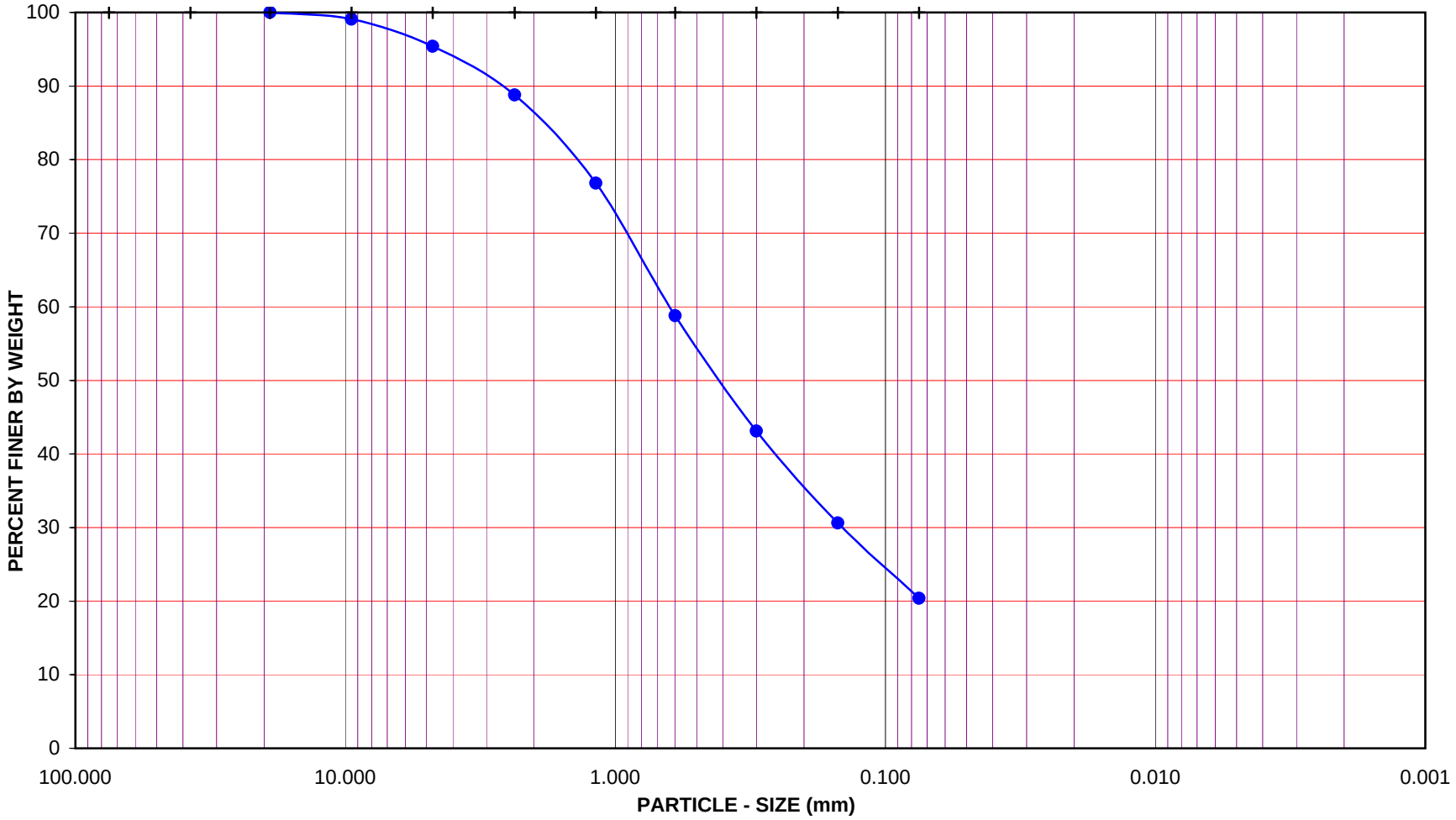
Remarks: Insufficient sample mass available to meet the ASTM specification for this material

GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY

U.S. STANDARD SIEVE OPENING: 3.0" 1 1/2" 3/4" 3/8"

U.S. STANDARD SIEVE NUMBER: #4 #8 #16 #30 #50 #100 #200

HYDROMETER



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z3-B2 Sample No.: S30

Depth (feet): 90-91.5 Soil Type : SM

Soil Identification: Yellowish brown silty sand (SM)

GR:SA:FI : (%) 5 : 75 : 20

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PARTICLE - SIZE DISTRIBUTION ASTM D 422

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PARTICLE-SIZE ANALYSIS of SOILS
ASTM D 422

Project Name: SR-710 Tunnel Technical Study
Project No.: 378312.04.09.01
Exploration No.: R-09-Z3-B2
Sample No.: S34
Soil Identification: Yellowish brown silty sand (SM)

Tested By: V. Juliano Date: 05/11/09
Checked By: J. Ward Date: 05/15/09
Depth (feet): 100-101.5

		Moisture Content of Total Air - Dry Soil	
Container No.:	929	Wt. of Air-Dry Soil + Cont. (g)	0.00
Wt. of Air-Dried Soil + Cont.(g)	843.30	Wt. of Dry Soil + Cont. (g)	0.00
Wt. of Container (g)	108.40	Wt. of Container No._____ (g)	1.00
Dry Wt. of Soil (g)	734.90	Moisture Content (%)	0.00

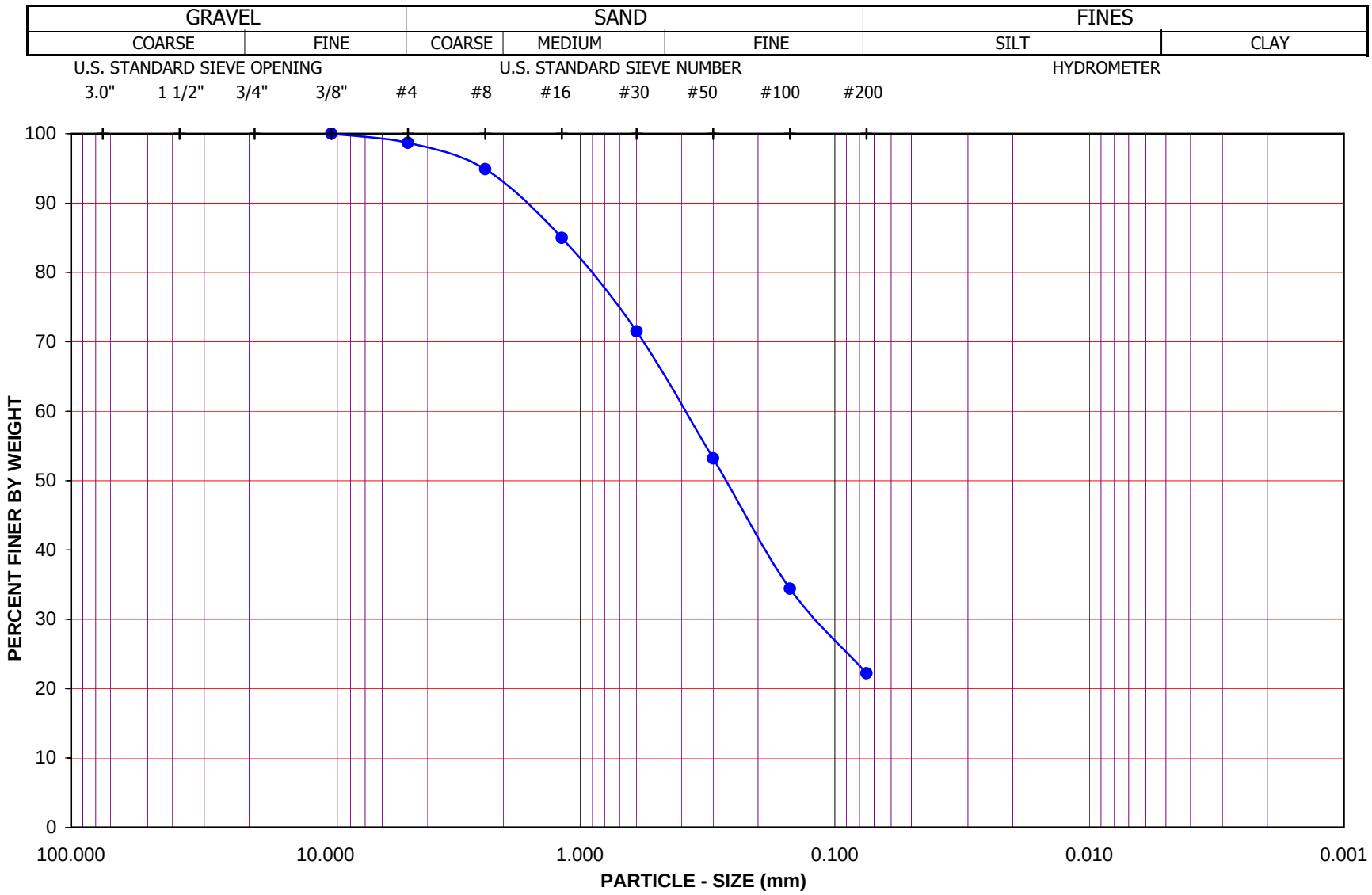
After Wet Sieve	Container No.	929
	Wt. of Dry Soil + Container (g)	689.80
	Wt. of Container (g)	108.40
	Dry Wt. of Soil Retained on # 200 Sieve (g)	581.40

U. S. Sieve Size (in.)	U. S. Sieve Size (mm.)	Cumulative Weight Dry Soil Retained (g)	Percent Passing (%)
6"	152.400		
3"	75.000		
1 1/2	37.500		
3/4"	19.000		
3/8"	9.500	0.00	100.0
#4	4.750	9.30	98.7
#8	2.360	37.20	94.9
#16	1.180	110.60	85.0
#30	0.600	209.70	71.5
#50	0.300	343.70	53.2
#100	0.150	482.00	34.4
#200	0.075	571.70	22.2
PAN			

GRAVEL: **1 %**
SAND: **77 %**
FINES: **22 %**
GROUP SYMBOL: **SM**

Cu = D60/D10 = _____
Cc = $(D30)^2/(D60*D10)$ = _____

Remarks: Insufficient sample mass available to meet the ASTM specification for this material



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z3-B2 Sample No.: S34

Depth (feet): 100-101.5 Soil Type : SM

Soil Identification: Yellowish brown silty sand (SM)

GR:SA:FI : (%) 1 : 77 : 22

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PARTICLE - SIZE DISTRIBUTION ASTM D 422

May-09

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PARTICLE-SIZE ANALYSIS of SOILS
ASTM D 422

Project Name: SR-710 Tunnel Technical Study
Project No.: 378312.04.09.01
Exploration No.: R-09-Z3-B2
Sample No.: C39
Soil Identification: Reddish brown silty sand (SM)

Tested By: V. Juliano Date: 05/11/09
Checked By: J. Ward Date: 05/15/09
Depth (feet): 111.5-115

		Moisture Content of Total Air - Dry Soil	
Container No.:	1490	Wt. of Air-Dry Soil + Cont. (g)	0.00
Wt. of Air-Dried Soil + Cont.(g)	543.20	Wt. of Dry Soil + Cont. (g)	0.00
Wt. of Container (g)	77.40	Wt. of Container No._____ (g)	1.00
Dry Wt. of Soil (g)	465.80	Moisture Content (%)	0.00

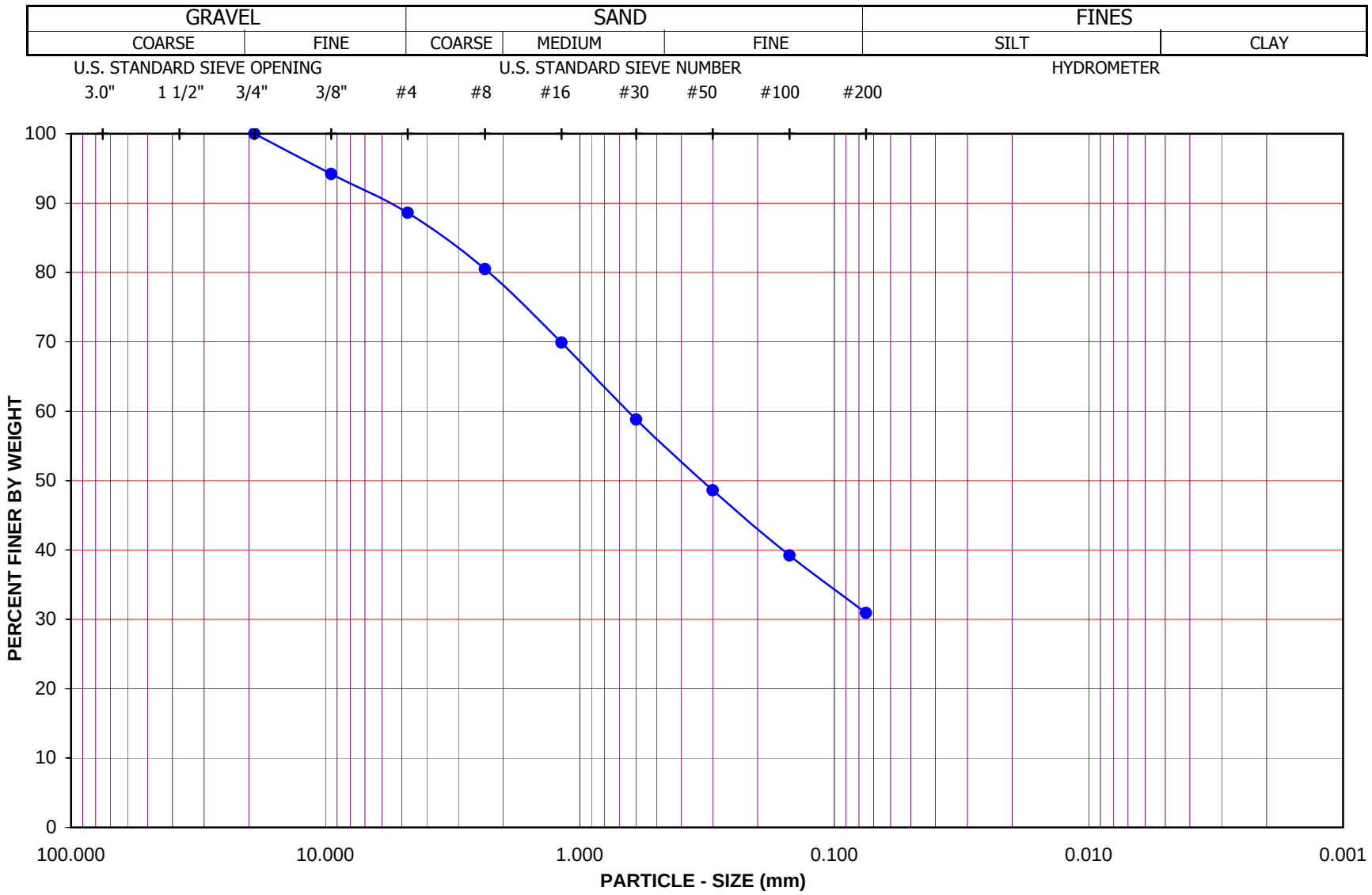
After Wet Sieve	Container No.	1490
	Wt. of Dry Soil + Container (g)	403.80
	Wt. of Container (g)	77.40
	Dry Wt. of Soil Retained on # 200 Sieve (g)	326.40

U. S. Sieve Size (in.)	U. S. Sieve Size (mm.)	Cumulative Weight Dry Soil Retained (g)	Percent Passing (%)
6"	152.400		
3"	75.000		
1 1/2	37.500		
3/4"	19.000	0.00	100.0
3/8"	9.500	27.10	94.2
#4	4.750	52.90	88.6
#8	2.360	90.90	80.5
#16	1.180	140.00	69.9
#30	0.600	192.10	58.8
#50	0.300	239.20	48.6
#100	0.150	283.20	39.2
#200	0.075	322.00	30.9
PAN			

GRAVEL: **11 %**
SAND: **58 %**
FINES: **31 %**
GROUP SYMBOL: **SM**

Cu = D60/D10 = _____
Cc = $(D30)^2/(D60*D10)$ = _____

Remarks: Insufficient sample mass available to meet the ASTM specification for this material



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z3-B2 Sample No.: C39

Depth (feet): 111.5-115 Soil Type : SM

Soil Identification: Reddish brown silty sand (SM)

GR:SA:FI : (%) 11 : 58 : 31

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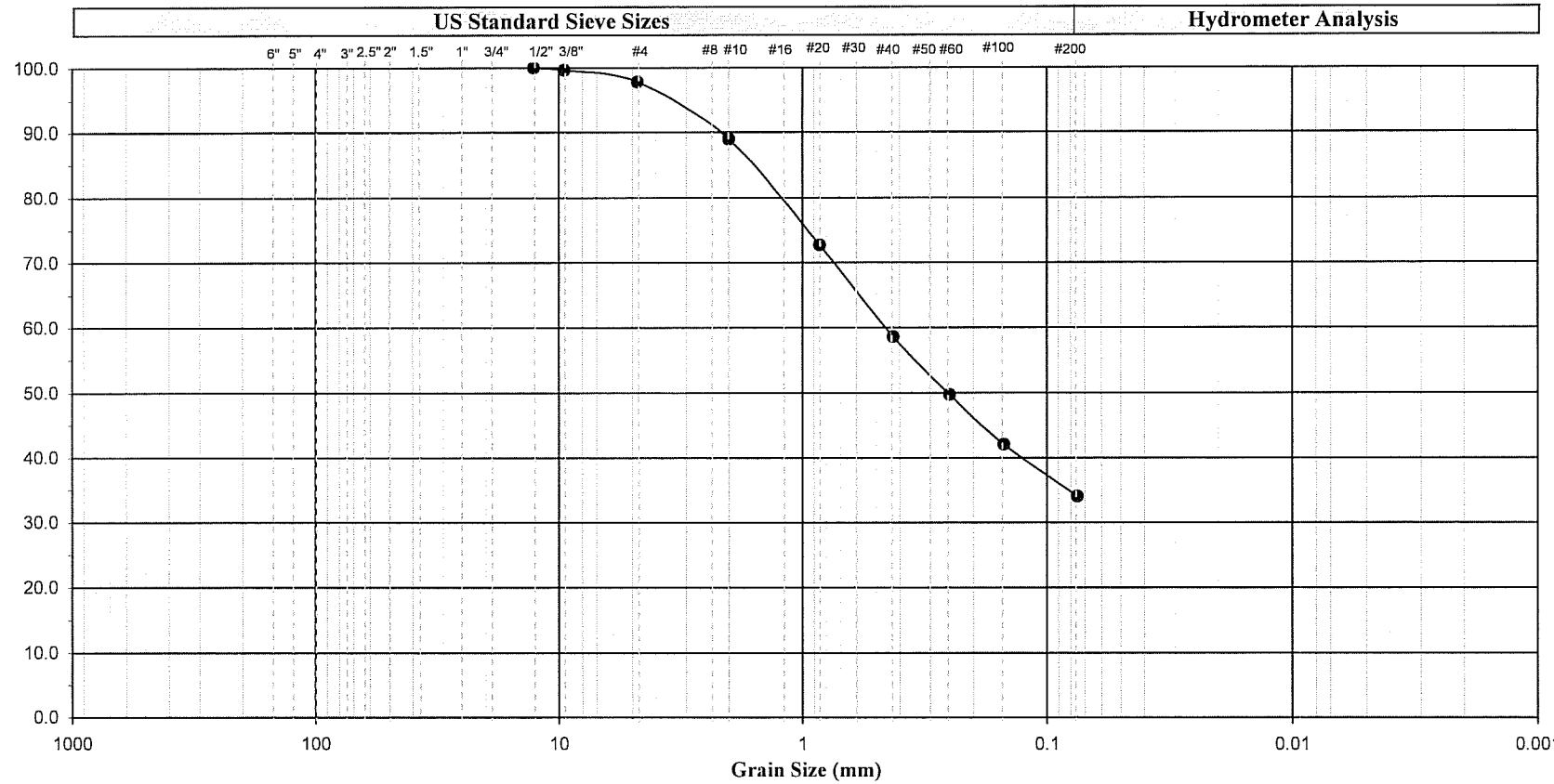
PARTICLE - SIZE DISTRIBUTION ASTM D 422

May-09



Cobbles	Gravel		Sand			Silt or Clay
	Coarse	Fine	Coarse	Medium	Fine	

Symbol	Boring Number	Sample Number	Depth (ft)	Depth (m)	Soil Color	Soil Description	U.S.C.S.
●	Z3-B3	C-28	246.4		White with light gray	Clayey sand	SC
Remark	excluded 1 piece 1.75" gravel						

Earth Mechanics, Inc.
Geotechnical and Earthquake Engineering

CH2MHill/SR-710 Tunnel Site Investigation T.O.4

Project No. : 08-169 Date : 03/23/09

GRAIN SIZE ANALYSIS
(ASTM D-422-63)

Figure No. :

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PARTICLE-SIZE ANALYSIS OF SOILS

ASTM D 422

Project Name: SR-710 Tunnel Technical Study | Tested By : V. Juliano | Date: 04/28/09

Project No. : 378312.04.09.01 | Data Input By: J. Ward | Date: 05/06/09

Exploration No.: R-09-Z3-B4

Sample No.: S-3 | Depth (feet) : 15.0

Soil Identification: Yellowish brown silty sand (SM)

% Gravel	**2**	**Soil Type**
% Sand	**60**	**SM**
% Fines	**38**	

			Moisture Content of Total Air-Dry Soil	Moisture Content of Air-Dry Soil Passing #10	After Hydrometer & Wet Sieve ret. in #200 Sieve
Specific Gravity (Assumed)	2.70	Wt.of Air-Dry Soil + Cont.(g)	0.00	0.00	
Correction for Specific Gravity	0.99	Dry Wt. of Soil + Cont. (g)	0.00	0.00	122.69
Wt.of Air-Dry Soil + Cont. (g)	851.00	Wt. of Container No.___ (g)	1.00	1.00	72.55
Wt. of Container	107.60	Moisture Content (%)	0.00	0.00	
Dry Wt. of Soil (g)	743.40	Wt. of Dry Soil (g)			50.14

Coarse Sieve

U.S. Sieve	Cumulative Wt. Of Dry Soil Retained (g)	% Passing
3"	0.00	100.0
1½"	0.00	100.0
3/4"	0.00	100.0
3/8"	7.32	99.0
No. 4	13.01	98.2
No. 10	22.21	97.0
Pan		

Sieve after Hydrometer & Wet Sieve

U.S. Sieve Size	Cumulative Wt. Of Dry Soil Retained (g)	% Passing	% Total Sample
No. 10	0.00	100.0	97.0
No. 16	0.87	98.9	96.0
No. 30	3.45	95.7	92.8
No. 50	10.14	87.3	84.7
No. 100	28.99	63.8	61.9
No. 200	49.03	38.8	37.7
Pan			

Hydrometer Wt. of Air-Dry Soil (g) 80.15 Wt. of Dry Soil (g) 80.15

Deflocculant 125 cc of 4% Solution

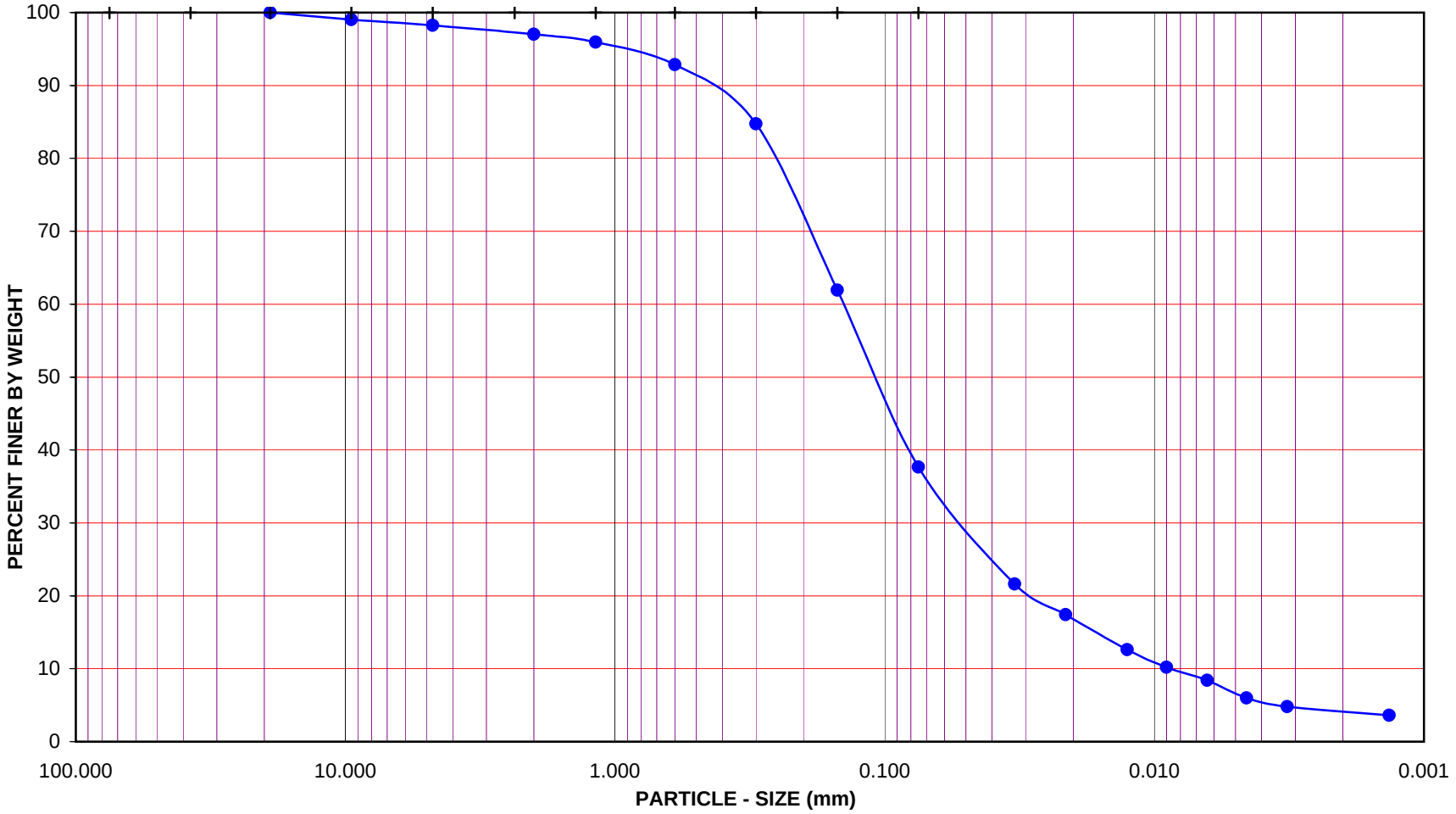
Date	Time	Elapsed Time (min)	Water Temperature (°C)	Composite Correction 152H	Actual Hydrometer Readings	% Total Sample (%)	Soil Particle Diameter (mm)
30-Apr-09	8:52	0		6.5			
	8:54	2	21.6	6.5	24.5	21.6	0.0329
	8:57	5	21.6	6.5	21.0	17.4	0.0213
	9:07	15	21.7	6.5	17.0	12.6	0.0126
	9:22	30	21.8	6.5	15.0	10.2	0.0090
	9:52	60	22.1	6.5	13.5	8.4	0.0064
	10:52	120	22.1	6.5	11.5	6.0	0.0045
	13:02	250	21.8	6.5	10.5	4.8	0.0032
01-May-09	8:52	1440	21.9	6.5	9.5	3.6	0.0013

GRAVEL		SAND			FINES	
COARSE	FINE	CRSE	MEDIUM	FINE	SILT	CLAY

U.S. STANDARD SIEVE OPENING: 3.0" 1 1/2" 3/4" 3/8"

U.S. STANDARD SIEVE NUMBER: #4 #8 #16 #30 #50 #100 #200

HYDROMETER



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z3-B4 Sample No.: S-3

Depth (feet) : 15.0 Soil Type : SM

Soil Identification: Yellowish brown silty sand (SM)

GR:SA:FI : (%) 2 : 60 : 38

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PARTICLE - SIZE DISTRIBUTION ASTM D 422

May-09

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PARTICLE-SIZE ANALYSIS OF SOILS

ASTM D 422

Project Name: SR-710 Tunnel Technical Study | Tested By : V. Juliano | Date: 04/28/09

Project No. : 378312.04.09.01 | Data Input By: J. Ward | Date: 05/06/09

Exploration No.: R-09-Z3-B4

Sample No.: S-8 | Depth (feet) : 40.0

Soil Identification: Olive silt with sand (ML)s

% Gravel	**0**	**Soil Type**	Moisture Content of Total Air-Dry Soil	Moisture Content of Air-Dry Soil Passing #10	After Hydrometer & Wet Sieve ret. in #200 Sieve
% Sand	**22**	**(ML)s**			
% Fines	**78**				
Specific Gravity (Assumed)	2.70	Wt.of Air-Dry Soil + Cont.(g)	0.00	0.00	
Correction for Specific Gravity	0.99	Dry Wt. of Soil + Cont. (g)	0.00	0.00	88.81
Wt.of Air-Dry Soil + Cont. (g)	697.50	Wt. of Container No.___ (g)	1.00	1.00	76.31
Wt. of Container	77.40	Moisture Content (%)	0.00	0.00	
Dry Wt. of Soil (g)	620.10	Wt. of Dry Soil (g)			12.50

Coarse Sieve

U.S. Sieve	Cumulative Wt. Of Dry Soil Retained (g)	% Passing
3"	0.00	100.0
1½"	0.00	100.0
3/4"	0.00	100.0
3/8"	0.00	100.0
No. 4	0.00	100.0
No. 10	3.70	99.4
Pan		

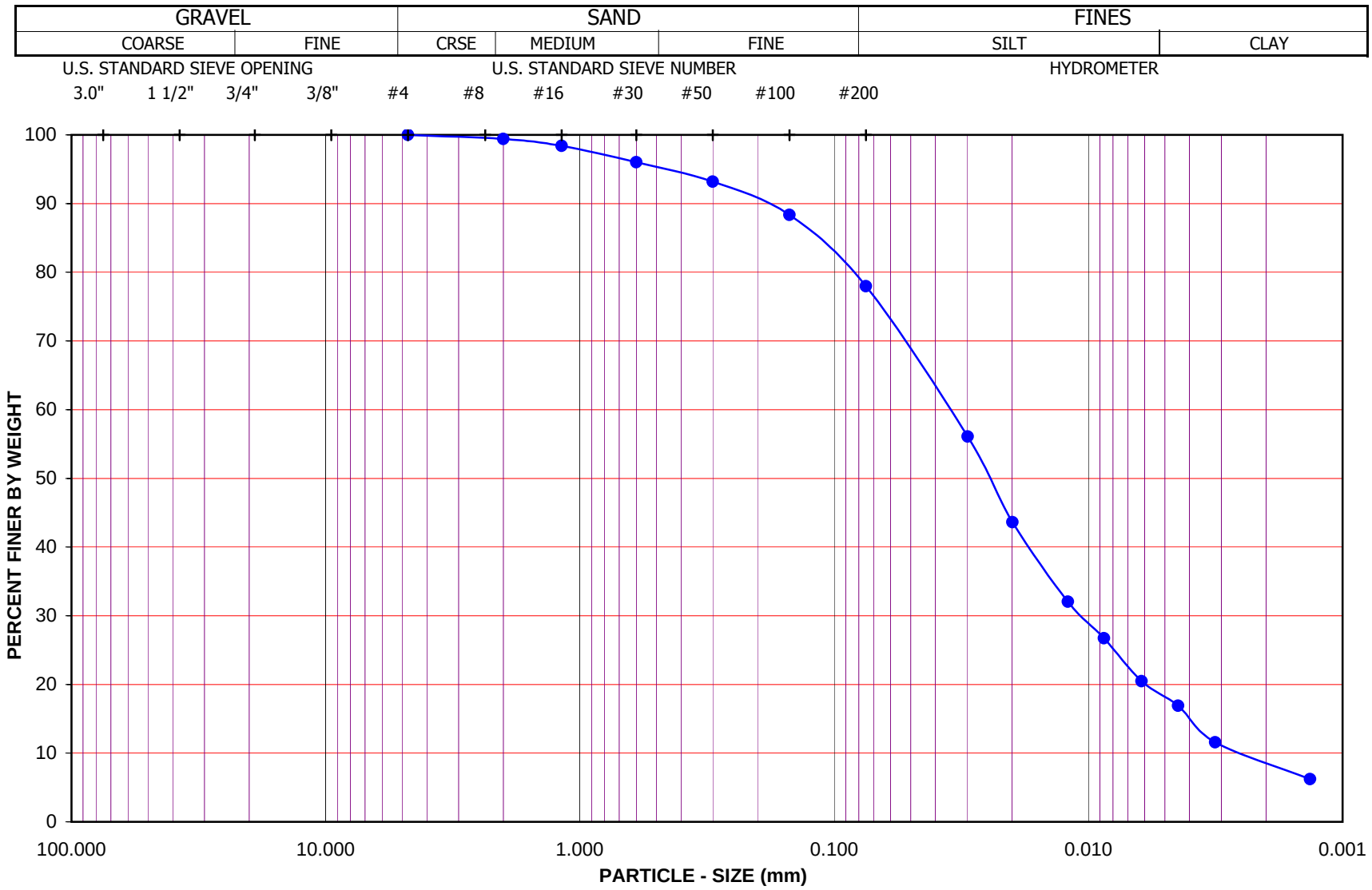
Sieve after Hydrometer & Wet Sieve

U.S. Sieve Size	Cumulative Wt. Of Dry Soil Retained (g)	% Passing	% Total Sample
No. 10	0.00	100.0	99.4
No. 16	0.56	99.0	98.4
No. 30	1.88	96.6	96.0
No. 50	3.46	93.8	93.2
No. 100	6.15	88.9	88.4
No. 200	11.95	78.4	78.0
Pan			

Hydrometer Wt. of Air-Dry Soil (g) 55.39 Wt. of Dry Soil (g) 55.39

Deflocculant 125 cc of 4% Solution

Date	Time	Elapsed Time (min)	Water Temperature (°C)	Composite Correction 152H	Actual Hydrometer Readings	% Total Sample (%)	Soil Particle Diameter (mm)
30-Apr-09	8:48	0		6.5			
	8:50	2	21.6	6.5	38.0	56.1	0.0298
	8:53	5	21.6	6.5	31.0	43.6	0.0199
	9:03	15	21.7	6.5	24.5	32.0	0.0120
	9:18	30	21.8	6.5	21.5	26.7	0.0087
	9:48	60	22.1	6.5	18.0	20.5	0.0062
	10:48	120	22.0	6.5	16.0	16.9	0.0044
	12:58	250	21.8	6.5	13.0	11.6	0.0032
01-May-09	8:48	1440	21.9	6.5	10.0	6.2	0.0013



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z3-B4 Sample No.: S-8

Depth (feet) : 40.0 Soil Type : (ML)s

Soil Identification: Olive silt with sand (ML)s

GR:SA:FI : (%) 0 : 22 : 78

Leighton

PARTICLE - SIZE DISTRIBUTION ASTM D 422

May-09

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PARTICLE-SIZE ANALYSIS of SOILS
ASTM D 422

Project Name: SR-710 Tunnel Technical Study
Project No.: 378312.04.09.01
Exploration No.: R-09-Z3-B4
Sample No.: S-10
Soil Identification: Yellowish brown silty sand (SM)

Tested By: V. Juliano Date: 04/28/09
Checked By: J. Ward Date: 05/12/09
Depth (feet): 50.0

		Moisture Content of Total Air - Dry Soil	
Container No.:	778	Wt. of Air-Dry Soil + Cont. (g)	0.00
Wt. of Air-Dried Soil + Cont.(g)	558.30	Wt. of Dry Soil + Cont. (g)	0.00
Wt. of Container (g)	75.80	Wt. of Container No._____ (g)	1.00
Dry Wt. of Soil (g)	482.50	Moisture Content (%)	0.00

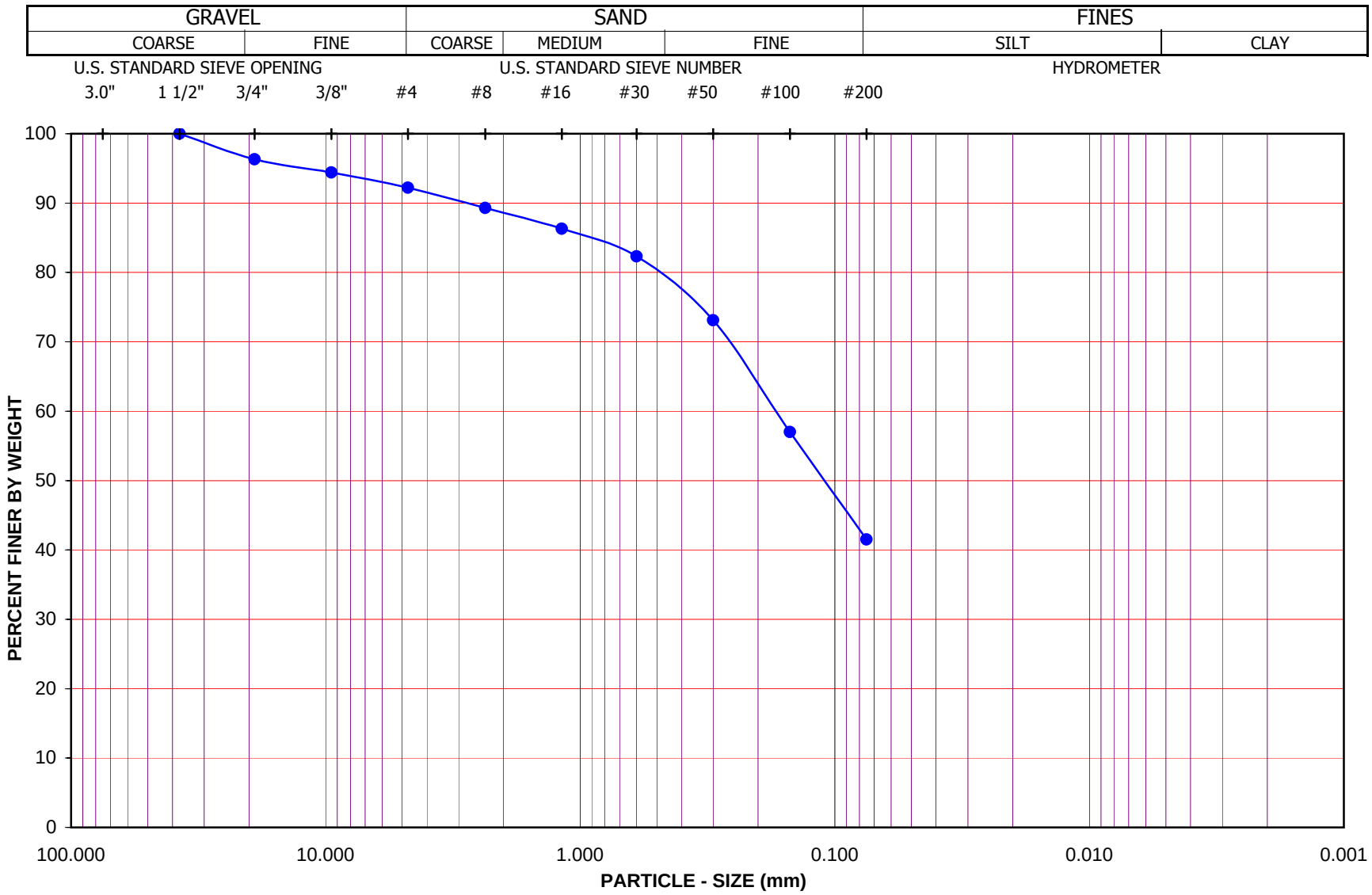
After Wet Sieve	Container No.	778
	Wt. of Dry Soil + Container (g)	365.30
	Wt. of Container (g)	75.80
	Dry Wt. of Soil Retained on # 200 Sieve (g)	289.50

U. S. Sieve Size (in.)	U. S. Sieve Size (mm.)	Cumulative Weight Dry Soil Retained (g)	Percent Passing (%)
6"	152.400		
3"	75.000		
1 1/2	37.500	0.00	100.0
3/4"	19.000	17.70	96.3
3/8"	9.500	26.80	94.4
#4	4.750	37.80	92.2
#8	2.360	51.40	89.3
#16	1.180	65.90	86.3
#30	0.600	85.60	82.3
#50	0.300	129.80	73.1
#100	0.150	207.30	57.0
#200	0.075	282.10	41.5
PAN			

GRAVEL: **8 %**
SAND: **50 %**
FINES: **42 %**
GROUP SYMBOL: **SM**

Cu = D60/D10 = _____
Cc = $(D30)^2/(D60*D10)$ = _____

Remarks: Insufficient sample mass available to meet the ASTM specification for this material



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z3-B4 Sample No.: S-10

Depth (feet): 50.0 Soil Type : SM

Soil Identification: Yellowish brown silty sand (SM)

GR:SA:FI : (%) 8 : 50 : 42

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PARTICLE - SIZE DISTRIBUTION ASTM D 422

May-09

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PARTICLE-SIZE ANALYSIS of SOILS
ASTM D 422

Project Name: SR-710 Tunnel Technical Study
Project No.: 378312.04.09.01
Exploration No.: R-09-Z3-B4
Sample No.: S-13
Soil Identification: Yellowish brown silty sand (SM)

Tested By: V. Juliano Date: 04/28/09
Checked By: J. Ward Date: 05/06/09
Depth (feet): 65.0

		Moisture Content of Total Air - Dry Soil	
Container No.:	166	Wt. of Air-Dry Soil + Cont. (g)	0.00
Wt. of Air-Dried Soil + Cont.(g)	448.80	Wt. of Dry Soil + Cont. (g)	0.00
Wt. of Container (g)	72.30	Wt. of Container No._____ (g)	1.00
Dry Wt. of Soil (g)	376.50	Moisture Content (%)	0.00

After Wet Sieve	Container No.	166
	Wt. of Dry Soil + Container (g)	291.50
	Wt. of Container (g)	72.30
	Dry Wt. of Soil Retained on # 200 Sieve (g)	219.20

U. S. Sieve Size (in.)	U. S. Sieve Size (mm.)	Cumulative Weight Dry Soil Retained (g)	Percent Passing (%)
6"	152.400		
3"	75.000		
1 1/2	37.500		
3/4"	19.000	0.00	100.0
3/8"	9.500	2.70	99.3
#4	4.750	3.90	99.0
#8	2.360	5.40	98.6
#16	1.180	7.10	98.1
#30	0.600	8.20	97.8
#50	0.300	10.80	97.1
#100	0.150	58.80	84.4
#200	0.075	194.40	48.4
PAN			

GRAVEL: **1 %**
SAND: **51 %**
FINES: **48 %**
GROUP SYMBOL: **SM**

Cu = D60/D10 = _____
Cc = $(D30)^2/(D60*D10)$ = _____

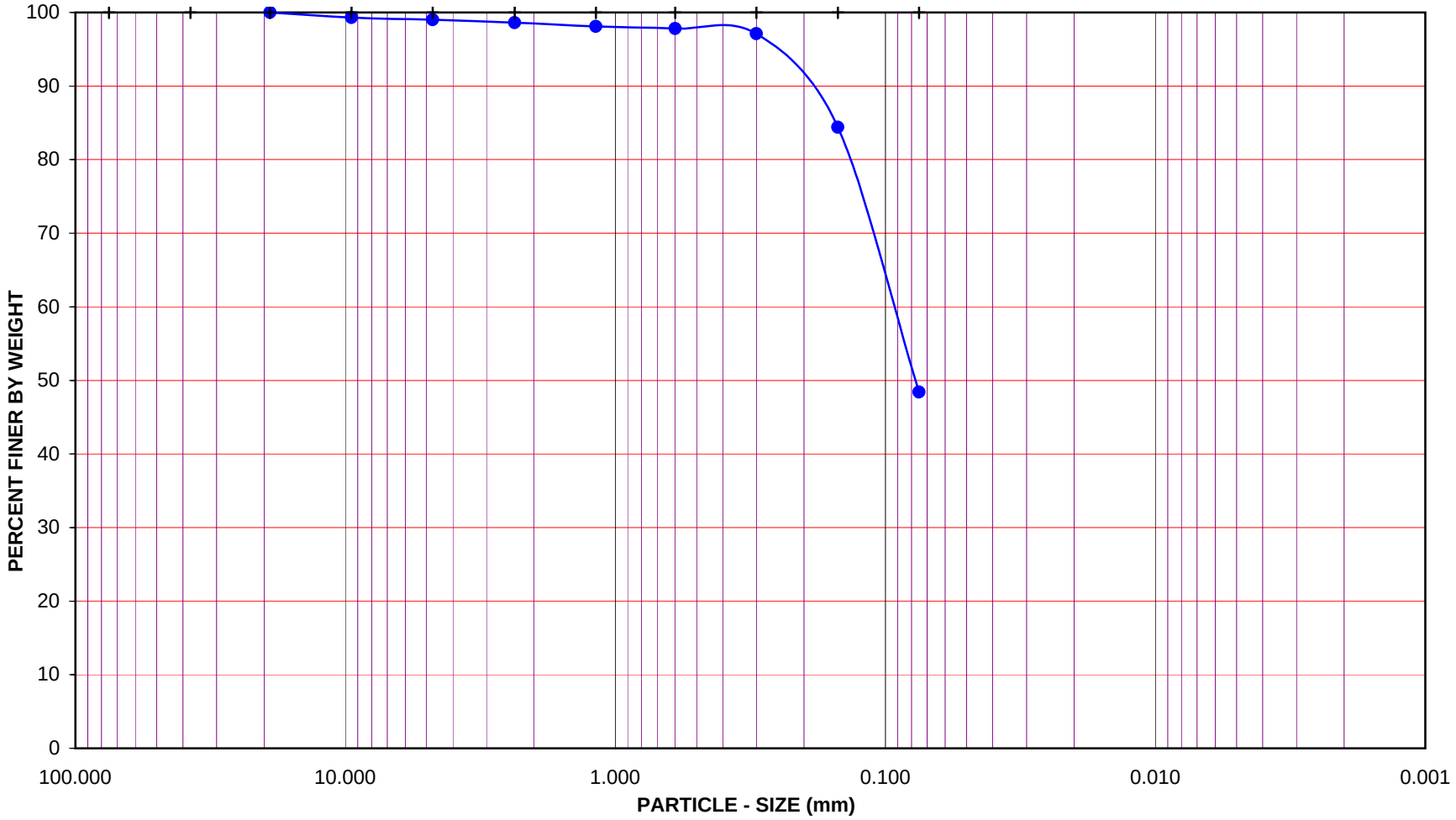
Remarks: Insufficient sample mass available to meet the ASTM specification for this material

GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY

U.S. STANDARD SIEVE OPENING: 3.0" 1 1/2" 3/4" 3/8"

U.S. STANDARD SIEVE NUMBER: #4 #8 #16 #30 #50 #100 #200

HYDROMETER



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z3-B4 Sample No.: S-13

Depth (feet): 65.0 Soil Type : SM

Soil Identification: Yellowish brown silty sand (SM)

GR:SA:FI : (%) 1 : 51 : 48

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PARTICLE - SIZE DISTRIBUTION ASTM D 422

May-09

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PARTICLE-SIZE ANALYSIS OF SOILS

ASTM D 422

Project Name: SR-710 Tunnel Technical Study | Tested By : V. Juliano | Date: 04/28/09

Project No. : 378312.04.09.01 | Data Input By: J. Ward | Date: 05/06/09

Exploration No.: R-09-Z3-B4

Sample No.: C-20 | Depth (feet) : 94-100

Soil Identification: Brown silty sand (SM)

% Gravel	**2**	**Soil Type**
% Sand	**65**	**SM**
% Fines	**33**	

			Moisture Content of Total Air-Dry Soil	Moisture Content of Air-Dry Soil Passing #10	After Hydrometer & Wet Sieve ret. in #200 Sieve
Specific Gravity (Assumed)	2.70	Wt.of Air-Dry Soil + Cont.(g)	0.00	0.00	
Correction for Specific Gravity	0.99	Dry Wt. of Soil + Cont. (g)	0.00	0.00	130.60
Wt.of Air-Dry Soil + Cont. (g)	743.10	Wt. of Container No.___ (g)	1.00	1.00	75.17
Wt. of Container	75.50	Moisture Content (%)	0.00	0.00	
Dry Wt. of Soil (g)	667.60	Wt. of Dry Soil (g)			55.43

Coarse Sieve

U.S. Sieve	Cumulative Wt. Of Dry Soil Retained (g)	% Passing
3"	0.00	100.0
1½"	0.00	100.0
3/4"	0.00	100.0
3/8"	4.38	99.3
No. 4	15.79	97.6
No. 10	49.10	92.6
Pan		

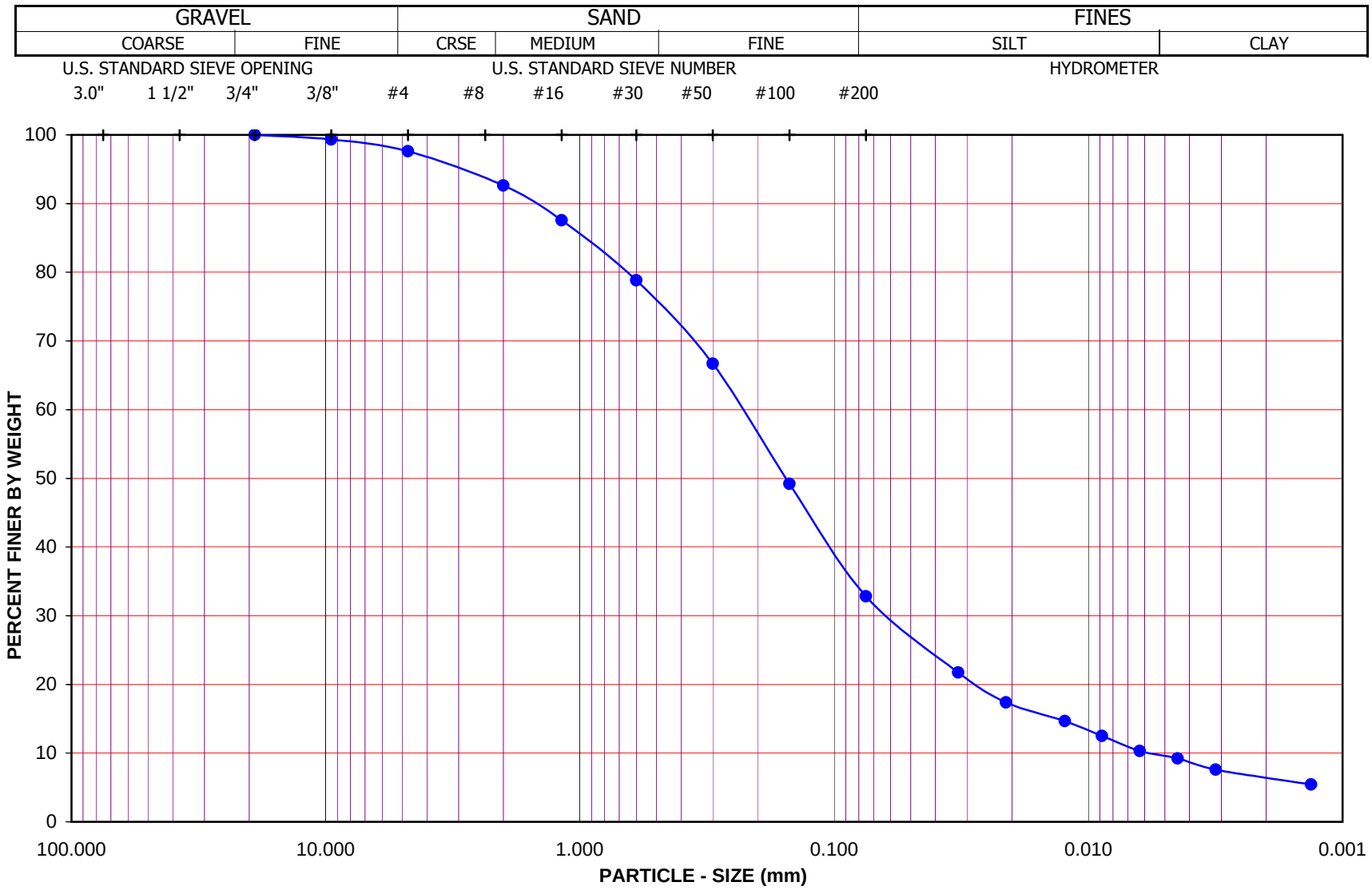
Sieve after Hydrometer & Wet Sieve

U.S. Sieve Size	Cumulative Wt. Of Dry Soil Retained (g)	% Passing	% Total Sample
No. 10	0.00	100.0	92.6
No. 16	4.65	94.5	87.6
No. 30	12.62	85.1	78.8
No. 50	23.71	72.0	66.7
No. 100	39.68	53.1	49.2
No. 200	54.64	35.4	32.8
Pan			

Hydrometer Wt. of Air-Dry Soil (g) 84.62 Wt. of Dry Soil (g) 84.62

Deflocculant 125 cc of 4% Solution

Date	Time	Elapsed Time (min)	Water Temperature (°C)	Composite Correction 152H	Actual Hydrometer Readings	% Total Sample (%)	Soil Particle Diameter (mm)
30-Apr-09	8:56	0		6.5			
	8:58	2	21.6	6.5	26.5	21.7	0.0325
	9:01	5	21.7	6.5	22.5	17.4	0.0211
	9:11	15	21.8	6.5	20.0	14.7	0.0124
	9:26	30	21.9	6.5	18.0	12.5	0.0088
	9:56	60	22.1	6.5	16.0	10.3	0.0063
	10:56	120	22.1	6.5	15.0	9.2	0.0045
	13:06	250	21.7	6.5	13.5	7.6	0.0032
01-May-09	8:56	1440	21.9	6.5	11.5	5.4	0.0013



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z3-B4 Sample No.: C-20

Depth (feet) : 94-100 Soil Type : SM

Soil Identification: Brown silty sand (SM)

GR:SA:FI : (%) 2 : 65 : 33

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PARTICLE - SIZE DISTRIBUTION ASTM D 422

May-09

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PARTICLE-SIZE ANALYSIS of SOILS
ASTM D 422

Project Name: SR-710 Tunnel Technical Study
Project No.: 378312.04.09.01
Exploration No.: R-09-Z3-B4
Sample No.: C-22
Soil Identification: Yellowish brown silty sand (SM)

Tested By: V. Juliano Date: 04/28/09
Checked By: J. Ward Date: 05/06/09
Depth (feet): 105-110

		Moisture Content of Total Air - Dry Soil	
Container No.:	745	Wt. of Air-Dry Soil + Cont. (g)	0.00
Wt. of Air-Dried Soil + Cont.(g)	650.70	Wt. of Dry Soil + Cont. (g)	0.00
Wt. of Container (g)	75.20	Wt. of Container No._____ (g)	1.00
Dry Wt. of Soil (g)	575.50	Moisture Content (%)	0.00

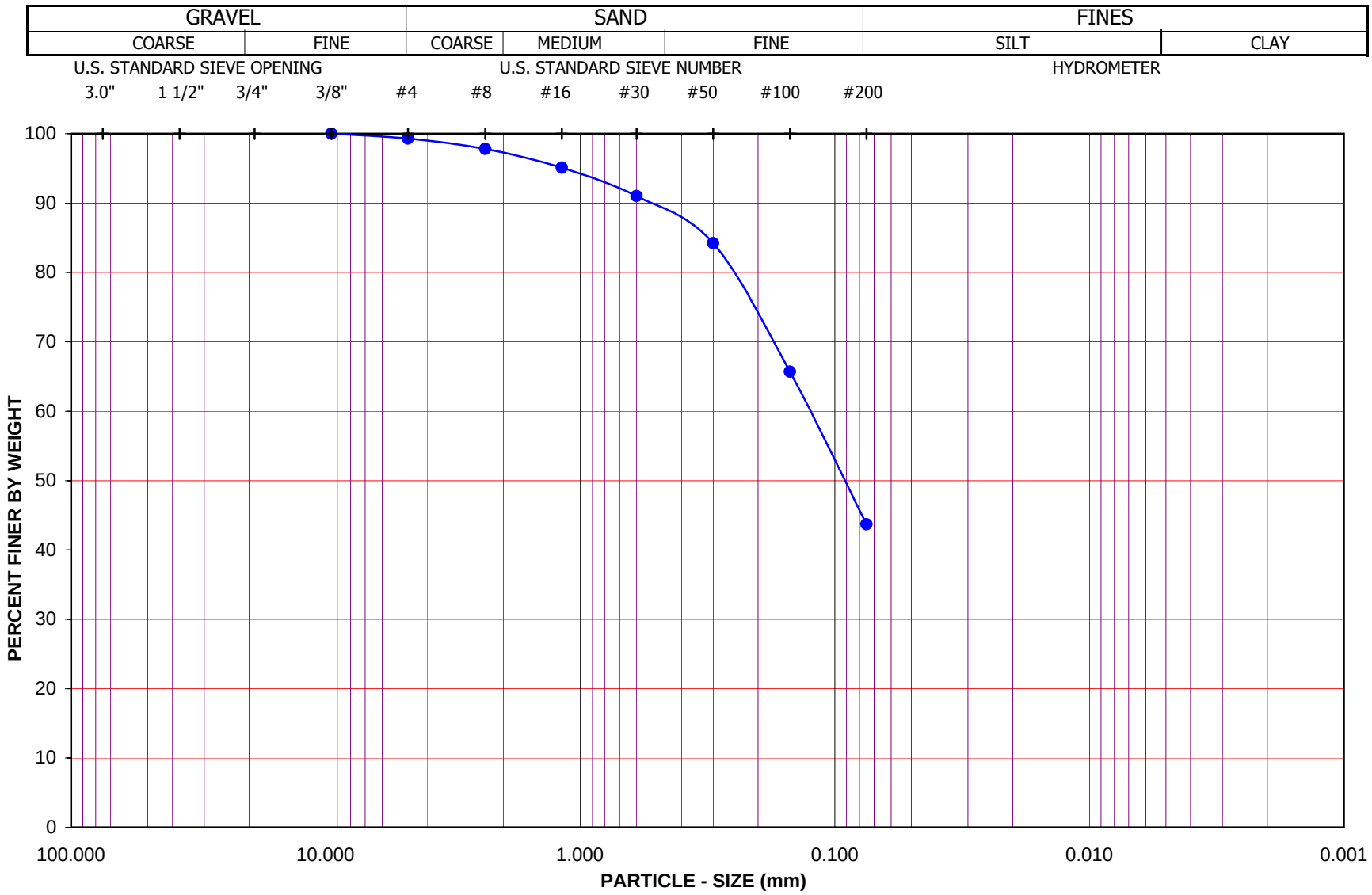
After Wet Sieve	Container No.	745
	Wt. of Dry Soil + Container (g)	408.30
	Wt. of Container (g)	75.20
	Dry Wt. of Soil Retained on # 200 Sieve (g)	333.10

U. S. Sieve Size (in.)	U. S. Sieve Size (mm.)	Cumulative Weight Dry Soil Retained (g)	Percent Passing (%)
6"	152.400		
3"	75.000		
1 1/2	37.500		
3/4"	19.000		
3/8"	9.500	0.00	100.0
#4	4.750	4.30	99.3
#8	2.360	12.40	97.8
#16	1.180	28.30	95.1
#30	0.600	51.90	91.0
#50	0.300	91.00	84.2
#100	0.150	197.20	65.7
#200	0.075	324.00	43.7
PAN			

GRAVEL: **1 %**
SAND: **55 %**
FINES: **44 %**
GROUP SYMBOL: **SM**

Cu = D60/D10 = _____
Cc = $(D30)^2/(D60*D10)$ = _____

Remarks: _____



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z3-B4 Sample No.: C-22

Depth (feet): 105-110 Soil Type : SM

Soil Identification: Yellowish brown silty sand (SM)

GR:SA:FI : (%) 1 : 55 : 44

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PARTICLE - SIZE DISTRIBUTION ASTM D 422

May-09

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PARTICLE-SIZE ANALYSIS of SOILS
ASTM D 422

Project Name: SR-710 Tunnel Technical Study
Project No.: 378312.04.09.01
Exploration No.: R-09-Z3-B4
Sample No.: C-32
Soil Identification: Yellowish brown poorly-graded sand with silt (SP-SM)

Tested By: V. Juliano Date: 04/28/09
Checked By: J. Ward Date: 05/06/09
Depth (feet): 155-160

		Moisture Content of Total Air - Dry Soil	
Container No.:	737	Wt. of Air-Dry Soil + Cont. (g)	0.00
Wt. of Air-Dried Soil + Cont.(g)	616.10	Wt. of Dry Soil + Cont. (g)	0.00
Wt. of Container (g)	76.60	Wt. of Container No._____ (g)	1.00
Dry Wt. of Soil (g)	539.50	Moisture Content (%)	0.00

After Wet Sieve	Container No.	737
	Wt. of Dry Soil + Container (g)	581.10
	Wt. of Container (g)	76.60
	Dry Wt. of Soil Retained on # 200 Sieve (g)	504.50

U. S. Sieve Size (in.)	U. S. Sieve Size (mm.)	Cumulative Weight Dry Soil Retained (g)	Percent Passing (%)
6"	152.400		
3"	75.000		
1 1/2	37.500	0.00	100.0
3/4"	19.000	18.30	96.6
3/8"	9.500	37.70	93.0
#4	4.750	48.60	91.0
#8	2.360	52.20	90.3
#16	1.180	61.60	88.6
#30	0.600	147.20	72.7
#50	0.300	372.00	31.0
#100	0.150	471.30	12.6
#200	0.075	503.90	6.6
PAN			

GRAVEL: **9 %**
SAND: **84 %**
FINES: **7 %**
GROUP SYMBOL: **SP-SM**

Cu = D60/D10 = 3.77
Cc = $(D30)^2/(D60*D10)$ = 1.32

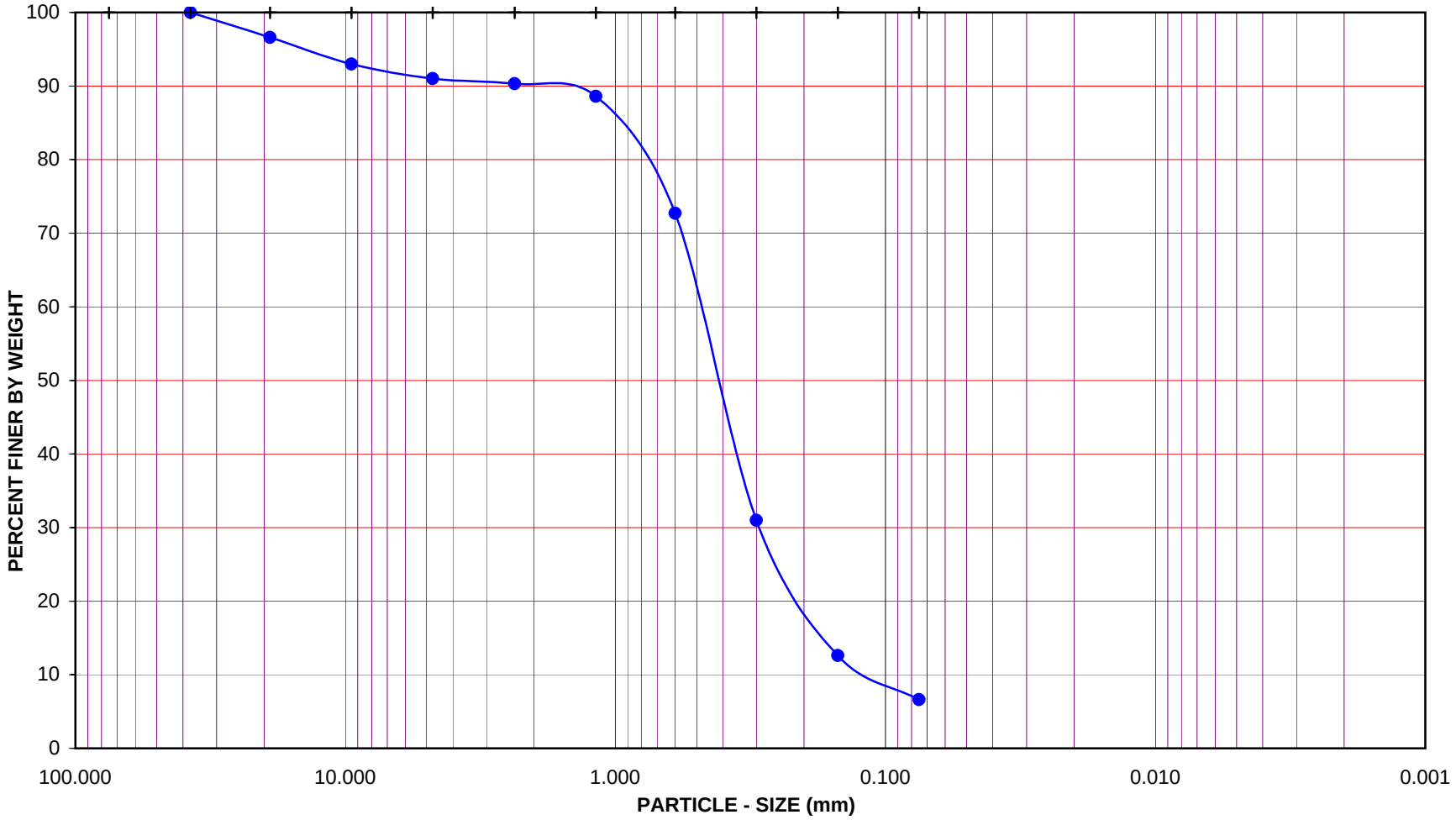
Remarks: Insufficient sample mass available to meet the ASTM specification for this material

GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY

U.S. STANDARD SIEVE OPENING: 3.0" 1 1/2" 3/4" 3/8"

U.S. STANDARD SIEVE NUMBER: #4 #8 #16 #30 #50 #100 #200

HYDROMETER



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z3-B4 Sample No.: C-32

Depth (feet): 155-160 Soil Type : SP-SM

Soil Identification: Yellowish brown poorly-graded sand with silt (SP-SM)

GR:SA:FI : (%) 9 : 84 : 7

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PARTICLE - SIZE DISTRIBUTION ASTM D 422

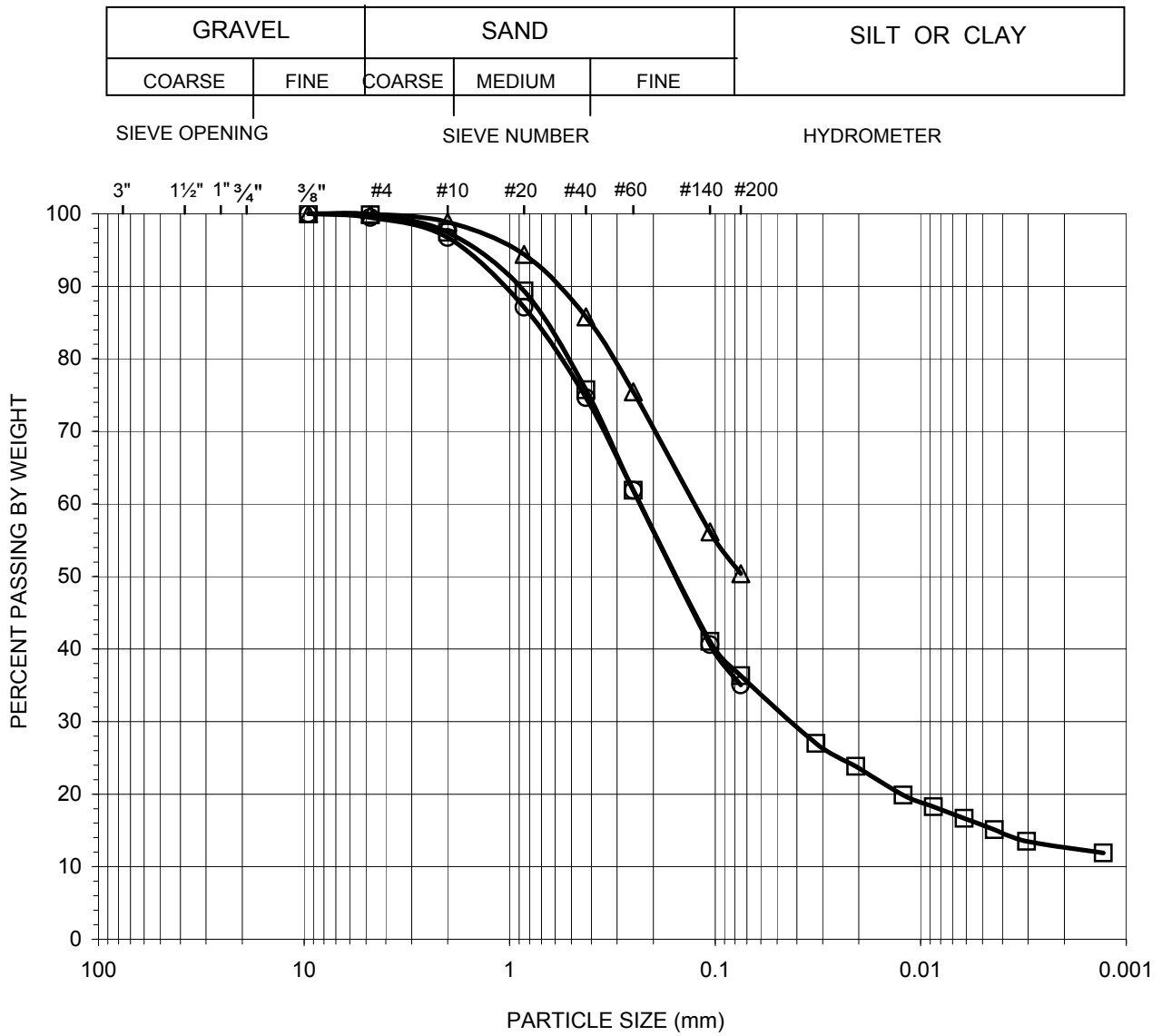
May-09

SA R-09-Z3-B4, C-32 @ 155-160

AP Engineering & Testing, Inc.

GRAIN SIZE DISTRIBUTION CURVE
ASTM D 422

Project Name: SR-710 Tunnel Technical Study Tested by: DK Date: 06/02/09
Project Number: 378312.04.09.01 Checked by: AP Date: 06/11/09

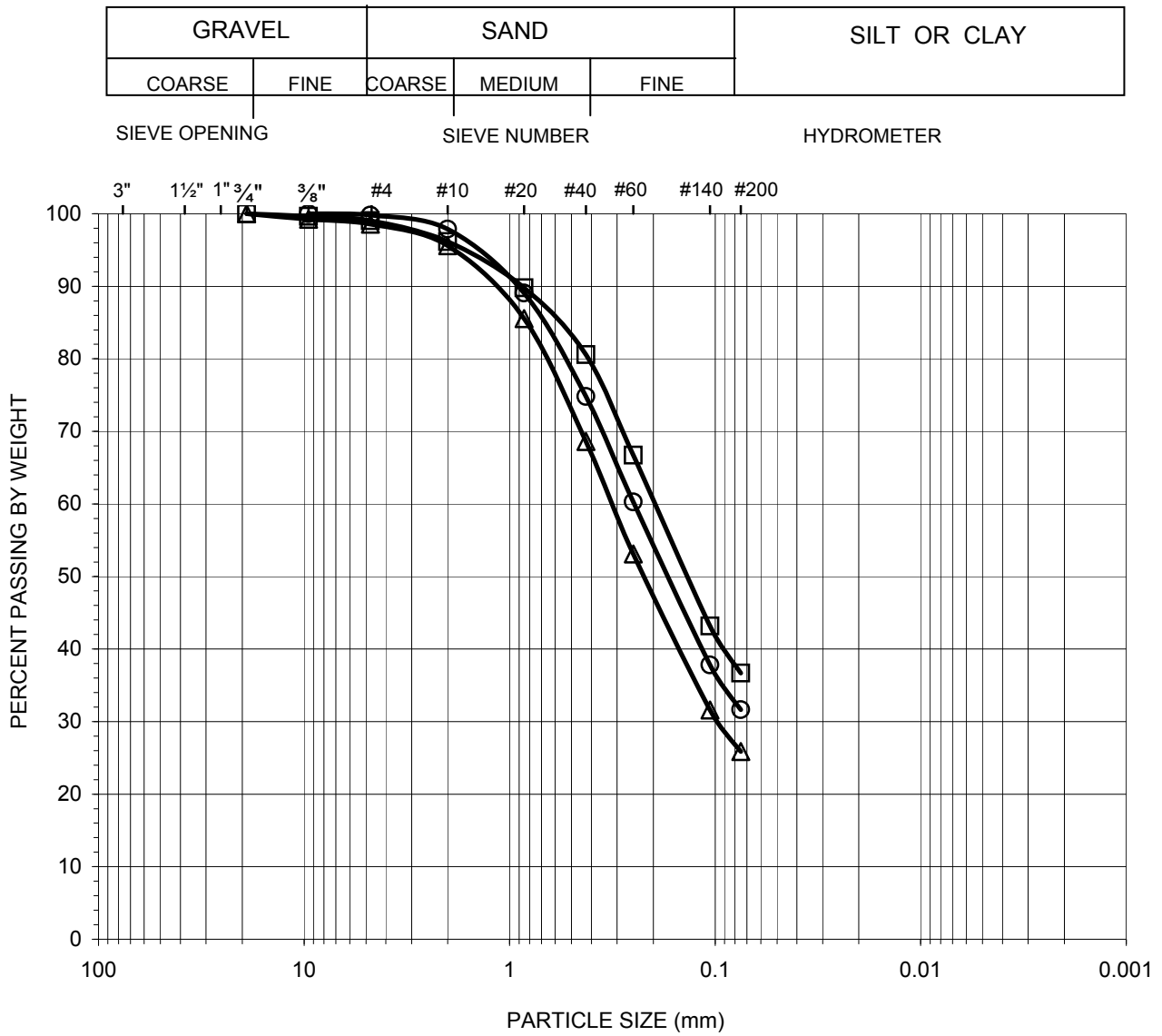


Symbol	Boring No.	Sample No.	Sample Date	Percent			Atterberg Limits LL:PL:PI	Soil Type U.S.C.S
				Gravel	Sand	Fines		
○	R-09-Z3-B5	S-7	35-36.5	0.53	64.43	35.04	N/A	SM
□	R-09-Z3-B5	S-11	55-56.5	0.17	63.49	36.34	N/A	SM
△	R-09-Z3-B5	S-13	65-66.5	0.04	49.56	50.40	N/A	ML

AP Engineering & Testing, Inc.

GRAIN SIZE DISTRIBUTION CURVE
ASTM D 422

Project Name: SR-710 Tunnel Technical Study Tested by: DK Date: 06/02/09
Project Number: 378312.04.09.01 Checked by: AP Date: 06/11/09



Symbol	Boring No.	Sample No.	Depth (feet)	Percent			Atterberg Limits LL:PL:PI	Soil Type U.S.C.S
				Gravel	Sand	Fines		
○	R-09-Z3-B5	C-16	75-80	0.21	68.15	31.64	N/A	SM
□	R-09-Z3-B5	C-28	135-140	0.95	62.36	36.69	N/A	SM
△	R-09-Z3-B5	C-35	170-175	1.43	72.69	25.88	N/A	SM

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PARTICLE-SIZE ANALYSIS of SOILS
ASTM D 422

Project Name: SR-710 Tunnel Technical Study
Project No.: 378312.04.09.01
Exploration No.: R-09-Z3-B6
Sample No.: S2
Soil Identification: Dark olive silty sand with gravel (SM)g

Tested By: V. Juliano Date: 04/28/09
Checked By: J. Ward Date: 05/07/09
Depth (feet): 10.0

		Moisture Content of Total Air - Dry Soil	
Container No.:	R-2	Wt. of Air-Dry Soil + Cont. (g)	0.00
Wt. of Air-Dried Soil + Cont.(g)	1004.60	Wt. of Dry Soil + Cont. (g)	0.00
Wt. of Container (g)	108.80	Wt. of Container No._____ (g)	1.00
Dry Wt. of Soil (g)	895.80	Moisture Content (%)	0.00

After Wet Sieve	Container No.	R-2
	Wt. of Dry Soil + Container (g)	865.10
	Wt. of Container (g)	108.80
	Dry Wt. of Soil Retained on # 200 Sieve (g)	756.30

U. S. Sieve Size (in.)	U. S. Sieve Size (mm.)	Cumulative Weight Dry Soil Retained (g)	Percent Passing (%)
6"	152.400		
3"	75.000		
1 1/2	37.500	0.00	100.0
3/4"	19.000	71.90	92.0
3/8"	9.500	157.10	82.5
#4	4.750	245.90	72.5
#8	2.360	330.10	63.2
#16	1.180	414.60	53.7
#30	0.600	504.20	43.7
#50	0.300	616.70	31.2
#100	0.150	704.50	21.4
#200	0.075	752.10	16.0
PAN			

GRAVEL: **28 %**
SAND: **56 %**
FINES: **16 %**
GROUP SYMBOL: **(SM)g**

Cu = D60/D10 = _____
Cc = $(D30)^2/(D60*D10)$ = _____

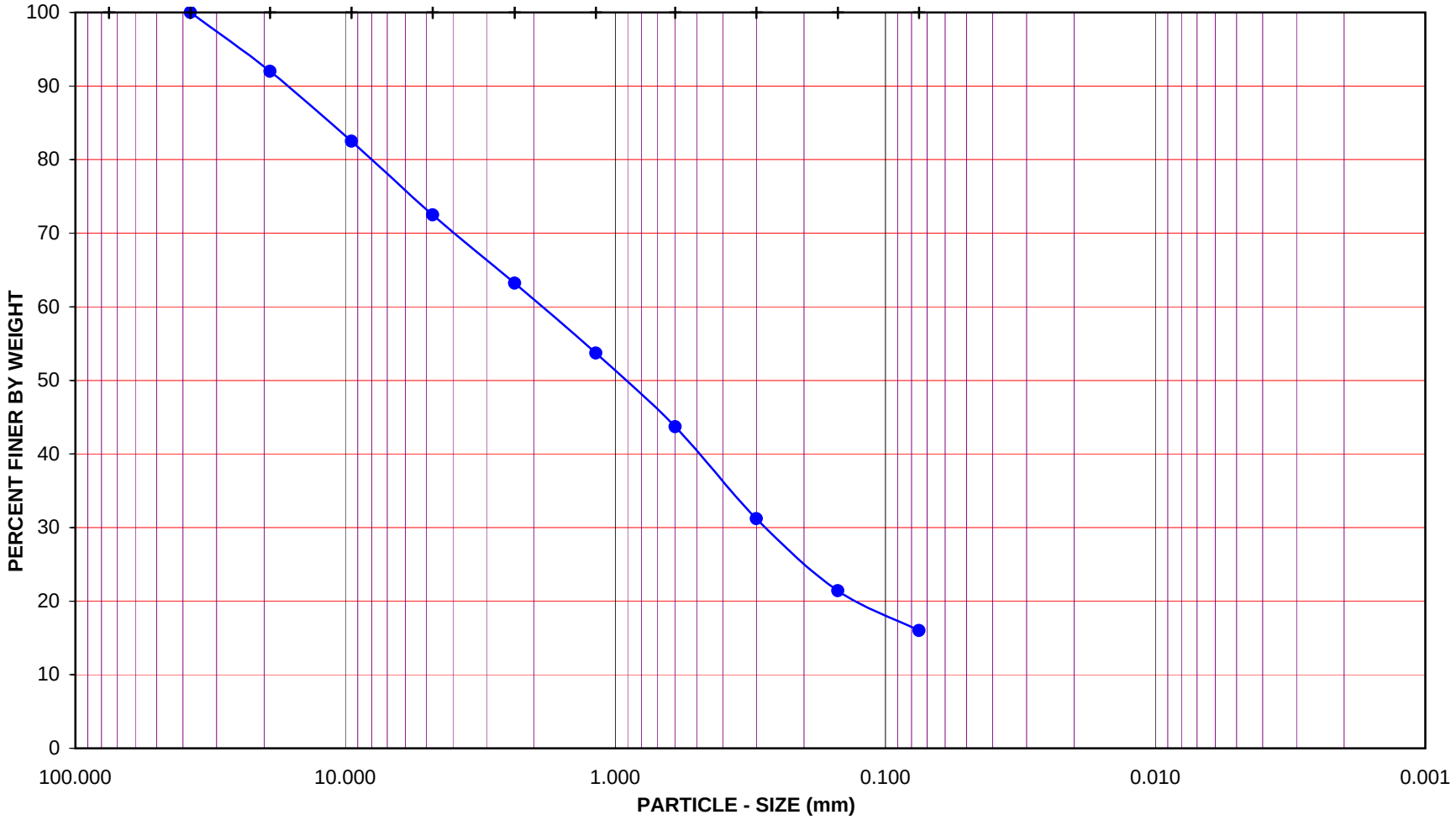
Remarks: Insufficient sample mass available to meet the ASTM specification for this material

GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY

U.S. STANDARD SIEVE OPENING: 3.0" 1 1/2" 3/4" 3/8"

U.S. STANDARD SIEVE NUMBER: #4 #8 #16 #30 #50 #100 #200

HYDROMETER



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z3-B6 Sample No.: S2

Depth (feet): 10.0 Soil Type : (SM)g

Soil Identification: Dark olive silty sand with gravel (SM)g

GR:SA:FI : (%) 28 : 56 : 16

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PARTICLE - SIZE DISTRIBUTION ASTM D 422

May-09

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PARTICLE-SIZE ANALYSIS of SOILS
ASTM D 422

Project Name: SR-710 Tunnel Technical Study
Project No.: 378312.04.09.01
Exploration No.: R-09-Z3-B6
Sample No.: S1
Soil Identification: Brown silty sand (SM)

Tested By: V. Juliano Date: 04/28/09
Checked By: J. Ward Date: 05/07/09
Depth (feet): 5.0

		Moisture Content of Total Air - Dry Soil	
Container No.:	531	Wt. of Air-Dry Soil + Cont. (g)	0.00
Wt. of Air-Dried Soil + Cont.(g)	446.50	Wt. of Dry Soil + Cont. (g)	0.00
Wt. of Container (g)	78.00	Wt. of Container No._____ (g)	1.00
Dry Wt. of Soil (g)	368.50	Moisture Content (%)	0.00

After Wet Sieve	Container No.	531
	Wt. of Dry Soil + Container (g)	320.50
	Wt. of Container (g)	78.00
	Dry Wt. of Soil Retained on # 200 Sieve (g)	242.50

U. S. Sieve Size (in.)	U. S. Sieve Size (mm.)	Cumulative Weight Dry Soil Retained (g)	Percent Passing (%)
6"	152.400		
3"	75.000		
1 1/2	37.500		
3/4"	19.000	0.00	100.0
3/8"	9.500	4.90	98.7
#4	4.750	13.20	96.4
#8	2.360	31.90	91.3
#16	1.180	67.10	81.8
#30	0.600	111.30	69.8
#50	0.300	158.70	56.9
#100	0.150	203.90	44.7
#200	0.075	240.70	34.7
PAN			

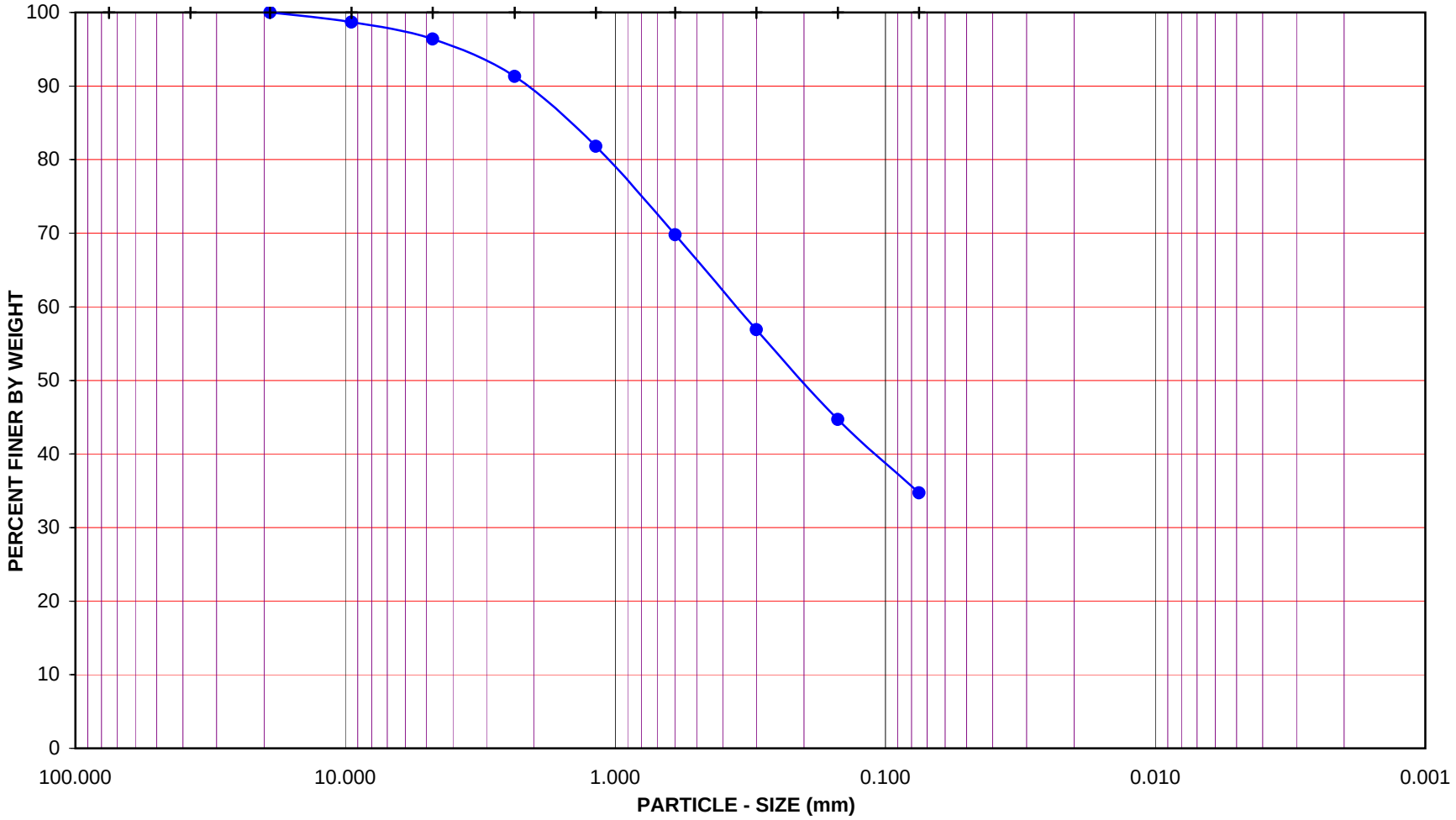
GRAVEL: **4 %**
SAND: **61 %**
FINES: **35 %**
GROUP SYMBOL: **SM**

Cu = D60/D10 = _____
Cc = $(D30)^2/(D60*D10)$ = _____

Remarks: Insufficient sample mass available to meet the ASTM specification for this material

GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY

U.S. STANDARD SIEVE OPENING: 3.0" | 1 1/2" | 3/4" | 3/8"
U.S. STANDARD SIEVE NUMBER: #4 | #8 | #16 | #30 | #50 | #100 | #200
HYDROMETER



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z3-B6 Sample No.: S1

Depth (feet): 5.0 Soil Type : SM

Soil Identification: Brown silty sand (SM)

GR:SA:FI : (%) 4 : 61 : 35

Leighton

PARTICLE - SIZE DISTRIBUTION ASTM D 422

May-09

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PARTICLE-SIZE ANALYSIS OF SOILS

ASTM D 422

Project Name: SR-710 Tunnel Technical Study | Tested By : V. Juliano | Date: 05/01/09

Project No. : 378312.04.09.01 | Data Input By: J. Ward | Date: 05/15/09

Exploration No.: R-09-Z3-B6

Sample No.: C27 | Depth (feet) : 173.0

Soil Identification: Light gray silty sand with gravel (SM)g

% Gravel	**16**	**Soil Type**	Moisture Content of Total Air-Dry Soil	Moisture Content of Air-Dry Soil Passing #10	After Hydrometer & Wet Sieve ret. in #200 Sieve
% Sand	**65**	**(SM)g**			
% Fines	**19**				

Specific Gravity (Assumed)	2.70	Wt.of Air-Dry Soil + Cont.(g)	0.00	0.00	
Correction for Specific Gravity	0.99	Dry Wt. of Soil + Cont. (g)	0.00	0.00	154.13
Wt.of Air-Dry Soil + Cont. (g)	1971.80	Wt. of Container No.___ (g)	1.00	1.00	77.33
Wt. of Container	217.40	Moisture Content (%)	0.00	0.00	
Dry Wt. of Soil (g)	1754.40	Wt. of Dry Soil (g)			76.80

Coarse Sieve

U.S. Sieve	Cumulative Wt. Of Dry Soil Retained (g)	% Passing
3"	0.00	100.0
1½"	0.00	100.0
3/4"	92.42	94.7
3/8"	197.21	88.8
No. 4	278.70	84.1
No. 10	458.50	73.9
Pan		

Sieve after Hydrometer & Wet Sieve

U.S. Sieve Size	Cumulative Wt. Of Dry Soil Retained (g)	% Passing	% Total Sample
No. 10	0.00	100.0	73.9
No. 16	8.74	91.3	67.4
No. 30	22.14	77.9	57.5
No. 50	39.02	61.0	45.0
No. 100	59.40	40.6	30.0
No. 200	74.18	25.8	19.1
Pan			

Hydrometer Wt. of Air-Dry Soil (g) 100.00 Wt. of Dry Soil (g) 100.00

Deflocculant 125 cc of 4% Solution

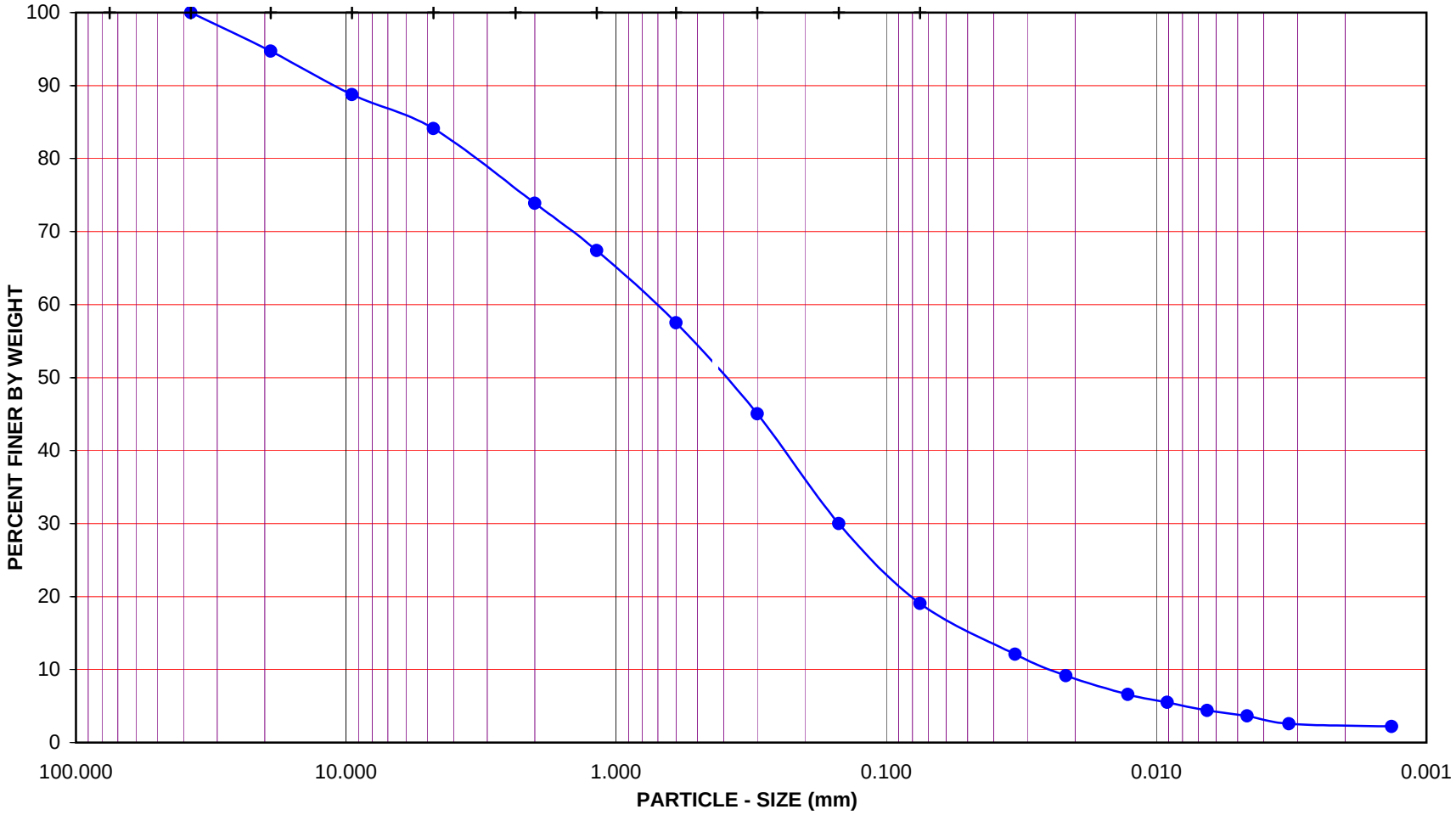
Date	Time	Elapsed Time (min)	Water Temperature (°C)	Composite Correction 152H	Actual Hydrometer Readings	% Total Sample (%)	Soil Particle Diameter (mm)
08-May-09	8:27	0		6.0			
	8:29	2	21.1	6.0	22.5	12.1	0.0333
	8:32	5	21.1	6.0	18.5	9.2	0.0216
	8:42	15	21.4	6.0	15.0	6.6	0.0127
	8:57	30	21.1	6.0	13.5	5.5	0.0091
	9:27	60	21.3	6.0	12.0	4.4	0.0065
	10:27	120	21.6	6.0	11.0	3.7	0.0046
	12:37	250	21.5	6.0	9.5	2.6	0.0032
09-May-09	8:27	1440	21.1	6.0	9.0	2.2	0.0013

GRAVEL		SAND			FINES	
COARSE	FINE	CRSE	MEDIUM	FINE	SILT	CLAY

U.S. STANDARD SIEVE OPENING: 3.0" 1 1/2" 3/4" 3/8"

U.S. STANDARD SIEVE NUMBER: #4 #8 #16 #30 #50 #100 #200

HYDROMETER



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z3-B6 Sample No.: C27

Depth (feet) : 173.0 Soil Type : (SM)g

Soil Identification: Light gray silty sand with gravel (SM)g

GR:SA:FI : (%) 16 : 65 : 19

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PARTICLE - SIZE DISTRIBUTION ASTM D 422

May-09

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PARTICLE-SIZE ANALYSIS OF SOILS

ASTM D 422

Project Name: SR-710 Tunnel Technical Study | Tested By : V. Juliano | Date: 05/01/09

Project No. : 378312.04.09.01 | Data Input By: J. Ward | Date: 05/15/09

Exploration No.: R-09-Z3-B6

Sample No.: C52 | Depth (feet) : 299.0

Soil Identification: Light gray silty sand with gravel (SM)g

% Gravel	**22**	**Soil Type**	Moisture Content of Total Air-Dry Soil	Moisture Content of Air-Dry Soil Passing #10	After Hydrometer & Wet Sieve ret. in #200 Sieve
% Sand	**56**	**(SM)g**			
% Fines	**22**				
Specific Gravity (Assumed)	2.70	Wt.of Air-Dry Soil + Cont.(g)	0.00	0.00	
Correction for Specific Gravity	0.99	Dry Wt. of Soil + Cont. (g)	0.00	0.00	148.70
Wt.of Air-Dry Soil + Cont. (g)	1088.20	Wt. of Container No.___ (g)	1.00	1.00	79.45
Wt. of Container	218.30	Moisture Content (%)	0.00	0.00	
Dry Wt. of Soil (g)	869.90	Wt. of Dry Soil (g)			69.25

Coarse Sieve

U.S. Sieve	Cumulative Wt. Of Dry Soil Retained (g)	% Passing
3"	0.00	100.0
1½"	0.00	100.0
3/4"	91.10	89.5
3/8"	140.73	83.8
No. 4	195.32	77.5
No. 10	284.80	67.3
Pan		

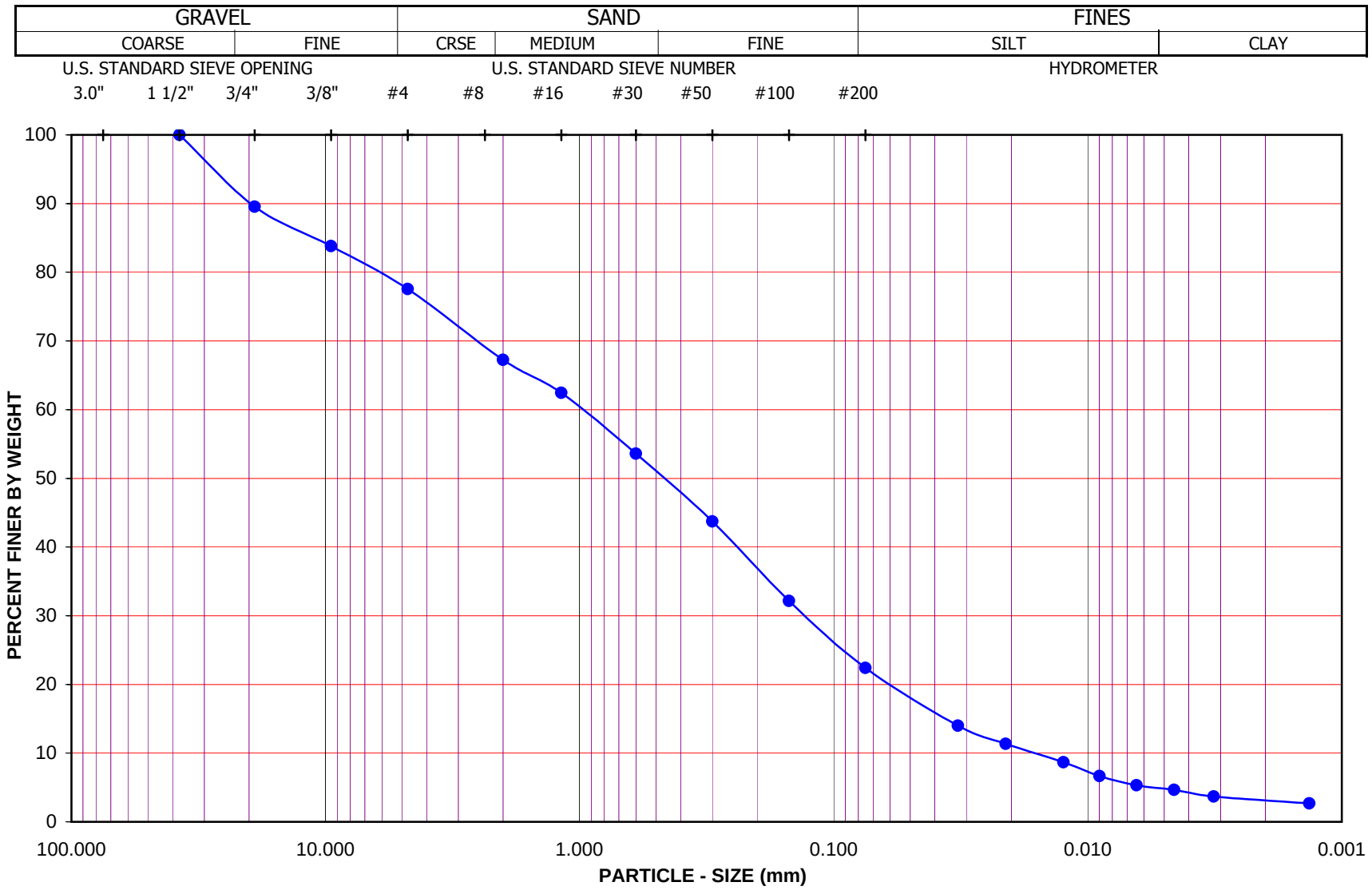
Sieve after Hydrometer & Wet Sieve

U.S. Sieve Size	Cumulative Wt. Of Dry Soil Retained (g)	% Passing	% Total Sample
No. 10	0.00	100.0	67.3
No. 16	7.17	92.8	62.4
No. 30	20.35	79.7	53.6
No. 50	35.02	65.0	43.7
No. 100	52.19	47.8	32.2
No. 200	66.71	33.3	22.4
Pan			

Hydrometer Wt. of Air-Dry Soil (g) 100.02 Wt. of Dry Soil (g) 100.02

Deflocculant 125 cc of 4% Solution

Date	Time	Elapsed Time (min)	Water Temperature (°C)	Composite Correction 152H	Actual Hydrometer Readings	% Total Sample (%)	Soil Particle Diameter (mm)
08-May-09	8:31	0		6.0			
	8:33	2	21.1	6.0	27.0	14.0	0.0324
	8:36	5	21.2	6.0	23.0	11.3	0.0210
	8:46	15	21.3	6.0	19.0	8.7	0.0125
	9:01	30	21.2	6.0	16.0	6.7	0.0090
	9:31	60	21.4	6.0	14.0	5.3	0.0064
	10:31	120	21.4	6.0	13.0	4.7	0.0046
	12:41	250	21.5	6.0	11.5	3.7	0.0032
09-May-09	8:31	1440	21.1	6.0	10.0	2.7	0.0013



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z3-B6 Sample No.: C52

Depth (feet) : 299.0 Soil Type : (SM)g

Soil Identification: Light gray silty sand with gravel (SM)g

GR:SA:FI : (%) 22 : 56 : 22

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PARTICLE - SIZE DISTRIBUTION ASTM D 422

May-09

SA & Hyd R-09-Z3-B6, C @ 299

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PARTICLE-SIZE ANALYSIS OF SOILS

ASTM D 422

Project Name: SR-710 Tunnel Technical Study | Tested By : V. Juliano | Date: 04/28/09

Project No. : 378312.04.09.01 | Data Input By: J. Ward | Date: 05/07/09

Exploration No.: R-09-Z3-B6

Sample No.: C53 | Depth (feet) : 304.5

Soil Identification: Light gray silty sand (SM)

% Gravel	**9**	**Soil Type**	Moisture Content of Total Air-Dry Soil	Moisture Content of Air-Dry Soil Passing #10	After Hydrometer & Wet Sieve ret. in #200 Sieve
% Sand	**58**	**SM**			
% Fines	**33**				

Specific Gravity (Assumed)	2.70	Wt.of Air-Dry Soil + Cont.(g)	0.00	0.00	
Correction for Specific Gravity	0.99	Dry Wt. of Soil + Cont. (g)	0.00	0.00	127.21
Wt.of Air-Dry Soil + Cont. (g)	1334.50	Wt. of Container No.___ (g)	1.00	1.00	77.25
Wt. of Container	111.20	Moisture Content (%)	0.00	0.00	
Dry Wt. of Soil (g)	1223.30	Wt. of Dry Soil (g)			49.96

Coarse Sieve

U.S. Sieve	Cumulative Wt. Of Dry Soil Retained (g)	% Passing
3"	0.00	100.0
1½"	0.00	100.0
3/4"	42.10	96.6
3/8"	74.10	93.9
No. 4	113.60	90.7
No. 10	168.60	86.2
Pan		

Sieve after Hydrometer & Wet Sieve

U.S. Sieve Size	Cumulative Wt. Of Dry Soil Retained (g)	% Passing	% Total Sample
No. 10	0.00	100.0	86.2
No. 16	3.12	96.1	82.9
No. 30	10.10	87.4	75.4
No. 50	21.01	73.9	63.7
No. 100	36.34	54.8	47.2
No. 200	49.42	38.5	33.2
Pan			

Hydrometer Wt. of Air-Dry Soil (g) 80.38 Wt. of Dry Soil (g) 80.38

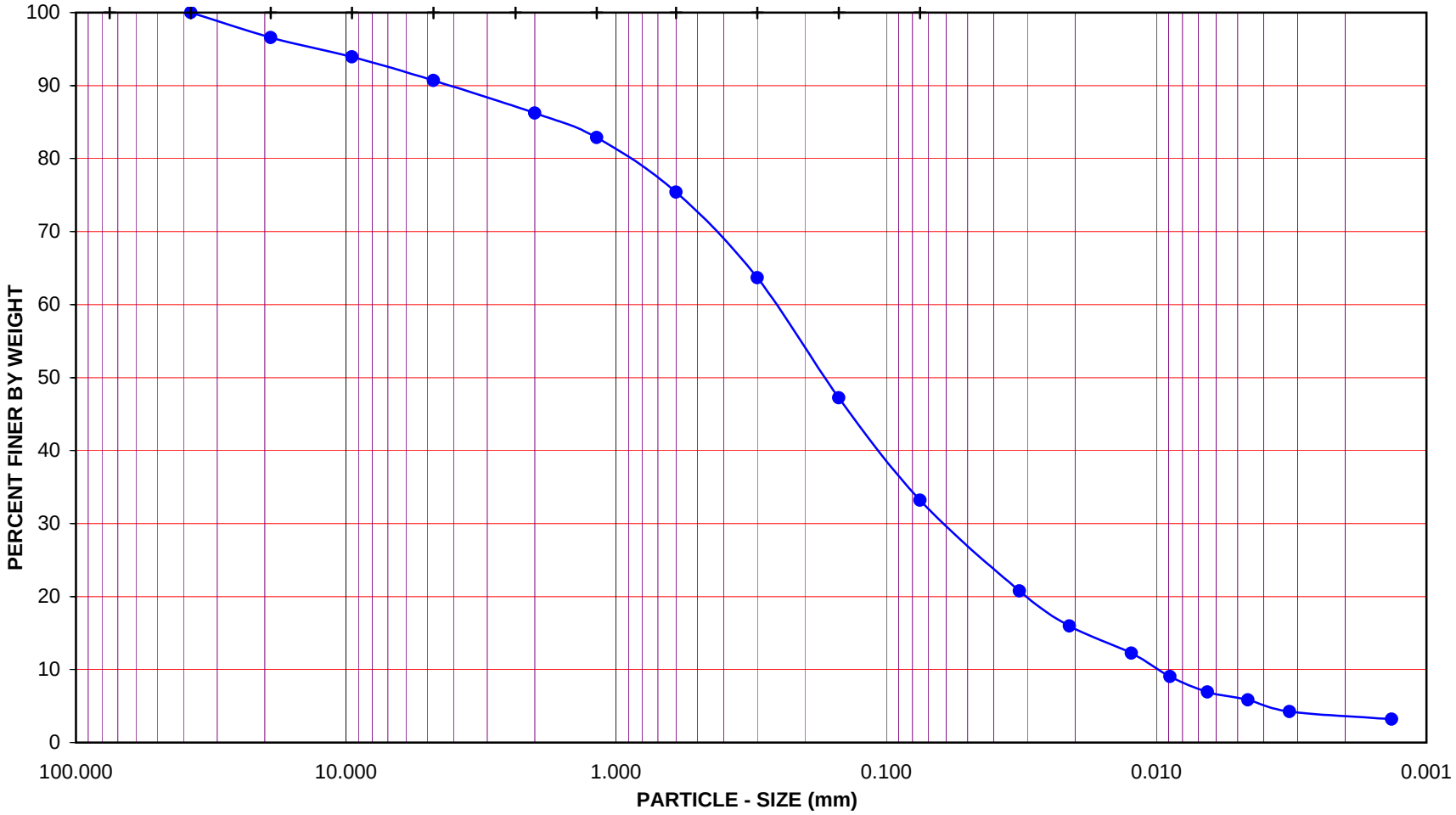
Deflocculant 125 cc of 4% Solution

Date	Time	Elapsed Time (min)	Water Temperature (°C)	Composite Correction 152H	Actual Hydrometer Readings	% Total Sample (%)	Soil Particle Diameter (mm)
30-Apr-09	10:18	0		6.5			
	10:20	2	22.3	6.5	26.0	20.7	0.0321
	10:23	5	22.4	6.5	21.5	16.0	0.0210
	10:33	15	22.0	6.5	18.0	12.2	0.0124
	10:48	30	22.0	6.5	15.0	9.0	0.0089
	11:18	60	21.8	6.5	13.0	6.9	0.0065
	12:18	120	21.9	6.5	12.0	5.9	0.0046
	14:28	250	21.7	6.5	10.5	4.3	0.0032
01-May-09	10:18	1440	21.5	6.5	9.5	3.2	0.0013

GRAVEL		SAND			FINES	
COARSE	FINE	CRSE	MEDIUM	FINE	SILT	CLAY

U.S. STANDARD SIEVE OPENING | U.S. STANDARD SIEVE NUMBER | HYDROMETER

3.0" 1 1/2" 3/4" 3/8" #4 #8 #16 #30 #50 #100 #200



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z3-B6 Sample No.: C53

Depth (feet) : 304.5 Soil Type : SM

Soil Identification: Light gray silty sand (SM)

GR:SA:FI : (%) 9 : 58 : 33

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PARTICLE - SIZE DISTRIBUTION ASTM D 422

May-09

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PARTICLE-SIZE ANALYSIS of SOILS
ASTM D 422

Project Name: SR-710 Tunnel Technical Study
Project No.: 378312.04.09.01
Exploration No.: R-09-Z3-B7
Sample No.: C-19
Soil Identification: Gray silty sand'stone' (SM)

Tested By: V. Juliano Date: 05/13/09
Checked By: J. Ward Date: 05/21/09
Depth (feet): 96-96.4

		Moisture Content of Total Air - Dry Soil	
Container No.:	731	Wt. of Air-Dry Soil + Cont. (g)	0.00
Wt. of Air-Dried Soil + Cont.(g)	723.40	Wt. of Dry Soil + Cont. (g)	0.00
Wt. of Container (g)	77.00	Wt. of Container No._____ (g)	1.00
Dry Wt. of Soil (g)	646.40	Moisture Content (%)	0.00

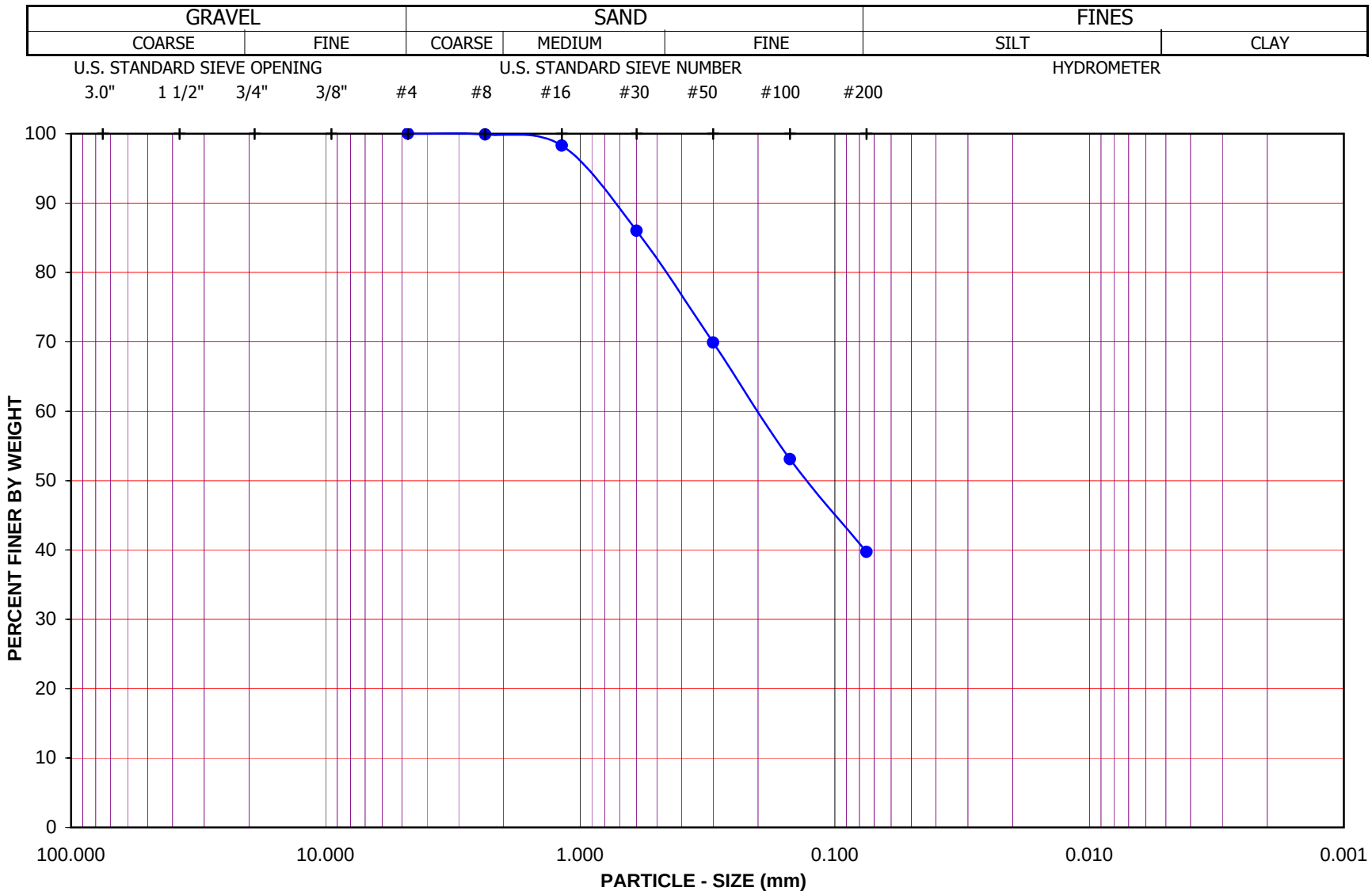
After Wet Sieve	Container No.	731
	Wt. of Dry Soil + Container (g)	478.90
	Wt. of Container (g)	77.00
	Dry Wt. of Soil Retained on # 200 Sieve (g)	401.90

U. S. Sieve Size (in.)	U. S. Sieve Size (mm.)	Cumulative Weight Dry Soil Retained (g)	Percent Passing (%)
6"	152.400		
3"	75.000		
1 1/2	37.500		
3/4"	19.000		
3/8"	9.500		
#4	4.750	0.00	100.0
#8	2.360	0.40	99.9
#16	1.180	11.10	98.3
#30	0.600	90.80	86.0
#50	0.300	194.60	69.9
#100	0.150	302.90	53.1
#200	0.075	390.00	39.7
PAN			

GRAVEL: **0 %**
SAND: **60 %**
FINES: **40 %**
GROUP SYMBOL: **SM**

Cu = D60/D10 = _____
Cc = $(D30)^2/(D60*D10)$ = _____

Remarks:



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z3-B7 Sample No.: C-19

Depth (feet): 96-96.4 Soil Type : SM

Soil Identification: Gray silty sand'stone' (SM)

GR:SA:FI : (%) 0 : 60 : 40

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PARTICLE - SIZE DISTRIBUTION ASTM D 422

May-09

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PARTICLE-SIZE ANALYSIS of SOILS
ASTM D 422

Project Name: SR-710 Tunnel Technical Study
Project No.: 378312.04.09.01
Exploration No.: R-09-Z3-B7
Sample No.: C-23
Soil Identification: Gray silty sand'stone' (SM)

Tested By: A. Santos Date: 05/13/09
Checked By: J. Ward Date: 05/21/09
Depth (feet): 120.1-120.7

		Moisture Content of Total Air - Dry Soil	
Container No.:	780	Wt. of Air-Dry Soil + Cont. (g)	0.00
Wt. of Air-Dried Soil + Cont.(g)	865.30	Wt. of Dry Soil + Cont. (g)	0.00
Wt. of Container (g)	76.10	Wt. of Container No._____ (g)	1.00
Dry Wt. of Soil (g)	789.20	Moisture Content (%)	0.00

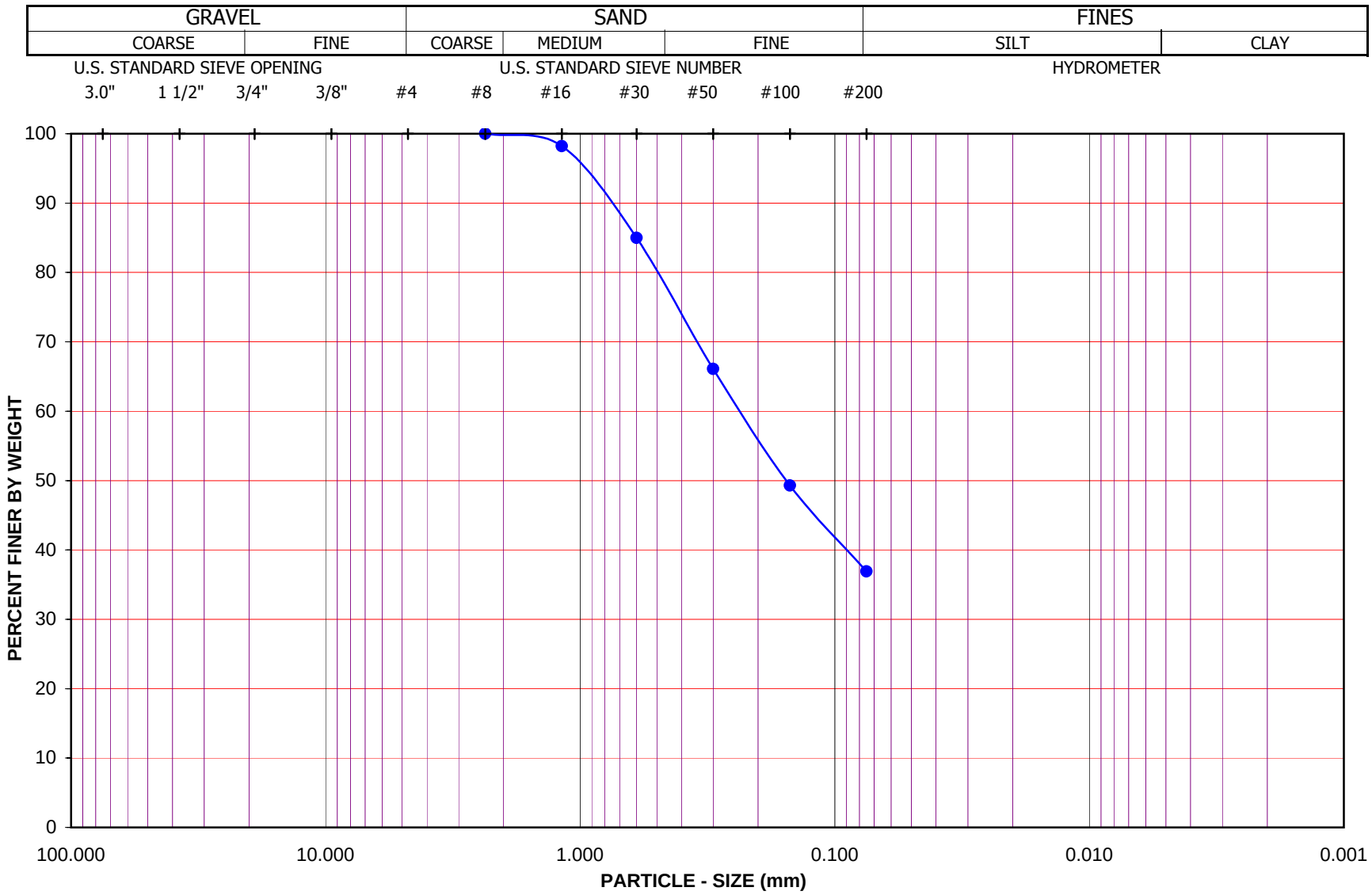
After Wet Sieve	Container No.	780
	Wt. of Dry Soil + Container (g)	590.30
	Wt. of Container (g)	76.10
	Dry Wt. of Soil Retained on # 200 Sieve (g)	514.20

U. S. Sieve Size (in.)	U. S. Sieve Size (mm.)	Cumulative Weight Dry Soil Retained (g)	Percent Passing (%)
6"	152.400		
3"	75.000		
1 1/2	37.500		
3/4"	19.000		
3/8"	9.500		
#4	4.750		
#8	2.360	0.00	100.0
#16	1.180	14.30	98.2
#30	0.600	118.60	85.0
#50	0.300	267.90	66.1
#100	0.150	400.30	49.3
#200	0.075	498.30	36.9
PAN			

GRAVEL: **0 %**
SAND: **63 %**
FINES: **37 %**
GROUP SYMBOL: **SM**

Cu = D60/D10 = _____
Cc = $(D30)^2/(D60*D10)$ = _____

Remarks:



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z3-B7 Sample No.: C-23

Depth (feet): 120.1-120.7 Soil Type : SM

Soil Identification: Gray silty sand'stone' (SM)

GR:SA:FI : (%) 0 : 63 : 37

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PARTICLE - SIZE DISTRIBUTION ASTM D 422

May-09

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PARTICLE-SIZE ANALYSIS of SOILS
ASTM D 422

Project Name: SR-710 Tunnel Technical Study
Project No.: 378312.04.09.01
Exploration No.: R-09-Z3-B7
Sample No.: O-18
Soil Identification: Yellowish brown sandy silt s(ML)

Tested By: V. Juliano Date: 04/09/09
Checked By: J. Ward Date: 04/29/09
Depth (feet): 51-53.5

		Moisture Content of Total Air - Dry Soil	
Container No.:	788	Wt. of Air-Dry Soil + Cont. (g)	0.00
Wt. of Air-Dried Soil + Cont.(g)	519.70	Wt. of Dry Soil + Cont. (g)	0.00
Wt. of Container (g)	75.90	Wt. of Container No._____ (g)	1.00
Dry Wt. of Soil (g)	443.80	Moisture Content (%)	0.00

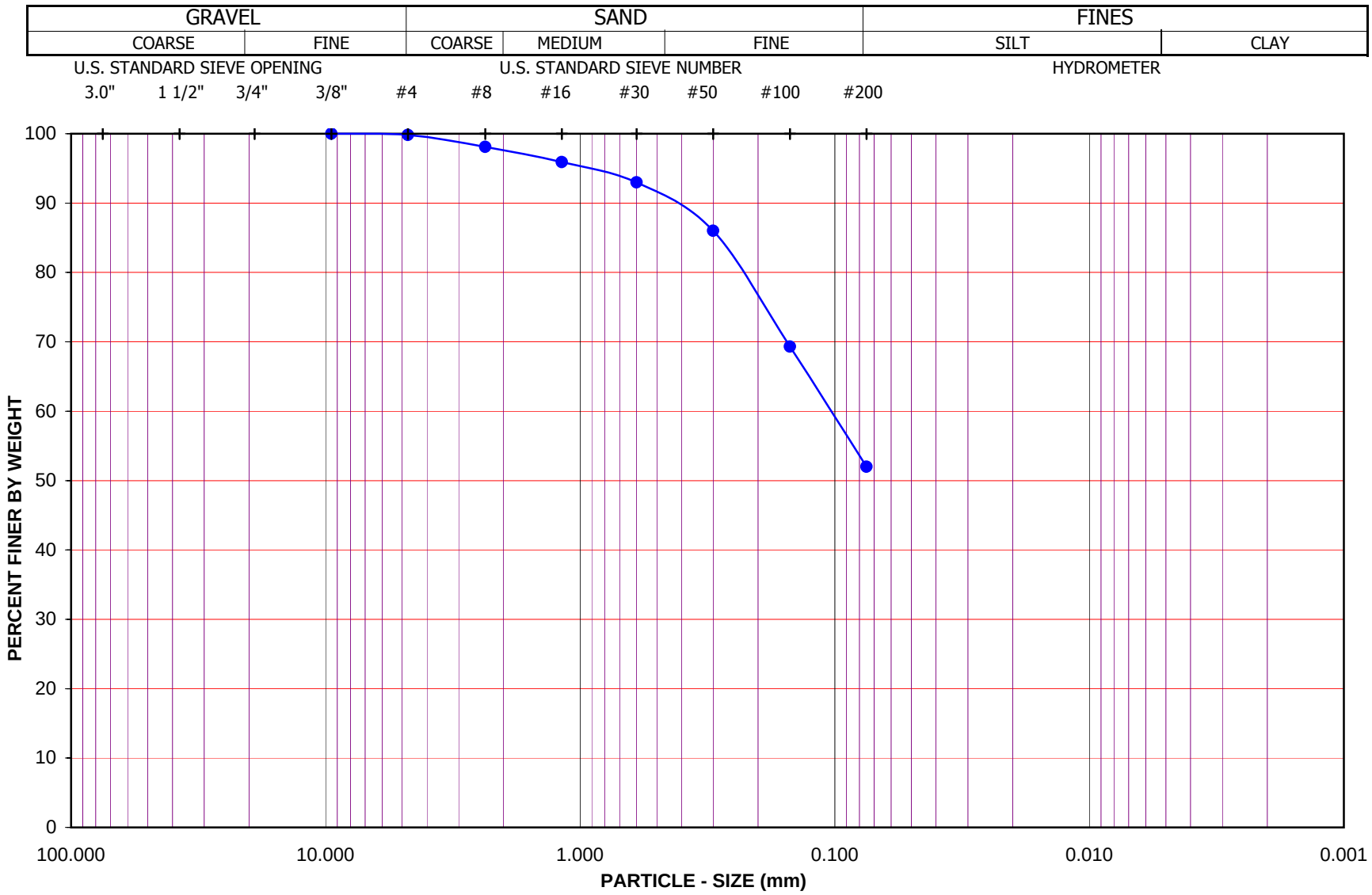
After Wet Sieve	Container No.	788
	Wt. of Dry Soil + Container (g)	290.00
	Wt. of Container (g)	75.90
	Dry Wt. of Soil Retained on # 200 Sieve (g)	214.10

U. S. Sieve Size (in.)	U. S. Sieve Size (mm.)	Cumulative Weight Dry Soil Retained (g)	Percent Passing (%)
6"	152.400		
3"	75.000		
1 1/2	37.500		
3/4"	19.000		
3/8"	9.500	0.00	100.0
#4	4.750	0.94	99.8
#8	2.360	8.65	98.1
#16	1.180	18.00	95.9
#30	0.600	31.15	93.0
#50	0.300	62.12	86.0
#100	0.150	136.41	69.3
#200	0.075	213.20	52.0
PAN			

GRAVEL: **0 %**
SAND: **48 %**
FINES: **52 %**
GROUP SYMBOL: **s(ML)**

Cu = D60/D10 = _____
Cc = $(D30)^2/(D60*D10)$ = _____

Remarks:



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z3-B7 Sample No.: O-18

Depth (feet): 51-53.5 Soil Type : s(ML)

Soil Identification: Yellowish brown sandy silt s(ML)

GR:SA:FI : (%) 0 : 48 : 52

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PARTICLE - SIZE DISTRIBUTION ASTM D 422

Apr-09

Leighton

PARTICLE-SIZE ANALYSIS OF SOILS

ASTM D 422

Project Name: SR-710 Tunnel Technical Study | Tested By : V. Juliano | Date: 05/14/09

Project No. : 378312.04.09.01 | Data Input By: J. Ward | Date: 05/21/09

Exploration No.: R-09-Z3-B7

Sample No.: C-13 | Depth (feet) : 71.3-71.6

Soil Identification: Olive yellow lean clay'stone' with sand (CL)s

% Gravel	**0**	**Soil Type**	
% Sand	**24**	**(CL)s**	
% Fines	**76**		

			Moisture Content of Total Air-Dry Soil	Moisture Content of Air-Dry Soil Passing #10	After Hydrometer & Wet Sieve ret. in #200 Sieve
Specific Gravity (Assumed)	2.70	Wt.of Air-Dry Soil + Cont.(g)	0.00	0.00	
Correction for Specific Gravity	0.99	Dry Wt. of Soil + Cont. (g)	0.00	0.00	N/A
Wt.of Air-Dry Soil + Cont. (g)	642.10	Wt. of Container No.___ (g)	1.00	1.00	N/A
Wt. of Container	0.00	Moisture Content (%)	0.00	0.00	
Dry Wt. of Soil (g)	642.10	Wt. of Dry Soil (g)			N/A

Coarse Sieve

U.S. Sieve	Cumulative Wt. Of Dry Soil Retained (g)	% Passing
3"	0.00	100.0
1½"	0.00	100.0
3/4"	0.00	100.0
3/8"	0.00	100.0
No. 4	0.00	100.0
No. 10	0.41	99.9
Pan		

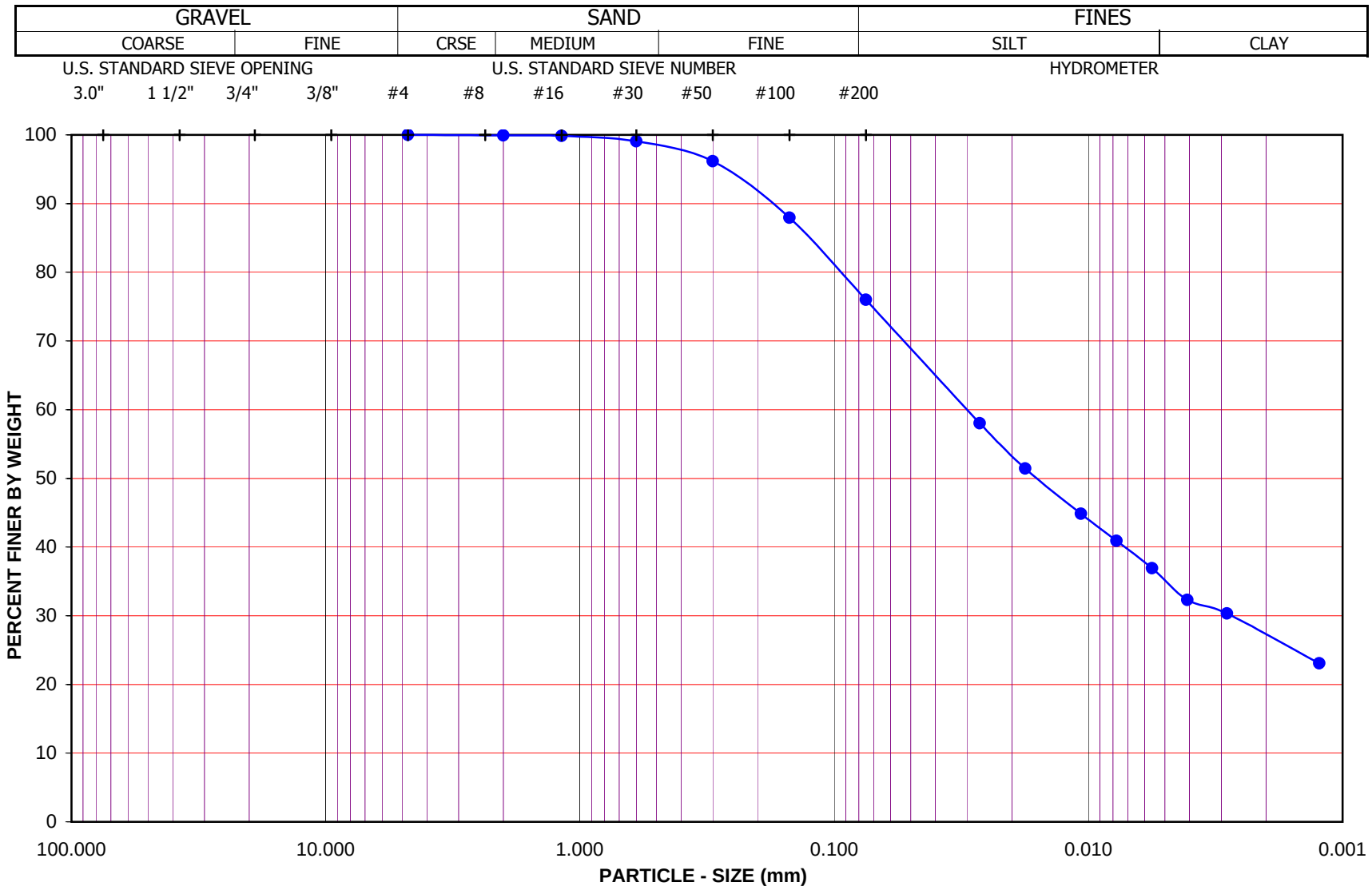
Sieve after Hydrometer & Wet Sieve

U.S. Sieve Size	Cumulative Wt. Of Dry Soil Retained (g)	% Passing	% Total Sample
No. 10	0.00	100.0	99.9
No. 16	0.05	99.9	99.9
No. 30	0.64	99.1	99.1
No. 50	2.83	96.2	96.2
No. 100	9.01	88.0	88.0
No. 200	18.00	76.1	76.0
Pan			

Hydrometer Wt. of Air-Dry Soil (g) 75.17 Wt. of Dry Soil (g) 75.17

Deflocculant 125 cc of 4% Solution

Date	Time	Elapsed Time (min)	Water Temperature (°C)	Composite Correction 152H	Actual Hydrometer Readings	% Total Sample (%)	Soil Particle Diameter (mm)
18-May-09	10:19	0		6.0			
	10:21	2	21.4	6.0	50.0	58.0	0.0267
	10:24	5	21.5	6.0	45.0	51.4	0.0177
	10:34	15	21.6	6.0	40.0	44.8	0.0107
	10:49	30	21.4	6.0	37.0	40.9	0.0077
	11:19	60	21.5	6.0	34.0	36.9	0.0056
	12:19	120	21.5	6.0	30.5	32.3	0.0041
	14:29	250	21.7	6.0	29.0	30.3	0.0028
19-May-09	10:19	1440	21.2	6.0	23.5	23.1	0.0012



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z3-B7 Sample No.: C-13

Depth (feet) : 71.3-71.6 Soil Type : (CL)s

Soil Identification: Olive yellow lean clay'stone' with sand (CL)s

GR:SA:FI : (%) 0 : 24 : 76

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PARTICLE - SIZE DISTRIBUTION ASTM D 422

May-09

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PARTICLE-SIZE ANALYSIS OF SOILS

ASTM D 422

Project Name: SR-710 Tunnel Technical Study | Tested By : V. Juliano | Date: 04/09/09

Project No. : 378312.04.09.01 | Data Input By: J. Ward | Date: 04/29/09

Exploration No.: R-09-Z3-B7

Sample No.: S-7 | Depth (feet) : 61.0

Soil Identification: Olive brown silty sand (SM)

% Gravel	**8**	**Soil Type**	
% Sand	**47**	**SM**	
% Fines	**45**		

			Moisture Content of Total Air-Dry Soil	Moisture Content of Air-Dry Soil Passing #10	After Hydrometer & Wet Sieve ret. in #200 Sieve
Specific Gravity (Assumed)	2.70	Wt.of Air-Dry Soil + Cont.(g)	0.00	0.00	
Correction for Specific Gravity	0.99	Dry Wt. of Soil + Cont. (g)	0.00	0.00	125.26
Wt.of Air-Dry Soil + Cont. (g)	687.30	Wt. of Container No.___ (g)	1.00	1.00	82.53
Wt. of Container	108.40	Moisture Content (%)	0.00	0.00	
Dry Wt. of Soil (g)	578.90	Wt. of Dry Soil (g)			42.73

Coarse Sieve

U.S. Sieve	Cumulative Wt. Of Dry Soil Retained (g)	% Passing
3"	0.00	100.0
1½"	0.00	100.0
3/4"	22.03	96.2
3/8"	23.70	95.9
No. 4	46.06	92.0
No. 10	70.26	87.9
Pan		

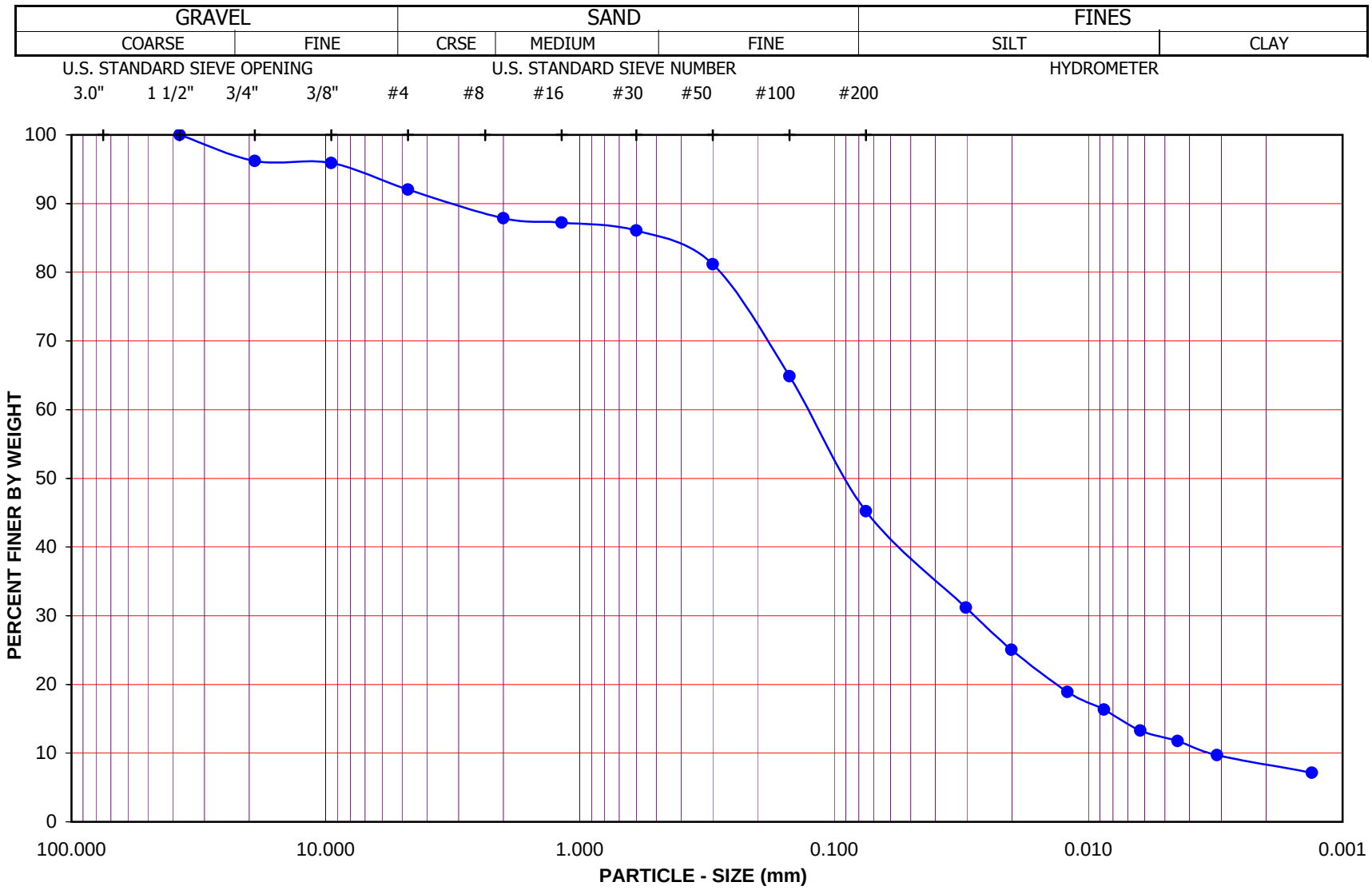
Sieve after Hydrometer & Wet Sieve

U.S. Sieve Size	Cumulative Wt. Of Dry Soil Retained (g)	% Passing	% Total Sample
No. 10	0.00	100.0	87.9
No. 16	0.61	99.3	87.2
No. 30	1.74	98.0	86.1
No. 50	6.49	92.4	81.2
No. 100	22.33	73.8	64.9
No. 200	41.40	51.5	45.2
Pan			

Hydrometer Wt. of Air-Dry Soil (g) 85.28 Wt. of Dry Soil (g) 85.28

Deflocculant 125 cc of 4% Solution

Date	Time	Elapsed Time (min)	Water Temperature (°C)	Composite Correction 152H	Actual Hydrometer Readings	% Total Sample (%)	Soil Particle Diameter (mm)
10-Apr-09	7:49	0		5.5			
	7:51	2	21.4	5.5	36.0	31.2	0.0303
	7:54	5	21.4	5.5	30.0	25.0	0.0201
	8:04	15	21.4	5.5	24.0	18.9	0.0121
	8:19	30	21.4	5.5	21.5	16.4	0.0087
	8:49	60	21.5	5.5	18.5	13.3	0.0062
	9:49	120	21.5	5.5	17.0	11.8	0.0045
	11:59	250	21.9	5.5	15.0	9.7	0.0031
11-Apr-09	7:49	1440	21.2	5.5	12.5	7.2	0.0013



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z3-B7 Sample No.: S-7

Depth (feet) : 61.0 Soil Type : SM

Soil Identification: Olive brown silty sand (SM)

GR:SA:FI : (%) 8 : 47 : 45

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PARTICLE - SIZE DISTRIBUTION ASTM D 422

Apr-09

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PARTICLE-SIZE ANALYSIS OF SOILS

ASTM D 422

Project Name: SR-710 Tunnel Technical Study | Tested By : V. Juliano | Date: 04/30/09

Project No. : 378312.04.09.01 | Data Input By: J. Ward | Date: 05/12/09

Exploration No.: R-09-Z3-B7

Sample No.: O-7 | Depth (feet) : 21-23.5

Soil Identification: Yellowish brown silty, clayey sand (SC-SM)

% Gravel	**0**	**Soil Type**
% Sand	**51**	**SC-SM**
% Fines	**49**	

			Moisture Content of Total Air-Dry Soil	Moisture Content of Air-Dry Soil Passing #10	After Hydrometer & Wet Sieve ret. in #200 Sieve
Specific Gravity (Assumed)	2.70	Wt.of Air-Dry Soil + Cont.(g)	0.00	0.00	
Correction for Specific Gravity	0.99	Dry Wt. of Soil + Cont. (g)	0.00	0.00	113.92
Wt.of Air-Dry Soil + Cont. (g)	508.60	Wt. of Container No.___ (g)	1.00	1.00	75.74
Wt. of Container	77.20	Moisture Content (%)	0.00	0.00	
Dry Wt. of Soil (g)	431.40	Wt. of Dry Soil (g)			38.18

Coarse Sieve

U.S. Sieve	Cumulative Wt. Of Dry Soil Retained (g)	% Passing
3"	0.00	100.0
1½"	0.00	100.0
3/4"	0.00	100.0
3/8"	1.03	99.8
No. 4	1.43	99.7
No. 10	3.56	99.2
Pan		

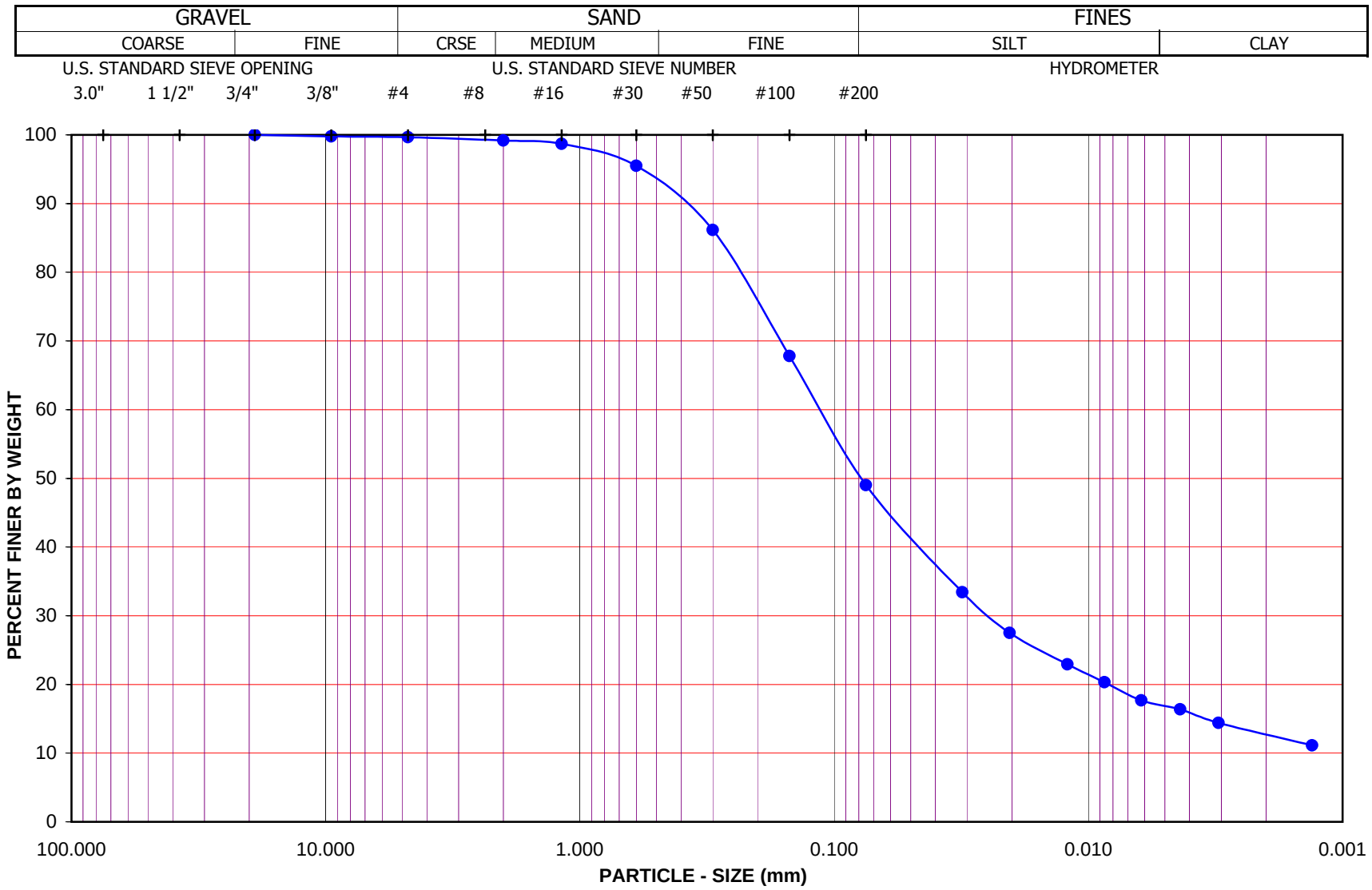
Sieve after Hydrometer & Wet Sieve

U.S. Sieve Size	Cumulative Wt. Of Dry Soil Retained (g)	% Passing	% Total Sample
No. 10	0.00	100.0	99.2
No. 16	0.37	99.5	98.7
No. 30	2.78	96.3	95.5
No. 50	9.86	86.9	86.2
No. 100	23.74	68.4	67.8
No. 200	37.98	49.4	49.0
Pan			

Hydrometer Wt. of Air-Dry Soil (g) 75.10 Wt. of Dry Soil (g) 75.10

Deflocculant 125 cc of 4% Solution

Date	Time	Elapsed Time (min)	Water Temperature (°C)	Composite Correction 152H	Actual Hydrometer Readings	% Total Sample (%)	Soil Particle Diameter (mm)
01-May-09	7:10	0		6.5			
	7:12	2	21.4	6.5	32.0	33.4	0.0313
	7:15	5	21.4	6.5	27.5	27.5	0.0204
	7:25	15	21.4	6.5	24.0	22.9	0.0121
	7:40	30	21.4	6.5	22.0	20.3	0.0086
	8:10	60	21.5	6.5	20.0	17.7	0.0062
	9:10	120	22.0	6.5	19.0	16.4	0.0044
	11:20	250	21.5	6.5	17.5	14.4	0.0031
02-May-09	7:10	1440	20.7	6.5	15.0	11.1	0.0013



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z3-B7 Sample No.: O-7

Depth (feet) : 21-23.5 Soil Type : SC-SM

Soil Identification: Yellowish brown silty, clayey sand (SC-SM)

GR:SA:FI : (%) 0 : 51 : 49

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PARTICLE - SIZE DISTRIBUTION ASTM D 422

May-09

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PARTICLE-SIZE ANALYSIS of SOILS
ASTM D 422

Project Name: SR-710 Tunnel Technical Study
Project No.: 378312.04.09.01
Exploration No.: R-09-Z3-B9
Sample No.: C-22
Soil Identification: Olive yellow silty sand (SM)

Tested By: A. Santos Date: 05/19/09
Checked By: J. Ward Date: 05/27/09
Depth (feet): 167-168

		Moisture Content of Total Air - Dry Soil	
Container No.:	731	Wt. of Air-Dry Soil + Cont. (g)	0.00
Wt. of Air-Dried Soil + Cont.(g)	930.90	Wt. of Dry Soil + Cont. (g)	0.00
Wt. of Container (g)	77.13	Wt. of Container No._____ (g)	1.00
Dry Wt. of Soil (g)	853.77	Moisture Content (%)	0.00

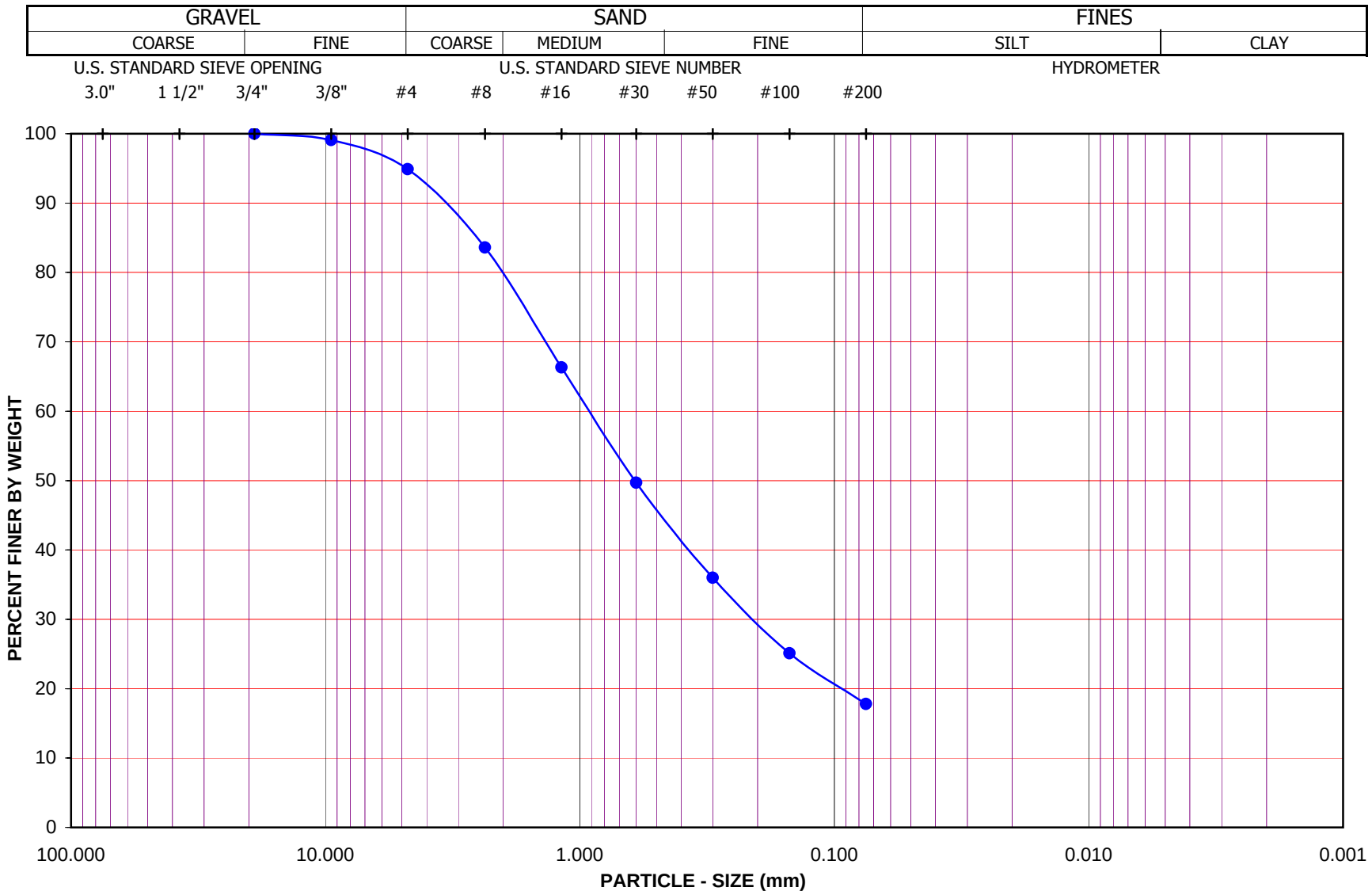
After Wet Sieve	Container No.	731
	Wt. of Dry Soil + Container (g)	788.30
	Wt. of Container (g)	77.13
	Dry Wt. of Soil Retained on # 200 Sieve (g)	711.17

U. S. Sieve Size (in.)	U. S. Sieve Size (mm.)	Cumulative Weight Dry Soil Retained (g)	Percent Passing (%)
6"	152.400		
3"	75.000		
1 1/2	37.500		
3/4"	19.000	0.00	100.0
3/8"	9.500	7.80	99.1
#4	4.750	43.20	94.9
#8	2.360	139.60	83.6
#16	1.180	288.00	66.3
#30	0.600	429.30	49.7
#50	0.300	546.40	36.0
#100	0.150	639.80	25.1
#200	0.075	702.10	17.8
PAN			

GRAVEL: **5 %**
SAND: **77 %**
FINES: **18 %**
GROUP SYMBOL: **SM**

Cu = D60/D10 = _____
Cc = $(D30)^2/(D60*D10)$ = _____

Remarks:



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z3-B9 Sample No.: C-22

Depth (feet): 167-168 Soil Type : SM

Soil Identification: Olive yellow silty sand (SM)

GR:SA:FI : (%) 5 : 77 : 18

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PARTICLE - SIZE DISTRIBUTION ASTM D 422

May-09

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PARTICLE-SIZE ANALYSIS of SOILS
ASTM D 422

Project Name: SR-710 Tunnel Technical Study
Project No.: 378312.04.09.01
Exploration No.: R-09-Z3-B9
Sample No.: C-26
Soil Identification: Olive yellow silty sand (SM)

Tested By: A. Santos Date: 05/19/09
Checked By: J. Ward Date: 05/27/09
Depth (feet): 187.5-187.9

		Moisture Content of Total Air - Dry Soil	
Container No.:	929	Wt. of Air-Dry Soil + Cont. (g)	0.00
Wt. of Air-Dried Soil + Cont.(g)	811.90	Wt. of Dry Soil + Cont. (g)	0.00
Wt. of Container (g)	108.34	Wt. of Container No._____ (g)	1.00
Dry Wt. of Soil (g)	703.56	Moisture Content (%)	0.00

After Wet Sieve	Container No.	929
	Wt. of Dry Soil + Container (g)	647.90
	Wt. of Container (g)	108.34
	Dry Wt. of Soil Retained on # 200 Sieve (g)	539.56

U. S. Sieve Size (in.)	U. S. Sieve Size (mm.)	Cumulative Weight Dry Soil Retained (g)	Percent Passing (%)
6"	152.400		
3"	75.000		
1 1/2	37.500		
3/4"	19.000	0.00	100.0
3/8"	9.500	13.10	98.1
#4	4.750	35.60	94.9
#8	2.360	85.40	87.9
#16	1.180	178.20	74.7
#30	0.600	281.10	60.0
#50	0.300	379.90	46.0
#100	0.150	469.70	33.2
#200	0.075	533.20	24.2
PAN			

GRAVEL: **5 %**
SAND: **71 %**
FINES: **24 %**
GROUP SYMBOL: **SM**

Cu = D60/D10 = _____
Cc = $(D30)^2/(D60*D10)$ = _____

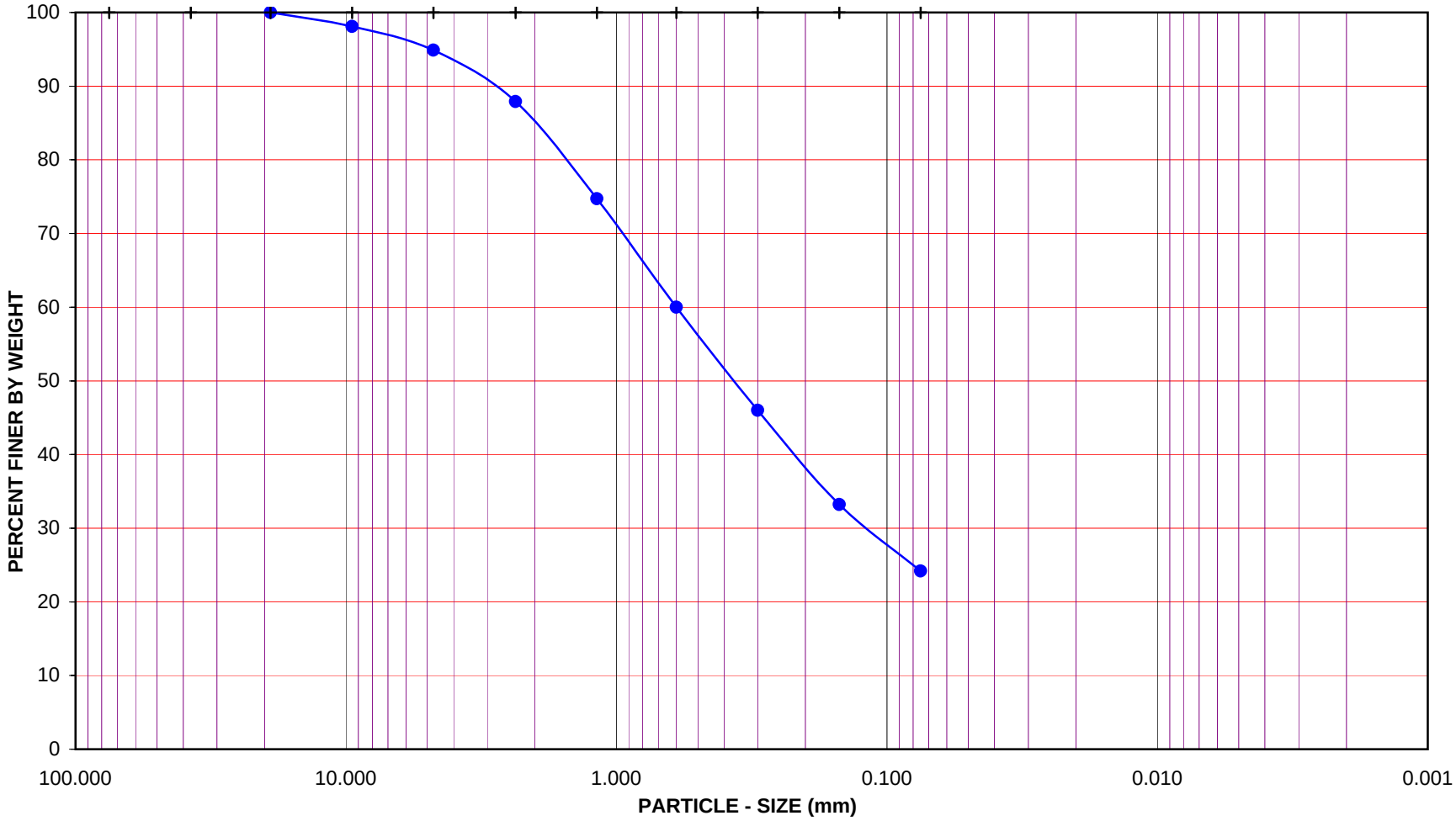
Remarks:

GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY

U.S. STANDARD SIEVE OPENING: 3.0" | 1 1/2" | 3/4" | 3/8"

U.S. STANDARD SIEVE NUMBER: #4 | #8 | #16 | #30 | #50 | #100 | #200

HYDROMETER



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z3-B9 Sample No.: C-26

Depth (feet): 187.5-187.9 Soil Type : SM

Soil Identification: Olive yellow silty sand (SM)

GR:SA:FI : (%) 5 : 71 : 24

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PARTICLE - SIZE DISTRIBUTION ASTM D 422

May-09

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PARTICLE-SIZE ANALYSIS of SOILS
ASTM D 422

Project Name: SR-710 Tunnel Technical Study
Project No.: 378312.04.09.01
Exploration No.: R-09-Z3-B9
Sample No.: S-4
Soil Identification: Light olive brown poorly-graded sand with silt and gravel (SP-SM)g

Tested By: A. Santos Date: 05/14/09
Checked By: J. Ward Date: 05/27/09
Depth (feet): 15.0

		Moisture Content of Total Air - Dry Soil	
Container No.:	957	Wt. of Air-Dry Soil + Cont. (g)	0.00
Wt. of Air-Dried Soil + Cont.(g)	1060.80	Wt. of Dry Soil + Cont. (g)	0.00
Wt. of Container (g)	108.40	Wt. of Container No._____ (g)	1.00
Dry Wt. of Soil (g)	952.40	Moisture Content (%)	0.00

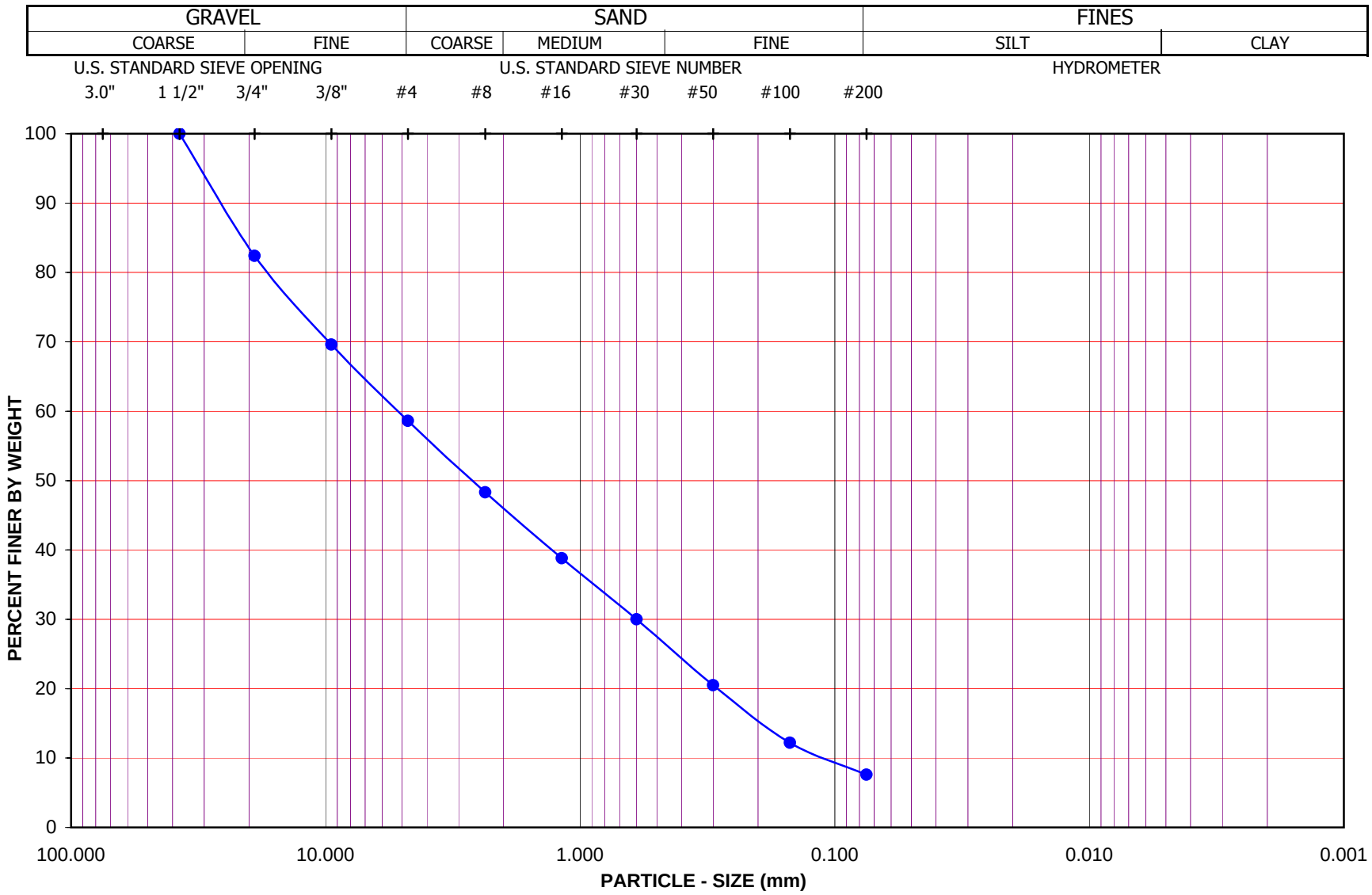
After Wet Sieve	Container No.	957
	Wt. of Dry Soil + Container (g)	993.70
	Wt. of Container (g)	108.40
	Dry Wt. of Soil Retained on # 200 Sieve (g)	885.30

U. S. Sieve Size (in.)	U. S. Sieve Size (mm.)	Cumulative Weight Dry Soil Retained (g)	Percent Passing (%)
6"	152.400		
3"	75.000		
1 1/2	37.500	0.00	100.0
3/4"	19.000	167.70	82.4
3/8"	9.500	289.90	69.6
#4	4.750	394.10	58.6
#8	2.360	492.80	48.3
#16	1.180	582.50	38.8
#30	0.600	666.40	30.0
#50	0.300	756.80	20.5
#100	0.150	836.50	12.2
#200	0.075	880.20	7.6
PAN			

GRAVEL: **41 %**
SAND: **51 %**
FINES: **8 %**
GROUP SYMBOL: **(SP-SM)g**

Cu = D60/D10 = 43.33
Cc = $(D30)^2/(D60*D10)$ = 0.58

Remarks: Insufficient sample mass available to meet the ASTM specification for this material



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z3-B9 Sample No.: S-4

Depth (feet): 15.0 Soil Type : (SP-SM)g

Soil Identification: Light olive brown poorly-graded sand with silt and gravel (SP-SM)g

GR:SA:FI : (%) 41 : 51 : 8

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PARTICLE - SIZE DISTRIBUTION ASTM D 422

May-09

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PARTICLE-SIZE ANALYSIS of SOILS
ASTM D 422

Project Name: SR-710 Tunnel Technical Study
Project No.: 378312.04.09.01
Exploration No.: R-09-Z3-B9
Sample No.: S-10
Soil Identification: Dark olive brown silty sand (SM)

Tested By: A. Santos Date: 05/14/09
Checked By: J. Ward Date: 05/27/09
Depth (feet): 60.0

		Moisture Content of Total Air - Dry Soil	
Container No.:	544	Wt. of Air-Dry Soil + Cont. (g)	0.00
Wt. of Air-Dried Soil + Cont.(g)	561.50	Wt. of Dry Soil + Cont. (g)	0.00
Wt. of Container (g)	77.70	Wt. of Container No._____ (g)	1.00
Dry Wt. of Soil (g)	483.80	Moisture Content (%)	0.00

After Wet Sieve	Container No.	544
	Wt. of Dry Soil + Container (g)	415.30
	Wt. of Container (g)	77.70
	Dry Wt. of Soil Retained on # 200 Sieve (g)	337.60

U. S. Sieve Size (in.)	U. S. Sieve Size (mm.)	Cumulative Weight Dry Soil Retained (g)	Percent Passing (%)
6"	152.400		
3"	75.000		
1 1/2	37.500		
3/4"	19.000		
3/8"	9.500	0.00	100.0
#4	4.750	1.10	99.8
#8	2.360	4.20	99.1
#16	1.180	10.30	97.9
#30	0.600	30.70	93.7
#50	0.300	100.20	79.3
#100	0.150	230.50	52.4
#200	0.075	325.50	32.7
PAN			

GRAVEL: **0 %**
SAND: **67 %**
FINES: **33 %**
GROUP SYMBOL: **SM**

Cu = D60/D10 = _____
Cc = $(D30)^2/(D60*D10)$ = _____

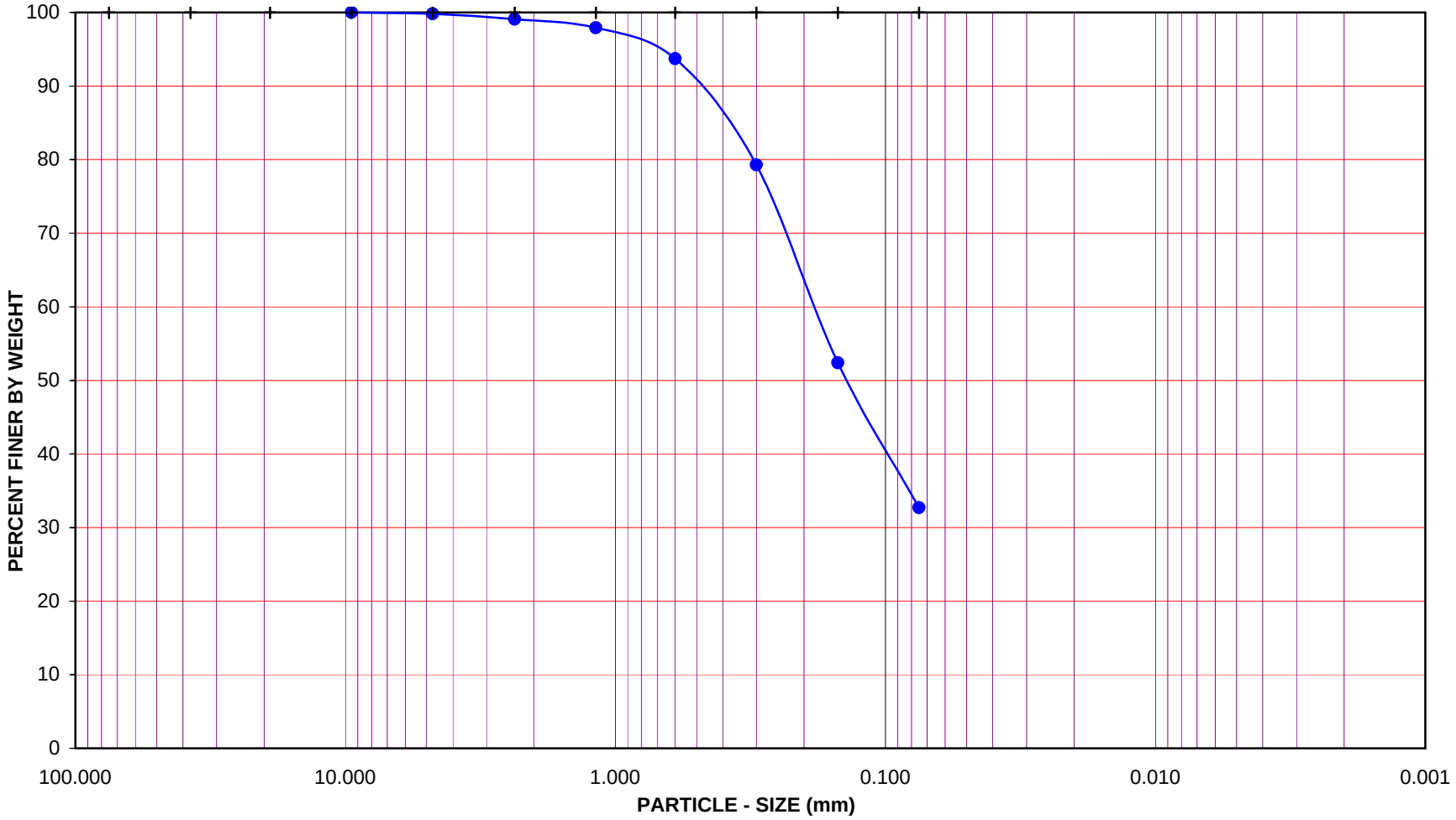
Remarks:

GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY

U.S. STANDARD SIEVE OPENING: 3.0" 1 1/2" 3/4" 3/8"

U.S. STANDARD SIEVE NUMBER: #4 #8 #16 #30 #50 #100 #200

HYDROMETER



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z3-B9 Sample No.: S-10

Depth (feet): 60.0 Soil Type : SM

Soil Identification: Dark olive brown silty sand (SM)

GR:SA:FI : (%) 0 : 67 : 33

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PARTICLE - SIZE DISTRIBUTION ASTM D 422

May-09

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PARTICLE-SIZE ANALYSIS of SOILS
ASTM D 422

Project Name: SR-710 Tunnel Technical Study
Project No.: 378312.04.09.01
Exploration No.: R-09-Z3-B9
Sample No.: S-13
Soil Identification: Dark olive silty sand (SM)

Tested By: A. Santos Date: 05/14/09
Checked By: J. Ward Date: 05/27/09
Depth (feet): 90.0

		Moisture Content of Total Air - Dry Soil	
Container No.:	524	Wt. of Air-Dry Soil + Cont. (g)	0.00
Wt. of Air-Dried Soil + Cont.(g)	660.90	Wt. of Dry Soil + Cont. (g)	0.00
Wt. of Container (g)	80.30	Wt. of Container No._____ (g)	1.00
Dry Wt. of Soil (g)	580.60	Moisture Content (%)	0.00

After Wet Sieve	Container No.	524
	Wt. of Dry Soil + Container (g)	477.00
	Wt. of Container (g)	80.30
	Dry Wt. of Soil Retained on # 200 Sieve (g)	396.70

U. S. Sieve Size (in.)	U. S. Sieve Size (mm.)	Cumulative Weight Dry Soil Retained (g)	Percent Passing (%)
6"	152.400		
3"	75.000		
1 1/2	37.500		
3/4"	19.000		
3/8"	9.500	0.00	100.0
#4	4.750	1.20	99.8
#8	2.360	4.70	99.2
#16	1.180	12.80	97.8
#30	0.600	38.30	93.4
#50	0.300	101.30	82.6
#100	0.150	236.60	59.2
#200	0.075	374.40	35.5
PAN			

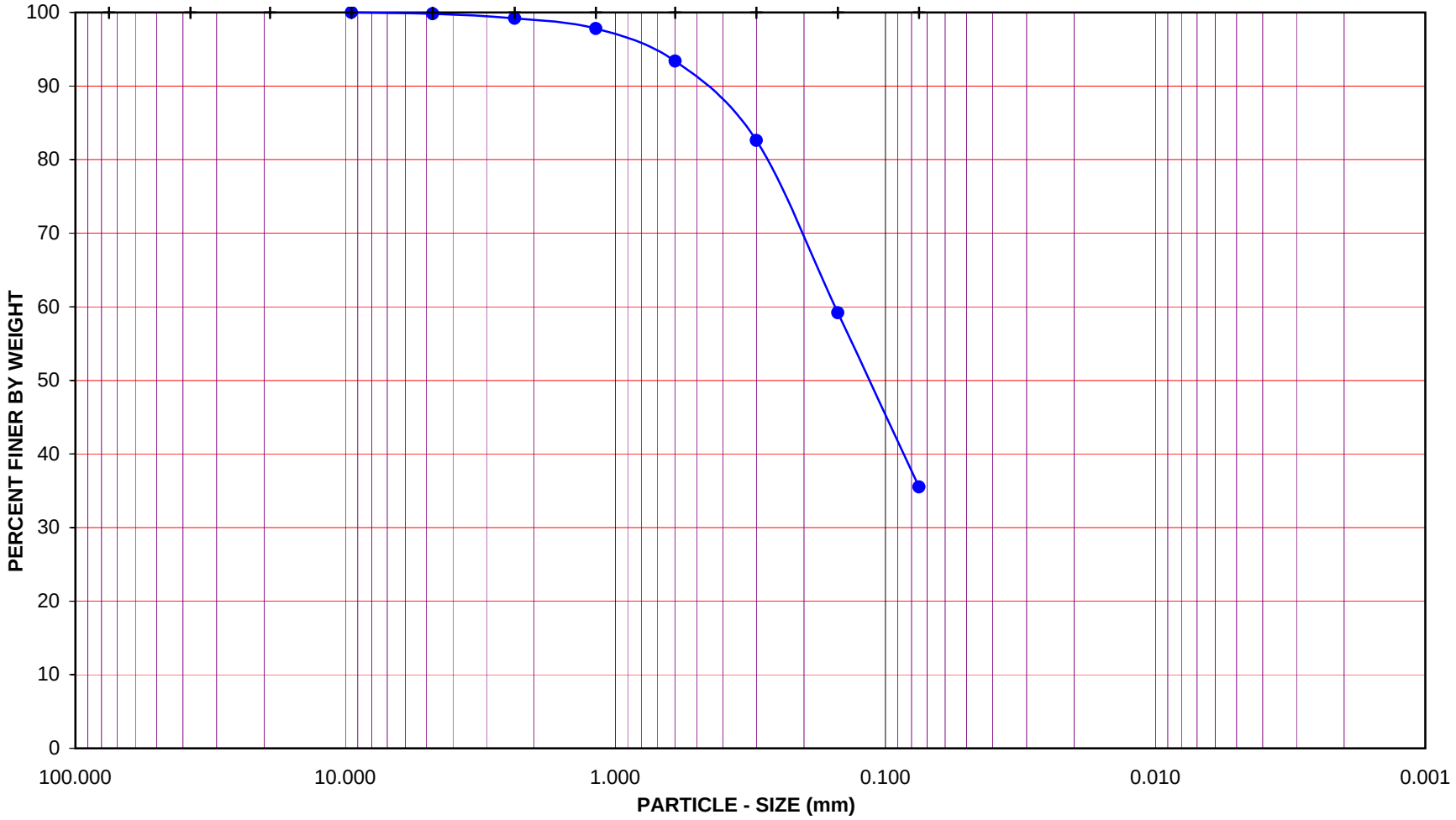
GRAVEL: **0 %**
SAND: **64 %**
FINES: **36 %**
GROUP SYMBOL: **SM**

Cu = D60/D10 = _____
Cc = $(D30)^2/(D60*D10)$ = _____

Remarks:

GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY

U.S. STANDARD SIEVE OPENING: 3.0" | 1 1/2" | 3/4" | 3/8"
U.S. STANDARD SIEVE NUMBER: #4 | #8 | #16 | #30 | #50 | #100 | #200
HYDROMETER



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z3-B9 Sample No.: S-13

Depth (feet): 90.0 Soil Type : SM

Soil Identification: Dark olive silty sand (SM)

GR:SA:FI : (%) 0 : 64 : 36

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PARTICLE - SIZE DISTRIBUTION ASTM D 422

May-09

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PARTICLE-SIZE ANALYSIS of SOILS
ASTM D 422

Project Name: SR-710 Tunnel Technical Study
Project No.: 378312.04.09.01
Exploration No.: R-09-Z3-B9
Sample No.: S-19
Soil Identification: Dark yellowish brown clayey sand (SC)

Tested By: V. Juliano Date: 05/17/09
Checked By: J. Ward Date: 05/28/09
Depth (feet): 150.0

		Moisture Content of Total Air - Dry Soil	
Container No.:	RX-21	Wt. of Air-Dry Soil + Cont. (g)	0.00
Wt. of Air-Dried Soil + Cont.(g)	491.30	Wt. of Dry Soil + Cont. (g)	0.00
Wt. of Container (g)	74.20	Wt. of Container No._____ (g)	1.00
Dry Wt. of Soil (g)	417.10	Moisture Content (%)	0.00

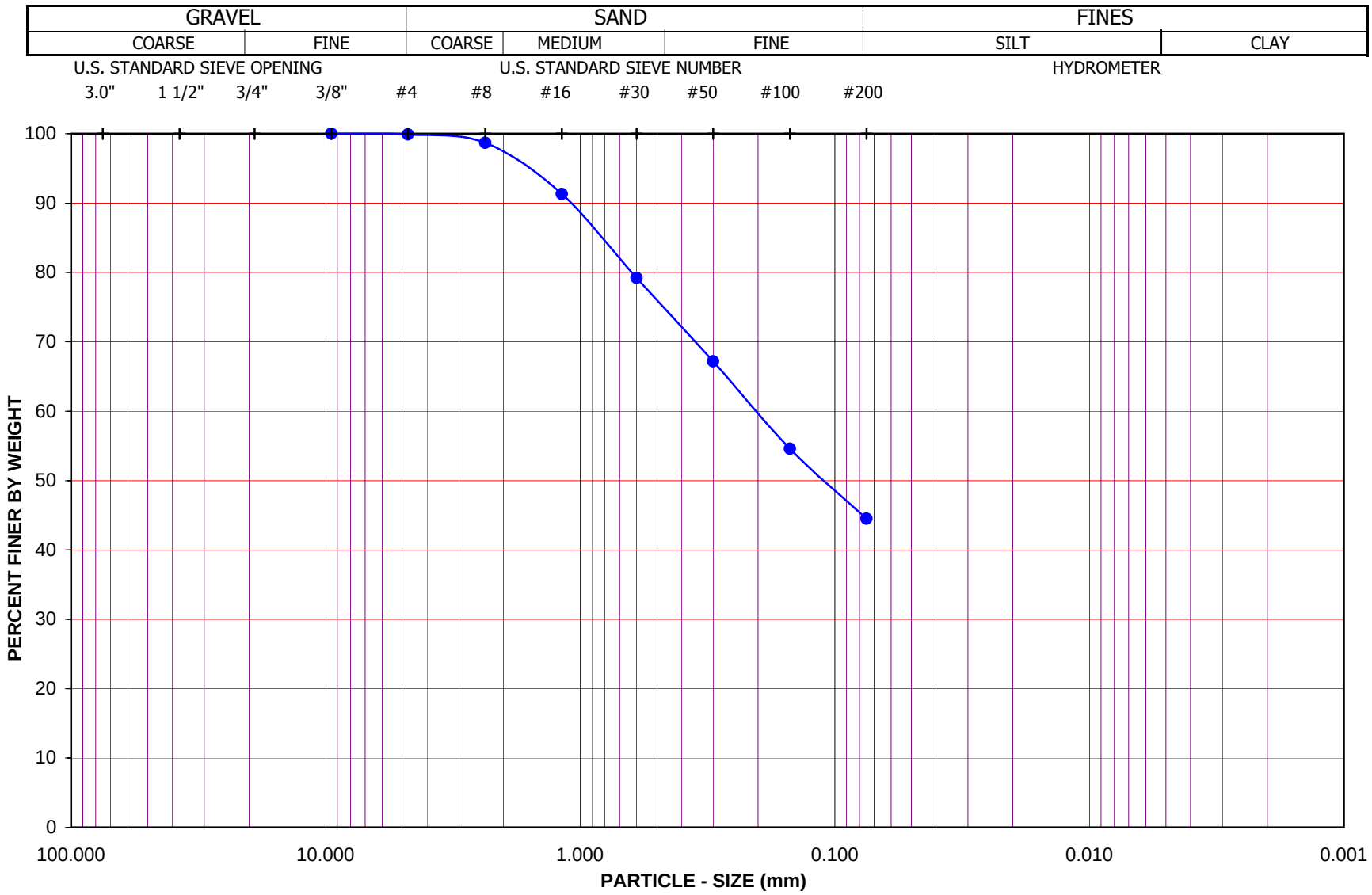
After Wet Sieve	Container No.	RX-21
	Wt. of Dry Soil + Container (g)	307.60
	Wt. of Container (g)	74.20
	Dry Wt. of Soil Retained on # 200 Sieve (g)	233.40

U. S. Sieve Size (in.)	U. S. Sieve Size (mm.)	Cumulative Weight Dry Soil Retained (g)	Percent Passing (%)
6"	152.400		
3"	75.000		
1 1/2	37.500		
3/4"	19.000		
3/8"	9.500	0.00	100.0
#4	4.750	0.43	99.9
#8	2.360	5.51	98.7
#16	1.180	36.44	91.3
#30	0.600	86.82	79.2
#50	0.300	136.87	67.2
#100	0.150	189.16	54.6
#200	0.075	231.60	44.5
PAN			

GRAVEL: **0 %**
SAND: **55 %**
FINES: **45 %**
GROUP SYMBOL: **SC**

Cu = D60/D10 = _____
Cc = $(D30)^2/(D60*D10)$ = _____

Remarks:



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z3-B9 Sample No.: S-19

Depth (feet): 150.0 Soil Type : SC

Soil Identification: Dark yellowish brown clayey sand (SC)

GR:SA:FI : (%) 0 : 55 : 45

Leighton

PARTICLE - SIZE DISTRIBUTION ASTM D 422

May-09

Leighton

PARTICLE-SIZE ANALYSIS OF SOILS

ASTM D 422

Project Name: SR-710 Tunnel Technical Study | Tested By : V. Juliano | Date: 05/20/09

Project No. : 378312.04.09.01 | Data Input By: J. Ward | Date: 06/06/09

Exploration No.: R-09-Z3-B10

Sample No.: C16 | Depth (feet) : 70.7-71.4

Soil Identification: Very dark olive lean clay'stone' with sand (CL)s

% Gravel	**0**	**Soil Type**	Moisture Content of Total Air-Dry Soil	Moisture Content of Air-Dry Soil Passing #10	After Hydrometer & Wet Sieve ret. in #200 Sieve
% Sand	**18**	**(CL)s**			
% Fines	**82**				
Specific Gravity (Assumed)	2.70	Wt.of Air-Dry Soil + Cont.(g)	0.00	0.00	
Correction for Specific Gravity	0.99	Dry Wt. of Soil + Cont. (g)	0.00	0.00	87.63
Wt.of Air-Dry Soil + Cont. (g)	913.60	Wt. of Container No.___ (g)	1.00	1.00	76.85
Wt. of Container	107.60	Moisture Content (%)	0.00	0.00	
Dry Wt. of Soil (g)	806.00	Wt. of Dry Soil (g)			10.78

Coarse Sieve

U.S. Sieve	Cumulative Wt. Of Dry Soil Retained (g)	% Passing
3"	0.00	100.0
1½"	0.00	100.0
3/4"	0.00	100.0
3/8"	0.00	100.0
No. 4	0.00	100.0
No. 10	0.00	100.0
Pan		

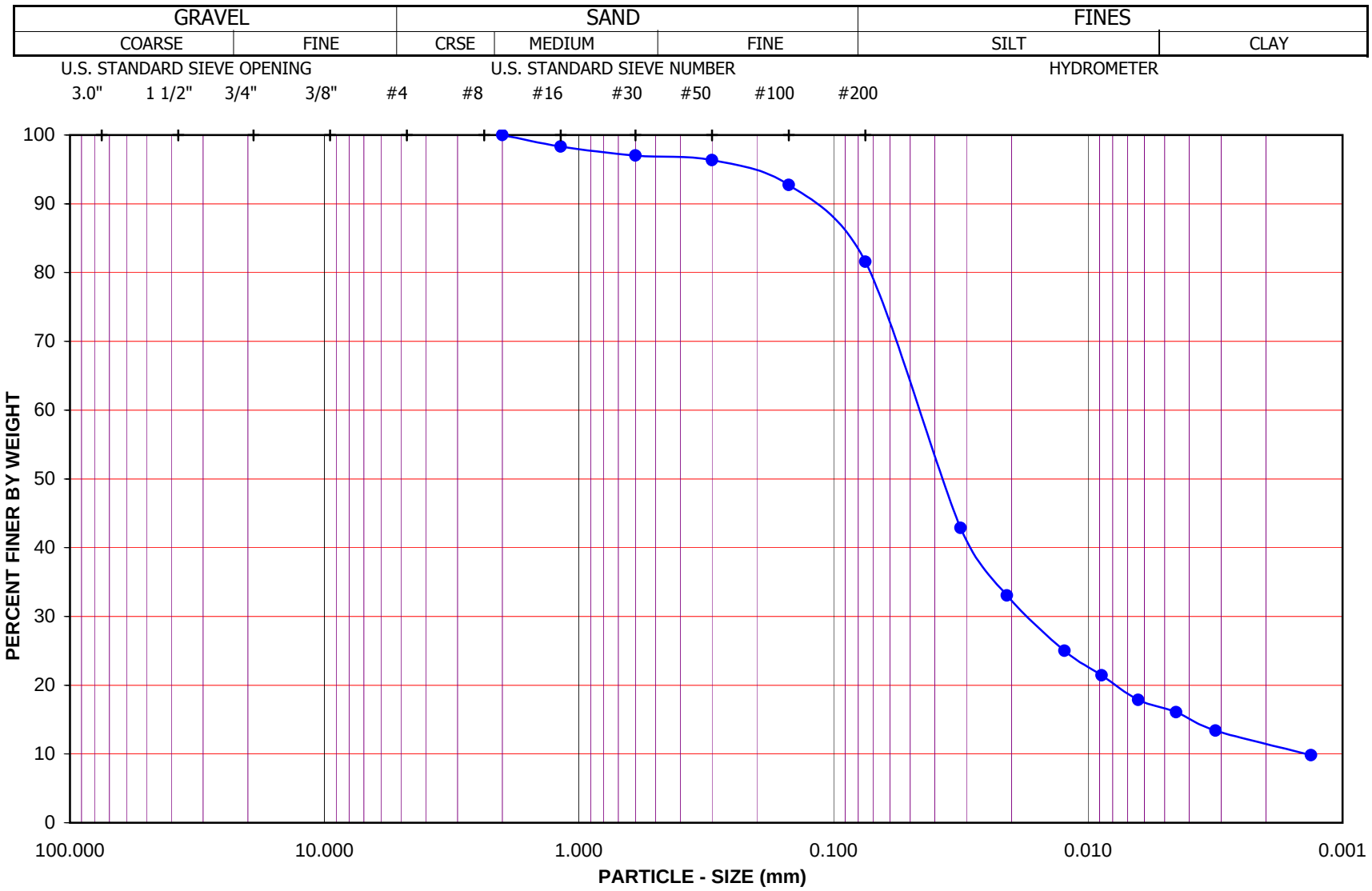
Sieve after Hydrometer & Wet Sieve

U.S. Sieve Size	Cumulative Wt. Of Dry Soil Retained (g)	% Passing	% Total Sample
No. 10	0.00	100.0	100.0
No. 16	0.93	98.3	98.3
No. 30	1.66	97.0	97.0
No. 50	2.02	96.4	96.4
No. 100	4.03	92.7	92.7
No. 200	10.23	81.6	81.6
Pan			

Hydrometer Wt. of Air-Dry Soil (g) 55.53 Wt. of Dry Soil (g) 55.53

Deflocculant 125 cc of 4% Solution

Date	Time	Elapsed Time (min)	Water Temperature (°C)	Composite Correction 152H	Actual Hydrometer Readings	% Total Sample (%)	Soil Particle Diameter (mm)
21-May-09	10:46	0		6.0			
	10:48	2	21.5	6.0	30.0	42.9	0.0317
	10:51	5	21.6	6.0	24.5	33.0	0.0208
	11:01	15	21.5	6.0	20.0	25.0	0.0124
	11:16	30	21.6	6.0	18.0	21.4	0.0088
	11:46	60	21.4	6.0	16.0	17.9	0.0063
	12:46	120	21.4	6.0	15.0	16.1	0.0045
	14:56	250	21.4	6.0	13.5	13.4	0.0032
22-May-09	10:46	1440	21.4	6.0	11.5	9.8	0.0013



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z3-B10 Sample No.: C16

Depth (feet) : 70.7-71.4 Soil Type : (CL)s

Soil Identification: Very dark olive lean clay'stone' with sand (CL)s

GR:SA:FI : (%) 0 : 18 : 82

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PARTICLE - SIZE DISTRIBUTION ASTM D 422

Jun-09

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PARTICLE-SIZE ANALYSIS OF SOILS

ASTM D 422

Project Name: SR-710 Tunnel Technical Study | Tested By : V. Juliano | Date: 05/20/09

Project No. : 378312.04.09.01 | Data Input By: J. Ward | Date: 06/06/09

Exploration No.: R-09-Z3-B10

Sample No.: C27 | Depth (feet) : 124.2-124.8

Soil Identification: Dark olive fat clay'stone' (CH)

% Gravel	**0**	**Soil Type**	Moisture Content of Total Air-Dry Soil	Moisture Content of Air-Dry Soil Passing #10	After Hydrometer & Wet Sieve ret. in #200 Sieve
% Sand	**11**	**CH**			
% Fines	**89**				
Specific Gravity (Assumed)	2.70	Wt.of Air-Dry Soil + Cont.(g)	0.00	0.00	
Correction for Specific Gravity	0.99	Dry Wt. of Soil + Cont. (g)	0.00	0.00	86.84
Wt.of Air-Dry Soil + Cont. (g)	872.20	Wt. of Container No.___ (g)	1.00	1.00	80.32
Wt. of Container	159.90	Moisture Content (%)	0.00	0.00	
Dry Wt. of Soil (g)	712.30	Wt. of Dry Soil (g)			6.52

Coarse Sieve

U.S. Sieve	Cumulative Wt. Of Dry Soil Retained (g)	% Passing
3"	0.00	100.0
1½"	0.00	100.0
3/4"	0.00	100.0
3/8"	0.00	100.0
No. 4	0.00	100.0
No. 10	0.00	100.0
Pan		

Sieve after Hydrometer & Wet Sieve

U.S. Sieve Size	Cumulative Wt. Of Dry Soil Retained (g)	% Passing	% Total Sample
No. 10	0.00	100.0	100.0
No. 16	0.00	100.0	100.0
No. 30	0.00	100.0	100.0
No. 50	0.05	99.9	99.9
No. 100	0.66	98.8	98.8
No. 200	5.86	89.4	89.4
Pan			

Hydrometer Wt. of Air-Dry Soil (g) 55.31 Wt. of Dry Soil (g) 55.31

Deflocculant 125 cc of 4% Solution

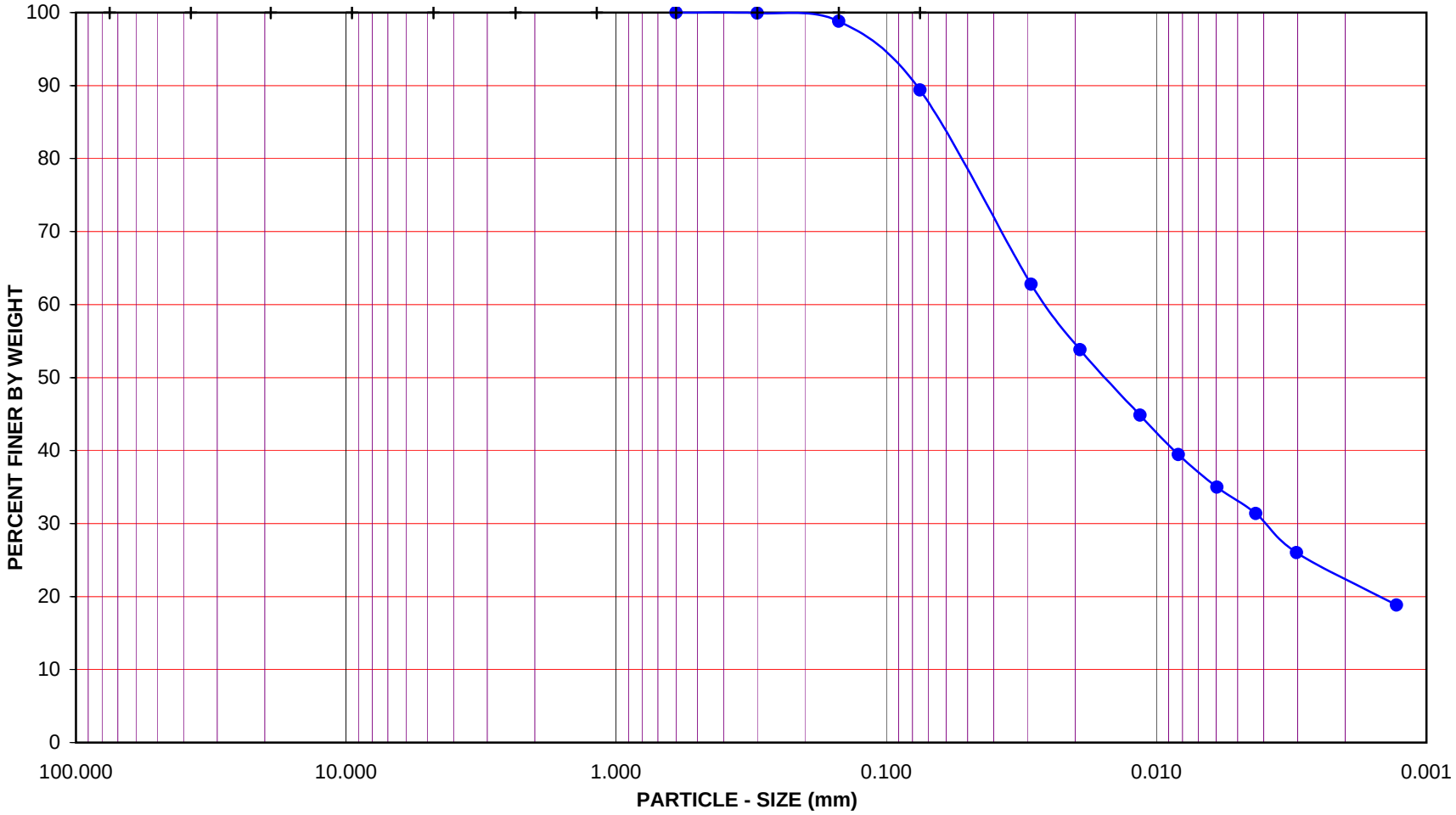
Date	Time	Elapsed Time (min)	Water Temperature (°C)	Composite Correction 152H	Actual Hydrometer Readings	% Total Sample (%)	Soil Particle Diameter (mm)
21-May-09	10:42	0		6.0			
	10:44	2	21.5	6.0	41.0	62.8	0.0291
	10:47	5	21.5	6.0	36.0	53.8	0.0192
	10:57	15	21.5	6.0	31.0	44.8	0.0115
	11:12	30	21.4	6.0	28.0	39.5	0.0083
	11:42	60	21.5	6.0	25.5	35.0	0.0060
	12:42	120	21.4	6.0	23.5	31.4	0.0043
	14:52	250	21.4	6.0	20.5	26.0	0.0030
22-May-09	10:42	1440	21.4	6.0	16.5	18.8	0.0013

GRAVEL		SAND			FINES	
COARSE	FINE	CRSE	MEDIUM	FINE	SILT	CLAY

U.S. STANDARD SIEVE OPENING: 3.0" 1 1/2" 3/4" 3/8"

U.S. STANDARD SIEVE NUMBER: #4 #8 #16 #30 #50 #100 #200

HYDROMETER



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z3-B10 Sample No.: C27

Depth (feet) : 124.2-124.8 Soil Type : CH

Soil Identification: Dark olive fat clay'stone' (CH)

GR:SA:FI : (%) 0 : 11 : 89

Leighton

PARTICLE - SIZE DISTRIBUTION ASTM D 422

Jun-09

Leighton

PARTICLE-SIZE ANALYSIS OF SOILS

ASTM D 422

Project Name: SR-710 Tunnel Technical Study | Tested By : V. Juliano | Date: 05/17/09

Project No. : 378312.04.09.01 | Data Input By: J. Ward | Date: 06/06/09

Exploration No.: R-09-Z3-B10

Sample No.: S6 | Depth (feet) : 25-26.5

Soil Identification: Yellowish brown fat clay with sand (CH)s

% Gravel	**0**	**Soil Type**
% Sand	**22**	**(CH)s**
% Fines	**78**	

			Moisture Content of Total Air-Dry Soil	Moisture Content of Air-Dry Soil Passing #10	After Hydrometer & Wet Sieve ret. in #200 Sieve
Specific Gravity (Assumed)	2.70	Wt.of Air-Dry Soil + Cont.(g)	0.00	0.00	
Correction for Specific Gravity	0.99	Dry Wt. of Soil + Cont. (g)	0.00	0.00	N/A
Wt.of Air-Dry Soil + Cont. (g)	453.00	Wt. of Container No.___ (g)	1.00	1.00	N/A
Wt. of Container	107.60	Moisture Content (%)	0.00	0.00	
Dry Wt. of Soil (g)	345.40	Wt. of Dry Soil (g)			N/A

Coarse Sieve

U.S. Sieve	Cumulative Wt. Of Dry Soil Retained (g)	% Passing
3"	0.00	100.0
1½"	0.00	100.0
3/4"	0.00	100.0
3/8"	0.00	100.0
No. 4	0.83	99.8
No. 10	3.42	99.0
Pan		

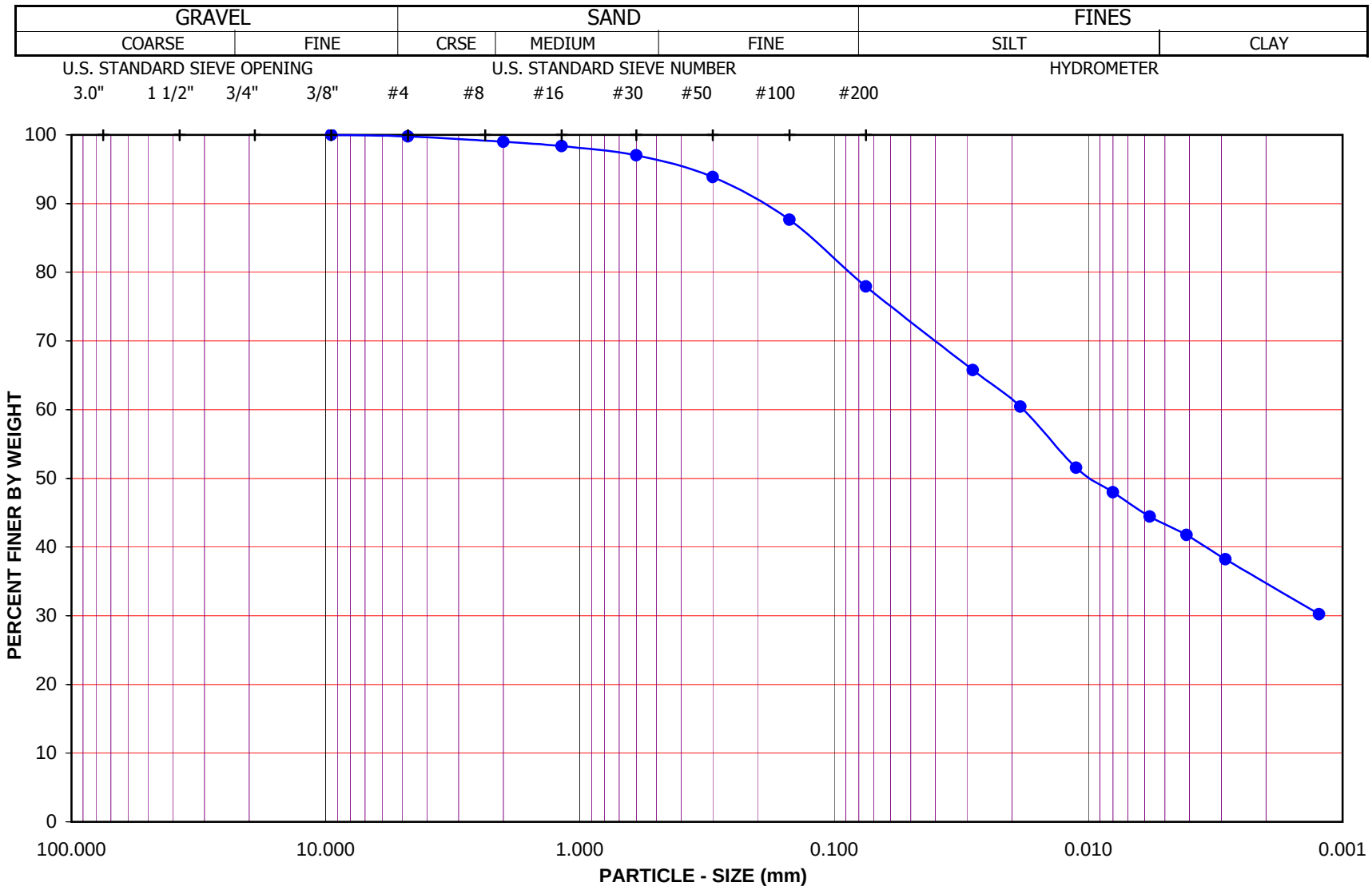
Sieve after Hydrometer & Wet Sieve

U.S. Sieve Size	Cumulative Wt. Of Dry Soil Retained (g)	% Passing	% Total Sample
No. 10	0.00	100.0	99.0
No. 16	0.37	99.3	98.3
No. 30	1.10	98.0	97.0
No. 50	2.87	94.8	93.9
No. 100	6.35	88.5	87.6
No. 200	11.77	78.7	77.9
Pan			

Hydrometer Wt. of Air-Dry Soil (g) 55.26 Wt. of Dry Soil (g) 55.26

Deflocculant 125 cc of 4% Solution

Date	Time	Elapsed Time (min)	Water Temperature (°C)	Composite Correction 152H	Actual Hydrometer Readings	% Total Sample (%)	Soil Particle Diameter (mm)
18-May-09	10:35	0		6.0			
	10:37	2	21.6	6.0	43.0	65.8	0.0285
	10:40	5	21.5	6.0	40.0	60.4	0.0185
	10:50	15	21.5	6.0	35.0	51.5	0.0112
	11:05	30	21.6	6.0	33.0	48.0	0.0080
	11:35	60	21.7	6.0	31.0	44.4	0.0057
	12:35	120	21.5	6.0	29.5	41.8	0.0041
	14:45	250	21.7	6.0	27.5	38.2	0.0029
19-May-09	10:35	1440	21.3	6.0	23.0	30.2	0.0012



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z3-B10 Sample No.: S6

Depth (feet) : 25-26.5 Soil Type : (CH)s

Soil Identification: Yellowish brown fat clay with sand (CH)s

GR:SA:FI : (%) 0 : 22 : 78

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PARTICLE - SIZE DISTRIBUTION ASTM D 422

Jun-09

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PARTICLE-SIZE ANALYSIS of SOILS
ASTM D 422

Project Name: SR-710 Tunnel Technical Study
Project No.: 378312.04.09.01
Exploration No.: R-09-Z3-B11
Sample No.: C-24
Soil Identification: Olive yellow silty sand with gravel (SM)g

Tested By: V. Juliano Date: 05/17/09
Checked By: J. Ward Date: 05/26/09
Depth (feet): 116.4-116.9

Calculation of Dry Weights	Whole Sample	Sample Passing #8	Moisture Contents	Whole Sample	Sample passing #8
Container No.:	778	788	Wt. of Air-Dry Soil + Cont.(g)	0.00	0.00
Wt. Air-Dried Soil + Cont.(g)	859.80	285.10	Wt. of Dry Soil + Cont. (g)	0.00	0.00
Wt. of Container (g)	75.80	75.90	Wt. of Container No._____(g)	1.00	1.00
Dry Wt. of Soil (g)	784.00	209.20	Moisture Content (%)	0.00	0.00

Passing #8 Material After Wet Sieve		
	Container No.	788
	Wt. of Dry Soil + Container (g)	234.50
	Wt. of Container (g)	75.90
	Dry Wt. of Soil Retained on # 200 Sieve (g)	158.60

U. S. Sieve Size		Cumulative Weight of Dry Soil Retained (g)		Percent Passing (%)
	(mm.)	Whole Sample	Sample Passing #4	
6"	152.400			
3"	75.000			
1 1/2	37.500	0.00		100.0
3/4"	19.000	26.16		96.7
3/8"	9.500	56.85		92.7
#4	4.750	122.91		84.3
#8	2.360	202.70		74.1
#16	1.180		29.01	63.8
#30	0.600		68.43	49.9
#50	0.300		105.86	36.6
#100	0.150		138.04	25.2
#200	0.075		158.01	18.1
PAN				

GRAVEL: **16 %**
SAND: **66 %**
FINES: **18 %**
GROUP SYMBOL **(SM)g**

Cu = D60/D10 = _____
Cc = $(D30)^2/(D60*D10)$ = _____

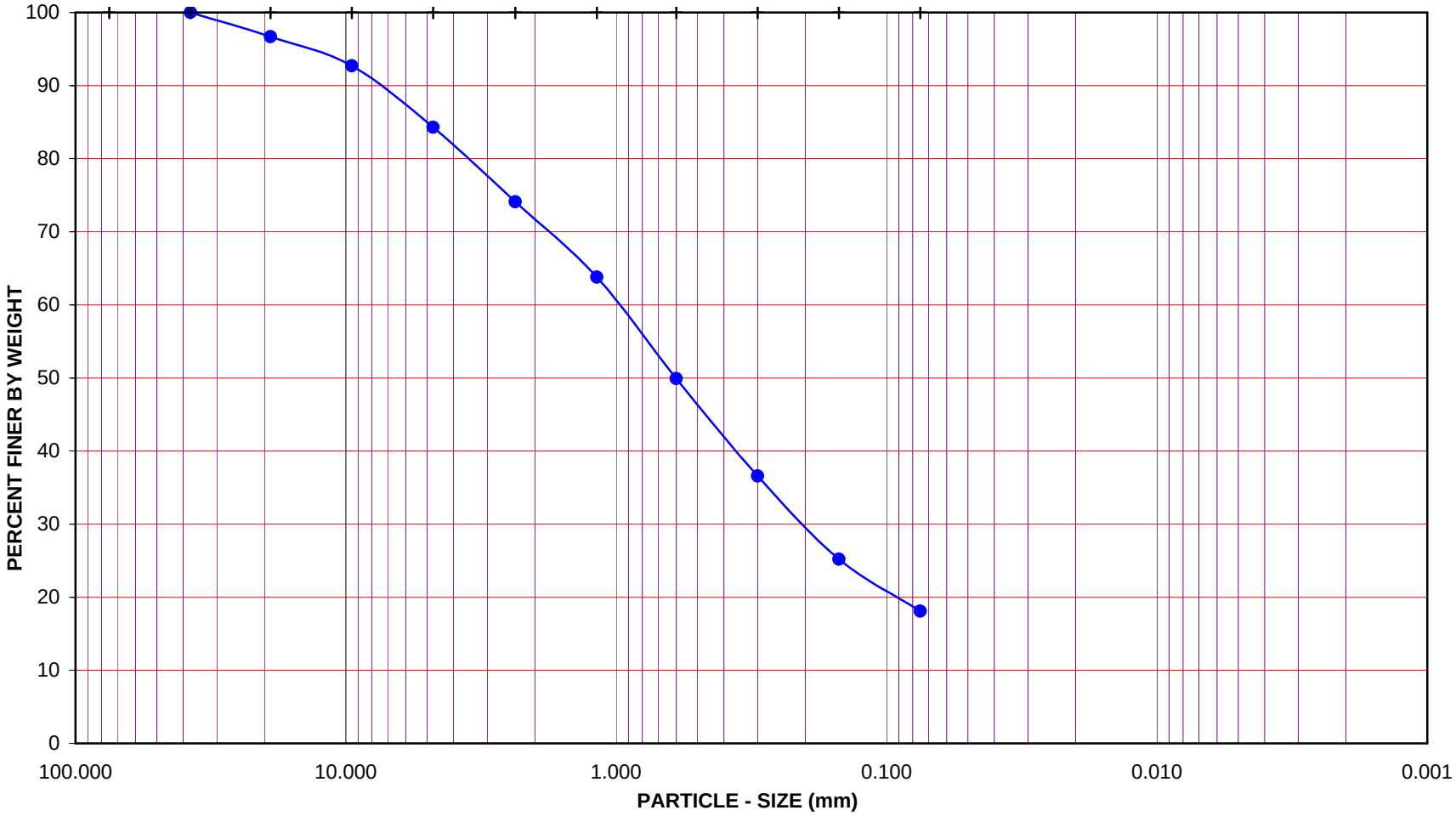
Remarks: Insufficient sample mass available to meet the ASTM specification for this material

GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY

U.S. STANDARD SIEVE OPENING: 3.0" 1 1/2" 3/4" 3/8"

U.S. STANDARD SIEVE NUMBER: #4 #8 #16 #30 #50 #100 #200

HYDROMETER



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z3-B11 Sample No.: C-24

Depth (feet): 116.4-116.9 Soil Type : (SM)g

Soil Identification: Olive yellow silty sand with gravel (SM)g

GR:SA:FI : (%) 16 : 66 : 18

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PARTICLE - SIZE DISTRIBUTION ASTM D 422

May-09

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PARTICLE-SIZE ANALYSIS of SOILS
ASTM D 422

Project Name: SR-710 Tunnel Technical Study
Project No.: 378312.04.09.01
Exploration No.: R-09-Z3-B11
Sample No.: C-25
Soil Identification: Olive yellow silty sand (SM)

Tested By: A. Santos Date: 05/14/09
Checked By: J. Ward Date: 05/26/09
Depth (feet): 125-125.5

		Moisture Content of Total Air - Dry Soil	
Container No.:	737	Wt. of Air-Dry Soil + Cont. (g)	0.00
Wt. of Air-Dried Soil + Cont.(g)	830.20	Wt. of Dry Soil + Cont. (g)	0.00
Wt. of Container (g)	76.70	Wt. of Container No._____ (g)	1.00
Dry Wt. of Soil (g)	753.50	Moisture Content (%)	0.00

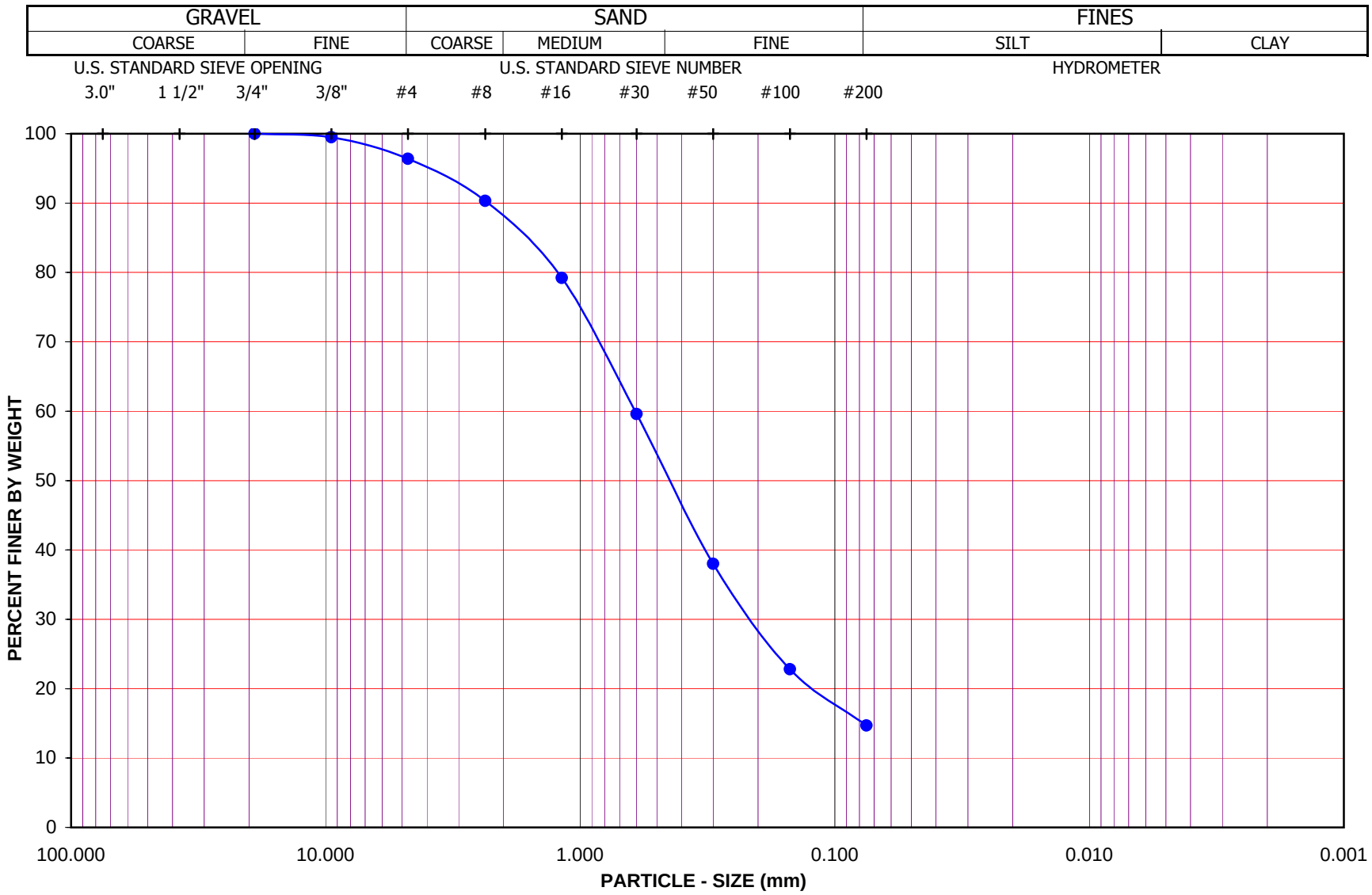
After Wet Sieve	Container No.	737
	Wt. of Dry Soil + Container (g)	726.50
	Wt. of Container (g)	76.70
	Dry Wt. of Soil Retained on # 200 Sieve (g)	649.80

U. S. Sieve Size (in.)	U. S. Sieve Size (mm.)	Cumulative Weight Dry Soil Retained (g)	Percent Passing (%)
6"	152.400		
3"	75.000		
1 1/2	37.500		
3/4"	19.000	0.00	100.0
3/8"	9.500	4.00	99.5
#4	4.750	27.40	96.4
#8	2.360	72.90	90.3
#16	1.180	156.60	79.2
#30	0.600	304.60	59.6
#50	0.300	466.80	38.0
#100	0.150	581.90	22.8
#200	0.075	642.60	14.7
PAN			

GRAVEL: **4 %**
SAND: **81 %**
FINES: **15 %**
GROUP SYMBOL: **SM**

Cu = D60/D10 = _____
Cc = $(D30)^2/(D60*D10)$ = _____

Remarks:



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z3-B11 Sample No.: C-25

Depth (feet): 125-125.5 Soil Type : SM

Soil Identification: Olive yellow silty sand (SM)

GR:SA:FI : (%) 4 : 81 : 15

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PARTICLE - SIZE DISTRIBUTION ASTM D 422

May-09

Leighton

PARTICLE-SIZE ANALYSIS of SOILS
ASTM D 422

Project Name: SR-710 Tunnel Technical Study
Project No.: 378312.04.09.01
Exploration No.: R-09-Z3-B11
Sample No.: C-30
Soil Identification: Olive brown well-graded sand with silt (SW-SM)

Tested By: A. Santos Date: 05/14/09
Checked By: J. Ward Date: 05/26/09
Depth (feet): 150.5-151

		Moisture Content of Total Air - Dry Soil	
Container No.:	K-14	Wt. of Air-Dry Soil + Cont. (g)	0.00
Wt. of Air-Dried Soil + Cont.(g)	734.20	Wt. of Dry Soil + Cont. (g)	0.00
Wt. of Container (g)	75.10	Wt. of Container No._____ (g)	1.00
Dry Wt. of Soil (g)	659.10	Moisture Content (%)	0.00

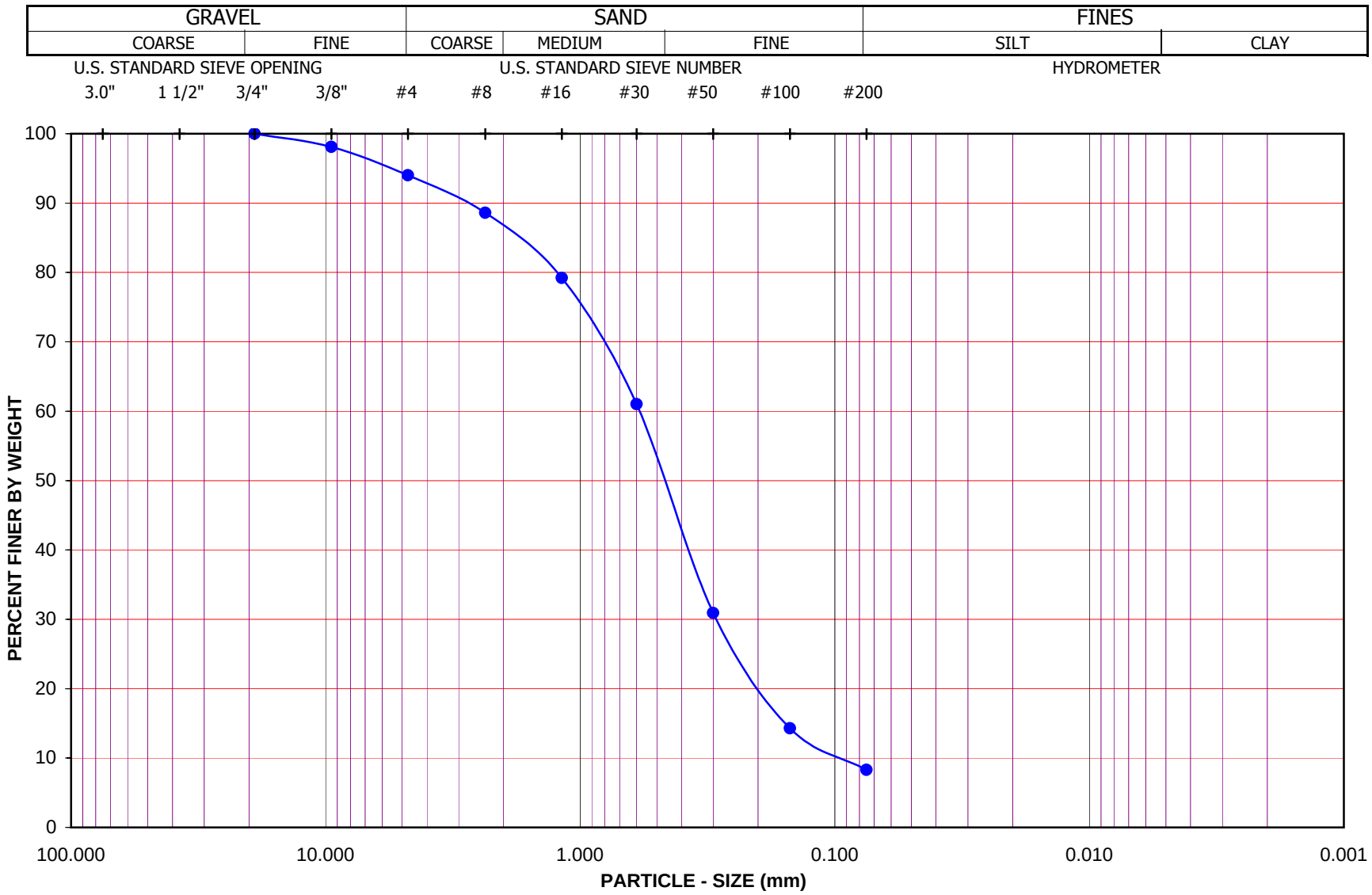
After Wet Sieve	Container No.	K-14
	Wt. of Dry Soil + Container (g)	682.20
	Wt. of Container (g)	75.10
	Dry Wt. of Soil Retained on # 200 Sieve (g)	607.10

U. S. Sieve Size (in.)	U. S. Sieve Size (mm.)	Cumulative Weight Dry Soil Retained (g)	Percent Passing (%)
6"	152.400		
3"	75.000		
1 1/2	37.500		
3/4"	19.000	0.00	100.0
3/8"	9.500	12.80	98.1
#4	4.750	39.40	94.0
#8	2.360	75.00	88.6
#16	1.180	137.20	79.2
#30	0.600	257.00	61.0
#50	0.300	455.40	30.9
#100	0.150	564.80	14.3
#200	0.075	604.50	8.3
PAN			

GRAVEL: **6 %**
SAND: **86 %**
FINES: **8 %**
GROUP SYMBOL: **SW-SM**

Cu = D60/D10 = 5.90
Cc = $(D30)^2/(D60*D10)$ = 1.43

Remarks:



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z3-B11 Sample No.: C-30

Depth (feet): 150.5-151 Soil Type : SW-SM

Soil Identification: Olive brown well-graded sand with silt (SW-SM)

GR:SA:FI : (%) 6 : 86 : 8

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PARTICLE - SIZE DISTRIBUTION ASTM D 422

May-09

SA R-09-Z3-B11, C-30 @ 150.5-151

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PARTICLE-SIZE ANALYSIS of SOILS
ASTM D 422

Project Name: SR-710 Tunnel Technical Study
Project No.: 378312.04.09.01
Exploration No.: R-09-Z3-B11
Sample No.: O-3
Soil Identification: Olive silty sand (SM)

Tested By: V. Juliano Date: 04/06/09
Checked By: J. Ward Date: 04/29/09
Depth (feet): 11.5-16

		Moisture Content of Total Air - Dry Soil	
Container No.:	1955	Wt. of Air-Dry Soil + Cont. (g)	0.00
Wt. of Air-Dried Soil + Cont.(g)	540.40	Wt. of Dry Soil + Cont. (g)	0.00
Wt. of Container (g)	72.50	Wt. of Container No._____ (g)	1.00
Dry Wt. of Soil (g)	467.90	Moisture Content (%)	0.00

After Wet Sieve	Container No.	1955
	Wt. of Dry Soil + Container (g)	399.50
	Wt. of Container (g)	72.50
	Dry Wt. of Soil Retained on # 200 Sieve (g)	327.00

U. S. Sieve Size (in.)	U. S. Sieve Size (mm.)	Cumulative Weight Dry Soil Retained (g)	Percent Passing (%)
6"	152.400		
3"	75.000		
1 1/2	37.500		
3/4"	19.000	0.00	100.0
3/8"	9.500	6.65	98.6
#4	4.750	13.85	97.0
#8	2.360	20.40	95.6
#16	1.180	29.89	93.6
#30	0.600	51.22	89.1
#50	0.300	115.70	75.3
#100	0.150	251.40	46.3
#200	0.075	324.40	30.7
PAN			

GRAVEL: **3 %**
SAND: **66 %**
FINES: **31 %**
GROUP SYMBOL: **SM**

Cu = D60/D10 = _____
Cc = $(D30)^2/(D60*D10)$ = _____

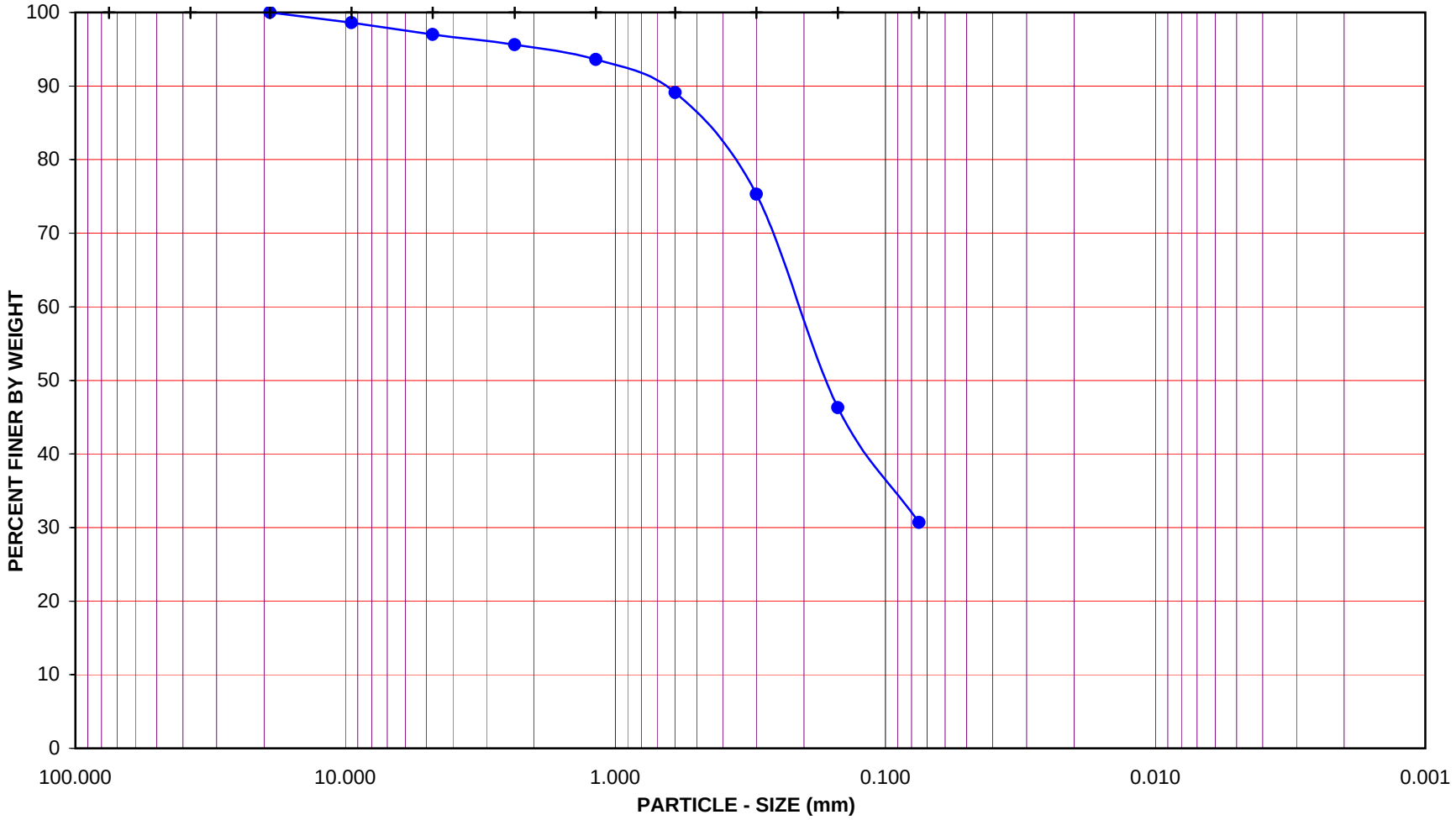
Remarks:

GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY

U.S. STANDARD SIEVE OPENING: 3.0" 1 1/2" 3/4" 3/8"

U.S. STANDARD SIEVE NUMBER: #4 #8 #16 #30 #50 #100 #200

HYDROMETER



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z3-B11 Sample No.: O-3

Depth (feet): 11.5-16 Soil Type : SM

Soil Identification: Olive silty sand (SM)

GR:SA:FI : (%) 3 : 66 : 31

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PARTICLE - SIZE DISTRIBUTION ASTM D 422

Apr-09

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PARTICLE-SIZE ANALYSIS of SOILS
ASTM D 422

Project Name: SR-710 Tunnel Technical Study
Project No.: 378312.04.09.01
Exploration No.: R-09-Z3-B11
Sample No.: O-9
Soil Identification: Olive poorly-graded sand with silt (SP-SM)

Tested By: V. Juliano Date: 04/06/09
Checked By: J. Ward Date: 04/29/09
Depth (feet): 41-46

		Moisture Content of Total Air - Dry Soil	
Container No.:	Q	Wt. of Air-Dry Soil + Cont. (g)	0.00
Wt. of Air-Dried Soil + Cont.(g)	426.20	Wt. of Dry Soil + Cont. (g)	0.00
Wt. of Container (g)	75.30	Wt. of Container No._____ (g)	1.00
Dry Wt. of Soil (g)	350.90	Moisture Content (%)	0.00

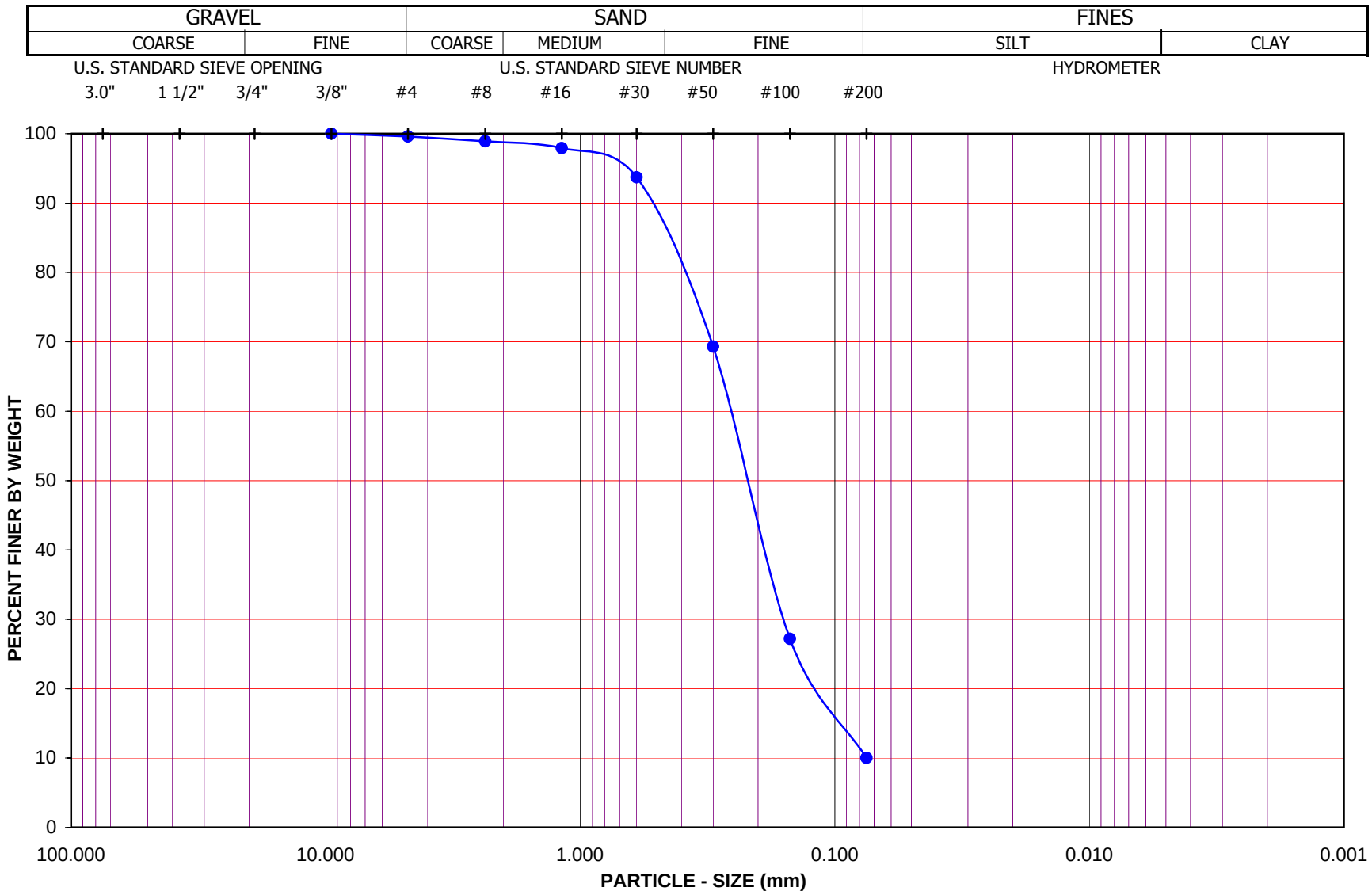
After Wet Sieve	Container No.	Q
	Wt. of Dry Soil + Container (g)	394.30
	Wt. of Container (g)	75.30
	Dry Wt. of Soil Retained on # 200 Sieve (g)	319.00

U. S. Sieve Size (in.)	U. S. Sieve Size (mm.)	Cumulative Weight Dry Soil Retained (g)	Percent Passing (%)
6"	152.400		
3"	75.000		
1 1/2	37.500		
3/4"	19.000		
3/8"	9.500	0.00	100.0
#4	4.750	1.41	99.6
#8	2.360	3.72	98.9
#16	1.180	7.52	97.9
#30	0.600	22.16	93.7
#50	0.300	107.73	69.3
#100	0.150	255.60	27.2
#200	0.075	315.70	10.0
PAN			

GRAVEL: **0 %**
SAND: **90 %**
FINES: **10 %**
GROUP SYMBOL: **SP-SM**

Cu = D60/D10 = 3.33
Cc = $(D30)^2/(D60*D10)$ = 1.20

Remarks:



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z3-B11 Sample No.: O-9

Depth (feet): 41-46 Soil Type : SP-SM

Soil Identification: Olive poorly-graded sand with silt (SP-SM)

GR:SA:FI : (%) 0 : 90 : 10

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PARTICLE - SIZE DISTRIBUTION ASTM D 422

Apr-09

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PARTICLE-SIZE ANALYSIS of SOILS
ASTM D 422

Project Name: SR-710 Tunnel Technical Study
Project No.: 378312.04.09.01
Exploration No.: R-09-Z3-B11
Sample No.: O-12
Soil Identification: Olive well-graded sand with silt and gravel (SW-SM)g

Tested By: V. Juliano Date: 04/06/09
Checked By: J. Ward Date: 04/29/09
Depth (feet): 61-66

		Moisture Content of Total Air - Dry Soil	
Container No.:	934	Wt. of Air-Dry Soil + Cont. (g)	0.00
Wt. of Air-Dried Soil + Cont.(g)	1006.30	Wt. of Dry Soil + Cont. (g)	0.00
Wt. of Container (g)	108.20	Wt. of Container No._____ (g)	1.00
Dry Wt. of Soil (g)	898.10	Moisture Content (%)	0.00

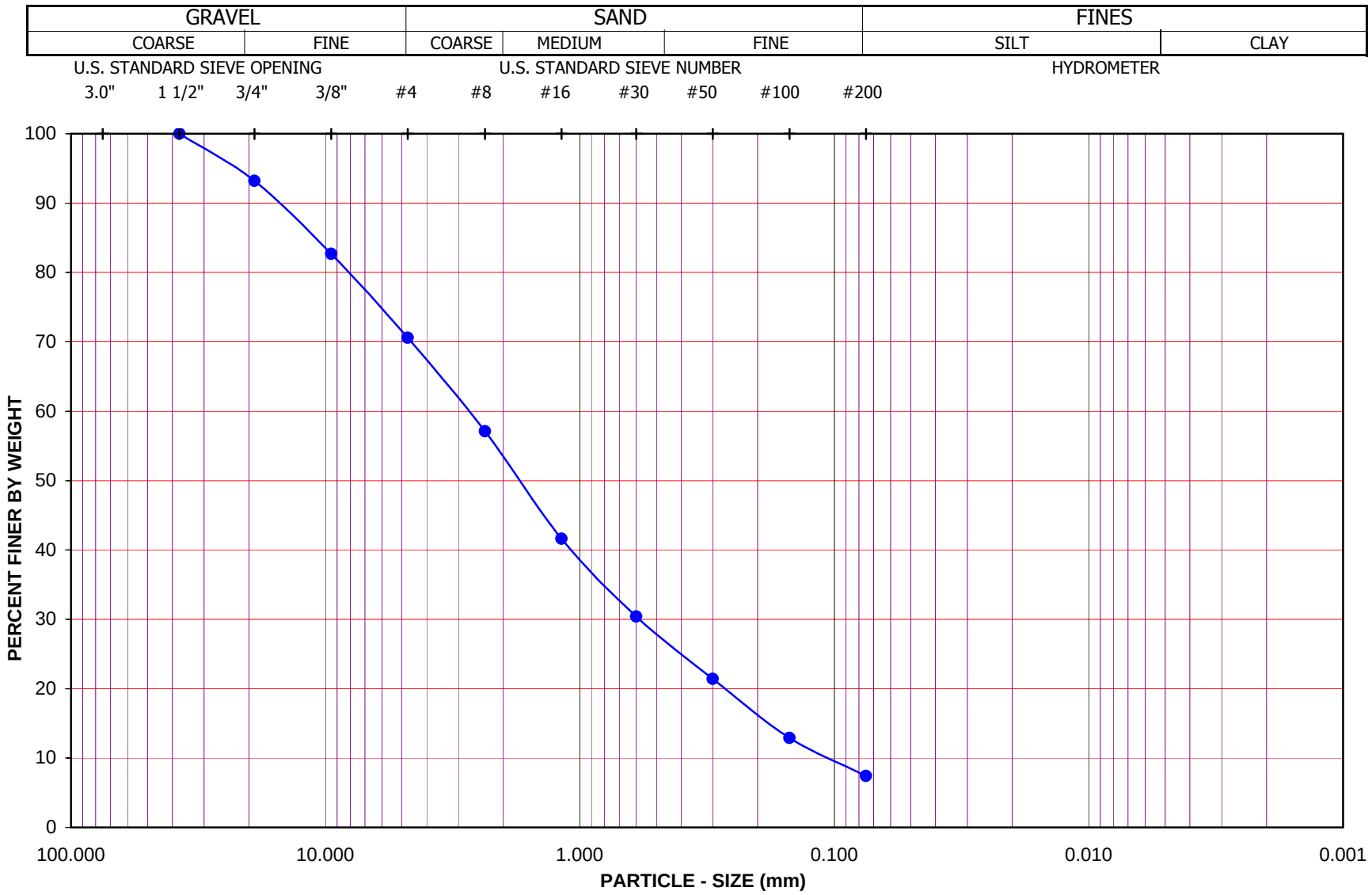
After Wet Sieve	Container No.	934
	Wt. of Dry Soil + Container (g)	945.60
	Wt. of Container (g)	108.20
	Dry Wt. of Soil Retained on # 200 Sieve (g)	837.40

U. S. Sieve Size (in.)	U. S. Sieve Size (mm.)	Cumulative Weight Dry Soil Retained (g)	Percent Passing (%)
6"	152.400		
3"	75.000		
1 1/2	37.500	0.00	100.0
3/4"	19.000	61.04	93.2
3/8"	9.500	155.17	82.7
#4	4.750	263.80	70.6
#8	2.360	385.10	57.1
#16	1.180	524.80	41.6
#30	0.600	624.90	30.4
#50	0.300	705.90	21.4
#100	0.150	782.50	12.9
#200	0.075	831.30	7.4
PAN			

GRAVEL: **29 %**
SAND: **64 %**
FINES: **7 %**
GROUP SYMBOL: **(SW-SM)g**

Cu = D60/D10 = 24.55
Cc = $(D30)^2/(D60*D10)$ = 1.21

Remarks:



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z3-B11 Sample No.: O-12

Depth (feet): 61-66 Soil Type : (SW-SM)g

Soil Identification: Olive well-graded sand with silt and gravel (SW-SM)g

GR:SA:FI : (%) 29 : 64 : 7

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PARTICLE - SIZE DISTRIBUTION ASTM D 422

Apr-09

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PARTICLE-SIZE ANALYSIS OF SOILS

ASTM D 422

Project Name: SR-710 Tunnel Technical Study | Tested By : V. Juliano | Date: 05/17/09

Project No. : 378312.04.09.01 | Data Input By: J. Ward | Date: 05/26/09

Exploration No.: R-09-Z3-B11

Sample No.: C-27 | Depth (feet) : 131.5-132.0

Soil Identification: Dark olive brown sandy lean clay s(CL)

% Gravel	1	Soil Type
% Sand	35	s(CL)
% Fines	64	

			Moisture Content of Total Air-Dry Soil	Moisture Content of Air-Dry Soil Passing #10	After Hydrometer & Wet Sieve ret. in #200 Sieve
Specific Gravity (Assumed)	2.70	Wt.of Air-Dry Soil + Cont.(g)	0.00	0.00	
Correction for Specific Gravity	0.99	Dry Wt. of Soil + Cont. (g)	0.00	0.00	N/A
Wt.of Air-Dry Soil + Cont. (g)	700.70	Wt. of Container No.___ (g)	1.00	1.00	N/A
Wt. of Container	107.00	Moisture Content (%)	0.00	0.00	
Dry Wt. of Soil (g)	593.70	Wt. of Dry Soil (g)			N/A

Coarse Sieve

U.S. Sieve	Cumulative Wt. Of Dry Soil Retained (g)	% Passing
3"	0.00	100.0
1½"	0.00	100.0
3/4"	0.00	100.0
3/8"	0.00	100.0
No. 4	3.33	99.4
No. 10	12.82	97.8
Pan		

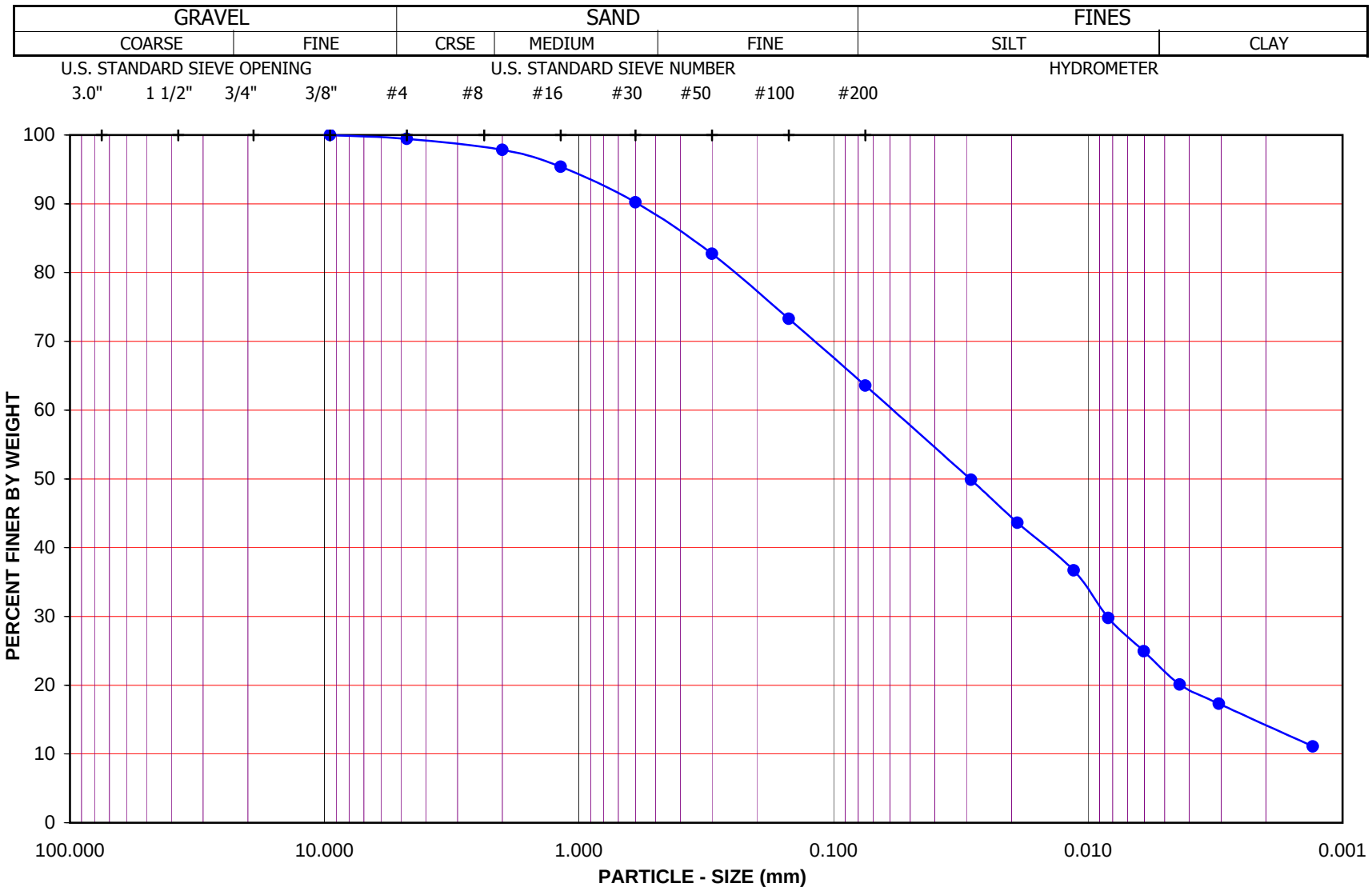
Sieve after Hydrometer & Wet Sieve

U.S. Sieve Size	Cumulative Wt. Of Dry Soil Retained (g)	% Passing	% Total Sample
No. 10	0.00	100.0	97.8
No. 16	1.77	97.5	95.4
No. 30	5.47	92.2	90.2
No. 50	10.82	84.6	82.7
No. 100	17.60	74.9	73.3
No. 200	24.56	65.0	63.6
Pan			

Hydrometer Wt. of Air-Dry Soil (g) 70.08 Wt. of Dry Soil (g) 70.08

Deflocculant 125 cc of 4% Solution

Date	Time	Elapsed Time (min)	Water Temperature (°C)	Composite Correction 152H	Actual Hydrometer Readings	% Total Sample (%)	Soil Particle Diameter (mm)
18-May-09	10:27	0		6.0			
	10:29	2	21.5	6.0	42.0	49.9	0.0288
	10:32	5	21.6	6.0	37.5	43.6	0.0189
	10:42	15	21.4	6.0	32.5	36.7	0.0114
	10:57	30	21.6	6.0	27.5	29.8	0.0083
	11:27	60	21.7	6.0	24.0	24.9	0.0060
	12:27	120	21.5	6.0	20.5	20.1	0.0044
	14:37	250	21.7	6.0	18.5	17.3	0.0031
19-May-09	10:27	1440	21.2	6.0	14.0	11.1	0.0013



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z3-B11 Sample No.: C-27

Depth (feet) : 131.5-132.0 Soil Type : s(CL)

Soil Identification: Dark olive brown sandy lean clay s(CL)

GR:SA:FI : (%) 1 : 35 : 64

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PARTICLE - SIZE DISTRIBUTION ASTM D 422

May-09

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PARTICLE-SIZE ANALYSIS OF SOILS

ASTM D 422

Project Name: SR-710 Tunnel Technical Study | Tested By : V. Juliano | Date: 05/14/09

Project No. : 378312.04.09.01 | Data Input By: J. Ward | Date: 05/29/09

Exploration No.: R-09-Z3-B11

Sample No.: C-35 | Depth (feet) : 171.5-172.25

Soil Identification: Light olive brown fat clay'stone' with sand (CH)s

% Gravel	**0**	**Soil Type**	
% Sand	**18**	**(CH)s**	
% Fines	**82**		

			Moisture Content of Total Air-Dry Soil	Moisture Content of Air-Dry Soil Passing #10	After Hydrometer & Wet Sieve ret. in #200 Sieve
Specific Gravity (Assumed)	2.70	Wt.of Air-Dry Soil + Cont.(g)	0.00	0.00	
Correction for Specific Gravity	0.99	Dry Wt. of Soil + Cont. (g)	0.00	0.00	N/A
Wt.of Air-Dry Soil + Cont. (g)	1209.30	Wt. of Container No.___ (g)	1.00	1.00	N/A
Wt. of Container	0.00	Moisture Content (%)	0.00	0.00	
Dry Wt. of Soil (g)	1209.30	Wt. of Dry Soil (g)			N/A

Coarse Sieve

U.S. Sieve	Cumulative Wt. Of Dry Soil Retained (g)	% Passing
3"	0.00	100.0
1½"	0.00	100.0
3/4"	0.00	100.0
3/8"	0.00	100.0
No. 4	0.00	100.0
No. 10	0.00	100.0
Pan		

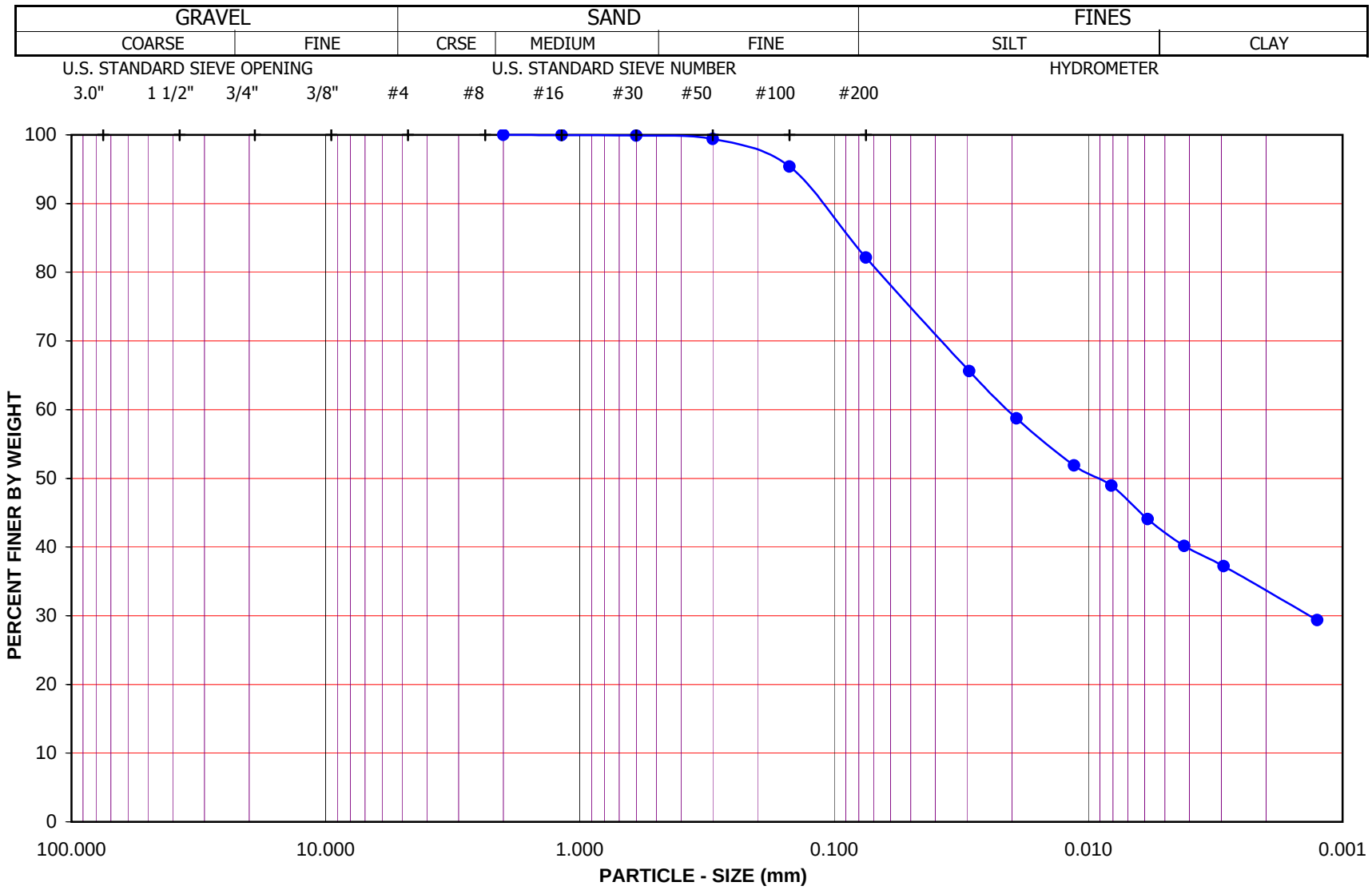
Sieve after Hydrometer & Wet Sieve

U.S. Sieve Size	Cumulative Wt. Of Dry Soil Retained (g)	% Passing	% Total Sample
No. 10	0.00	100.0	100.0
No. 16	0.01	100.0	100.0
No. 30	0.05	99.9	99.9
No. 50	0.31	99.4	99.4
No. 100	2.34	95.4	95.4
No. 200	9.05	82.1	82.1
Pan			

Hydrometer Wt. of Air-Dry Soil (g) 50.66 Wt. of Dry Soil (g) 50.66

Deflocculant 125 cc of 4% Solution

Date	Time	Elapsed Time (min)	Water Temperature (°C)	Composite Correction 152H	Actual Hydrometer Readings	% Total Sample (%)	Soil Particle Diameter (mm)
18-May-09	10:15	0		6.0			
	10:17	2	21.4	6.0	39.5	65.6	0.0294
	10:20	5	21.4	6.0	36.0	58.7	0.0192
	10:30	15	21.5	6.0	32.5	51.9	0.0114
	10:45	30	21.3	6.0	31.0	49.0	0.0081
	11:15	60	21.4	6.0	28.5	44.1	0.0058
	12:15	120	21.5	6.0	26.5	40.1	0.0042
	14:25	250	21.7	6.0	25.0	37.2	0.0029
19-May-09	10:15	1440	21.2	6.0	21.0	29.4	0.0013



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z3-B11 Sample No.: C-35

Depth (feet) : 171.5-172.25 Soil Type : (CH)s

Soil Identification: Light olive brown fat clay'stone' with sand (CH)s

GR:SA:FI : (%) 0 : 18 : 82

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PARTICLE - SIZE DISTRIBUTION ASTM D 422

May-09

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PARTICLE-SIZE ANALYSIS OF SOILS

ASTM D 422

Project Name: SR-710 Tunnel Technical Study | Tested By : V. Juliano | Date: 04/06/09

Project No. : 378312.04.09.01 | Data Input By: J. Ward | Date: 04/29/09

Exploration No.: R-09-Z3-B11

Sample No.: O-14 | Depth (feet) : 71-76

Soil Identification: Olive silty sand (SM)

% Gravel	**0**	**Soil Type**
% Sand	**61**	**SM**
% Fines	**39**	

			Moisture Content of Total Air-Dry Soil	Moisture Content of Air-Dry Soil Passing #10	After Hydrometer & Wet Sieve ret. in #200 Sieve
Specific Gravity (Assumed)	2.70	Wt.of Air-Dry Soil + Cont.(g)	0.00	0.00	
Correction for Specific Gravity	0.99	Dry Wt. of Soil + Cont. (g)	0.00	0.00	137.01
Wt.of Air-Dry Soil + Cont. (g)	381.80	Wt. of Container No.___ (g)	1.00	1.00	75.25
Wt. of Container	79.40	Moisture Content (%)	0.00	0.00	
Dry Wt. of Soil (g)	302.40	Wt. of Dry Soil (g)			61.76

Coarse Sieve

U.S. Sieve	Cumulative Wt. Of Dry Soil Retained (g)	% Passing
3"	0.00	100.0
1½"	0.00	100.0
3/4"	0.00	100.0
3/8"	0.00	100.0
No. 4	0.46	99.8
No. 10	0.56	99.8
Pan		

Sieve after Hydrometer & Wet Sieve

U.S. Sieve Size	Cumulative Wt. Of Dry Soil Retained (g)	% Passing	% Total Sample
No. 10	0.00	100.0	99.8
No. 16	0.10	99.9	99.7
No. 30	0.28	99.7	99.5
No. 50	1.90	98.1	97.9
No. 100	23.70	76.3	76.2
No. 200	61.32	38.8	38.7
Pan			

Hydrometer Wt. of Air-Dry Soil (g) 100.19 Wt. of Dry Soil (g) 100.19

Deflocculant 125 cc of 4% Solution

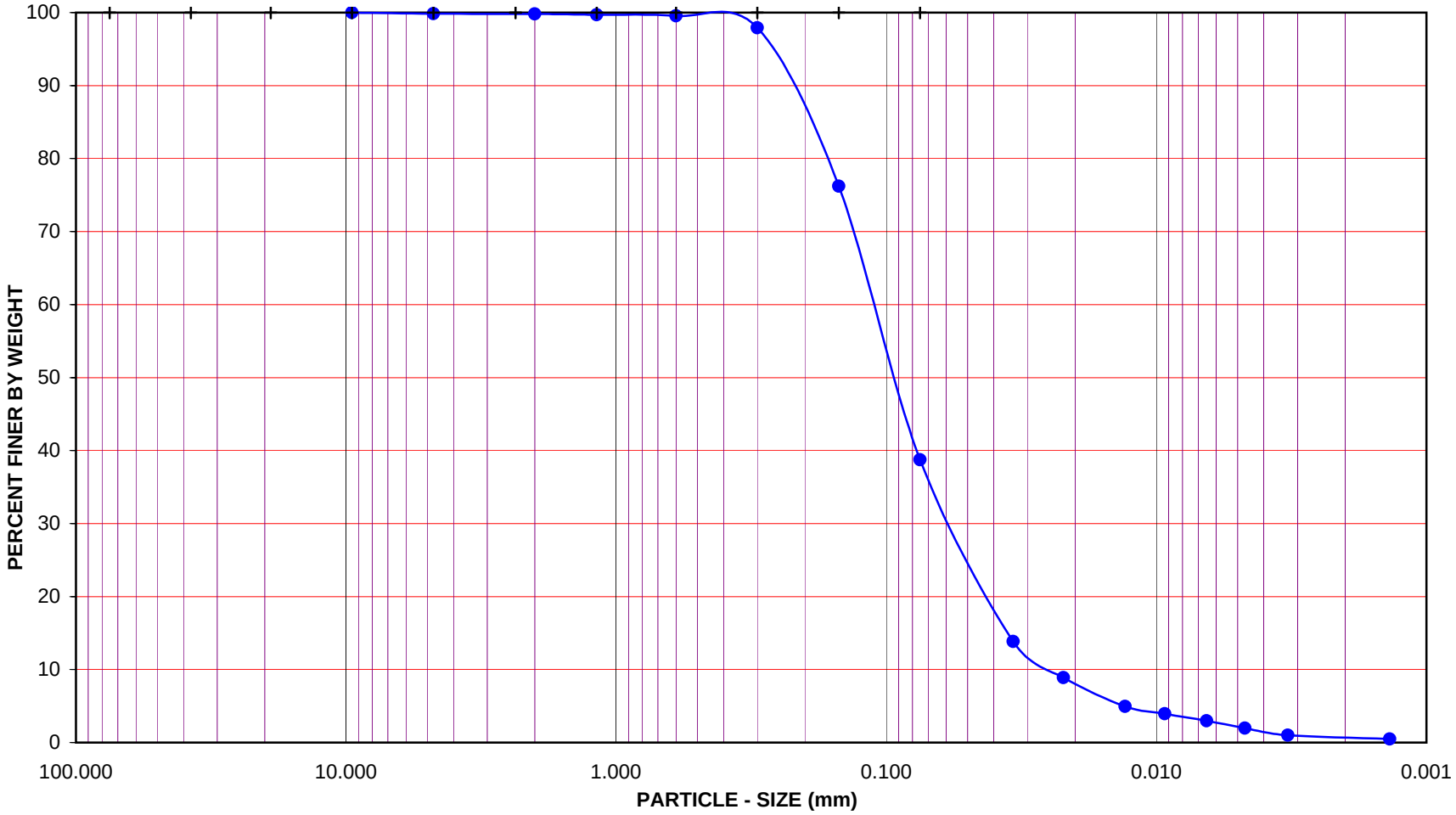
Date	Time	Elapsed Time (min)	Water Temperature (°C)	Composite Correction 152H	Actual Hydrometer Readings	% Total Sample (%)	Soil Particle Diameter (mm)
07-Apr-09	8:20	0		6.0			
	8:22	2	21.4	6.0	20.0	13.8	0.0339
	8:25	5	21.4	6.0	15.0	8.9	0.0221
	8:35	15	21.4	6.0	11.0	4.9	0.0131
	8:50	30	21.6	6.0	10.0	4.0	0.0093
	9:20	60	22.0	6.0	9.0	3.0	0.0065
	10:20	120	21.8	6.0	8.0	2.0	0.0047
	12:32	252	21.8	6.0	7.0	1.0	0.0033
08-Apr-09	8:20	1440	21.7	6.0	6.5	0.5	0.0014

GRAVEL		SAND			FINES	
COARSE	FINE	CRSE	MEDIUM	FINE	SILT	CLAY

U.S. STANDARD SIEVE OPENING: 3.0" 1 1/2" 3/4" 3/8"

U.S. STANDARD SIEVE NUMBER: #4 #8 #16 #30 #50 #100 #200

HYDROMETER



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z3-B11 Sample No.: O-14

Depth (feet) : 71-76 Soil Type : SM

Soil Identification: Olive silty sand (SM)

GR:SA:FI : (%) 0 : 61 : 39

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PARTICLE - SIZE DISTRIBUTION ASTM D 422

Apr-09

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PARTICLE-SIZE ANALYSIS OF SOILS

ASTM D 422

Project Name: SR-710 Tunnel Technical Study | Tested By : V. Juliano | Date: 05/17/09

Project No. : 378312.04.09.01 | Data Input By: J. Ward | Date: 05/26/09

Exploration No.: R-09-Z3-B11

Sample No.: O-18 | Depth (feet) : 91-96

Soil Identification: Yellowish brown sandy silt s(ML)

% Gravel	0	Soil Type
% Sand	44	s(ML)
% Fines	56	

			Moisture Content of Total Air-Dry Soil	Moisture Content of Air-Dry Soil Passing #10	After Hydrometer & Wet Sieve ret. in #200 Sieve
Specific Gravity (Assumed)	2.70	Wt.of Air-Dry Soil + Cont.(g)	0.00	0.00	
Correction for Specific Gravity	0.99	Dry Wt. of Soil + Cont. (g)	0.00	0.00	N/A
Wt.of Air-Dry Soil + Cont. (g)	812.30	Wt. of Container No.___ (g)	1.00	1.00	N/A
Wt. of Container	111.10	Moisture Content (%)	0.00	0.00	
Dry Wt. of Soil (g)	701.20	Wt. of Dry Soil (g)			N/A

Coarse Sieve

U.S. Sieve	Cumulative Wt. Of Dry Soil Retained (g)	% Passing
3"	0.00	100.0
1½"	0.00	100.0
3/4"	0.00	100.0
3/8"	0.00	100.0
No. 4	0.00	100.0
No. 10	0.00	100.0
Pan		

Sieve after Hydrometer & Wet Sieve

U.S. Sieve Size	Cumulative Wt. Of Dry Soil Retained (g)	% Passing	% Total Sample
No. 10	0.00	100.0	100.0
No. 16	0.00	100.0	100.0
No. 30	0.05	99.9	99.9
No. 50	0.40	99.5	99.5
No. 100	9.40	89.0	89.0
No. 200	37.24	56.5	56.5
Pan			

Hydrometer Wt. of Air-Dry Soil (g) 85.52 Wt. of Dry Soil (g) 85.52

Deflocculant 125 cc of 4% Solution

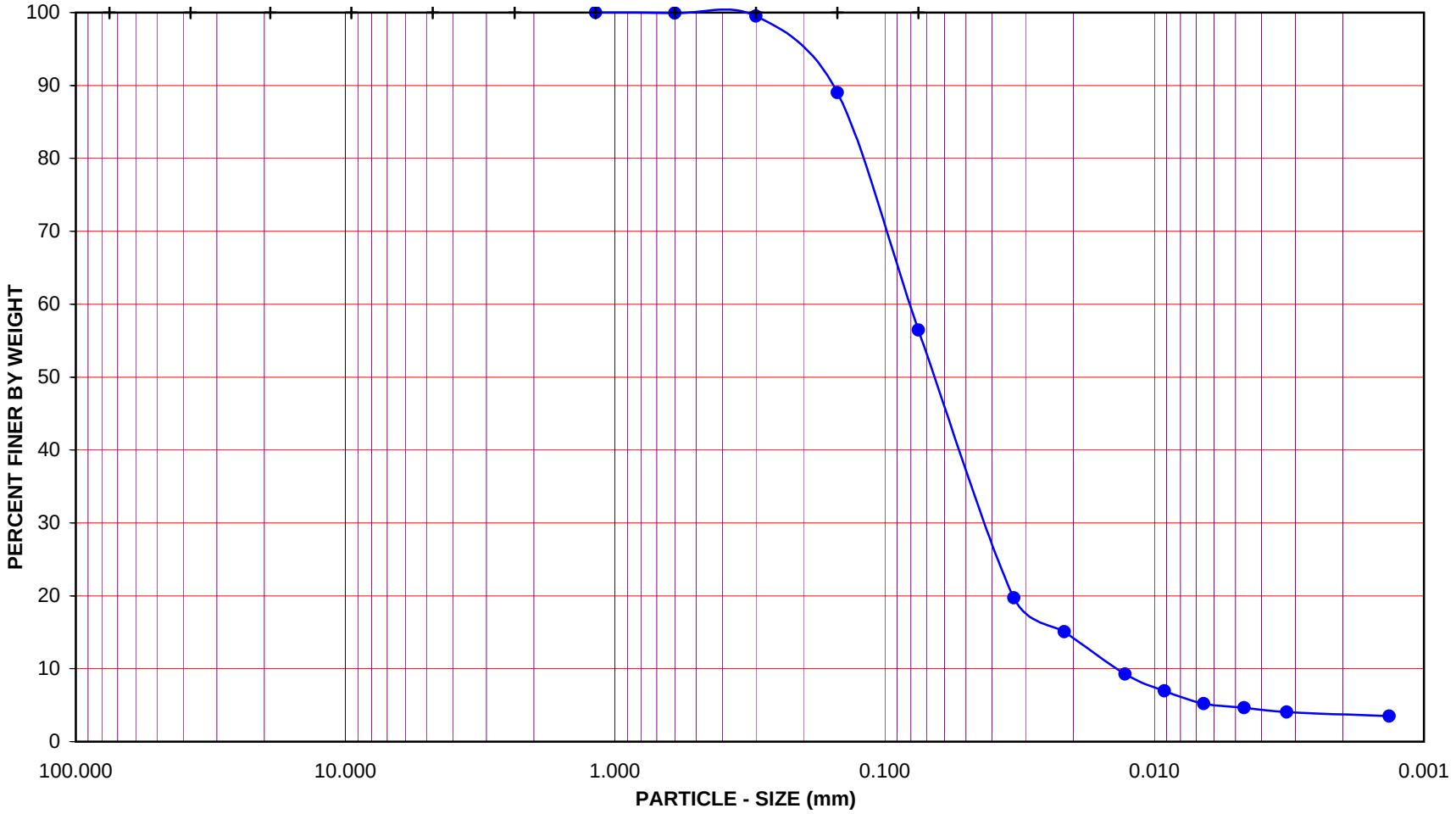
Date	Time	Elapsed Time (min)	Water Temperature (°C)	Composite Correction 152H	Actual Hydrometer Readings	% Total Sample (%)	Soil Particle Diameter (mm)
18-May-09	10:39	0		6.0			
	10:41	2	21.4	6.0	23.0	19.7	0.0332
	10:44	5	21.3	6.0	19.0	15.1	0.0216
	10:54	15	21.6	6.0	14.0	9.3	0.0128
	11:09	30	21.6	6.0	12.0	7.0	0.0092
	11:39	60	21.6	6.0	10.5	5.2	0.0066
	12:39	120	21.5	6.0	10.0	4.6	0.0046
	14:49	250	21.7	6.0	9.5	4.1	0.0032
19-May-09	10:39	1440	21.3	6.0	9.0	3.5	0.0013

GRAVEL		SAND			FINES	
COARSE	FINE	CRSE	MEDIUM	FINE	SILT	CLAY

U.S. STANDARD SIEVE OPENING: 3.0" 1 1/2" 3/4" 3/8"

U.S. STANDARD SIEVE NUMBER: #4 #8 #16 #30 #50 #100 #200

HYDROMETER



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z3-B11 Sample No.: O-18

Depth (feet) : 91-96 Soil Type : s(ML)

Soil Identification: Yellowish brown sandy silt s(ML)

GR:SA:FI : (%) 0 : 44 : 56

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PARTICLE - SIZE DISTRIBUTION ASTM D 422

May-09

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PARTICLE-SIZE ANALYSIS of SOILS
ASTM D 422

Project Name: SR-710 Tunnel Technical Study
Project No.: 378312.04.09.01
Exploration No.: R-09-Z3-B12
Sample No.: S9
Soil Identification: Dark grayish brown silty sand (SM)

Tested By: S. Felter Date: 04/01/09
Checked By: J. Ward Date: 04/08/09
Depth (feet): 45.0

		Moisture Content of Total Air - Dry Soil	
Container No.:	936	Wt. of Air-Dry Soil + Cont. (g)	0.00
Wt. of Air-Dried Soil + Cont.(g)	463.70	Wt. of Dry Soil + Cont. (g)	0.00
Wt. of Container (g)	108.40	Wt. of Container No._____ (g)	1.00
Dry Wt. of Soil (g)	355.30	Moisture Content (%)	0.00

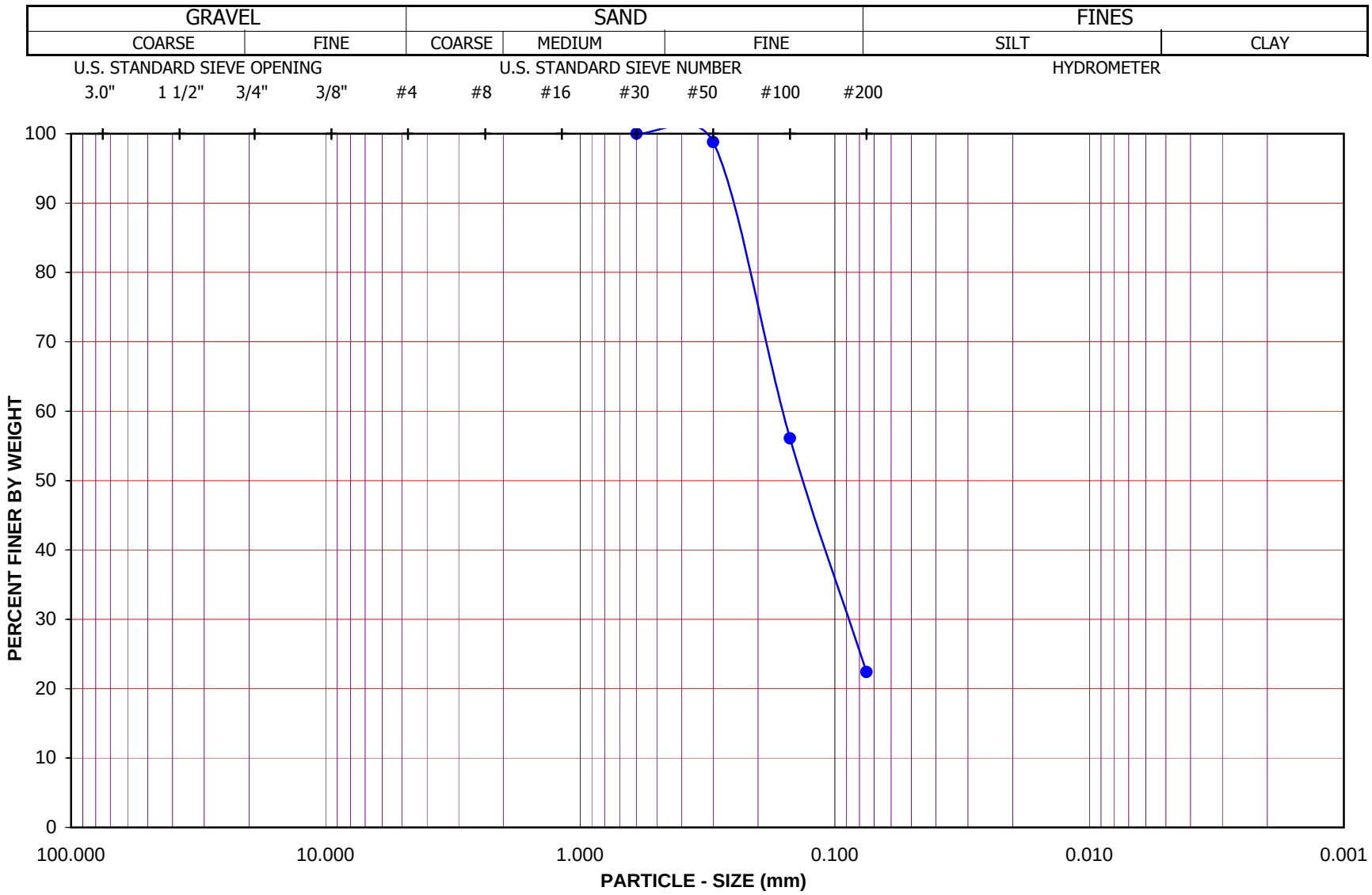
After Wet Sieve	Container No.	936
	Wt. of Dry Soil + Container (g)	391.70
	Wt. of Container (g)	108.40
	Dry Wt. of Soil Retained on # 200 Sieve (g)	283.30

U. S. Sieve Size (in.)	U. S. Sieve Size (mm.)	Cumulative Weight Dry Soil Retained (g)	Percent Passing (%)
6"	152.400		
3"	75.000		
1 1/2	37.500		
3/4"	19.000		
3/8"	9.500		
#4	4.750		
#8	2.360		
#16	1.180		
#30	0.600	0.00	100.0
#50	0.300	4.10	98.8
#100	0.150	156.10	56.1
#200	0.075	275.80	22.4
PAN			

GRAVEL: **0 %**
SAND: **78 %**
FINES: **22 %**
GROUP SYMBOL: **SM**

Cu = D60/D10 = _____
Cc = $(D30)^2/(D60*D10)$ = _____

Remarks:



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z3-B12 Sample No.: S9

Depth (feet): 45.0 Soil Type : SM

Soil Identification: Dark grayish brown silty sand (SM)

GR:SA:FI : (%) 0 : 78 : 22

Leighton

PARTICLE - SIZE DISTRIBUTION ASTM D 422

Apr-09

Leighton

PARTICLE-SIZE ANALYSIS OF SOILS

ASTM D 422

Project Name: SR-710 Tunnel Technical Study Tested By : V. Juliano Date: 04/23/09

Project No. : 378312.04.09.01 Data Input By: J. Ward Date: 05/11/09

Exploration No.: R-09-Z3-B12

Sample No.: C21 Depth (feet) : 101-101.5

Soil Identification: Olive lean clay with sand (CL)s

% Gravel	1	Soil Type
% Sand	19	(CL)s
% Fines	80	

			Moisture Content of Total Air-Dry Soil	Moisture Content of Air-Dry Soil Passing #10	After Hydrometer & Wet Sieve ret. in #200 Sieve
Specific Gravity (Assumed)	2.70	Wt.of Air-Dry Soil + Cont.(g)	0.00	0.00	
Correction for Specific Gravity	0.99	Dry Wt. of Soil + Cont. (g)	0.00	0.00	85.98
Wt.of Air-Dry Soil + Cont. (g)	1423.00	Wt. of Container No.___ (g)	1.00	1.00	76.10
Wt. of Container	106.80	Moisture Content (%)	0.00	0.00	
Dry Wt. of Soil (g)	1316.20	Wt. of Dry Soil (g)			9.88

Coarse Sieve

U.S. Sieve	Cumulative Wt. Of Dry Soil Retained (g)	% Passing
3"	0.00	100.0
1½"	0.00	100.0
3/4"	0.00	100.0
3/8"	1.10	99.9
No. 4	6.70	99.5
No. 10	12.70	99.0
Pan		

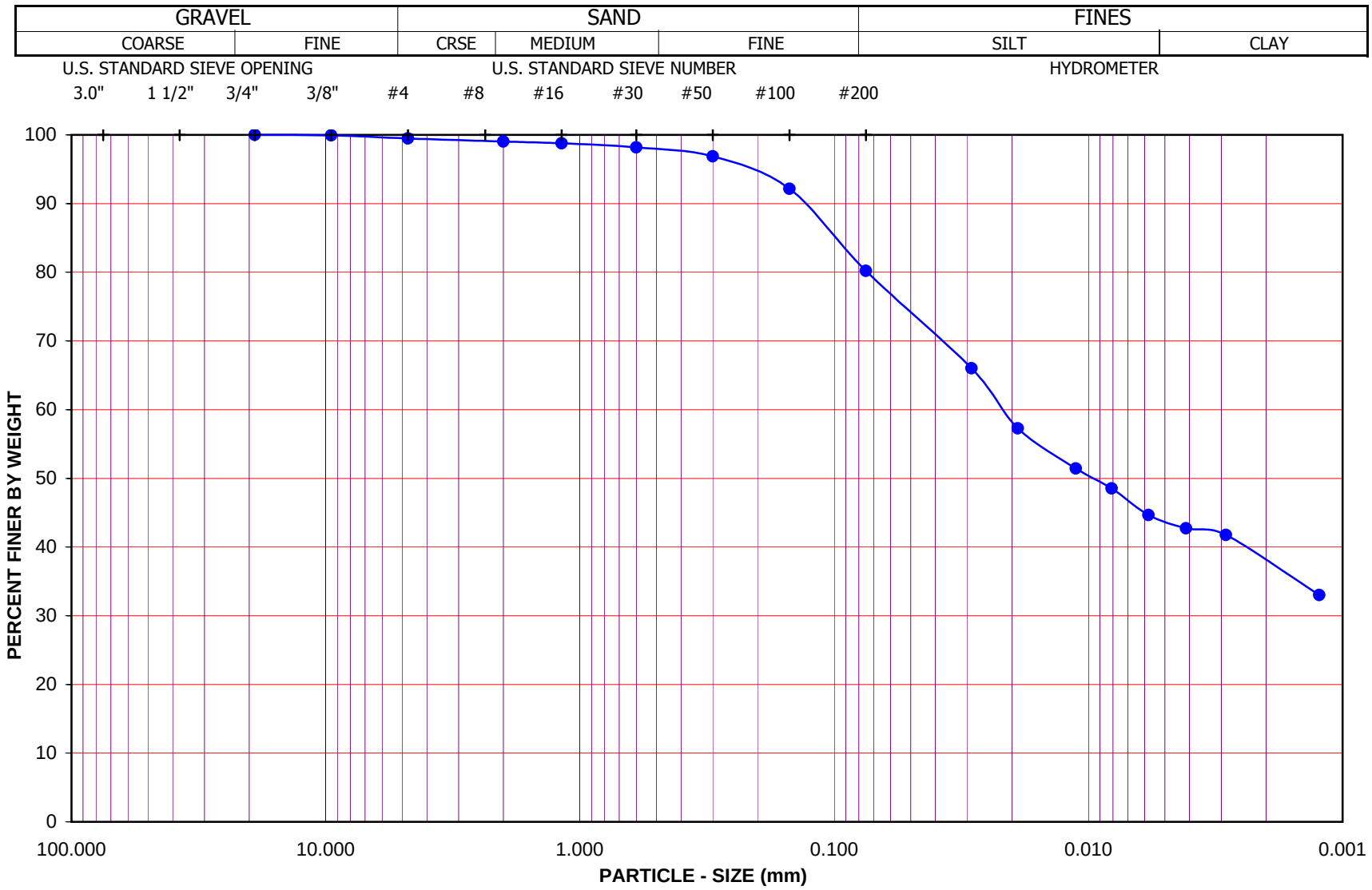
Sieve after Hydrometer & Wet Sieve

U.S. Sieve Size	Cumulative Wt. Of Dry Soil Retained (g)	% Passing	% Total Sample
No. 10	0.00	100.0	99.0
No. 16	0.14	99.7	98.8
No. 30	0.44	99.1	98.2
No. 50	1.10	97.8	96.9
No. 100	3.52	93.0	92.1
No. 200	9.62	81.0	80.2
Pan			

Hydrometer Wt. of Air-Dry Soil (g): 50.60 Wt. of Dry Soil (g): 50.60

Deflocculant 125 cc of 4% Solution

Date	Time	Elapsed Time (min)	Water Temperature (°C)	Composite Correction 152H	Actual Hydrometer Readings	% Total Sample (%)	Soil Particle Diameter (mm)
30-Apr-09	10:10	0		6.5			
	10:12	2	22.3	6.5	40.5	66.0	0.0288
	10:15	5	22.3	6.5	36.0	57.3	0.0189
	10:25	15	22.4	6.5	33.0	51.5	0.0112
	10:40	30	21.8	6.5	31.5	48.5	0.0081
	11:10	60	21.7	6.5	29.5	44.7	0.0058
	12:10	120	21.7	6.5	28.5	42.7	0.0041
	14:20	250	21.6	6.5	28.0	41.7	0.0029
01-May-09	10:10	1440	21.5	6.5	23.5	33.0	0.0012



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z3-B12 Sample No.: C21

Depth (feet) : 101-101.5 Soil Type : (CL)s

Soil Identification: Olive lean clay with sand (CL)s

GR:SA:FI : (%) 1 : 19 : 80

Leighton

PARTICLE - SIZE DISTRIBUTION ASTM D 422

May-09

Leighton

PARTICLE-SIZE ANALYSIS OF SOILS

ASTM D 422

Project Name: SR-710 Tunnel Technical Study | Tested By : V. Juliano | Date: 04/22/09

Project No. : 378312.04.09.01 | Data Input By: J. Ward | Date: 05/11/09

Exploration No.: R-09-Z3-B12

Sample No.: C27 | Depth (feet) : 124.3-125.2

Soil Identification: Olive fat clay'stone' (CH)

% Gravel	**0**	**Soil Type**	
% Sand	**4**	**CH**	
% Fines	**96**		

			Moisture Content of Total Air-Dry Soil	Moisture Content of Air-Dry Soil Passing #10	After Hydrometer & Wet Sieve ret. in #200 Sieve
Specific Gravity (Assumed)	2.70	Wt.of Air-Dry Soil + Cont.(g)	0.00	0.00	
Correction for Specific Gravity	0.99	Dry Wt. of Soil + Cont. (g)	0.00	0.00	76.05
Wt.of Air-Dry Soil + Cont. (g)	729.60	Wt. of Container No.___ (g)	1.00	1.00	74.29
Wt. of Container	110.50	Moisture Content (%)	0.00	0.00	
Dry Wt. of Soil (g)	619.10	Wt. of Dry Soil (g)			1.76

Coarse Sieve

U.S. Sieve	Cumulative Wt. Of Dry Soil Retained (g)	% Passing
3"	0.00	100.0
1½"	0.00	100.0
3/4"	0.00	100.0
3/8"	0.00	100.0
No. 4	0.00	100.0
No. 10	0.70	99.9
Pan		

Sieve after Hydrometer & Wet Sieve

U.S. Sieve Size	Cumulative Wt. Of Dry Soil Retained (g)	% Passing	% Total Sample
No. 10	0.00	100.0	99.9
No. 16	0.05	99.9	99.8
No. 30	0.18	99.6	99.5
No. 50	0.38	99.2	99.1
No. 100	0.76	98.5	98.4
No. 200	1.72	96.6	96.5
Pan			

Hydrometer Wt. of Air-Dry Soil (g) 50.11 Wt. of Dry Soil (g) 50.11

Deflocculant 125 cc of 4% Solution

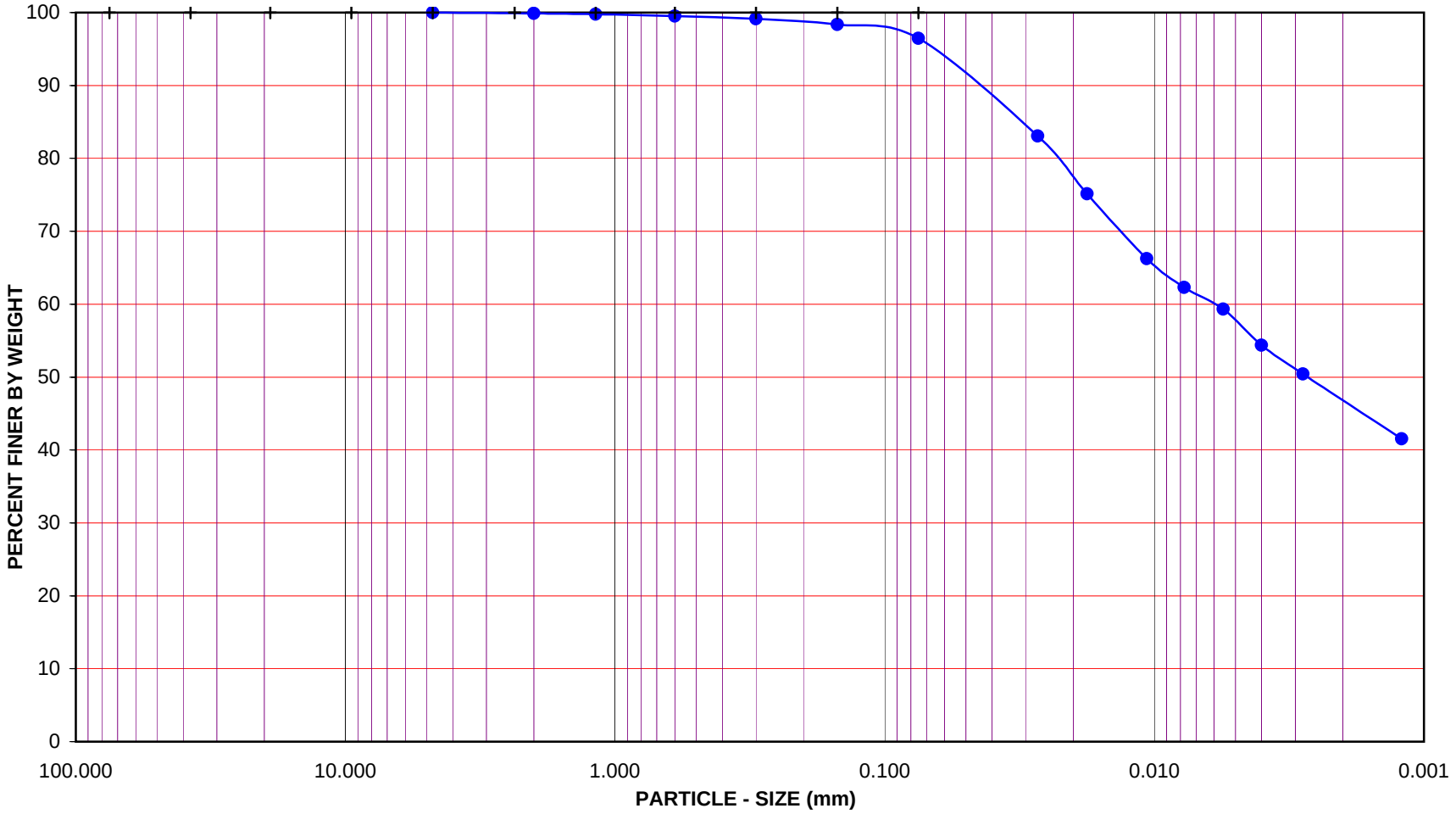
Date	Time	Elapsed Time (min)	Water Temperature (°C)	Composite Correction 152H	Actual Hydrometer Readings	% Total Sample (%)	Soil Particle Diameter (mm)
23-Apr-09	11:19	0		5.5			
	11:21	2	22.3	5.5	47.5	83.1	0.0271
	11:24	5	22.3	5.5	43.5	75.1	0.0178
	11:34	15	22.1	5.5	39.0	66.2	0.0107
	11:49	30	21.9	5.5	37.0	62.3	0.0077
	12:19	60	21.6	5.5	35.5	59.3	0.0056
	13:19	120	21.4	5.5	33.0	54.4	0.0040
	15:29	250	21.4	5.5	31.0	50.4	0.0028
24-Apr-09	11:19	1440	21.7	5.5	26.5	41.5	0.0012

GRAVEL		SAND			FINES	
COARSE	FINE	CRSE	MEDIUM	FINE	SILT	CLAY

U.S. STANDARD SIEVE OPENING: 3.0" 1 1/2" 3/4" 3/8"

U.S. STANDARD SIEVE NUMBER: #4 #8 #16 #30 #50 #100 #200

HYDROMETER



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z3-B12 Sample No.: C27

Depth (feet) : 124.3-125.2 Soil Type : CH

Soil Identification: Olive fat clay'stone' (CH)

GR:SA:FI : (%) 0 : 4 : 96

Leighton

PARTICLE - SIZE DISTRIBUTION ASTM D 422

May-09

Leighton

PARTICLE-SIZE ANALYSIS OF SOILS

ASTM D 422

Project Name: SR-710 Tunnel Technical Study | Tested By : V. Juliano | Date: 04/24/09

Project No. : 378312.04.09.01 | Data Input By: J. Ward | Date: 05/11/09

Exploration No.: R-09-Z3-B12

Sample No.: C29 | Depth (feet) : 140-140.6

Soil Identification: Olive lean clay'stone' (CL)

% Gravel	**1**	**Soil Type**
% Sand	**4**	**CL**
% Fines	**95**	

			Moisture Content of Total Air-Dry Soil	Moisture Content of Air-Dry Soil Passing #10	After Hydrometer & Wet Sieve ret. in #200 Sieve
Specific Gravity (Assumed)	2.70	Wt.of Air-Dry Soil + Cont.(g)	0.00	0.00	
Correction for Specific Gravity	0.99	Dry Wt. of Soil + Cont. (g)	0.00	0.00	84.44
Wt.of Air-Dry Soil + Cont. (g)	1331.30	Wt. of Container No.___ (g)	1.00	1.00	82.66
Wt. of Container	108.20	Moisture Content (%)	0.00	0.00	
Dry Wt. of Soil (g)	1223.10	Wt. of Dry Soil (g)			1.78

Coarse Sieve

U.S. Sieve	Cumulative Wt. Of Dry Soil Retained (g)	% Passing
3"	0.00	100.0
1½"	0.00	100.0
3/4"	0.00	100.0
3/8"	0.00	100.0
No. 4	6.81	99.4
No. 10	22.26	98.2
Pan		

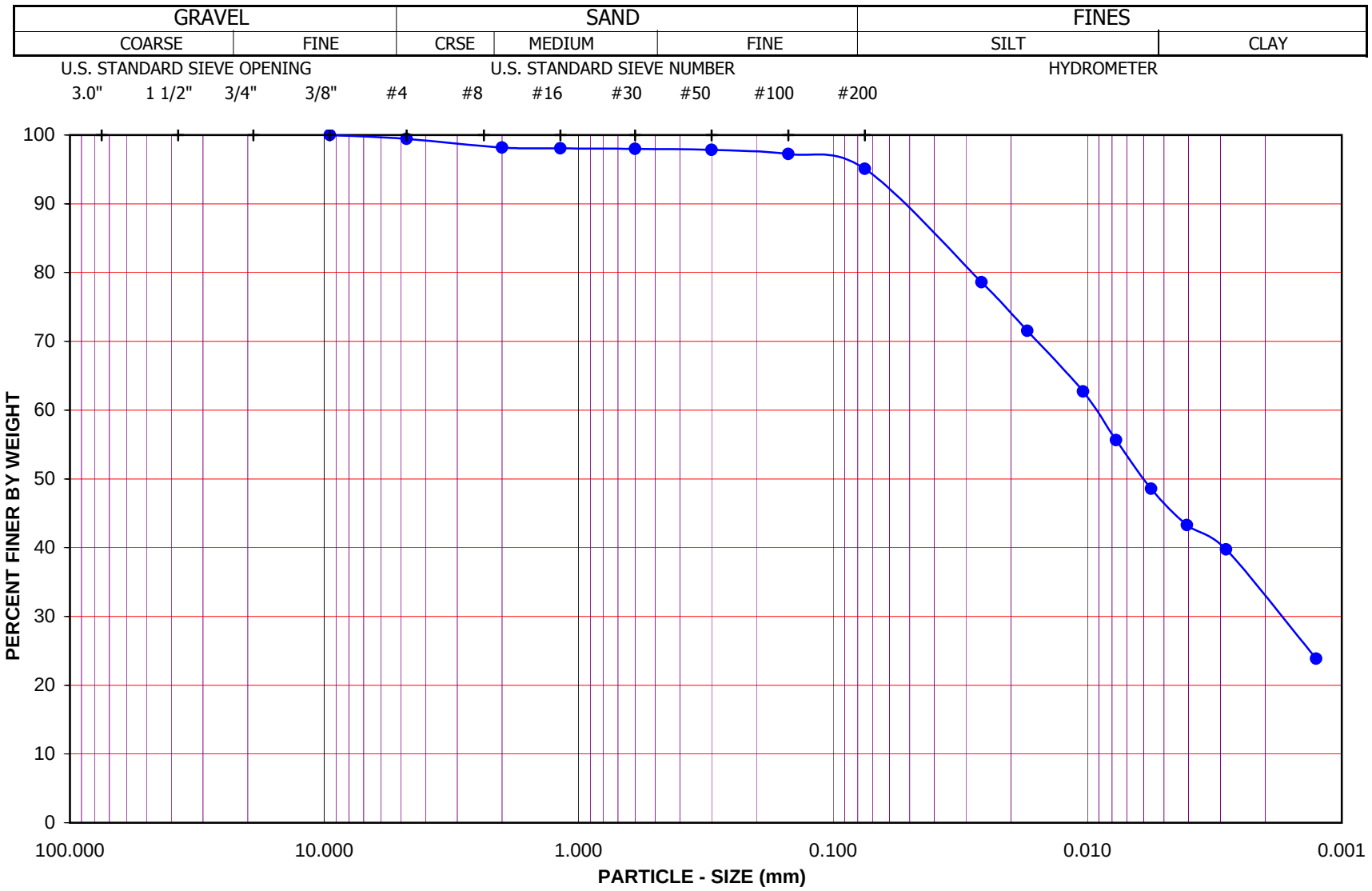
Sieve after Hydrometer & Wet Sieve

U.S. Sieve Size	Cumulative Wt. Of Dry Soil Retained (g)	% Passing	% Total Sample
No. 10	0.00	100.0	98.2
No. 16	0.06	99.9	98.1
No. 30	0.11	99.8	98.0
No. 50	0.20	99.6	97.8
No. 100	0.52	99.1	97.3
No. 200	1.74	96.8	95.1
Pan			

Hydrometer Wt. of Air-Dry Soil (g) 55.14 Wt. of Dry Soil (g) 55.14

Deflocculant 125 cc of 4% Solution

Date	Time	Elapsed Time (min)	Water Temperature (°C)	Composite Correction 152H	Actual Hydrometer Readings	% Total Sample (%)	Soil Particle Diameter (mm)
30-Apr-09	10:14	0		6.5			
	10:16	2	22.3	6.5	51.0	78.6	0.0261
	10:19	5	22.3	6.5	47.0	71.5	0.0172
	10:29	15	22.2	6.5	42.0	62.7	0.0104
	10:44	30	21.9	6.5	38.0	55.6	0.0077
	11:14	60	21.8	6.5	34.0	48.6	0.0056
	12:14	120	21.9	6.5	31.0	43.3	0.0041
	14:24	250	21.6	6.5	29.0	39.7	0.0028
01-May-09	10:14	1440	21.5	6.5	20.0	23.8	0.0013



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z3-B12 Sample No.: C29

Depth (feet) : 140-140.6 Soil Type : CL

Soil Identification: Olive lean clay'stone' (CL)

GR:SA:FI : (%) 1 : 4 : 95

Leighton

PARTICLE - SIZE DISTRIBUTION ASTM D 422

May-09

Leighton

PARTICLE-SIZE ANALYSIS OF SOILS

ASTM D 422

Project Name: SR-710 Tunnel Technical Study | Tested By : A. Santos | Date: 03/10/09

Project No. : 378312.04.09.01 | Data Input By: J. Ward | Date: 04/08/09

Exploration No.: R-09-Z3-B12

Sample No.: S7 | Depth (feet) : 35.0

Soil Identification: Yellowish brown silt with sand (ML)s

				Moisture Content of Total Air-Dry Soil	Moisture Content of Air-Dry Soil Passing #10	After Hydrometer & Wet Sieve ret. in #200 Sieve
% Gravel	**0**	**Soil Type**				
% Sand	**25**	**(ML)s**				
% Fines	**75**					
Specific Gravity (Assumed)	2.70	Wt.of Air-Dry Soil + Cont.(g)		0.00	0.00	
Correction for Specific Gravity	0.99	Dry Wt. of Soil + Cont. (g)		0.00	0.00	102.48
Wt.of Air-Dry Soil + Cont. (g)	665.70	Wt. of Container No.___ (g)		1.00	1.00	76.33
Wt. of Container	108.00	Moisture Content (%)		0.00	0.00	
Dry Wt. of Soil (g)	557.70	Wt. of Dry Soil (g)				26.15

Coarse Sieve

U.S. Sieve	Cumulative Wt. Of Dry Soil Retained (g)	% Passing
3"	0.00	100.0
1½"	0.00	100.0
3/4"	0.00	100.0
3/8"	0.00	100.0
No. 4	0.00	100.0
No. 10	0.08	100.0
Pan		

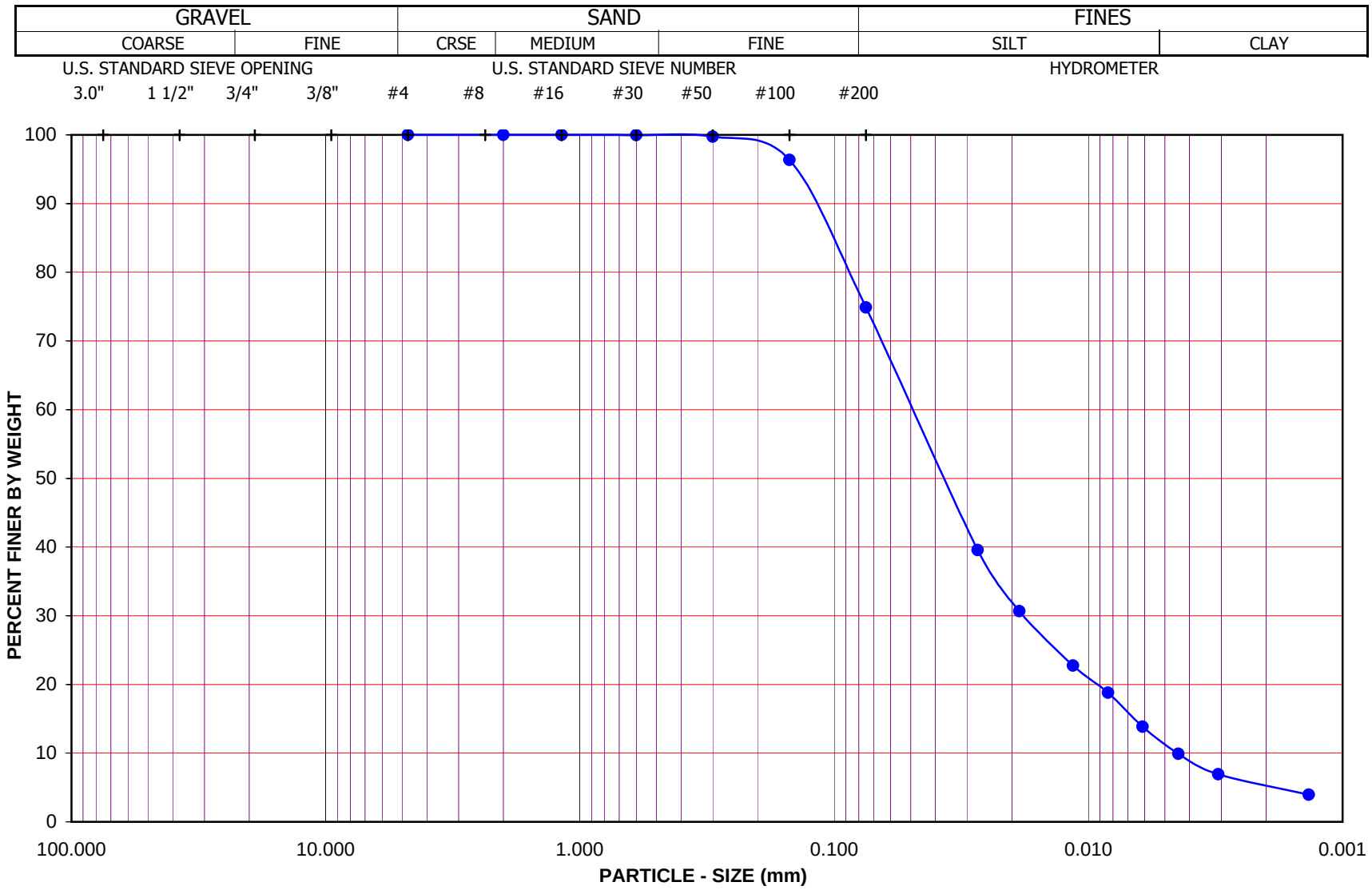
Sieve after Hydrometer & Wet Sieve

U.S. Sieve Size	Cumulative Wt. Of Dry Soil Retained (g)	% Passing	% Total Sample
No. 10	0.00	100.0	100.0
No. 16	0.00	100.0	100.0
No. 30	0.02	100.0	100.0
No. 50	0.23	99.8	99.8
No. 100	3.64	96.4	96.4
No. 200	25.20	74.9	74.9
Pan			

Hydrometer Wt. of Air-Dry Soil (g) 100.30 Wt. of Dry Soil (g) 100.30

Deflocculant 125 cc of 4% Solution

Date	Time	Elapsed Time (min)	Water Temperature (°C)	Composite Correction 152H	Actual Hydrometer Readings	% Total Sample (%)	Soil Particle Diameter (mm)
12-Mar-09	9:36	0		8.0			
	9:38	2	21.0	8.0	48.0	39.6	0.0272
	9:41	5	21.0	8.0	39.0	30.7	0.0187
	9:51	15	21.0	8.0	31.0	22.7	0.0115
	10:06	30	21.1	8.0	27.0	18.8	0.0084
	10:36	60	21.4	8.0	22.0	13.8	0.0061
	11:36	120	21.8	8.0	18.0	9.9	0.0044
	13:46	250	22.5	8.0	15.0	6.9	0.0031
13-Mar-09	9:36	1440	19.9	8.0	12.0	4.0	0.0014



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z3-B12 Sample No.: S7

Depth (feet) : 35.0 Soil Type : (ML)s

Soil Identification: Yellowish brown silt with sand (ML)s

GR:SA:FI : (%) 0 : 25 : 75

Leighton

PARTICLE - SIZE DISTRIBUTION ASTM D 422

Apr-09

Leighton

PARTICLE-SIZE ANALYSIS OF SOILS

ASTM D 422

Project Name: SR-710 Tunnel Technical Study | Tested By : A. Santos | Date: 04/01/09

Project No. : 378312.04.09.01 | Data Input By: J. Ward | Date: 04/08/09

Exploration No.: R-09-Z3-B12

Sample No.: S15 | Depth (feet) : 75.0

Soil Identification: Olive brown lean clay with sand (CL)s

% Gravel	**1**	**Soil Type**	Moisture Content of Total Air-Dry Soil	Moisture Content of Air-Dry Soil Passing #10	After Hydrometer & Wet Sieve ret. in #200 Sieve
% Sand	**16**	**(CL)s**			
% Fines	**83**				

Specific Gravity (Assumed)	2.70	Wt.of Air-Dry Soil + Cont.(g)	0.00	0.00	
Correction for Specific Gravity	0.99	Dry Wt. of Soil + Cont. (g)	0.00	0.00	84.56
Wt.of Air-Dry Soil + Cont. (g)	614.30	Wt. of Container No.___ (g)	1.00	1.00	76.15
Wt. of Container	106.90	Moisture Content (%)	0.00	0.00	
Dry Wt. of Soil (g)	507.40	Wt. of Dry Soil (g)			8.41

Coarse Sieve

U.S. Sieve	Cumulative Wt. Of Dry Soil Retained (g)	% Passing
3"	0.00	100.0
1½"	0.00	100.0
3/4"	0.00	100.0
3/8"	0.00	100.0
No. 4	4.43	99.1
No. 10	7.47	98.5
Pan		

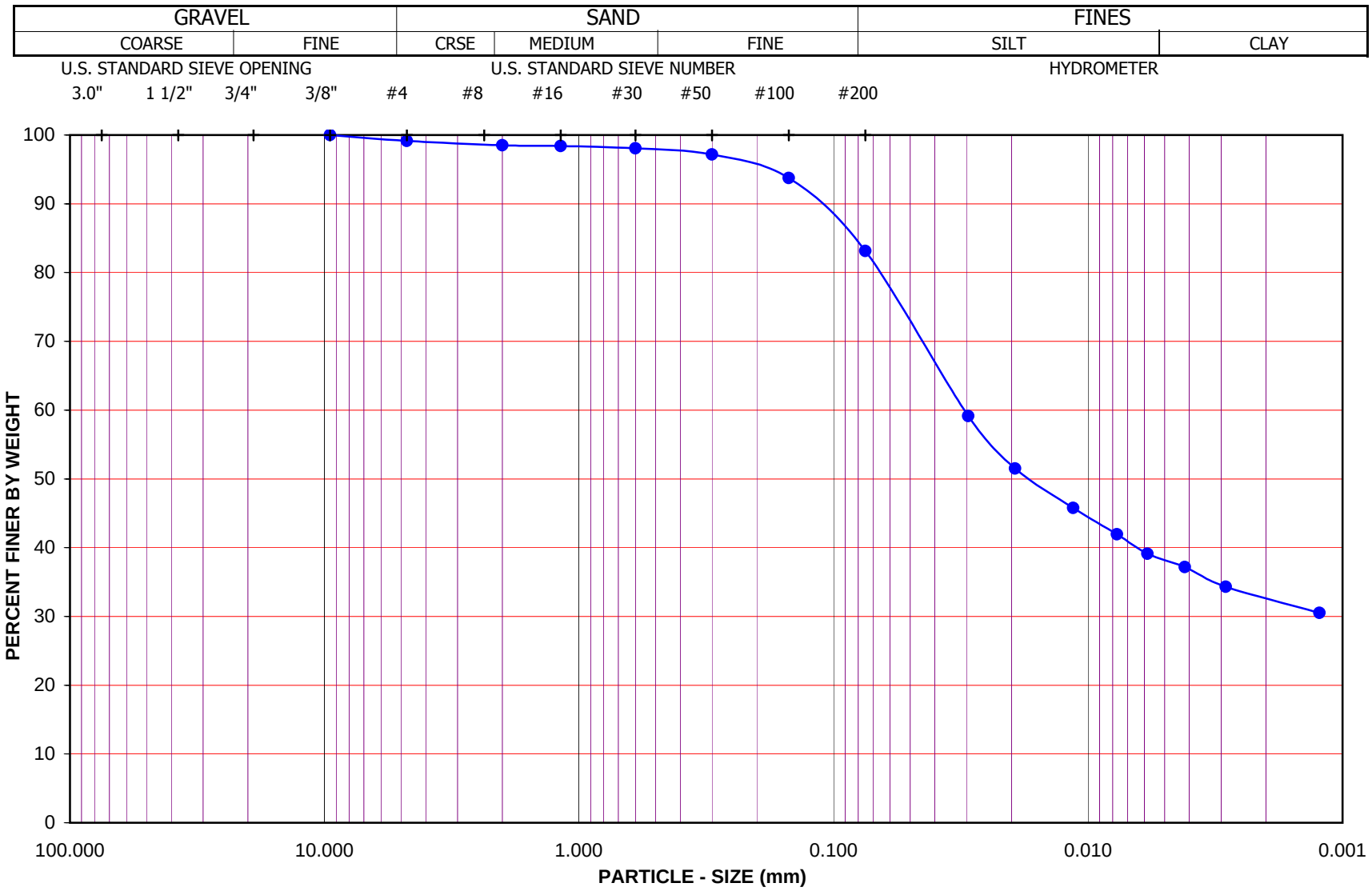
Sieve after Hydrometer & Wet Sieve

U.S. Sieve Size	Cumulative Wt. Of Dry Soil Retained (g)	% Passing	% Total Sample
No. 10	0.00	100.0	98.5
No. 16	0.07	99.9	98.4
No. 30	0.24	99.5	98.1
No. 50	0.71	98.6	97.2
No. 100	2.48	95.2	93.8
No. 200	8.00	84.4	83.1
Pan			

Hydrometer Wt. of Air-Dry Soil (g) 51.25 Wt. of Dry Soil (g) 51.25

Deflocculant 125 cc of 4% Solution

Date	Time	Elapsed Time (min)	Water Temperature (°C)	Composite Correction 152H	Actual Hydrometer Readings	% Total Sample (%)	Soil Particle Diameter (mm)
02-Apr-09	10:15	0		8.0			
	10:17	2	21.5	8.0	39.0	59.1	0.0295
	10:20	5	21.5	8.0	35.0	51.5	0.0193
	10:30	15	21.6	8.0	32.0	45.8	0.0114
	10:49	34	21.6	8.0	30.0	42.0	0.0077
	11:15	60	21.7	8.0	28.5	39.1	0.0058
	12:15	120	21.8	8.0	27.5	37.2	0.0042
	14:25	250	22.4	8.0	26.0	34.3	0.0029
03-Apr-09	10:15	1440	21.6	8.0	24.0	30.5	0.0012



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z3-B12 Sample No.: S15

Depth (feet) : 75.0 Soil Type : (CL)s

Soil Identification: Olive brown lean clay with sand (CL)s

GR:SA:FI : (%) 1 : 16 : 83

Leighton

PARTICLE - SIZE DISTRIBUTION ASTM D 422

Apr-09

Leighton

PARTICLE-SIZE ANALYSIS of SOILS
ASTM D 422

Project Name: SR-710 Tunnel Technical Study
Project No.: 378312.04.09.01
Exploration No.: R-09-Z4-B4
Sample No.: S-10
Soil Identification: Yellowish brown silty sand with gravel (SM)g

Tested By: V. Juliano Date: 04/28/09
Checked By: J. Ward Date: 05/07/09
Depth (feet): 50.0

		Moisture Content of Total Air - Dry Soil	
Container No.:	544	Wt. of Air-Dry Soil + Cont. (g)	0.00
Wt. of Air-Dried Soil + Cont.(g)	667.60	Wt. of Dry Soil + Cont. (g)	0.00
Wt. of Container (g)	77.60	Wt. of Container No._____ (g)	1.00
Dry Wt. of Soil (g)	590.00	Moisture Content (%)	0.00

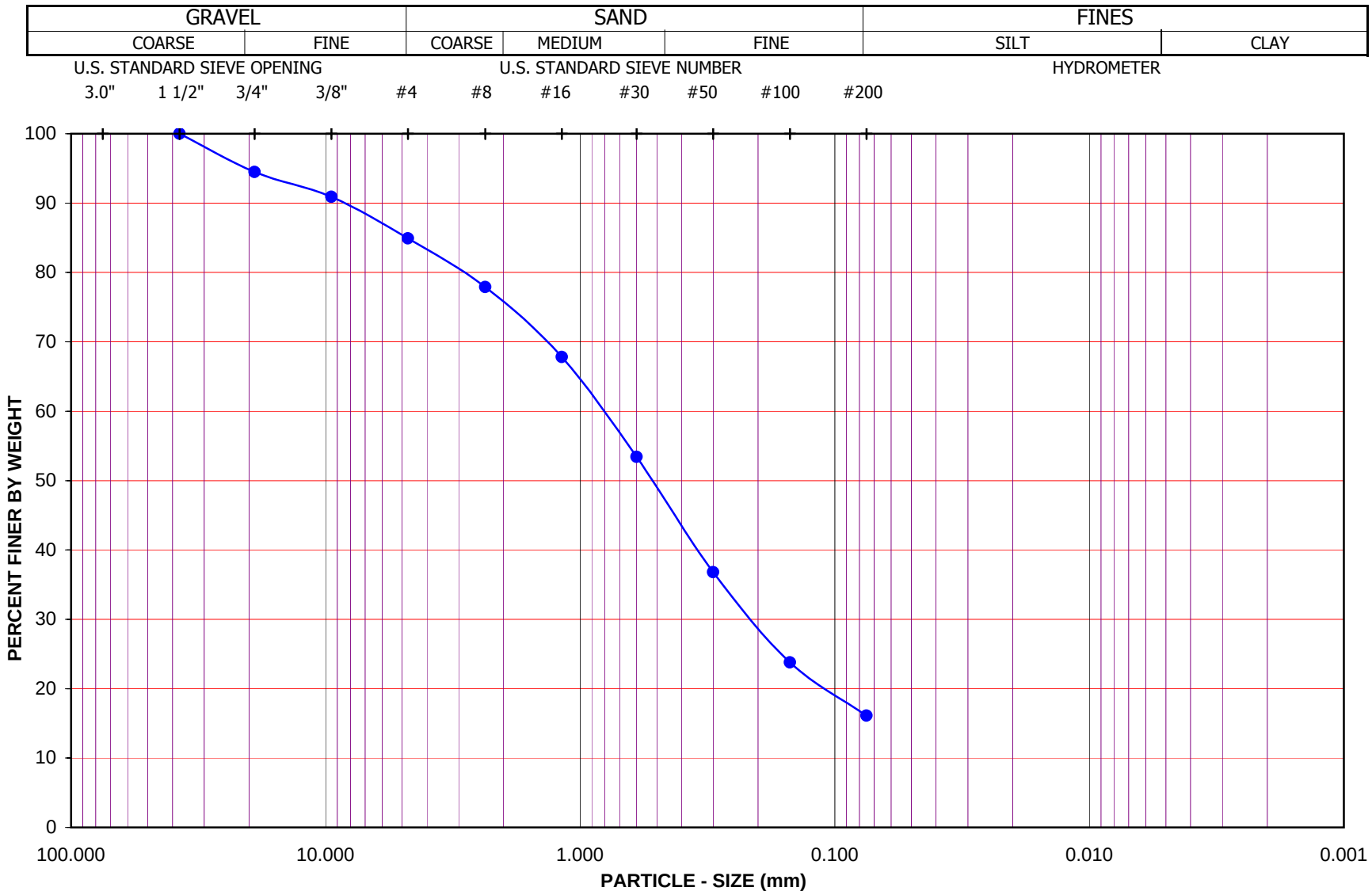
After Wet Sieve	Container No.	544
	Wt. of Dry Soil + Container (g)	575.90
	Wt. of Container (g)	77.60
	Dry Wt. of Soil Retained on # 200 Sieve (g)	498.30

U. S. Sieve Size (in.)	U. S. Sieve Size (mm.)	Cumulative Weight Dry Soil Retained (g)	Percent Passing (%)
6"	152.400		
3"	75.000		
1 1/2	37.500	0.00	100.0
3/4"	19.000	32.30	94.5
3/8"	9.500	53.80	90.9
#4	4.750	88.90	84.9
#8	2.360	130.40	77.9
#16	1.180	189.70	67.8
#30	0.600	275.10	53.4
#50	0.300	373.10	36.8
#100	0.150	449.50	23.8
#200	0.075	494.80	16.1
PAN			

GRAVEL: **15 %**
SAND: **69 %**
FINES: **16 %**
GROUP SYMBOL: **(SM)g**

Cu = D60/D10 = _____
Cc = $(D30)^2/(D60*D10)$ = _____

Remarks: Insufficient sample mass available to meet the ASTM specification for this material



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z4-B4 Sample No.: S-10

Depth (feet): 50.0 Soil Type : (SM)g

Soil Identification: Yellowish brown silty sand with gravel (SM)g

GR:SA:FI : (%) 15 : 69 : 16

Leighton

PARTICLE - SIZE DISTRIBUTION ASTM D 422

May-09

Leighton

PARTICLE-SIZE ANALYSIS of SOILS
ASTM D 422

Project Name: SR-710 Tunnel Technical Study
Project No.: 378312.04.09.01
Exploration No.: R-09-Z4-B4
Sample No.: S-13
Soil Identification: Brown silty sand (SM)

Tested By: V. Juliano Date: 04/28/09
Checked By: J. Ward Date: 05/07/09
Depth (feet): 65.0

		Moisture Content of Total Air - Dry Soil	
Container No.:	524	Wt. of Air-Dry Soil + Cont. (g)	0.00
Wt. of Air-Dried Soil + Cont.(g)	616.70	Wt. of Dry Soil + Cont. (g)	0.00
Wt. of Container (g)	80.10	Wt. of Container No._____ (g)	1.00
Dry Wt. of Soil (g)	536.60	Moisture Content (%)	0.00

After Wet Sieve	Container No.	524
	Wt. of Dry Soil + Container (g)	416.60
	Wt. of Container (g)	80.10
	Dry Wt. of Soil Retained on # 200 Sieve (g)	336.50

U. S. Sieve Size (in.)	U. S. Sieve Size (mm.)	Cumulative Weight Dry Soil Retained (g)	Percent Passing (%)
6"	152.400		
3"	75.000		
1 1/2	37.500		
3/4"	19.000	0.00	100.0
3/8"	9.500	1.90	99.6
#4	4.750	4.60	99.1
#8	2.360	11.50	97.9
#16	1.180	22.50	95.8
#30	0.600	47.50	91.1
#50	0.300	109.50	79.6
#100	0.150	231.20	56.9
#200	0.075	331.60	38.2
PAN			

GRAVEL: **1 %**
SAND: **61 %**
FINES: **38 %**
GROUP SYMBOL: **SM**

Cu = D60/D10 = _____
Cc = $(D30)^2/(D60*D10)$ = _____

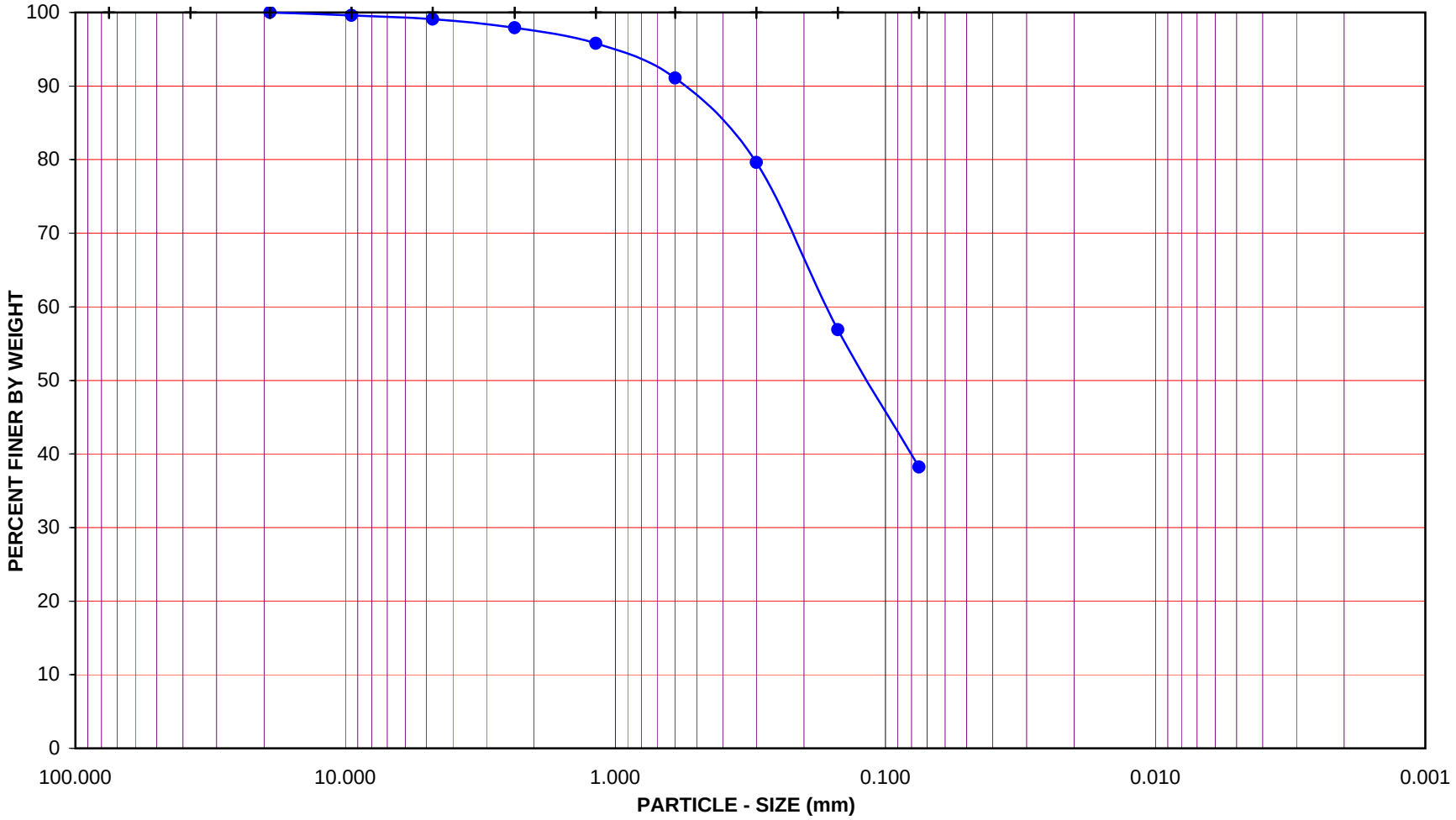
Remarks: Insufficient sample mass available to meet the ASTM specification for this material

GRAVEL		SAND			FINES	
COARSE	FINE	COARSE	MEDIUM	FINE	SILT	CLAY

U.S. STANDARD SIEVE OPENING: 3.0" 1 1/2" 3/4" 3/8"

U.S. STANDARD SIEVE NUMBER: #4 #8 #16 #30 #50 #100 #200

HYDROMETER



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z4-B4 Sample No.: S-13

Depth (feet): 65.0 Soil Type : SM

Soil Identification: Brown silty sand (SM)

GR:SA:FI : (%) 1 : 61 : 38

Leighton

PARTICLE - SIZE DISTRIBUTION ASTM D 422

May-09

Leighton

PARTICLE-SIZE ANALYSIS OF SOILS

ASTM D 422

Project Name: SR-710 Tunnel Technical Study | Tested By : V. Juliano | Date: 05/06/09

Project No. : 378312.04.09.01 | Data Input By: J. Ward | Date: 05/21/09

Exploration No.: R-09-Z4-B4

Sample No.: C-19 | Depth (feet) : 97.5-98.3

Soil Identification: Yellow fat clay'stone' (CH)

% Gravel	0	Soil Type
% Sand	1	CH
% Fines	99	

			Moisture Content of Total Air-Dry Soil	Moisture Content of Air-Dry Soil Passing #10	After Hydrometer & Wet Sieve ret. in #200 Sieve
Specific Gravity (Assumed)	2.70	Wt.of Air-Dry Soil + Cont.(g)	0.00	0.00	
Correction for Specific Gravity	0.99	Dry Wt. of Soil + Cont. (g)	0.00	0.00	75.90
Wt.of Air-Dry Soil + Cont. (g)	589.60	Wt. of Container No.___ (g)	1.00	1.00	75.13
Wt. of Container	78.40	Moisture Content (%)	0.00	0.00	
Dry Wt. of Soil (g)	511.20	Wt. of Dry Soil (g)			0.77

Coarse Sieve

U.S. Sieve	Cumulative Wt. Of Dry Soil Retained (g)	% Passing
3"	0.00	100.0
1½"	0.00	100.0
3/4"	0.00	100.0
3/8"	0.00	100.0
No. 4	0.00	100.0
No. 10	0.00	100.0
Pan		

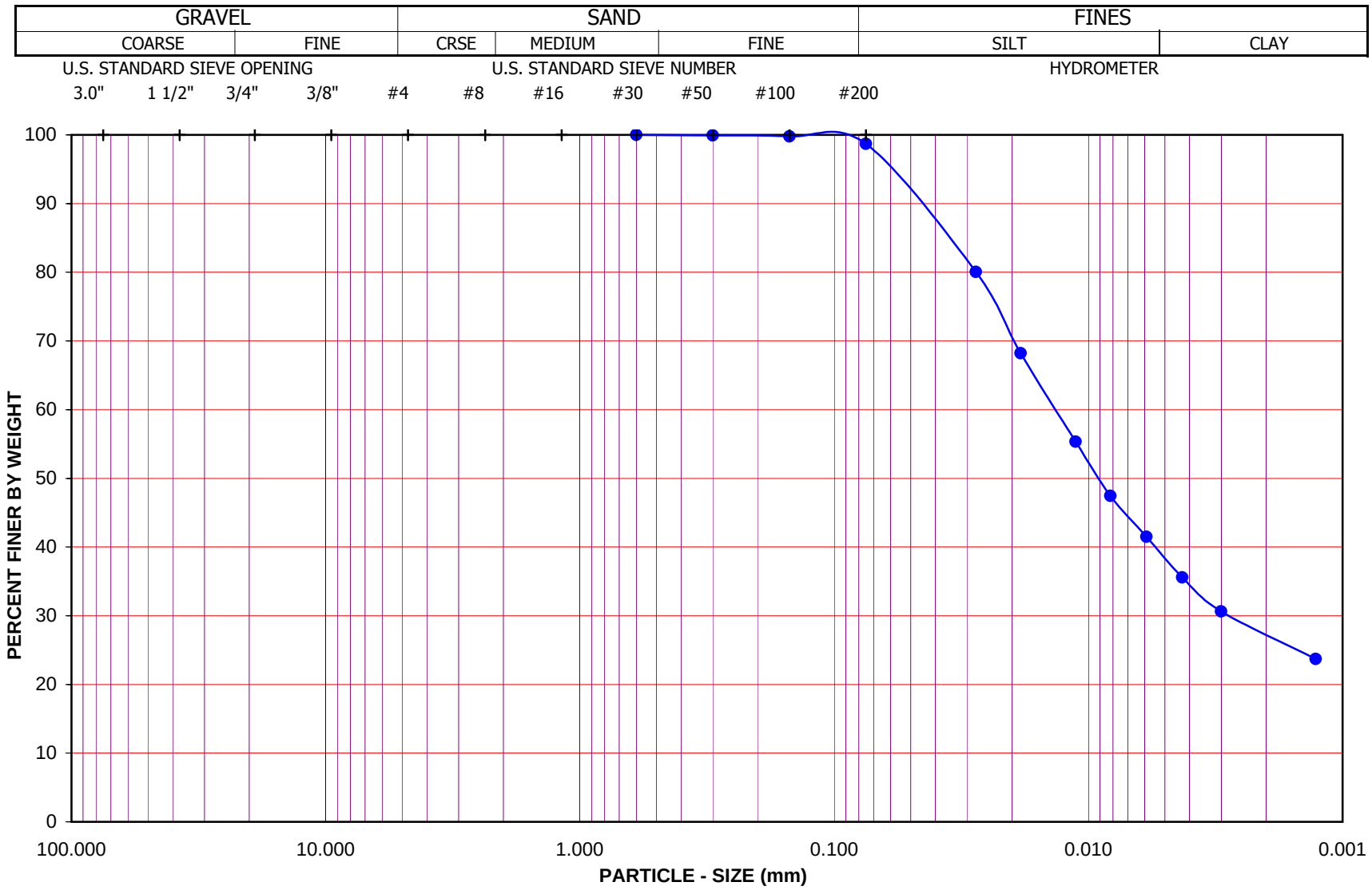
Sieve after Hydrometer & Wet Sieve

U.S. Sieve Size	Cumulative Wt. Of Dry Soil Retained (g)	% Passing	% Total Sample
No. 10	0.00	100.0	100.0
No. 16	0.00	100.0	100.0
No. 30	0.00	100.0	100.0
No. 50	0.04	99.9	99.9
No. 100	0.11	99.8	99.8
No. 200	0.65	98.7	98.7
Pan			

Hydrometer Wt. of Air-Dry Soil (g) 50.18 Wt. of Dry Soil (g) 50.18

Deflocculant 125 cc of 4% Solution

Date	Time	Elapsed Time (min)	Water Temperature (°C)	Composite Correction 152H	Actual Hydrometer Readings	% Total Sample (%)	Soil Particle Diameter (mm)
08-May-09	8:15	0		6.0			
	8:17	2	21.3	6.0	46.5	80.1	0.0277
	8:20	5	21.3	6.0	40.5	68.2	0.0185
	8:30	15	21.1	6.0	34.0	55.4	0.0112
	8:45	30	21.2	6.0	30.0	47.4	0.0082
	9:15	60	21.3	6.0	27.0	41.5	0.0059
	10:15	120	21.5	6.0	24.0	35.6	0.0043
	12:25	250	21.5	6.0	21.5	30.6	0.0030
09-May-09	8:15	1440	21.1	6.0	18.0	23.7	0.0013



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z4-B4 Sample No.: C-19

Depth (feet) : 97.5-98.3 Soil Type : CH

Soil Identification: Yellow fat clay'stone' (CH)

GR:SA:FI : (%) 0 : 1 : 99

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PARTICLE - SIZE DISTRIBUTION ASTM D 422

May-09

Leighton

PARTICLE-SIZE ANALYSIS OF SOILS

ASTM D 422

Project Name: SR-710 Tunnel Technical Study | Tested By : V. Juliano | Date: 04/28/09

Project No. : 378312.04.09.01 | Data Input By: J. Ward | Date: 05/07/09

Exploration No.: R-09-Z4-B4

Sample No.: S-3 | Depth (feet) : 15.0

Soil Identification: Yellowish brown sandy silty clay s(CL-ML)

% Gravel	**0**	**Soil Type**	
% Sand	**31**	**s(CL-ML)**	
% Fines	**69**		

			Moisture Content of Total Air-Dry Soil	Moisture Content of Air-Dry Soil Passing #10	After Hydrometer & Wet Sieve ret. in #200 Sieve
Specific Gravity (Assumed)	2.70	Wt.of Air-Dry Soil + Cont.(g)	0.00	0.00	
Correction for Specific Gravity	0.99	Dry Wt. of Soil + Cont. (g)	0.00	0.00	93.96
Wt.of Air-Dry Soil + Cont. (g)	496.00	Wt. of Container No.___ (g)	1.00	1.00	75.97
Wt. of Container	75.90	Moisture Content (%)	0.00	0.00	
Dry Wt. of Soil (g)	420.10	Wt. of Dry Soil (g)			17.99

Coarse Sieve

U.S. Sieve	Cumulative Wt. Of Dry Soil Retained (g)	% Passing
3"	0.00	100.0
1½"	0.00	100.0
3/4"	0.00	100.0
3/8"	0.00	100.0
No. 4	0.00	100.0
No. 10	1.03	99.8
Pan		

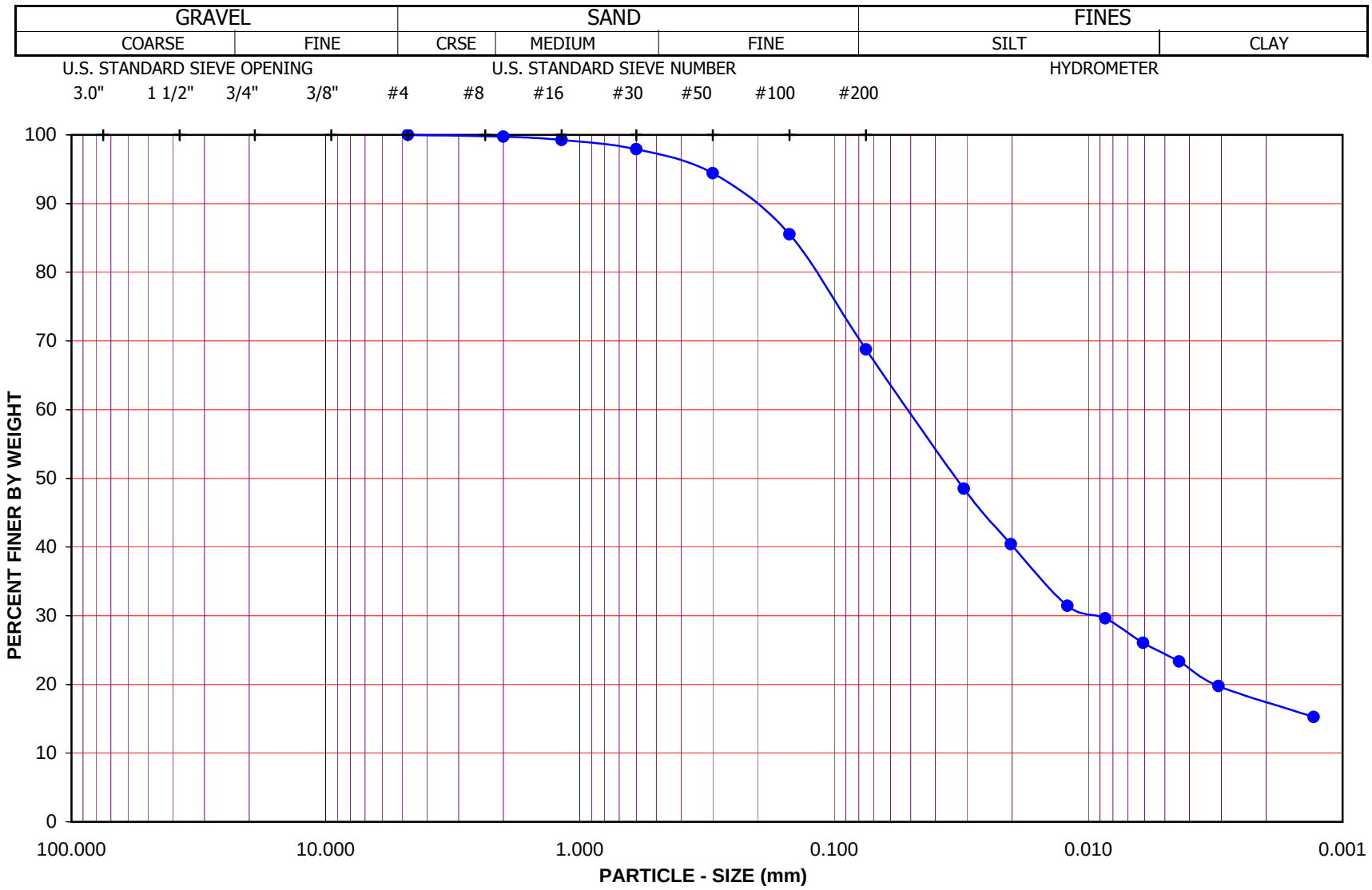
Sieve after Hydrometer & Wet Sieve

U.S. Sieve Size	Cumulative Wt. Of Dry Soil Retained (g)	% Passing	% Total Sample
No. 10	0.00	100.0	99.8
No. 16	0.28	99.5	99.2
No. 30	1.01	98.2	97.9
No. 50	2.95	94.6	94.4
No. 100	7.87	85.7	85.5
No. 200	17.12	68.9	68.8
Pan			

Hydrometer Wt. of Air-Dry Soil (g) 55.10 Wt. of Dry Soil (g) 55.10

Deflocculant 125 cc of 4% Solution

Date	Time	Elapsed Time (min)	Water Temperature (°C)	Composite Correction 152H	Actual Hydrometer Readings	% Total Sample (%)	Soil Particle Diameter (mm)
30-Apr-09	8:44	0		6.5			
	8:46	2	21.6	6.5	33.5	48.5	0.0309
	8:49	5	21.6	6.5	29.0	40.4	0.0201
	8:59	15	21.7	6.5	24.0	31.4	0.0121
	9:14	30	21.8	6.5	23.0	29.6	0.0086
	9:44	60	22.0	6.5	21.0	26.0	0.0061
	10:44	120	21.9	6.5	19.5	23.3	0.0044
	12:54	250	21.8	6.5	17.5	19.8	0.0031
01-May-09	8:44	1440	21.7	6.5	15.0	15.3	0.0013



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z4-B4 Sample No.: S-3

Depth (feet) : 15.0 Soil Type : s(CL-ML)

Soil Identification: Yellowish brown sandy silty clay s(CL-ML)

GR:SA:FI : (%) 0 : 31 : 69

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PARTICLE - SIZE DISTRIBUTION ASTM D 422

May-09

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PARTICLE-SIZE ANALYSIS OF SOILS

ASTM D 422

Project Name: SR-710 Tunnel Technical Study | Tested By : V. Juliano | Date: 04/28/09

Project No. : 378312.04.09.01 | Data Input By: J. Ward | Date: 05/12/09

Exploration No.: R-09-Z4-B4

Sample No.: S-7 | Depth (feet) : 35.0

Soil Identification: Yellowish brown sandy silty clay s(CL-ML)

% Gravel	**0**	**Soil Type**	
% Sand	**43**	**s(CL-ML)**	
% Fines	**57**		

			Moisture Content of Total Air-Dry Soil	Moisture Content of Air-Dry Soil Passing #10	After Hydrometer & Wet Sieve ret. in #200 Sieve
Specific Gravity (Assumed)	2.70	Wt.of Air-Dry Soil + Cont.(g)	0.00	0.00	
Correction for Specific Gravity	0.99	Dry Wt. of Soil + Cont. (g)	0.00	0.00	113.26
Wt.of Air-Dry Soil + Cont. (g)	764.60	Wt. of Container No.___ (g)	1.00	1.00	79.18
Wt. of Container	108.60	Moisture Content (%)	0.00	0.00	
Dry Wt. of Soil (g)	656.00	Wt. of Dry Soil (g)			34.08

Coarse Sieve

U.S. Sieve	Cumulative Wt. Of Dry Soil Retained (g)	% Passing
3"	0.00	100.0
1½"	0.00	100.0
3/4"	0.00	100.0
3/8"	0.00	100.0
No. 4	2.21	99.7
No. 10	6.21	99.1
Pan		

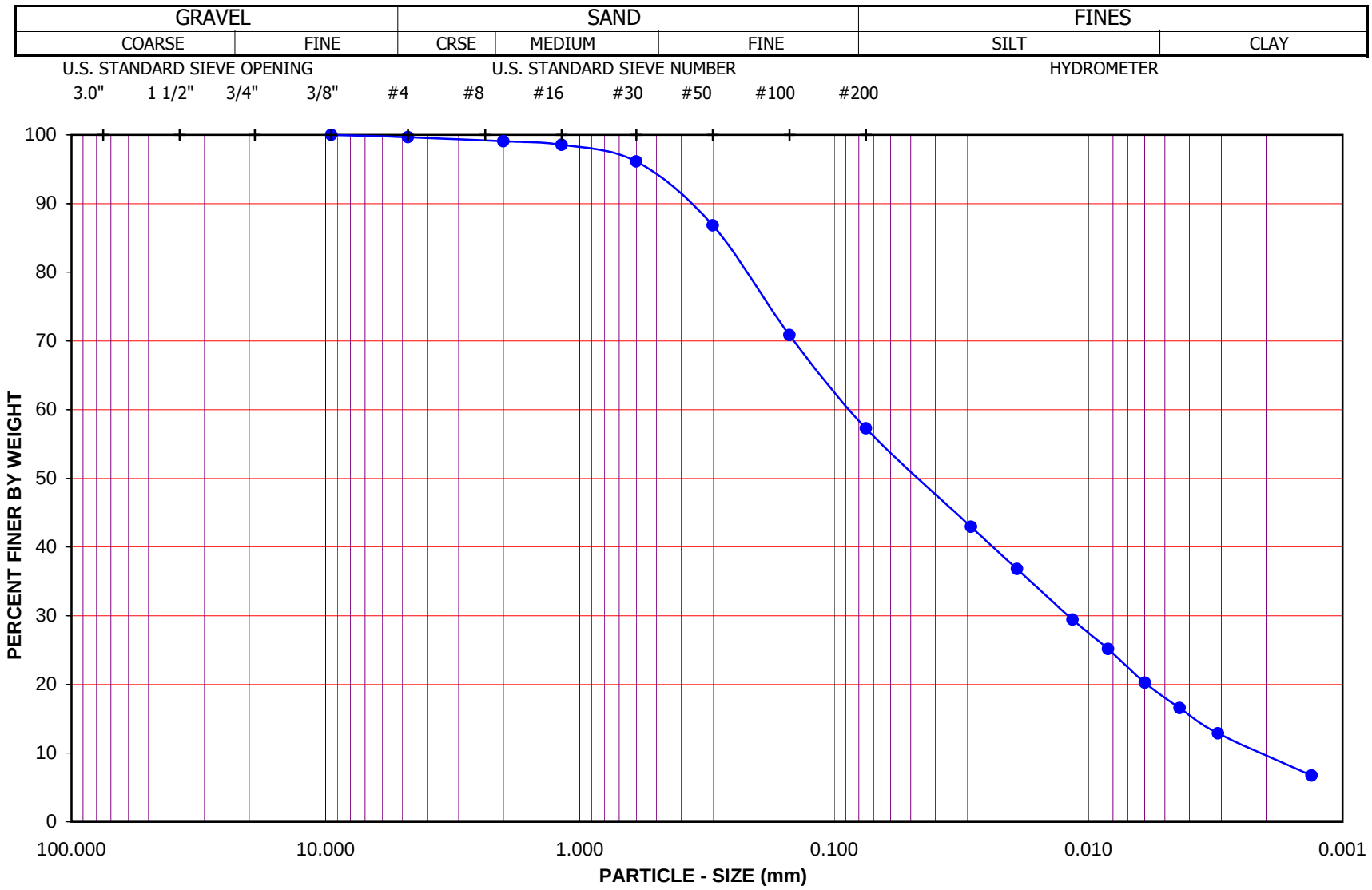
Sieve after Hydrometer & Wet Sieve

U.S. Sieve Size	Cumulative Wt. Of Dry Soil Retained (g)	% Passing	% Total Sample
No. 10	0.00	100.0	99.1
No. 16	0.42	99.5	98.5
No. 30	2.35	97.1	96.1
No. 50	9.89	87.6	86.8
No. 100	22.80	71.5	70.8
No. 200	33.77	57.8	57.3
Pan			

Hydrometer Wt. of Air-Dry Soil (g) 80.06 Wt. of Dry Soil (g) 80.06

Deflocculant 125 cc of 4% Solution

Date	Time	Elapsed Time (min)	Water Temperature (°C)	Composite Correction 152H	Actual Hydrometer Readings	% Total Sample (%)	Soil Particle Diameter (mm)
30-Apr-09	8:40	0		6.5			
	8:42	2	21.6	6.5	41.5	43.0	0.0289
	8:45	5	21.6	6.5	36.5	36.8	0.0191
	8:55	15	21.6	6.5	30.5	29.5	0.0115
	9:10	30	21.8	6.5	27.0	25.2	0.0084
	9:40	60	22.0	6.5	23.0	20.3	0.0060
	10:40	120	21.8	6.5	20.0	16.6	0.0044
	12:50	250	21.7	6.5	17.0	12.9	0.0031
01-May-09	8:40	1440	21.7	6.5	12.0	6.8	0.0013



Project Name: SR-710 Tunnel Technical Study

Project No.: 378312.04.09.01

Exploration No.: R-09-Z4-B4 Sample No.: S-7

Depth (feet) : 35.0 Soil Type : s(CL-ML)

Soil Identification: Yellowish brown sandy silty clay s(CL-ML)

GR:SA:FI : (%) 0 : 43 : 57

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PARTICLE - SIZE DISTRIBUTION ASTM D 422

May-09

Leighton

ATTERBERG LIMITS

ASTM D 4318

Project Name:	SR-710 Tunnel Technical Study	Tested By:	F. Tabibkhoei	Date:	06/04/09
Project No. :	378312.04.09.01	Input By:	J. Ward	Date:	06/06/09
Boring No.:	R-09-Z1-B4	Checked By:	J. Ward		
Sample No.:	C-22	Depth (ft.)	66-66.6		
Soil Identification:	Yellowish brown fat clay'stone' (CH)				

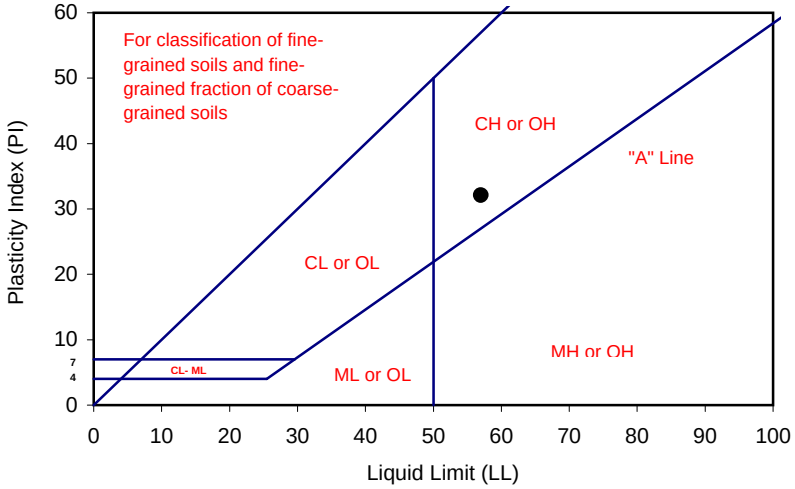
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			32	25	20	15
Wet Wt. of Soil + Cont. (g)	49.82	47.09	52.81	55.79	43.95	51.22
Dry Wt. of Soil + Cont. (g)	46.21	44.01	45.13	46.76	36.57	41.31
Wt. of Container (g)	31.69	31.66	31.42	30.95	24.16	25.04
Moisture Content (%) [Wn]	24.86	24.94	56.02	57.12	59.47	60.91

Liquid Limit	**57**
Plastic Limit	**25**
Plasticity Index	**32**
Classification	**CH**

PI at "A" - Line = 0.73(LL-20) 27.01

One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.12}$



PROCEDURES USED

☐ Wet Preparation

Multipoint - Wet

☒ Dry Preparation

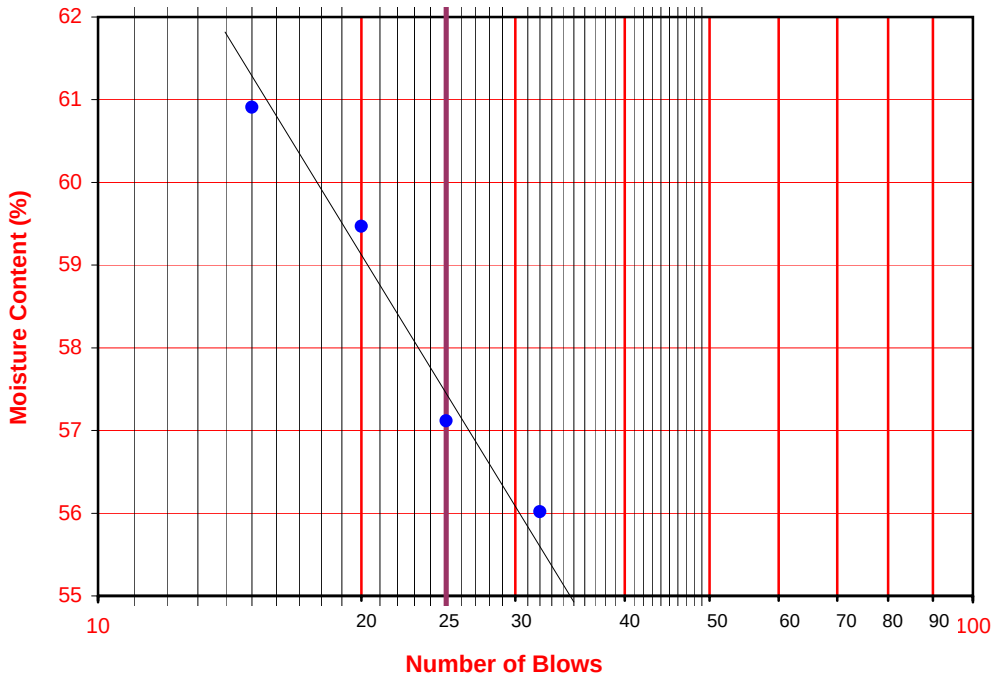
Multipoint - Dry

☒ Procedure A

Multipoint Test

☐ Procedure B

One-point Test



ATTERBERG LIMITS

ASTM D 4318

Project Name:	SR-710 Tunnel Technical Study	Tested By:	F. Tabibkhoei	Date:	06/01/09
Project No. :	378312.04.09.01	Input By:	J. Ward	Date:	06/06/09
Boring No.:	R-09-Z1-B4	Checked By:	J. Ward		
Sample No.:	C-40	Depth (ft.)	164.4-165		
Soil Identification:	Dark olive elastic silt'stone' (MH)				

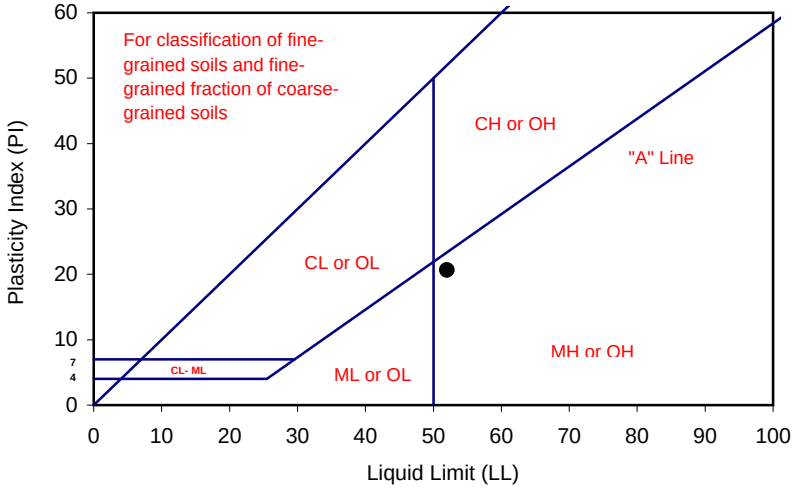
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			33	28	18	
Wet Wt. of Soil + Cont. (g)	40.49	41.44	45.01	39.55	51.72	
Dry Wt. of Soil + Cont. (g)	36.66	37.45	40.50	34.58	41.98	
Wt. of Container (g)	24.45	24.71	31.17	24.72	24.67	
Moisture Content (%) [Wn]	31.37	31.32	48.34	50.41	56.27	

Liquid Limit	**52**
Plastic Limit	**31**
Plasticity Index	**21**
Classification	**MH**

PI at "A" - Line = 0.73(LL-20) 23.36

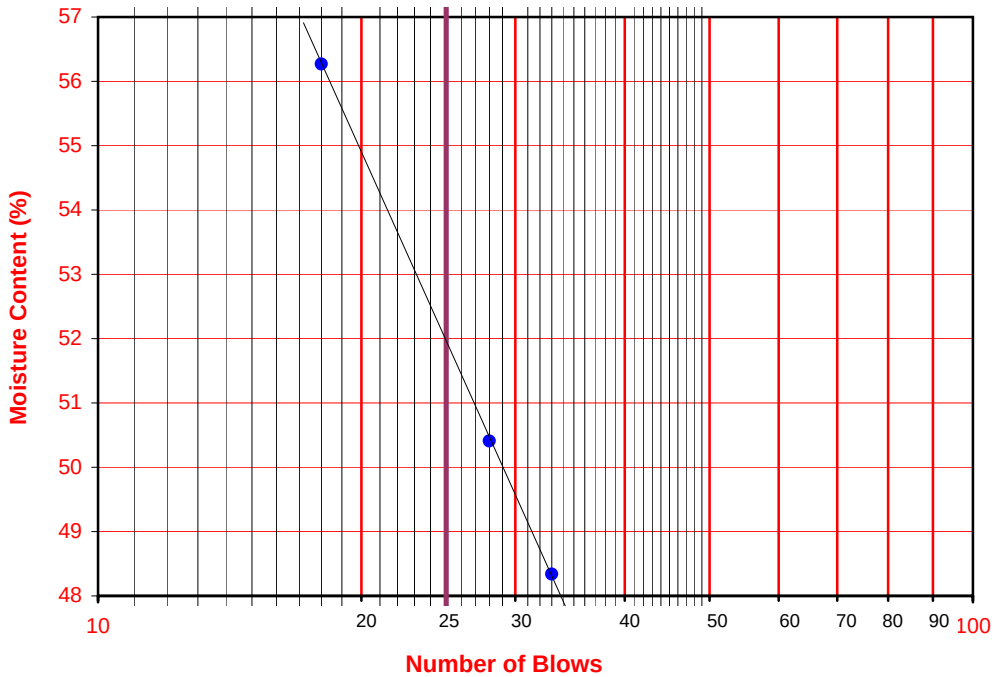
One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.12}$



PROCEDURES USED

- [ ] Wet Preparation
  Multipoint - Wet
- [X] Dry Preparation
  Multipoint - Dry
- [X] Procedure A
  Multipoint Test
- [ ] Procedure B
  One-point Test



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ATTERBERG LIMITS

ASTM D 4318

Project Name:	SR-710 Tunnel Technical Study	Tested By:	V. Juliano	Date:	04/08/09
Project No. :	378312.04.09.01	Input By:	J. Ward	Date:	04/28/09
Boring No.:	R-09-Z1-B5	Checked By:	J. Ward		
Sample No.:	S7	Depth (ft.)	35.0		
Soil Identification:	Brown sandy lean clay s(CL)				

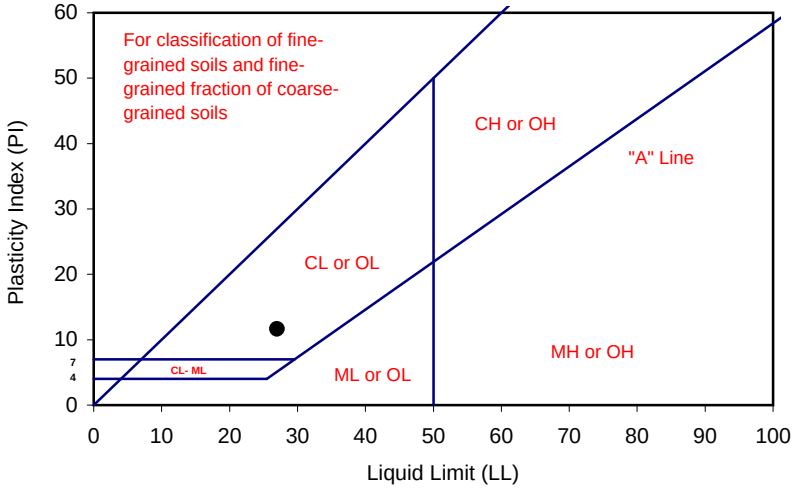
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			32	24	16	
Wet Wt. of Soil + Cont. (g)	9.86	9.81	16.57	17.52	18.39	
Dry Wt. of Soil + Cont. (g)	8.69	8.64	13.30	13.96	14.53	
Wt. of Container (g)	1.05	1.02	1.06	1.06	1.08	
Moisture Content (%) [Wn]	15.31	15.35	26.72	27.60	28.70	

Liquid Limit	**27**
Plastic Limit	**15**
Plasticity Index	**12**
Classification	**CL**

PI at "A" - Line = 0.73(LL-20) 5.11

One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.12}$



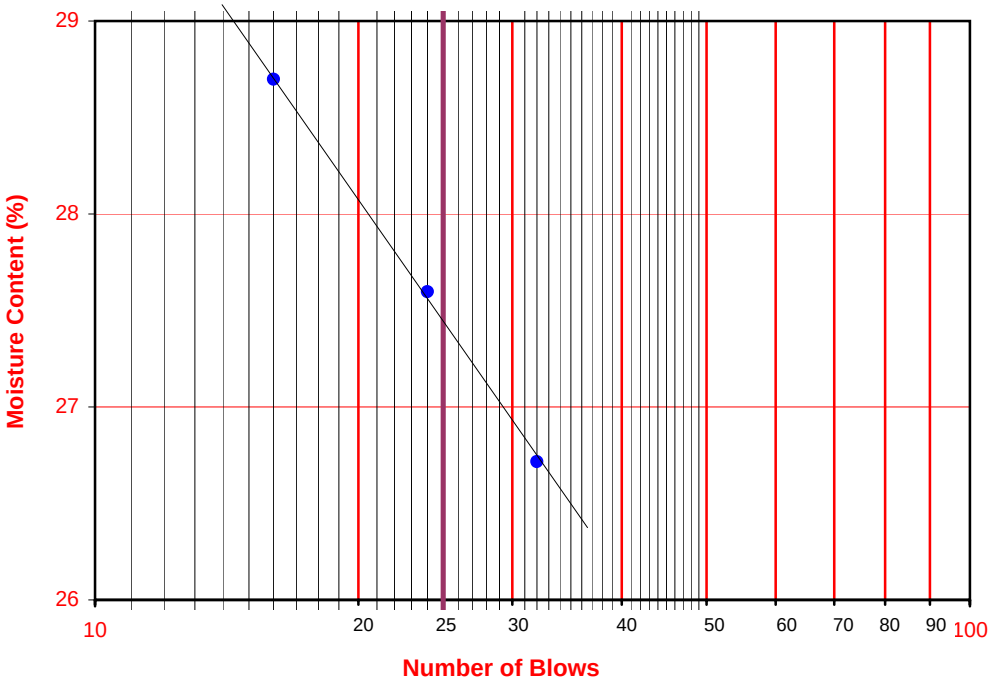
PROCEDURES USED

☐ Wet Preparation
Multipoint - Wet

☒ Dry Preparation
Multipoint - Dry

☒ Procedure A
Multipoint Test

☐ Procedure B
One-point Test



ATTERBERG LIMITS

ASTM D 4318

Project Name:	SR-710 Tunnel Technical Study	Tested By:	A. Santos	Date:	03/11/09
Project No. :	378312.04.09.01	Input By:	J. Ward	Date:	04/08/09
Boring No.:	R-09-Z1-B6	Checked By:	J. Ward		
Sample No.:	S7	Depth (ft.)	30.0		
Soil Identification:	Dark yellowish brown lean clay (CL)				

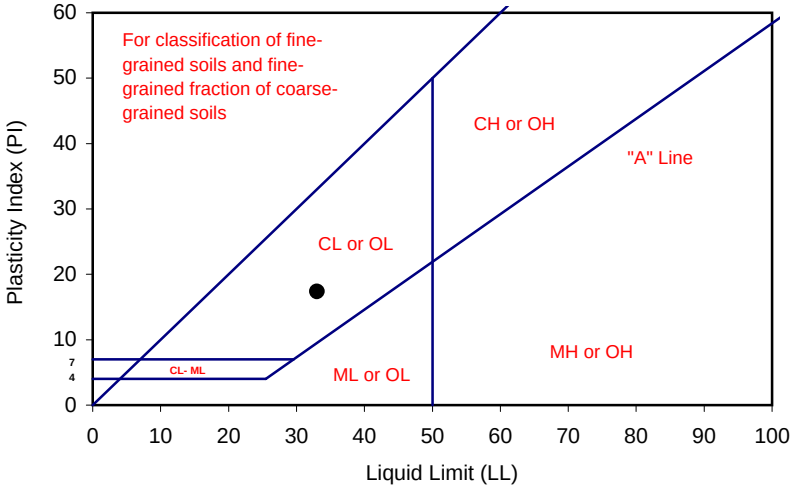
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			30	26	21	
Wet Wt. of Soil + Cont. (g)	9.71	9.94	22.37	21.87	24.49	
Dry Wt. of Soil + Cont. (g)	8.54	8.74	17.18	16.69	18.49	
Wt. of Container (g)	1.02	1.08	1.08	1.04	1.10	
Moisture Content (%) [Wn]	15.56	15.67	32.24	33.10	34.50	

Liquid Limit	**33**
Plastic Limit	**16**
Plasticity Index	**17**
Classification	**CL**

PI at "A" - Line = 0.73(LL-20) 9.49

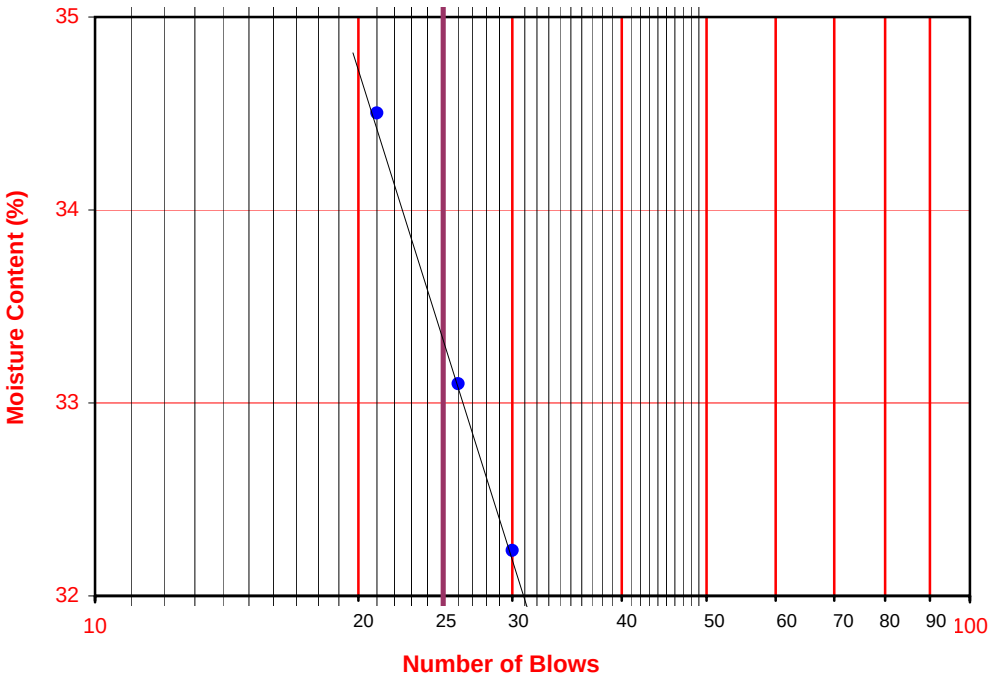
One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.12}$



PROCEDURES USED

- [ ] Wet Preparation
  Multipoint - Wet
- [X] Dry Preparation
  Multipoint - Dry
- [X] Procedure A
  Multipoint Test
- [ ] Procedure B
  One-point Test



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ATTERBERG LIMITS

ASTM D 4318

Project Name:	SR-710 Tunnel Technical Study	Tested By:	A. Santos	Date:	03/12/09
Project No. :	378312.04.09.01	Input By:	J. Ward	Date:	04/08/09
Boring No.:	R-09-Z1-B7	Checked By:	J. Ward		
Sample No.:	S4	Depth (ft.)	25.0		
Soil Identification:	Yellowish brown lean clay with sand (CL)s				

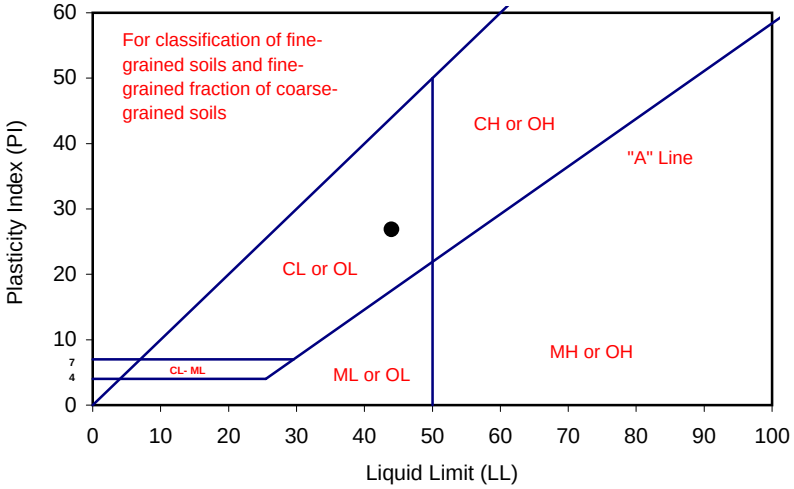
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			31	26	20	
Wet Wt. of Soil + Cont. (g)	9.52	9.57	19.73	20.70	22.93	
Dry Wt. of Soil + Cont. (g)	8.29	8.32	14.09	14.70	16.16	
Wt. of Container (g)	1.09	1.05	1.08	1.06	1.06	
Moisture Content (%) [Wn]	17.08	17.19	43.35	43.99	44.83	

Liquid Limit	**44**
Plastic Limit	**17**
Plasticity Index	**27**
Classification	**CL**

PI at "A" - Line = 0.73(LL-20) 17.52

One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.12}$



PROCEDURES USED

☐ Wet Preparation

Multipoint - Wet

☒ Dry Preparation

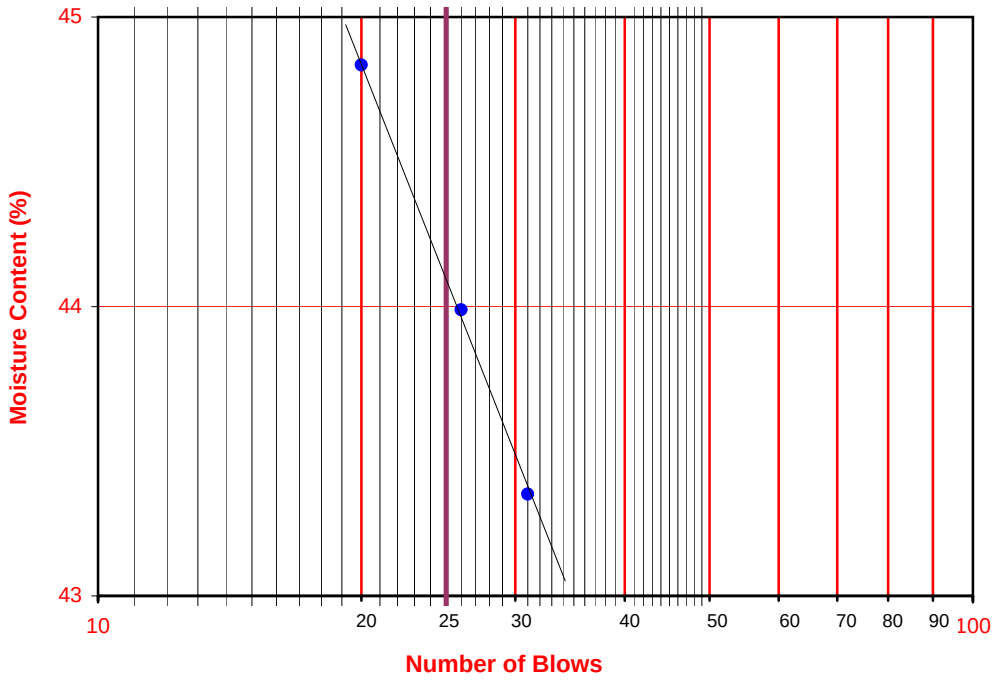
Multipoint - Dry

☒ Procedure A

Multipoint Test

☐ Procedure B

One-point Test



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ATTERBERG LIMITS

ASTM D 4318

Project Name:	SR-710 Tunnel Technical Study	Tested By:	F. Tabibkhoei	Date:	05/28/09
Project No. :	378312.04.09.01	Input By:	J. Ward	Date:	05/29/09
Boring No.:	R-09-Z1-B7	Checked By:	J. Ward		
Sample No.:	C19	Depth (ft.)	101.3-102.4		
Soil Identification:	Olive silt'stone' with sand (ML)s				

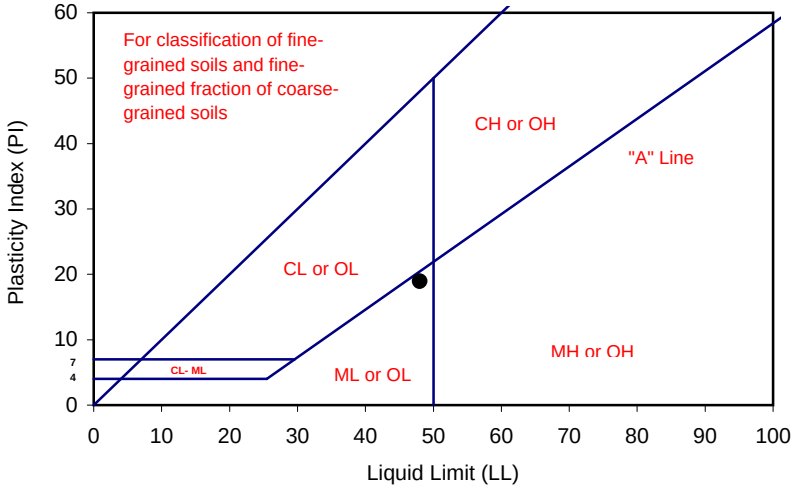
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			17	30	35	25
Wet Wt. of Soil + Cont. (g)	39.81	45.38	45.74	48.62	36.90	46.70
Dry Wt. of Soil + Cont. (g)	36.31	40.70	40.96	43.04	33.01	39.50
Wt. of Container (g)	24.32	24.54	31.58	31.12	24.39	24.68
Moisture Content (%) [Wn]	29.19	28.96	50.96	46.81	45.13	48.58

Liquid Limit	**48**
Plastic Limit	**29**
Plasticity Index	**19**
Classification	**ML**

PI at "A" - Line = 0.73(LL-20) 20.44

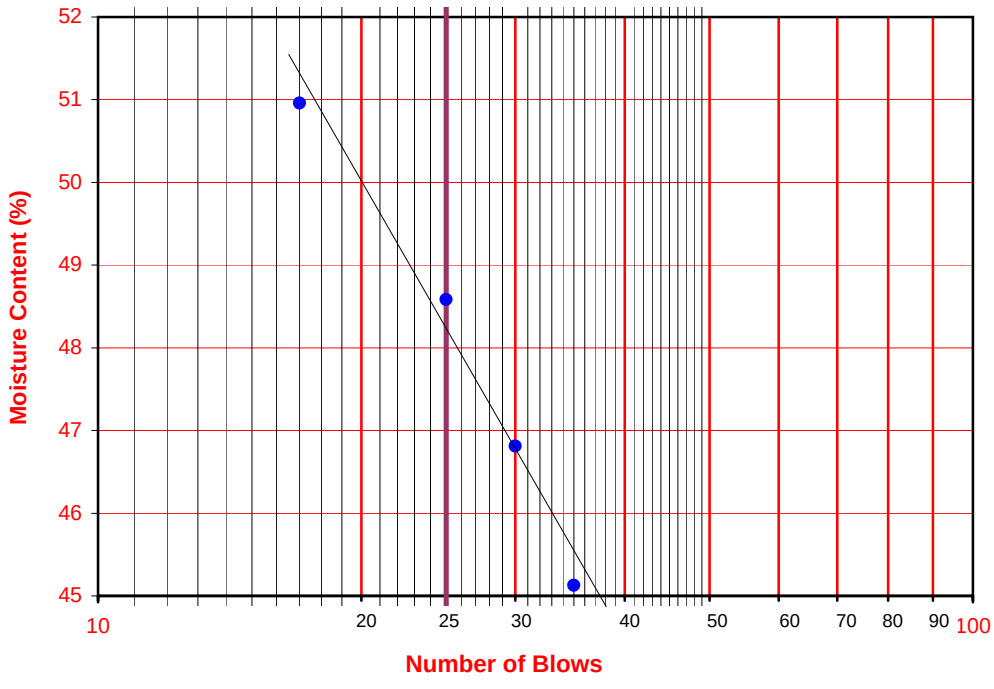
One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.12}$



PROCEDURES USED

	Wet Preparation
	Multipoint - Wet
X	Dry Preparation
	Multipoint - Dry
X	Procedure A
	Multipoint Test
	Procedure B
	One-point Test

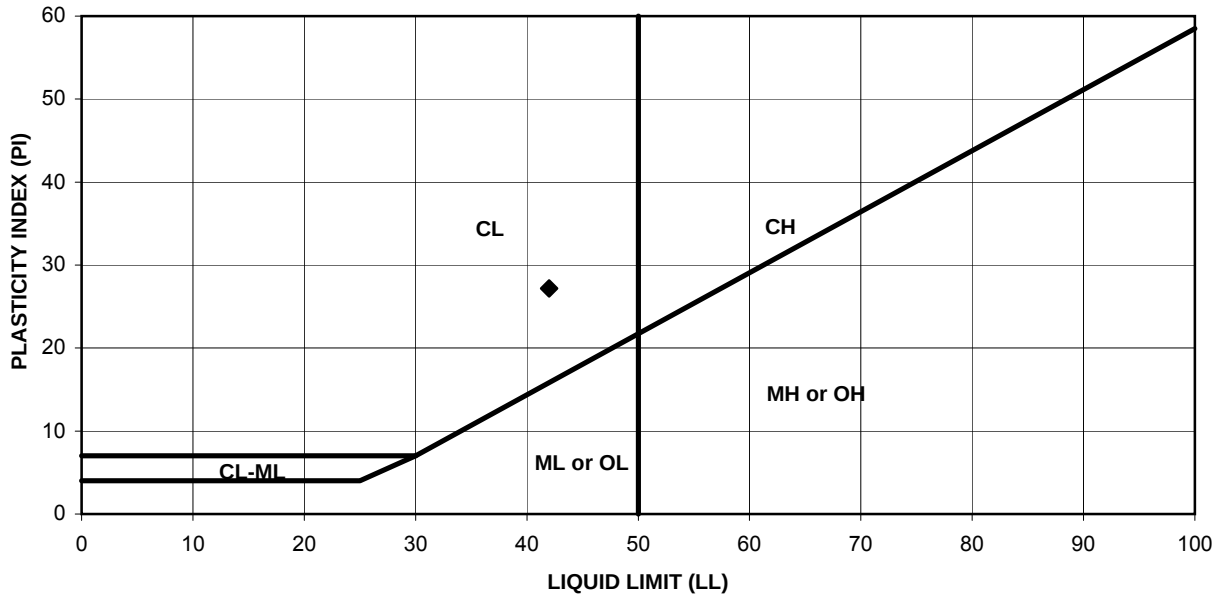


AP Engineering & Testing, Inc.

ATTERBERG LIMITS
ASTM D 4318

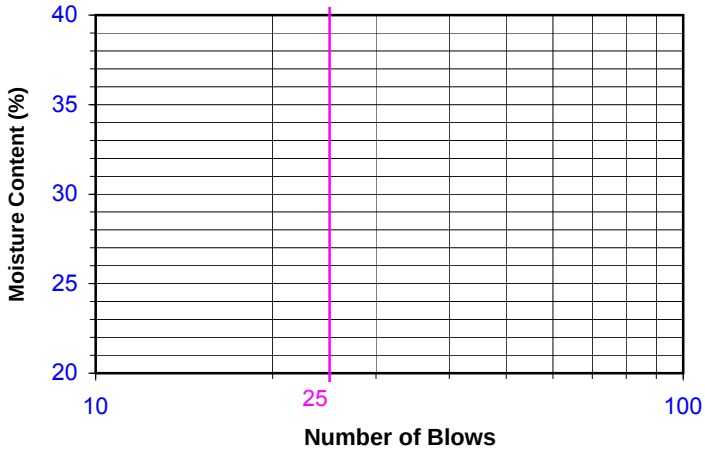
Project Name: SR-710 Tunnel Technical Study Tested By: KK Date: 06/08/09

Project No.: 378312.04.09.01 Checked By: AP Date: 06/15/09



PROCEDURE USED

- [ ] Wet Preparation
- [X] Dry Preparation
- [X] Procedure A Multipoint Test
- [ ] Procedure B One-point Test

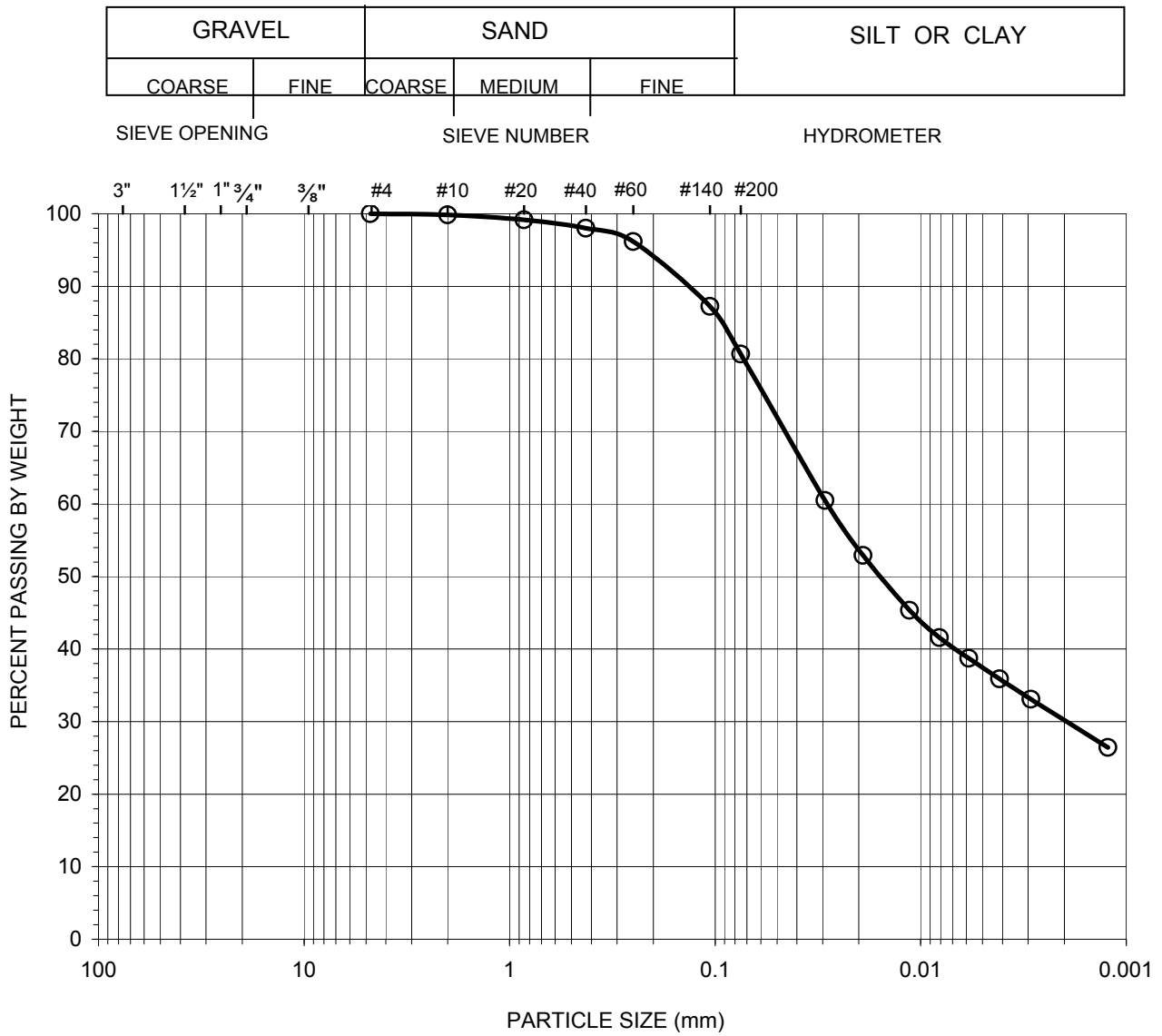


Symbol	Boring Number	Sample Number	Depth (feet)	LL	PL	PI	U.S.C.S Symbol
♦	R-09-Z1-B7	S6	35	42	15	27	CL

AP Engineering & Testing, Inc.

GRAIN SIZE DISTRIBUTION CURVE
ASTM D 422

Project Name: SR-710 Tunnel Technical Study Tested by: DK Date: 06/03/09
Project Number: 378312.04.09.01 Checked by: AP Date: 06/15/09



Symbol	Boring No.	Sample No.	Sample Date	Percent			Atterberg Limits LL:PL:PI	Soil Type U.S.C.S
				Gravel	Sand	Fines		
○	R-09-Z1-B7	S6	35	0.00	19.33	80.67	42:15:27	CL

ATTERBERG LIMITS

ASTM D 4318

Project Name:	SR-710 Tunnel Technical Study	Tested By:	G. Bathala	Date:	05/12/09
Project No. :	378312.04.09.01	Input By:	J. Ward	Date:	05/14/09
Boring No.:	R-09-Z1-B8	Checked By:	J. Ward		
Sample No.:	C17	Depth (ft.)	80-80.75		
Soil Identification:	Dark olive silt'stone' (ML)				

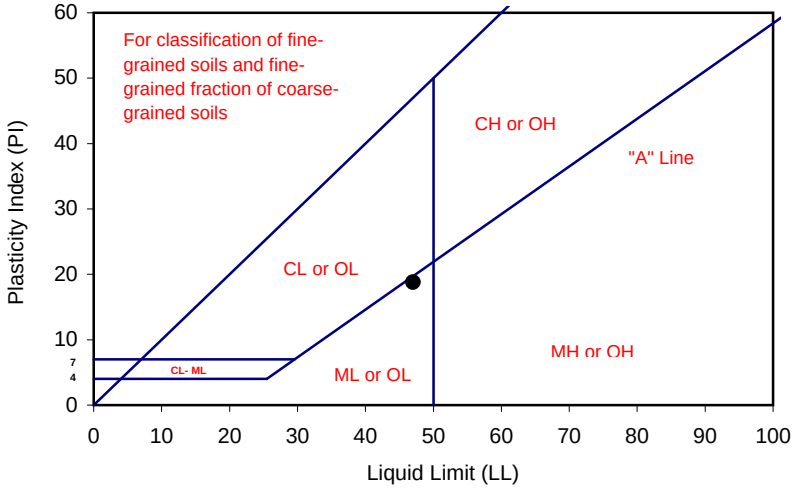
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			35	29	22	16
Wet Wt. of Soil + Cont. (g)	10.90	12.70	12.47	12.45	11.24	13.06
Dry Wt. of Soil + Cont. (g)	8.74	10.15	8.95	8.88	7.95	9.05
Wt. of Container (g)	1.10	1.08	1.12	1.05	1.07	1.05
Moisture Content (%) [Wn]	28.27	28.11	44.96	45.59	47.82	50.13

Liquid Limit	**47**
Plastic Limit	**28**
Plasticity Index	**19**
Classification	**ML**

PI at "A" - Line = 0.73(LL-20) 19.71

One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.12}$



PROCEDURES USED

☐ Wet Preparation

Multipoint - Wet

☒ Dry Preparation

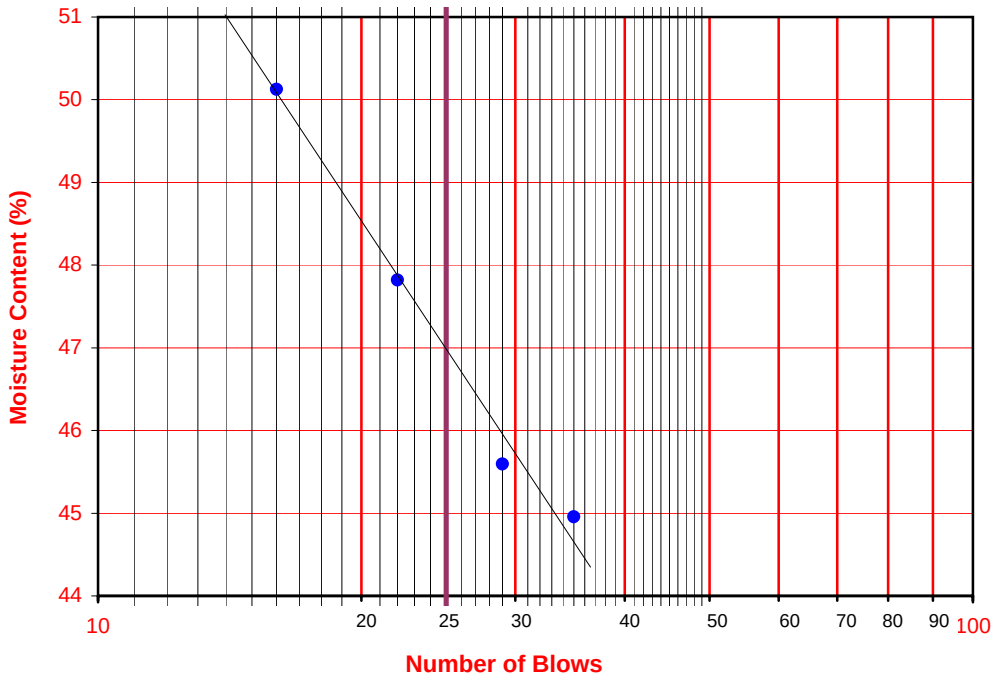
Multipoint - Dry

☒ Procedure A

Multipoint Test

☐ Procedure B

One-point Test



ATTERBERG LIMITS

ASTM D 4318

Project Name:	SR-710 Tunnel Technical Study	Tested By:	V. Juliano	Date:	05/12/09
Project No. :	378312.04.09.01	Input By:	J. Ward	Date:	05/14/09
Boring No.:	R-09-Z1-B8	Checked By:	J. Ward		
Sample No.:	C23	Depth (ft.)	109-109.7		
Soil Identification:	Dark olive lean clay'stone' (CL)				

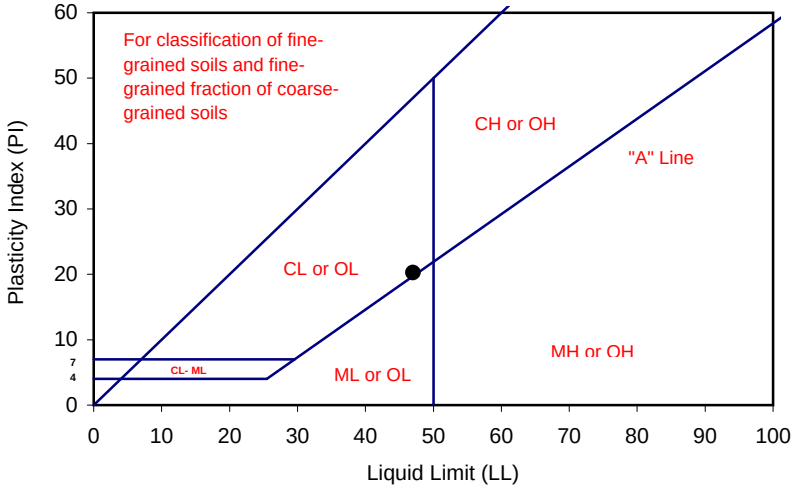
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			28	22	16	
Wet Wt. of Soil + Cont. (g)	10.95	10.99	13.81	14.25	14.09	
Dry Wt. of Soil + Cont. (g)	8.86	8.90	9.78	10.01	9.86	
Wt. of Container (g)	1.06	1.08	1.05	1.02	1.06	
Moisture Content (%) [Wn]	26.79	26.73	46.16	47.16	48.07	

Liquid Limit	**47**
Plastic Limit	**27**
Plasticity Index	**20**
Classification	**CL**

PI at "A" - Line = 0.73(LL-20) 19.71

One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.12}$



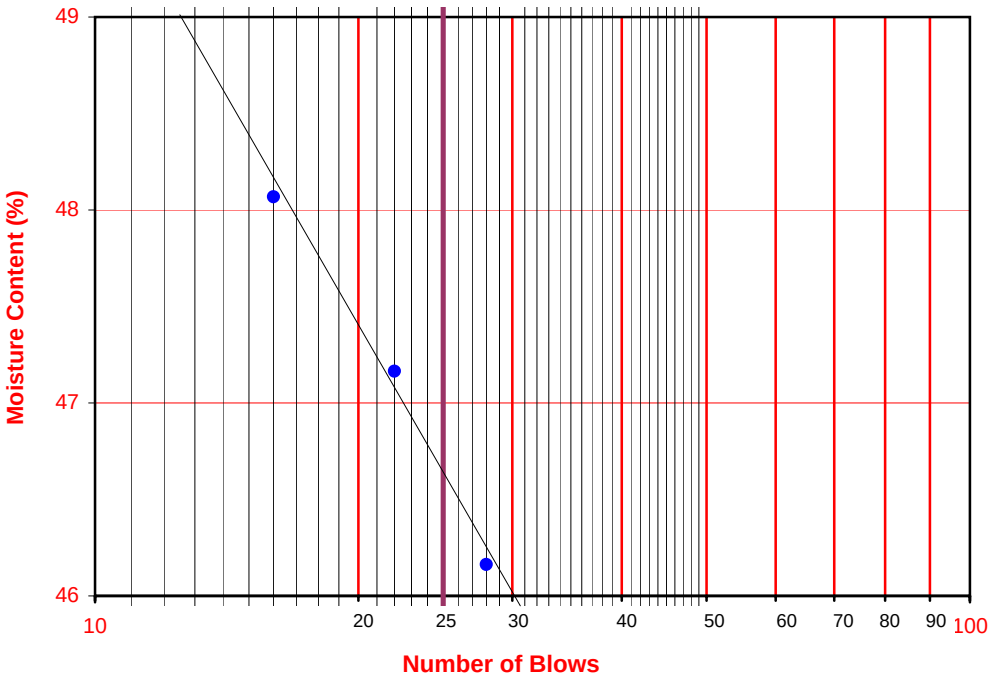
PROCEDURES USED

☐ Wet Preparation
Multipoint - Wet

☒ Dry Preparation
Multipoint - Dry

☒ Procedure A
Multipoint Test

☐ Procedure B
One-point Test



Leighton

ATTERBERG LIMITS

ASTM D 4318

Project Name:	SR-710 Tunnel Technical Study	Tested By:	V. Juliano	Date:	05/13/09
Project No. :	378312.04.09.01	Input By:	J. Ward	Date:	05/14/09
Boring No.:	R-09-Z1-B8	Checked By:	J. Ward		
Sample No.:	C26	Depth (ft.)	120-120.4		
Soil Identification:	Dark olive lean clay'stone' (CL)				

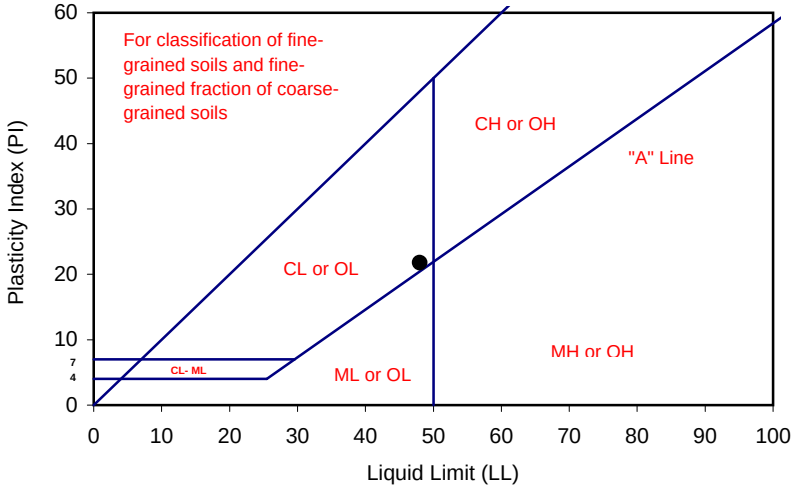
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			35	28	22	
Wet Wt. of Soil + Cont. (g)	8.72	9.23	14.48	14.53	16.71	
Dry Wt. of Soil + Cont. (g)	7.14	7.52	10.33	10.25	11.59	
Wt. of Container (g)	1.07	1.05	1.06	1.09	1.05	
Moisture Content (%) [Wn]	26.03	26.43	44.77	46.72	48.58	

Liquid Limit	**48**
Plastic Limit	**26**
Plasticity Index	**22**
Classification	**CL**

PI at "A" - Line = 0.73(LL-20) 20.44

One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.12}$



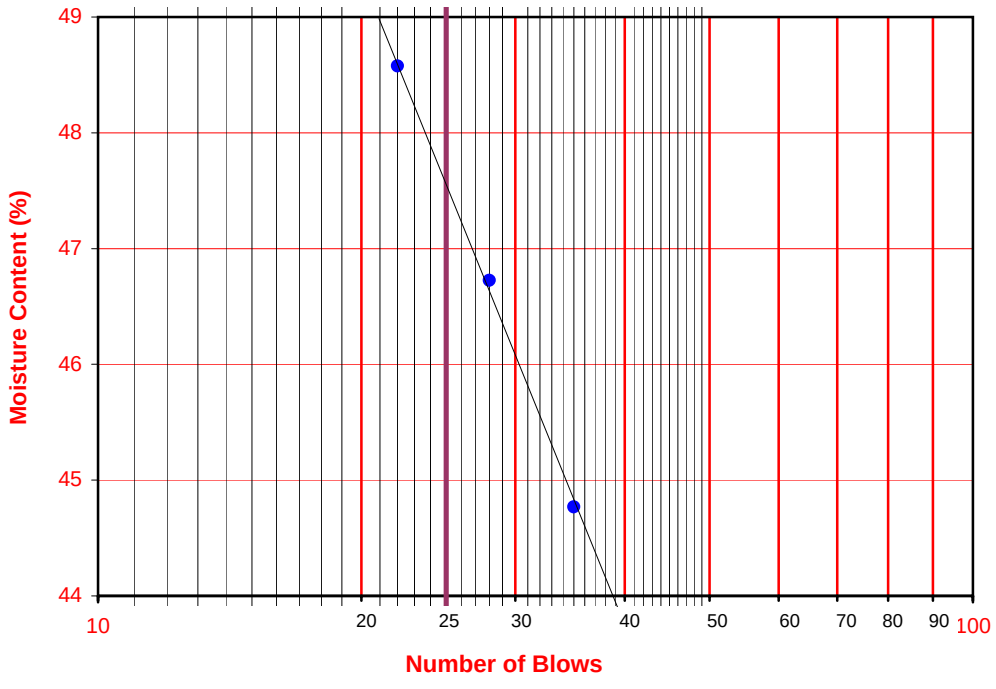
PROCEDURES USED

[ ] Wet Preparation
Multipoint - Wet

[X] Dry Preparation
Multipoint - Dry

[X] Procedure A
Multipoint Test

[ ] Procedure B
One-point Test



ATTERBERG LIMITS

ASTM D 4318

Project Name:	SR-710 Tunnel Technical Study	Tested By:	V. Juliano	Date:	05/12/09
Project No. :	378312.04.09.01	Input By:	J. Ward	Date:	05/14/09
Boring No.:	R-09-Z1-B8	Checked By:	J. Ward		
Sample No.:	C33	Depth (ft.)	159.25-160		
Soil Identification:	Dark olive lean clay'stone' (CL)				

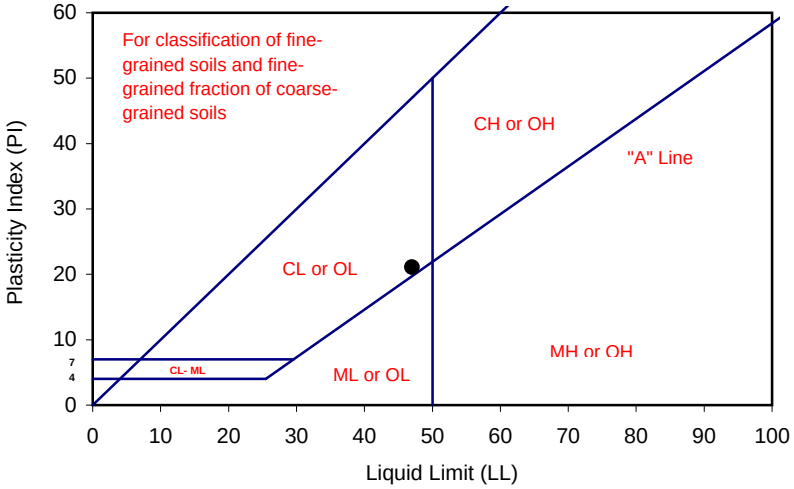
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			35	28	21	
Wet Wt. of Soil + Cont. (g)	9.24	9.76	13.43	14.68	16.16	
Dry Wt. of Soil + Cont. (g)	7.55	7.97	9.59	10.34	11.25	
Wt. of Container (g)	1.05	1.04	1.03	1.01	1.06	
Moisture Content (%) [Wn]	26.00	25.83	44.86	46.52	48.18	

Liquid Limit	**47**
Plastic Limit	**26**
Plasticity Index	**21**
Classification	**CL**

PI at "A" - Line = 0.73(LL-20) 19.71

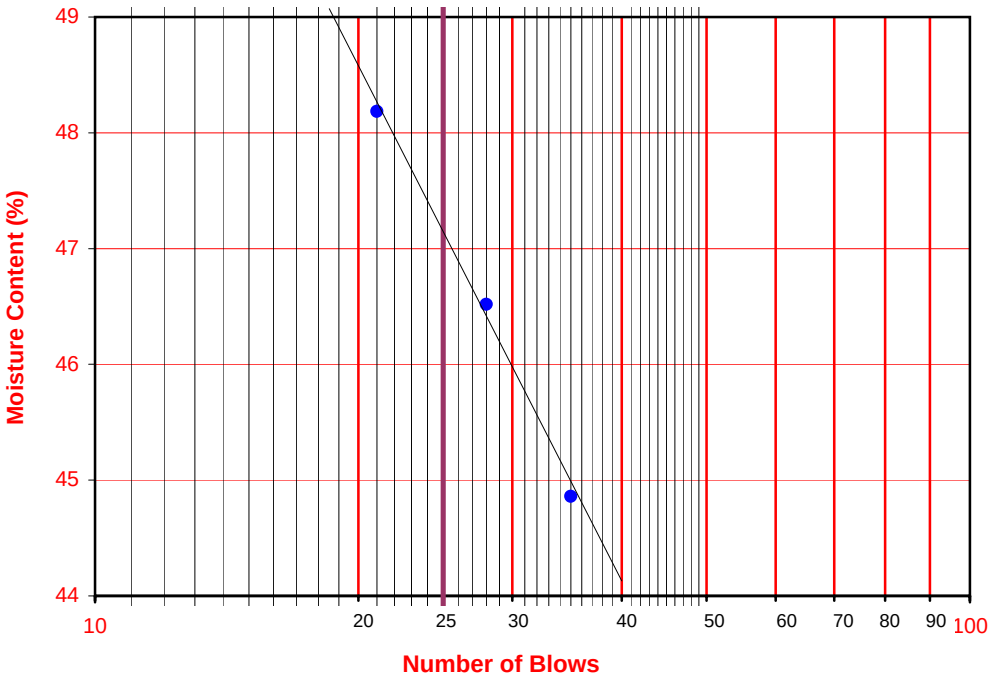
One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.12}$



PROCEDURES USED

- [ ] Wet Preparation
  Multipoint - Wet
- [X] Dry Preparation
  Multipoint - Dry
- [X] Procedure A
  Multipoint Test
- [ ] Procedure B
  One-point Test



ATTERBERG LIMITS

ASTM D 4318

Project Name:	SR-710 Tunnel Technical Study	Tested By:	V. Juliano	Date:	04/06/09
Project No. :	378312.04.09.01	Input By:	J. Ward	Date:	04/08/09
Boring No.:	R-09-Z1-B8	Checked By:	J. Ward		
Sample No.:	S06	Depth (ft.)	25-26.5		
Soil Identification:	Dark brown lean clay (CL)				

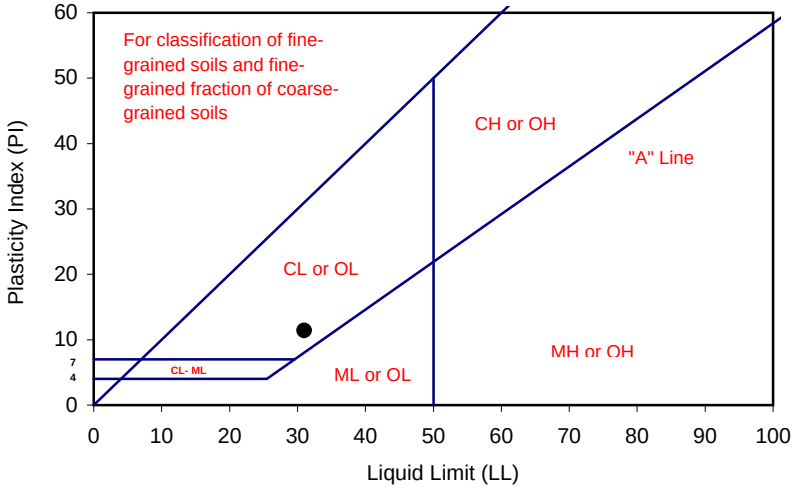
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			35	28	21	
Wet Wt. of Soil + Cont. (g)	9.59	9.08	15.44	14.68	14.63	
Dry Wt. of Soil + Cont. (g)	8.20	7.76	12.10	11.46	11.34	
Wt. of Container (g)	1.07	1.05	1.03	1.00	1.06	
Moisture Content (%) [Wn]	19.50	19.67	30.17	30.78	32.00	

Liquid Limit	**31**
Plastic Limit	**20**
Plasticity Index	**11**
Classification	**CL**

PI at "A" - Line = 0.73(LL-20) 8.03

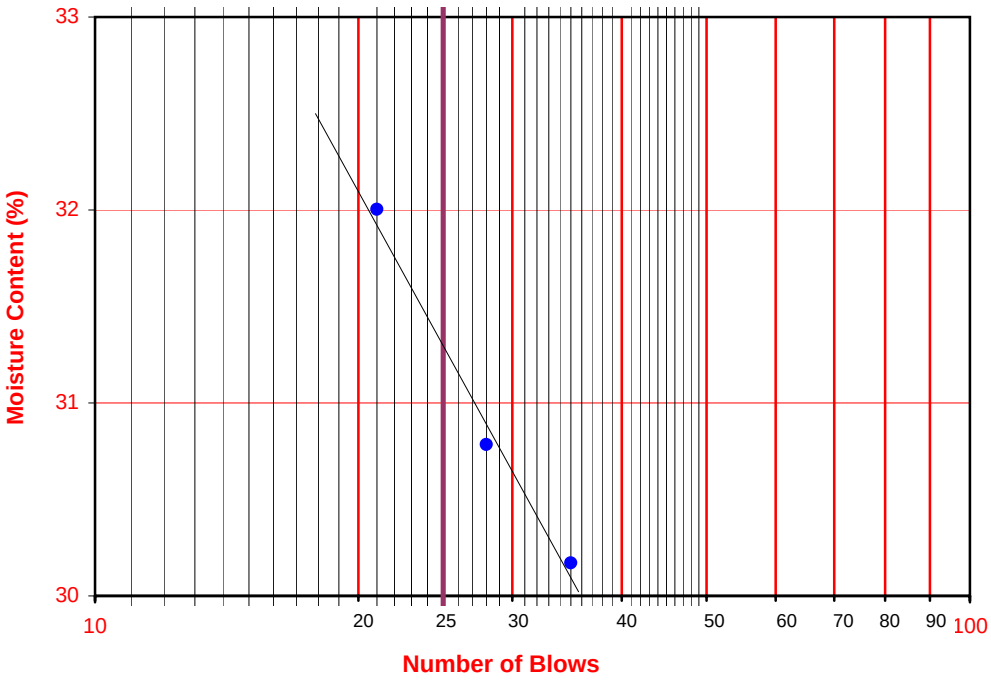
One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.12}$



PROCEDURES USED

	Wet Preparation
	Multipoint - Wet
X	Dry Preparation
	Multipoint - Dry
X	Procedure A
	Multipoint Test
	Procedure B
	One-point Test



Leighton

ATTERBERG LIMITS

ASTM D 4318

Project Name:	SR-710 Tunnel Technical Study	Tested By:	G. Bathala	Date:	05/29/09
Project No. :	378312.04.09.01	Input By:	J. Ward	Date:	06/01/09
Boring No.:	R-09-Z2-B2	Checked By:	J. Ward		
Sample No.:	C14	Depth (ft.)	77-78		
Soil Identification:	Dark yellowish brown sandy lean clay'stone' s(CL)				

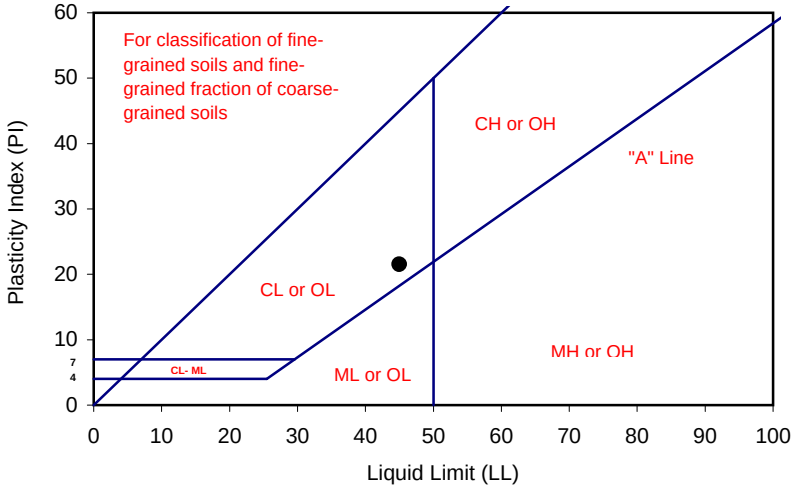
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			35	30	24	16
Wet Wt. of Soil + Cont. (g)	14.55	13.86	10.89	11.65	13.86	12.99
Dry Wt. of Soil + Cont. (g)	11.98	11.43	7.98	8.43	9.86	9.16
Wt. of Container (g)	1.02	1.10	1.08	1.01	1.11	1.06
Moisture Content (%) [Wn]	23.45	23.52	42.17	43.40	45.71	47.28

Liquid Limit	**45**
Plastic Limit	**23**
Plasticity Index	**22**
Classification	**CL**

PI at "A" - Line = 0.73(LL-20) 18.25

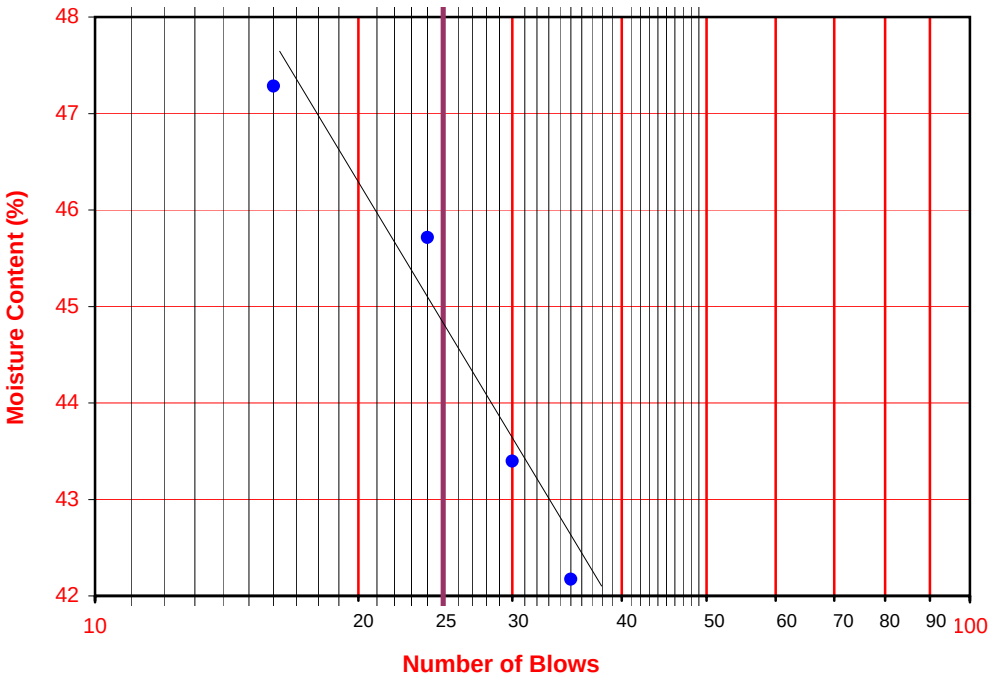
One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.12}$



PROCEDURES USED

	Wet Preparation
	Multipoint - Wet
X	Dry Preparation
	Multipoint - Dry
X	Procedure A
	Multipoint Test
	Procedure B
	One-point Test

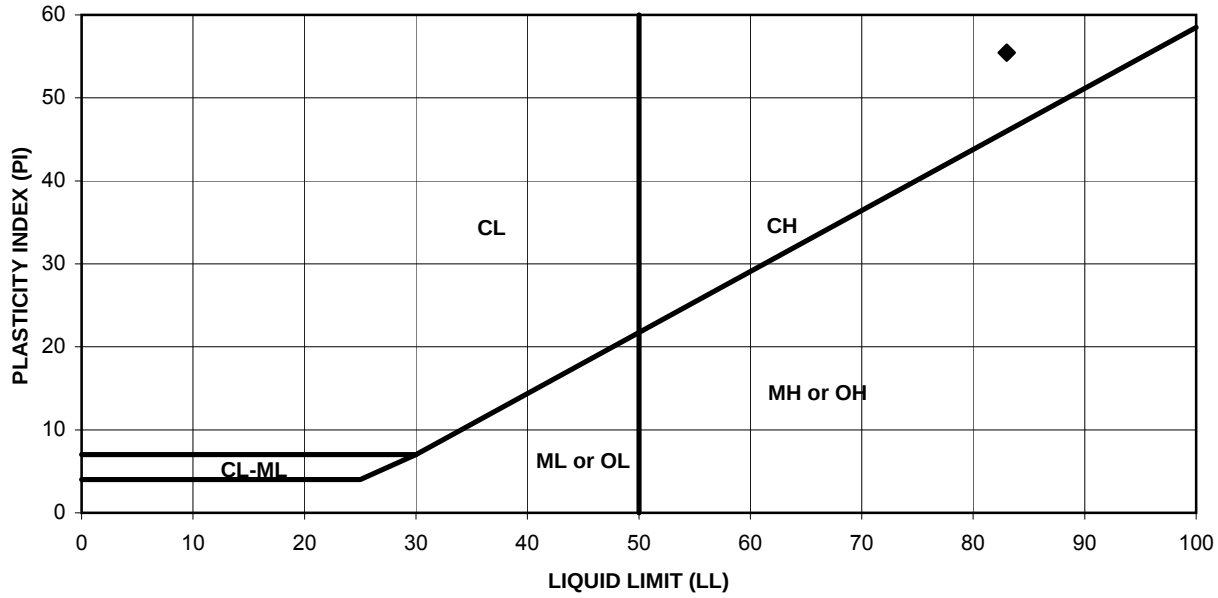


AP Engineering & Testing, Inc.

ATTERBERG LIMITS
ASTM D 4318

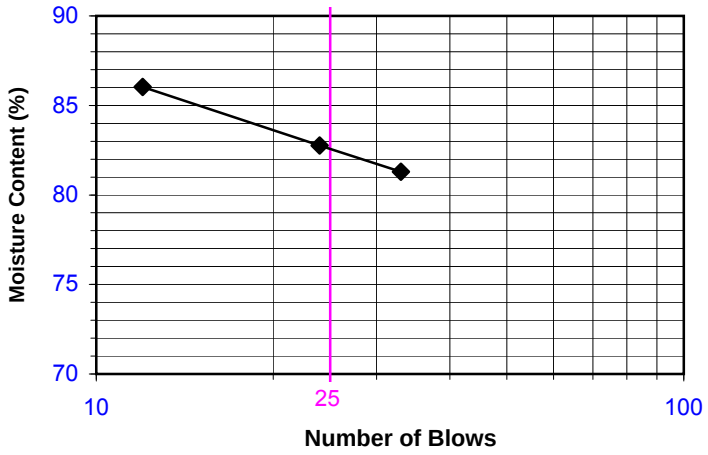
Project Name: SR-710 Tunnel Technical Study Tested By: KK Date: 06/08/09

Project No.: 378312.04.09.01 Checked By: AP Date: 06/11/09



PROCEDURE USED

- [ ] Wet Preparation
- [X] Dry Preparation
- [X] Procedure A Multipoint Test
- [ ] Procedure B One-point Test



Symbol	Boring Number	Sample Number	Depth (feet)	LL	PL	PI	U.S.C.S Symbol
♦	R-09-Z2-B3	C-29	105-110	83	28	55	CH

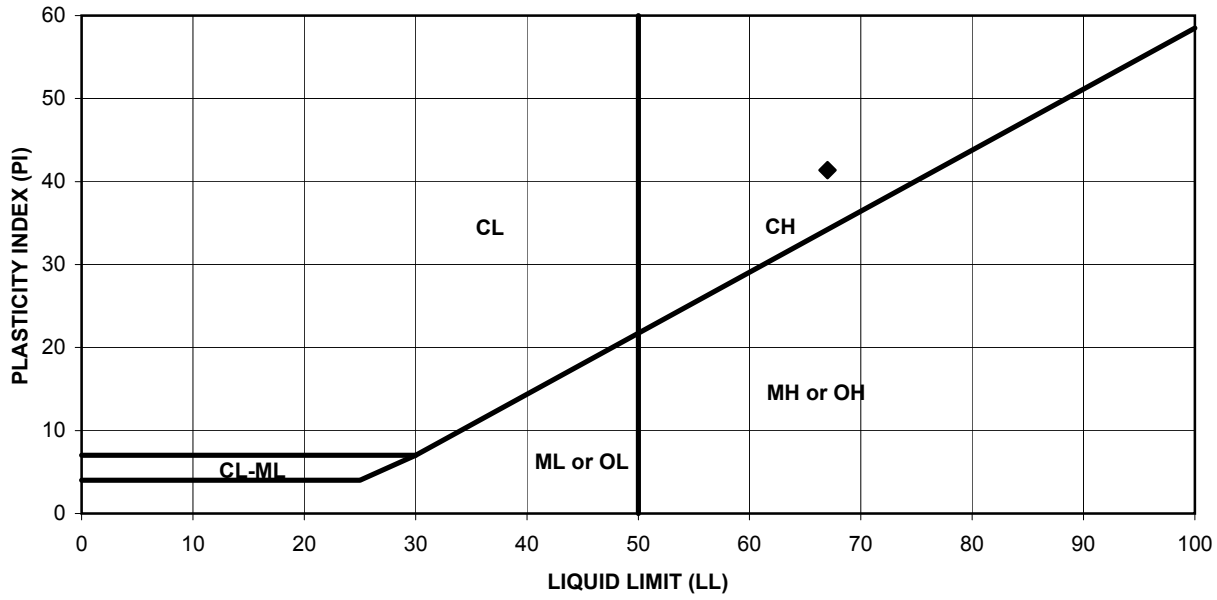
AP Engineering & Testing, Inc.

ATTERBERG LIMITS
ASTM D 4318

Project Name: SR-710 Tunnel Technical Study
Project No.: 378312.04.09.01

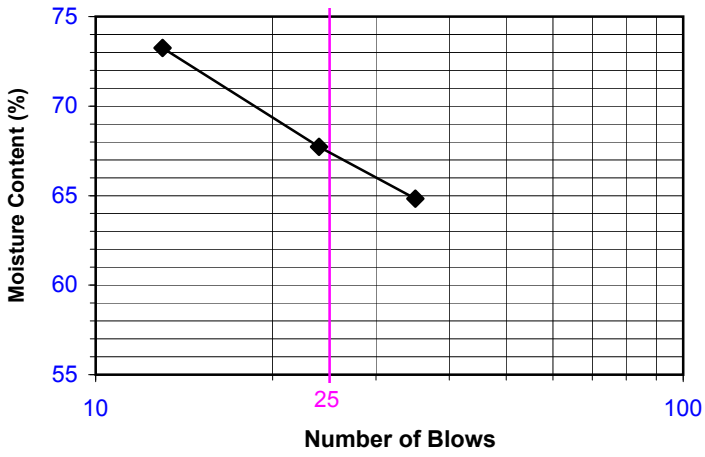
Tested By: KK
Checked By: AP

Date: 06/08/09
Date: 06/11/09



PROCEDURE USED

- [ ] Wet Preparation
- [X] Dry Preparation
- [X] Procedure A Multipoint Test
- [ ] Procedure B One-point Test



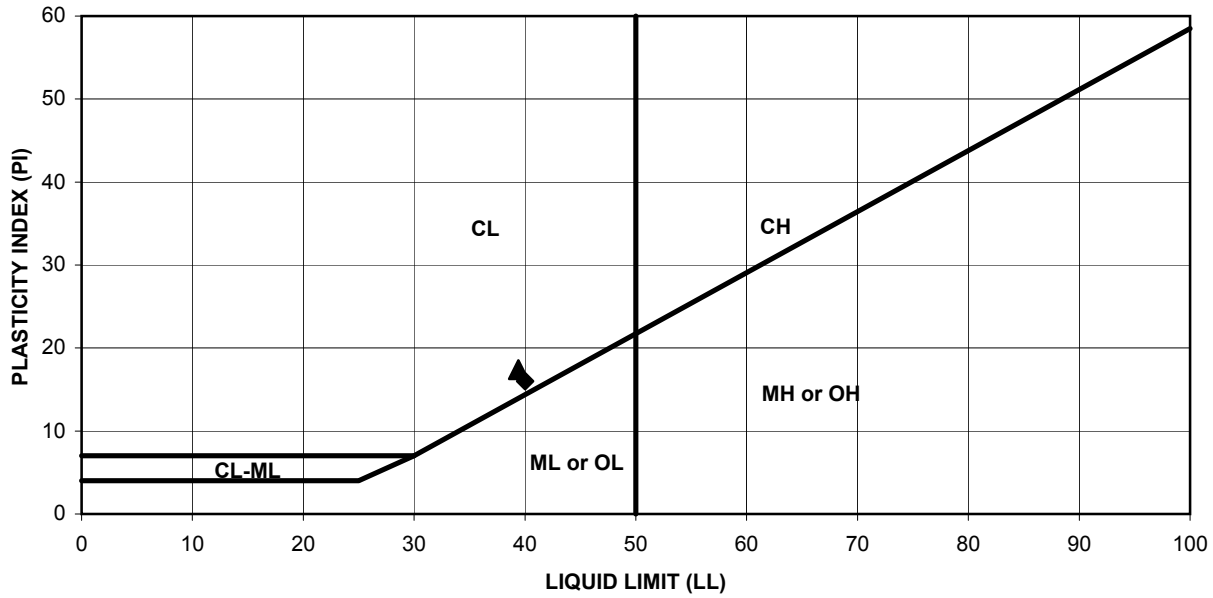
Symbol	Boring Number	Sample Number	Depth (feet)	LL	PL	PI	U.S.C.S Symbol
♦	R-09-Z2-B4	C49	185-189	67	26	41	CH

AP Engineering & Testing, Inc.

ATTERBERG LIMITS
ASTM D 4318

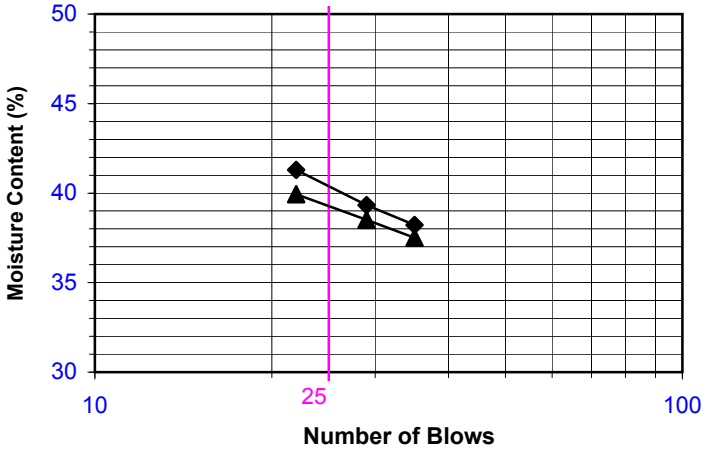
Project Name: SR-710 Tunnel Technical Study Tested By: KK Date: 06/08/09

Project No.: 378312.04.09.01 Checked By: AP Date: 06/11/09



PROCEDURE USED

- [ ] Wet Preparation
- [X] Dry Preparation
- [X] Procedure A Multipoint Test
- [ ] Procedure B One-point Test



Symbol	Boring Number	Sample Number	Depth (feet)	LL	PL	PI	U.S.C.S Symbol
♦	R-09-Z2-B4	C80	295-298.5	40	24	16	CL
▲	R-09-Z2-B4	C101	365-368.5	39	22	17	CL

ATTERBERG LIMITS

ASTM D 4318

Project Name:	SR-710 Tunnel Technical Study	Tested By:	F. Tabibkhoei	Date:	05/27/09
Project No. :	378312.04.09.01	Input By:	J. Ward	Date:	05/28/09
Boring No.:	R-09-Z2-B4	Checked By:	J. Ward		
Sample No.:	S3	Depth (ft.)	10.0		
Soil Identification:	Dark olive brown fat clay (CH)				

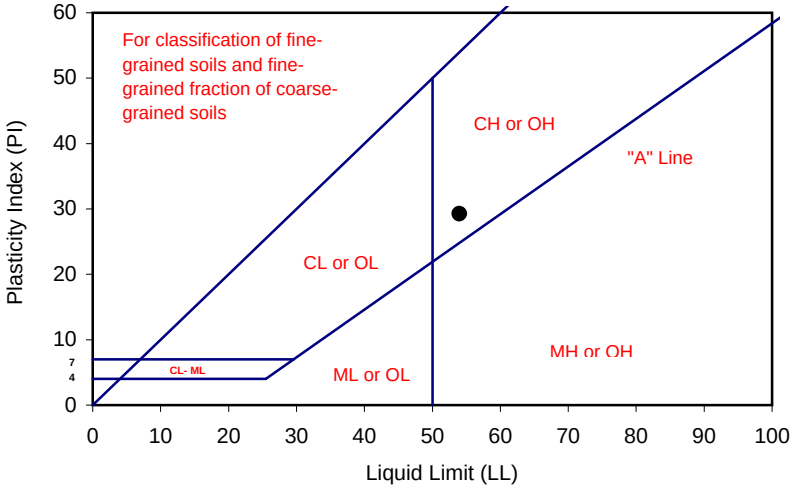
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			35	26	18	
Wet Wt. of Soil + Cont. (g)	48.57	45.21	42.78	47.32	54.17	
Dry Wt. of Soil + Cont. (g)	45.20	42.54	36.77	39.50	43.45	
Wt. of Container (g)	31.65	31.68	25.04	24.68	24.43	
Moisture Content (%) [Wn]	24.87	24.59	51.24	52.77	56.36	

Liquid Limit	**54**
Plastic Limit	**25**
Plasticity Index	**29**
Classification	**CH**

PI at "A" - Line = 0.73(LL-20) 24.82

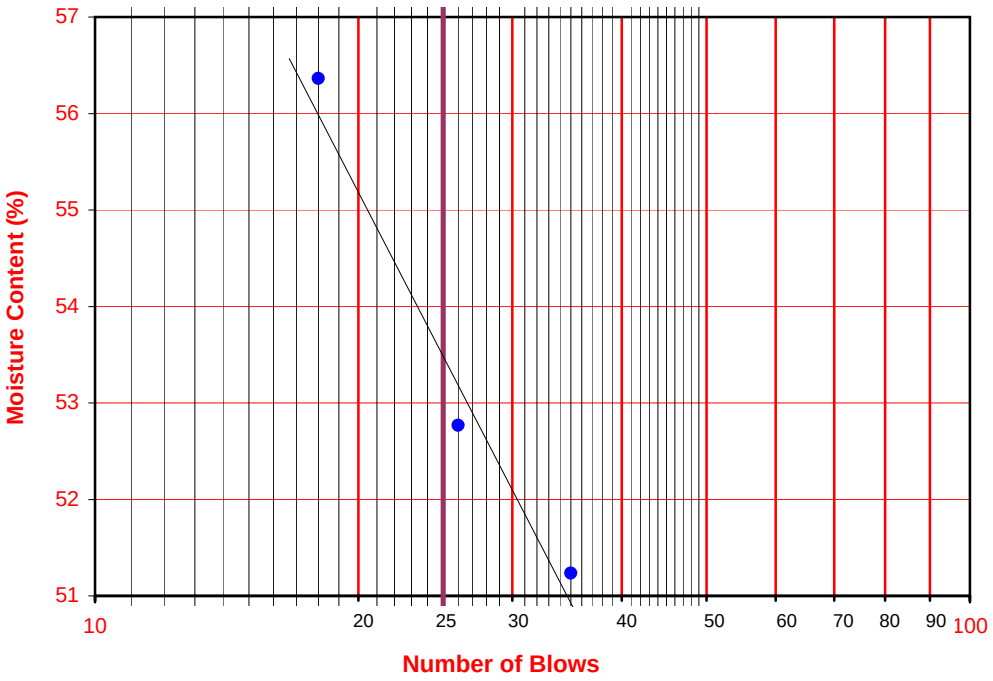
One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.12}$



PROCEDURES USED

☐	Wet Preparation
	Multipoint - Wet
X	Dry Preparation
	Multipoint - Dry
X	Procedure A
	Multipoint Test
☐	Procedure B
	One-point Test



Leighton

ATTERBERG LIMITS

ASTM D 4318

Project Name:	SR-710 Tunnel Technical Study	Tested By:	F. Tabibkhoei	Date:	06/01/09
Project No. :	378312.04.09.01	Input By:	J. Ward	Date:	06/02/09
Boring No.:	R-09-Z2-B4	Checked By:	J. Ward		
Sample No.:	C59	Depth (ft.)	219.4-220		
Soil Identification:	Dark olive fat clay'stone' (CH)				

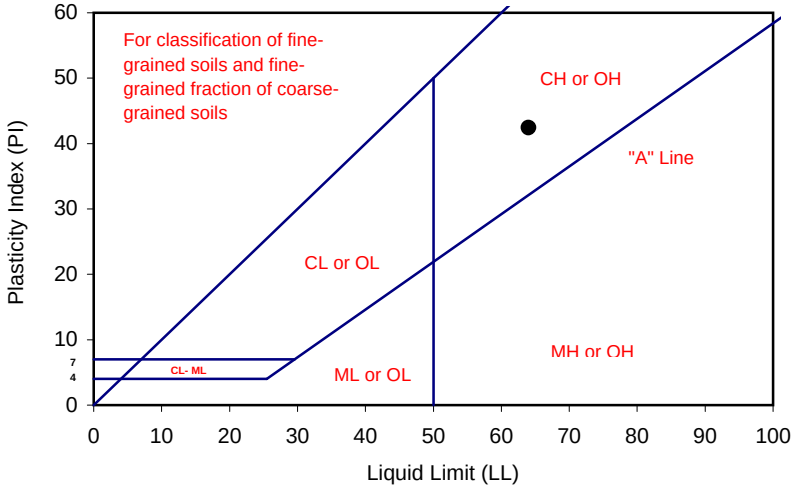
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			15	23	30	
Wet Wt. of Soil + Cont. (g)	46.79	40.63	45.89	51.82	57.71	
Dry Wt. of Soil + Cont. (g)	43.97	37.75	37.39	43.87	47.41	
Wt. of Container (g)	30.98	24.30	24.55	31.63	31.20	
Moisture Content (%) [Wn]	21.71	21.41	66.20	64.95	63.54	

Liquid Limit	**64**
Plastic Limit	**22**
Plasticity Index	**42**
Classification	**CH**

PI at "A" - Line = 0.73(LL-20) 32.12

One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.12}$



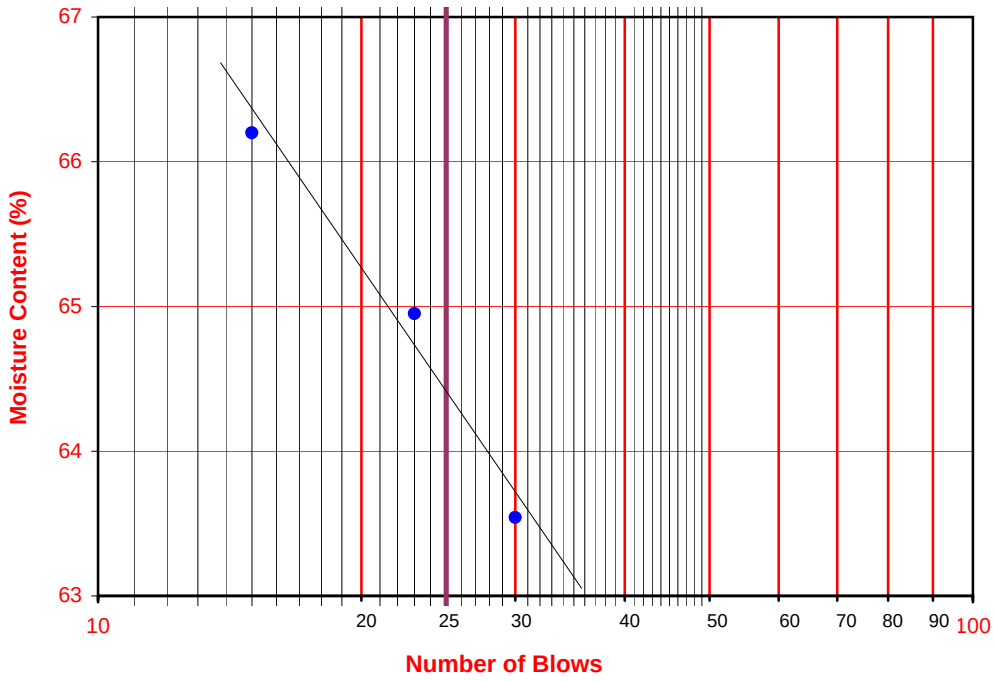
PROCEDURES USED

☐ Wet Preparation
Multipoint - Wet

☒ Dry Preparation
Multipoint - Dry

☒ Procedure A
Multipoint Test

☐ Procedure B
One-point Test



ATTERBERG LIMITS

ASTM D 4318

Project Name:	SR-710 Tunnel Technical Study	Tested By:	V. Juliano	Date:	05/20/09
Project No. :	378312.04.09.01	Input By:	J. Ward	Date:	05/27/09
Boring No.:	R-09-Z2-B4	Checked By:	J. Ward		
Sample No.:	C28	Depth (ft.)	112.5-113		
Soil Identification:	Olive sandy silt s(ML)				

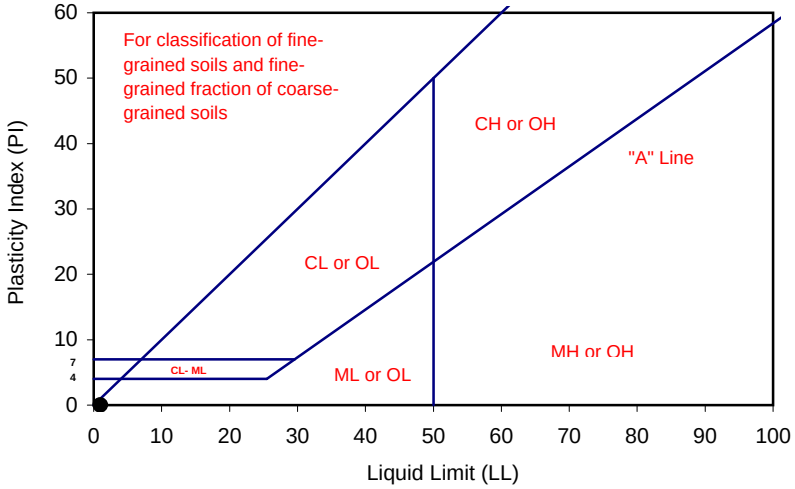
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			7			
Wet Wt. of Soil + Cont. (g)	**Cannot be rolled:**		12.50	**Cannot get more than 7 blows:**		
Dry Wt. of Soil + Cont. (g)	**NonPlastic**		10.17	**NonPlastic**		
Wt. of Container (g)			1.09			
Moisture Content (%) [Wn]			25.66			

Liquid Limit	**NP**
Plastic Limit	**NP**
Plasticity Index	**NP**
Classification	**NP**

PI at "A" - Line = 0.73(LL-20) =

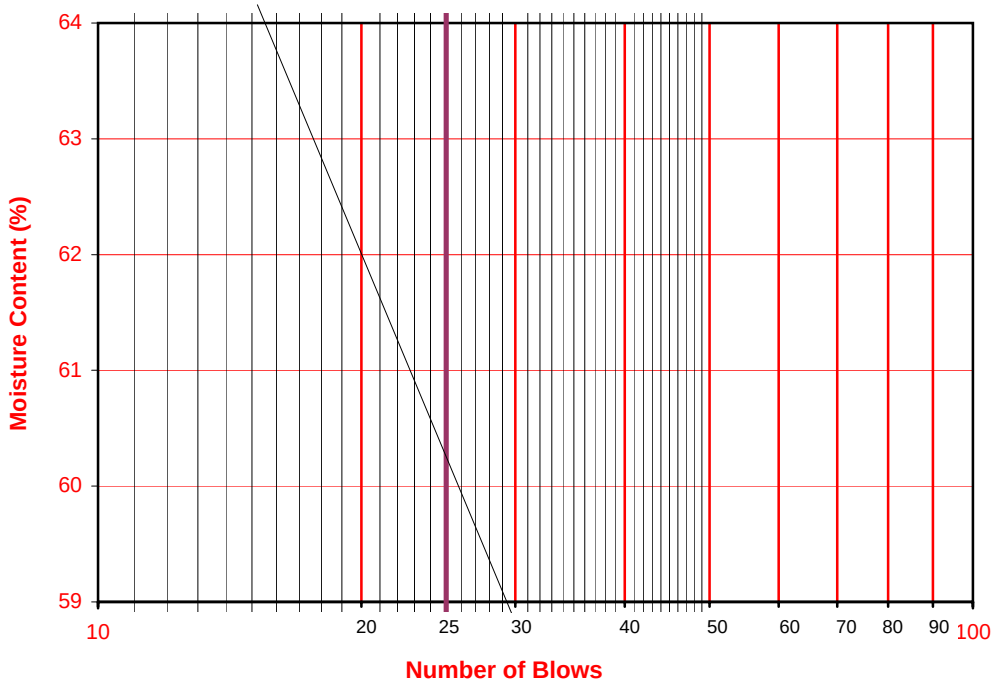
One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.12}$



PROCEDURES USED

	Wet Preparation
	Multipoint - Wet
X	Dry Preparation
	Multipoint - Dry
X	Procedure A
	Multipoint Test
	Procedure B
	One-point Test



Leighton

ATTERBERG LIMITS

ASTM D 4318

Project Name:	SR-710 Tunnel Technical Study	Tested By:	V. Juliano	Date:	05/26/09
Project No. :	378312.04.09.01	Input By:	J. Ward	Date:	05/27/09
Boring No.:	R-09-Z2-B4	Checked By:	J. Ward		
Sample No.:	C23	Depth (ft.)	88.5-89		
Soil Identification:	Dark olive elastic silt (MH)				

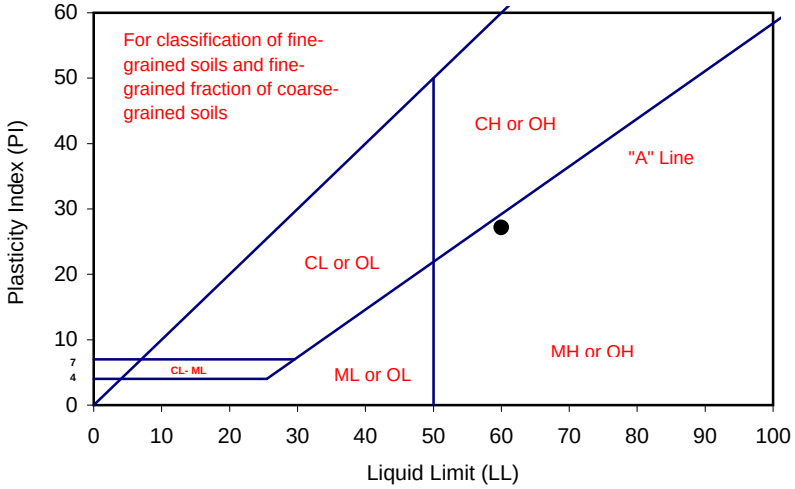
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			28	22	16	
Wet Wt. of Soil + Cont. (g)	10.29	10.20	14.48	14.30	16.78	
Dry Wt. of Soil + Cont. (g)	8.03	7.94	9.46	9.27	10.66	
Wt. of Container (g)	1.09	1.12	1.00	1.07	1.07	
Moisture Content (%) [Wn]	32.56	33.14	59.34	61.34	63.82	

Liquid Limit	**60**
Plastic Limit	**33**
Plasticity Index	**27**
Classification	**MH**

PI at "A" - Line = 0.73(LL-20) 29.2

One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.12}$



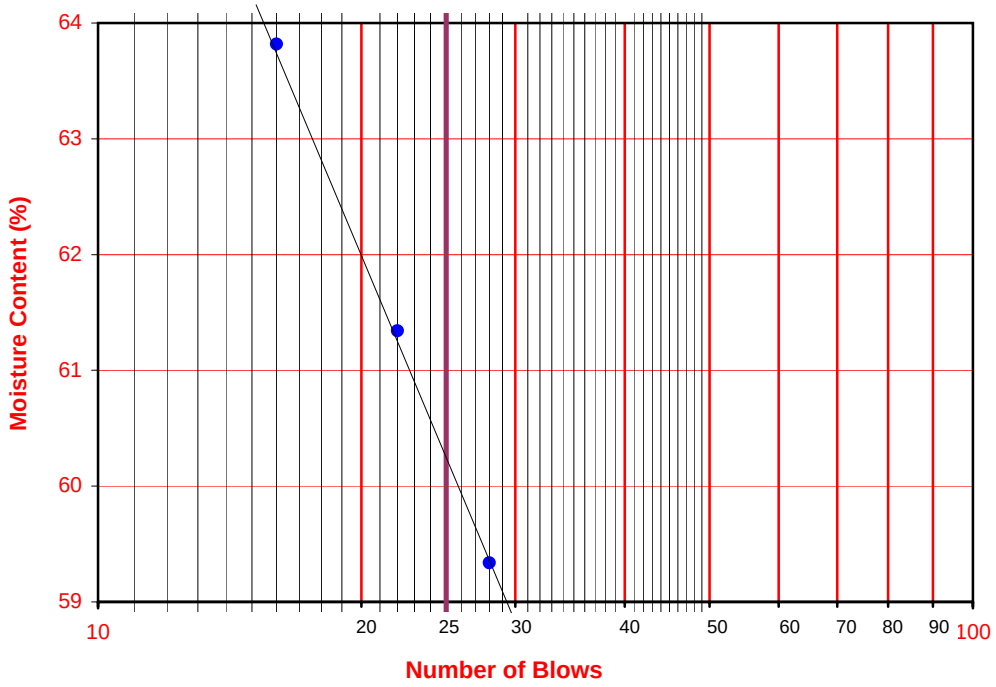
PROCEDURES USED

☐ Wet Preparation
Multipoint - Wet

☒ Dry Preparation
Multipoint - Dry

☒ Procedure A
Multipoint Test

☐ Procedure B
One-point Test



Leighton

ATTERBERG LIMITS

ASTM D 4318

Project Name:	SR-710 Tunnel Technical Study	Tested By:	V. Juliano	Date:	05/21/09
Project No. :	378312.04.09.01	Input By:	J. Ward	Date:	05/27/09
Boring No.:	R-09-Z2-B4	Checked By:	J. Ward		
Sample No.:	S9	Depth (ft.)	40.0		
Soil Identification:	Olive fat clay with sand (CH)s				

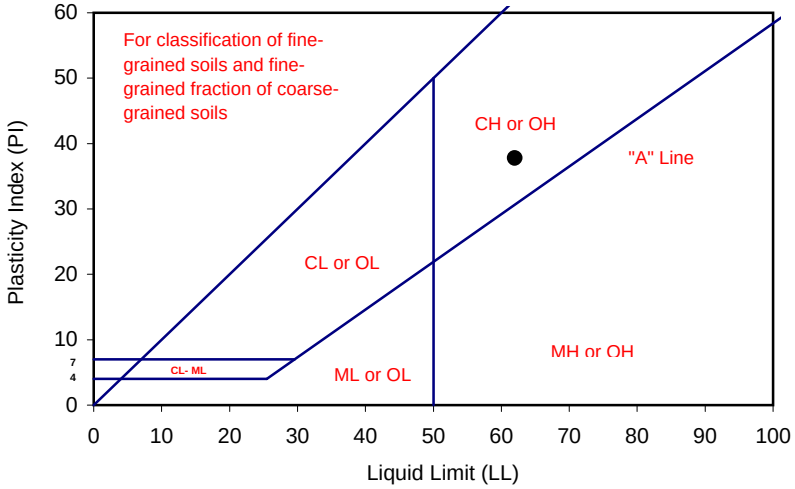
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			30	23	16	
Wet Wt. of Soil + Cont. (g)	9.60	9.55	11.85	12.66	14.30	
Dry Wt. of Soil + Cont. (g)	7.95	7.88	7.78	8.23	9.10	
Wt. of Container (g)	1.09	1.02	1.05	1.08	1.09	
Moisture Content (%) [Wn]	24.05	24.34	60.48	61.96	64.92	

Liquid Limit	**62**
Plastic Limit	**24**
Plasticity Index	**38**
Classification	**CH**

PI at "A" - Line = 0.73(LL-20) 30.66

One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.12}$



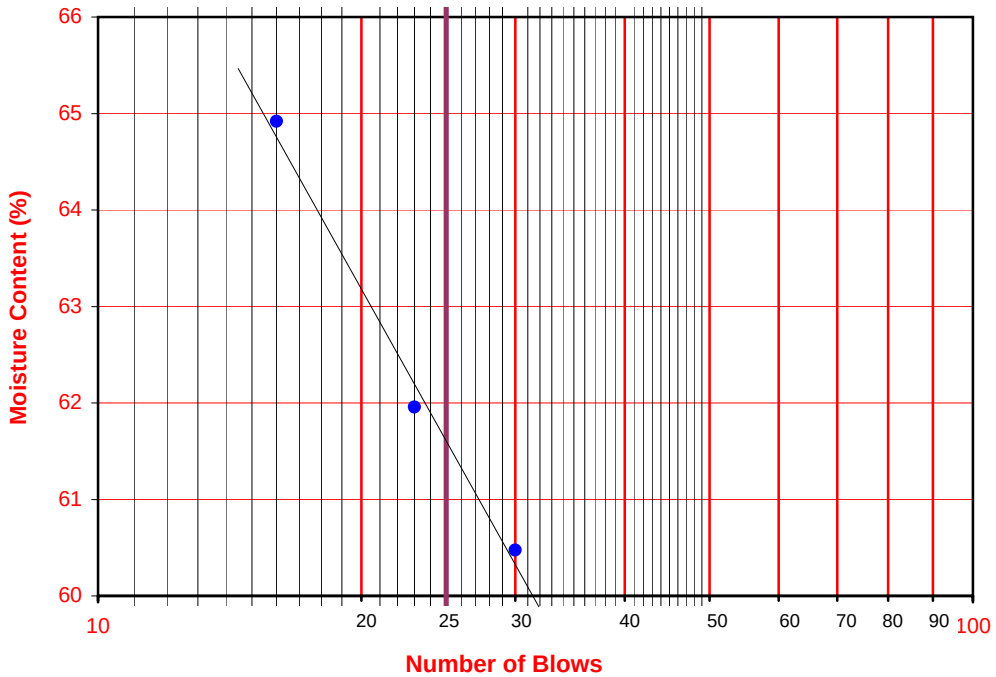
PROCEDURES USED

☐ Wet Preparation
Multipoint - Wet

☒ Dry Preparation
Multipoint - Dry

☒ Procedure A
Multipoint Test

☐ Procedure B
One-point Test



Leighton

ATTERBERG LIMITS

ASTM D 4318

Project Name:	SR-710 Tunnel Technical Study	Tested By:	V. Juliano	Date:	05/26/09
Project No. :	378312.04.09.01	Input By:	J. Ward	Date:	05/27/09
Boring No.:	R-09-Z2-B4	Checked By:	J. Ward		
Sample No.:	S6	Depth (ft.)	25.0		
Soil Identification:	Olive brown sandy fat clay s(CH)				

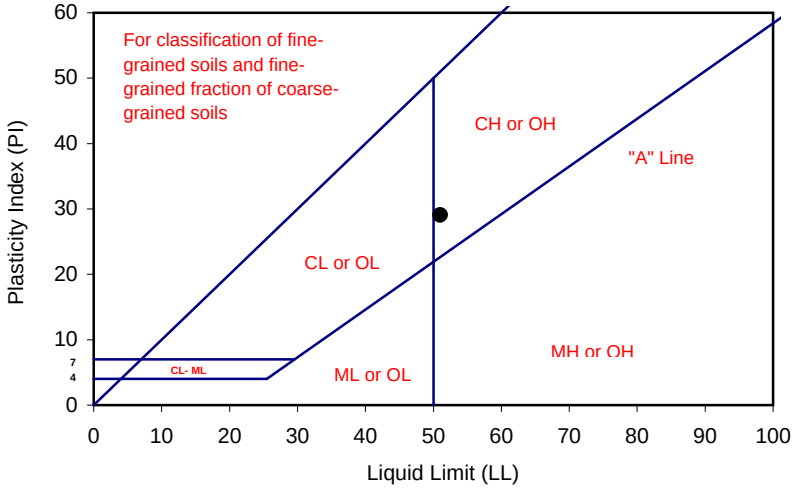
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			28	22	16	
Wet Wt. of Soil + Cont. (g)	10.17	10.02	15.54	14.03	14.49	
Dry Wt. of Soil + Cont. (g)	8.54	8.40	10.69	9.64	9.83	
Wt. of Container (g)	1.08	1.05	1.02	1.05	1.06	
Moisture Content (%) [Wn]	21.85	22.04	50.16	51.11	53.14	

Liquid Limit	**51**
Plastic Limit	**22**
Plasticity Index	**29**
Classification	**CH**

PI at "A" - Line = 0.73(LL-20) 22.63

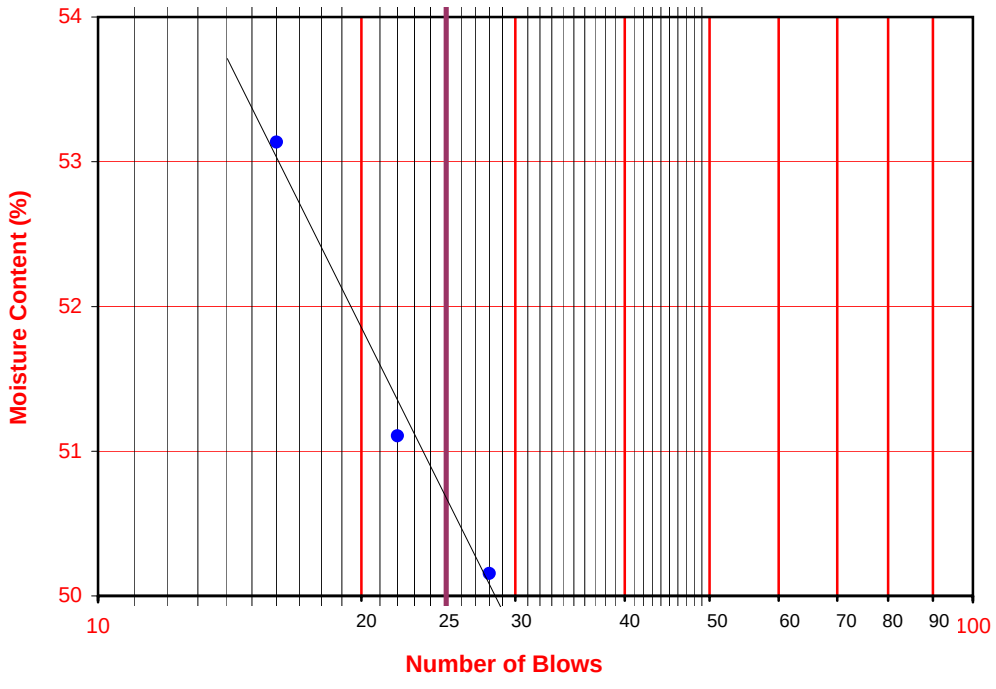
One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.12}$



PROCEDURES USED

	Wet Preparation
	Multipoint - Wet
X	Dry Preparation
	Multipoint - Dry
X	Procedure A
	Multipoint Test
	Procedure B
	One-point Test



Leighton

ATTERBERG LIMITS

ASTM D 4318

Project Name:	SR-710 Tunnel Technical Study	Tested By:	V. Juliano	Date:	05/27/09
Project No. :	378312.04.09.01	Input By:	J. Ward	Date:	06/01/09
Boring No.:	R-09-Z2-B5	Checked By:	J. Ward		
Sample No.:	S15	Depth (ft.)	75.0		
Soil Identification:	Olive brown fat clay (CH)				

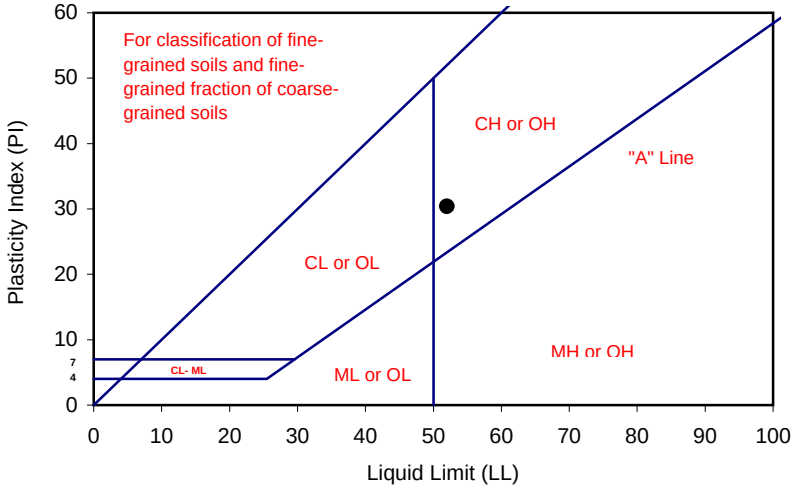
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			34	27	19	
Wet Wt. of Soil + Cont. (g)	9.46	9.57	14.31	15.20	18.48	
Dry Wt. of Soil + Cont. (g)	7.98	8.05	9.85	10.40	12.46	
Wt. of Container (g)	1.08	1.08	1.05	1.08	1.11	
Moisture Content (%) [Wn]	21.45	21.81	50.68	51.50	53.04	

Liquid Limit	**52**
Plastic Limit	**22**
Plasticity Index	**30**
Classification	**CH**

PI at "A" - Line = 0.73(LL-20) 23.36

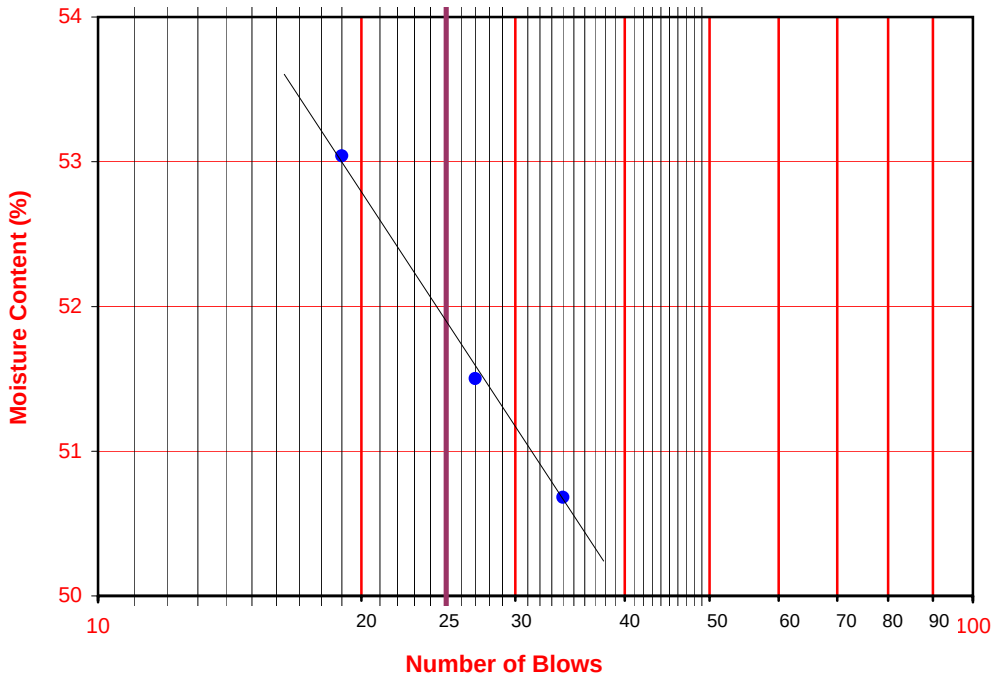
One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.12}$



PROCEDURES USED

	Wet Preparation
	Multipoint - Wet
X	Dry Preparation
	Multipoint - Dry
X	Procedure A
	Multipoint Test
	Procedure B
	One-point Test



ATTERBERG LIMITS

ASTM D 4318

Project Name:	SR-710 Tunnel Technical Study	Tested By:	F. Tabibkhoei	Date:	06/02/09
Project No. :	378312.04.09.01	Input By:	J. Ward	Date:	06/03/09
Boring No.:	R-09-Z2-B5	Checked By:	J. Ward		
Sample No.:	O21	Depth (ft.)	105-106.5		
Soil Identification:	Olive brown lean clay (CL)				

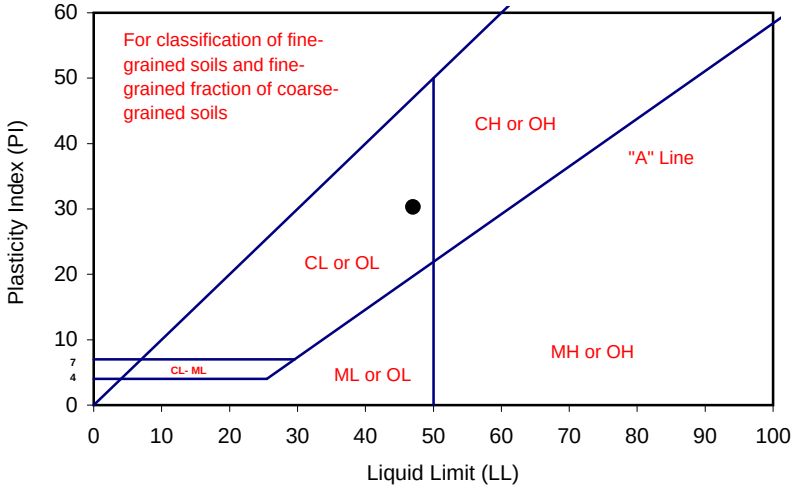
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			22	32	35	
Wet Wt. of Soil + Cont. (g)	39.74	51.46	48.87	52.76	59.41	
Dry Wt. of Soil + Cont. (g)	37.54	48.64	41.11	43.88	48.52	
Wt. of Container (g)	24.55	31.57	24.65	24.69	24.76	
Moisture Content (%) [Wn]	16.94	16.52	47.14	46.27	45.83	

Liquid Limit	**47**
Plastic Limit	**17**
Plasticity Index	**30**
Classification	**CL**

PI at "A" - Line = 0.73(LL-20) 19.71

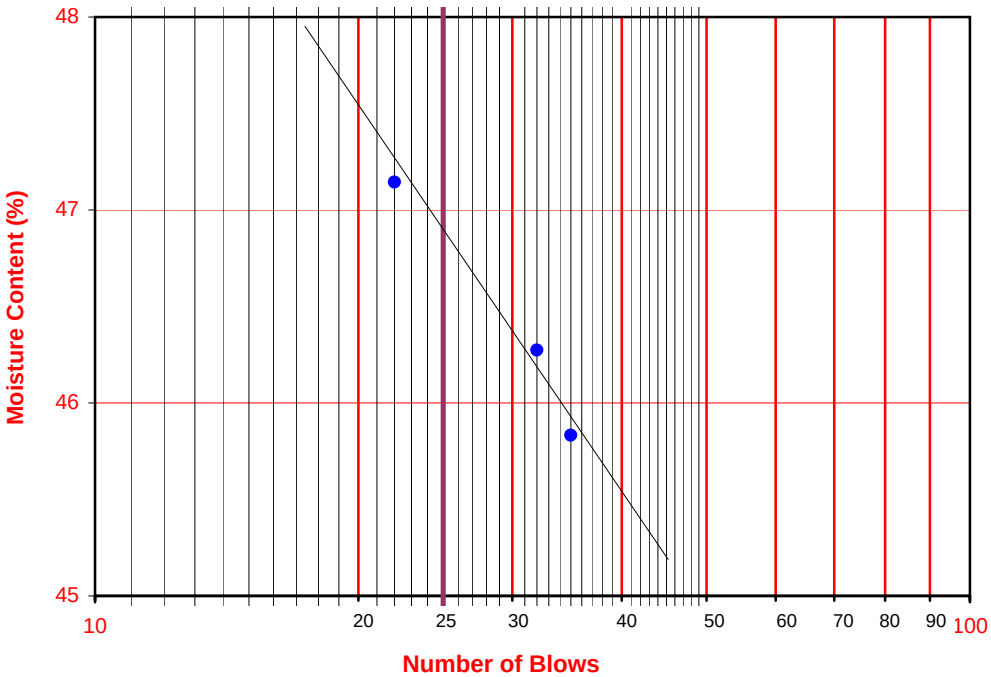
One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.12}$



PROCEDURES USED

- [ ] Wet Preparation
  Multipoint - Wet
- [X] Dry Preparation
  Multipoint - Dry
- [X] Procedure A
  Multipoint Test
- [ ] Procedure B
  One-point Test



ATTERBERG LIMITS

ASTM D 4318

Project Name:	SR-710 Tunnel Technical Study	Tested By:	G. Bathala	Date:	05/27/09
Project No. :	378312.04.09.01	Input By:	J. Ward	Date:	06/01/09
Boring No.:	R-09-Z2-B5	Checked By:	J. Ward		
Sample No.:	O25	Depth (ft.)	125.0		
Soil Identification:	Light olive brown fat clay (CH)				

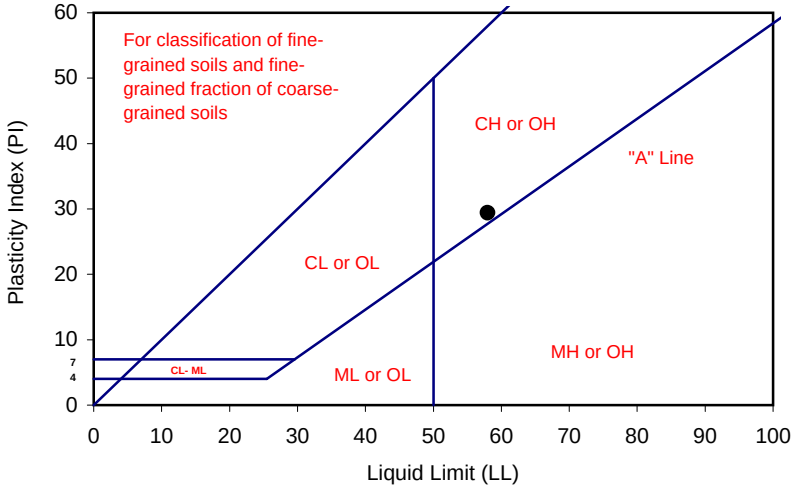
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			35	26	19	
Wet Wt. of Soil + Cont. (g)	12.21	12.56	10.86	11.48	11.92	
Dry Wt. of Soil + Cont. (g)	9.73	9.99	7.33	7.68	7.86	
Wt. of Container (g)	1.05	1.01	1.02	1.04	1.08	
Moisture Content (%) [Wn]	28.57	28.62	55.94	57.23	59.88	

Liquid Limit	**58**
Plastic Limit	**29**
Plasticity Index	**29**
Classification	**CH**

PI at "A" - Line = 0.73(LL-20) 27.74

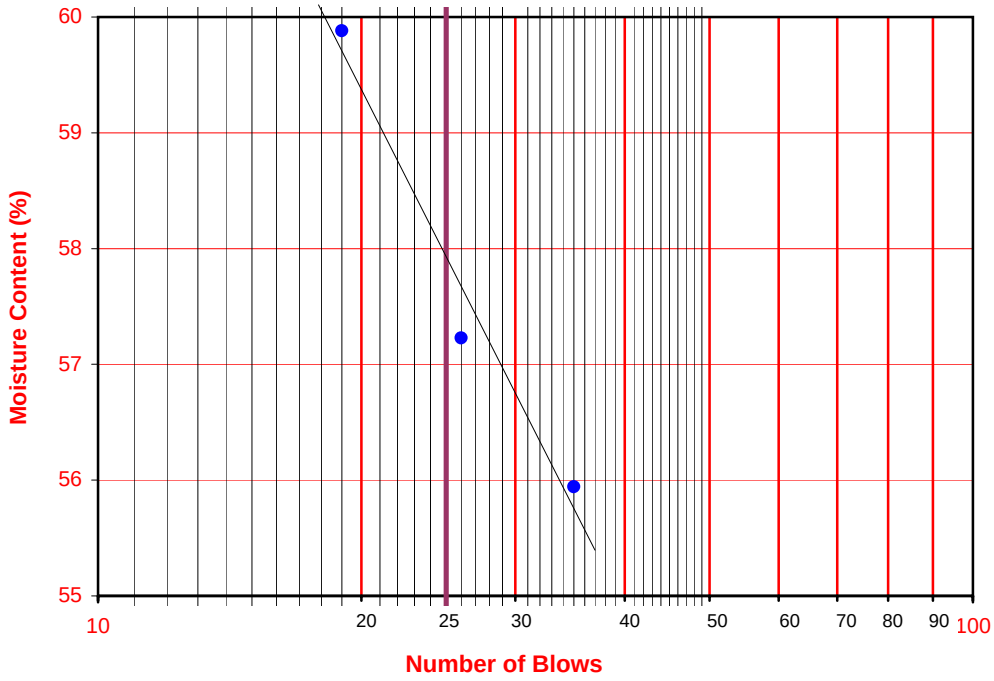
One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.12}$



PROCEDURES USED

- [ ] Wet Preparation
  Multipoint - Wet
- [X] Dry Preparation
  Multipoint - Dry
- [X] Procedure A
  Multipoint Test
- [ ] Procedure B
  One-point Test



Leighton

ATTERBERG LIMITS

ASTM D 4318

Project Name:	SR-710 Tunnel Technical Study	Tested By:	V. Juliano	Date:	04/28/09
Project No. :	378312.04.09.01	Input By:	J. Ward	Date:	05/07/09
Boring No.:	R-09-Z3-B1	Checked By:	J. Ward		
Sample No.:	S3	Depth (ft.)	20.0		
Soil Identification:	Brown silty sand (SM)				

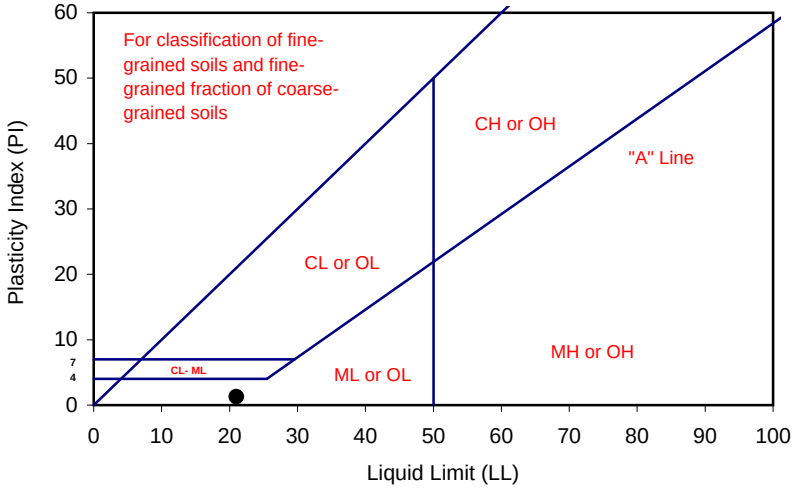
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			29	22	15	
Wet Wt. of Soil + Cont. (g)	11.30	11.37	12.77	14.14	12.34	
Dry Wt. of Soil + Cont. (g)	9.62	9.66	10.78	11.84	10.27	
Wt. of Container (g)	1.09	1.01	1.04	1.02	1.03	
Moisture Content (%) [Wn]	19.70	19.77	20.43	21.26	22.40	

Liquid Limit	**21**
Plastic Limit	**20**
Plasticity Index	**1**
Classification	**ML**

PI at "A" - Line = 0.73(LL-20) 0.73

One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.12}$



PROCEDURES USED

☐ Wet Preparation

Multipoint - Wet

☒ Dry Preparation

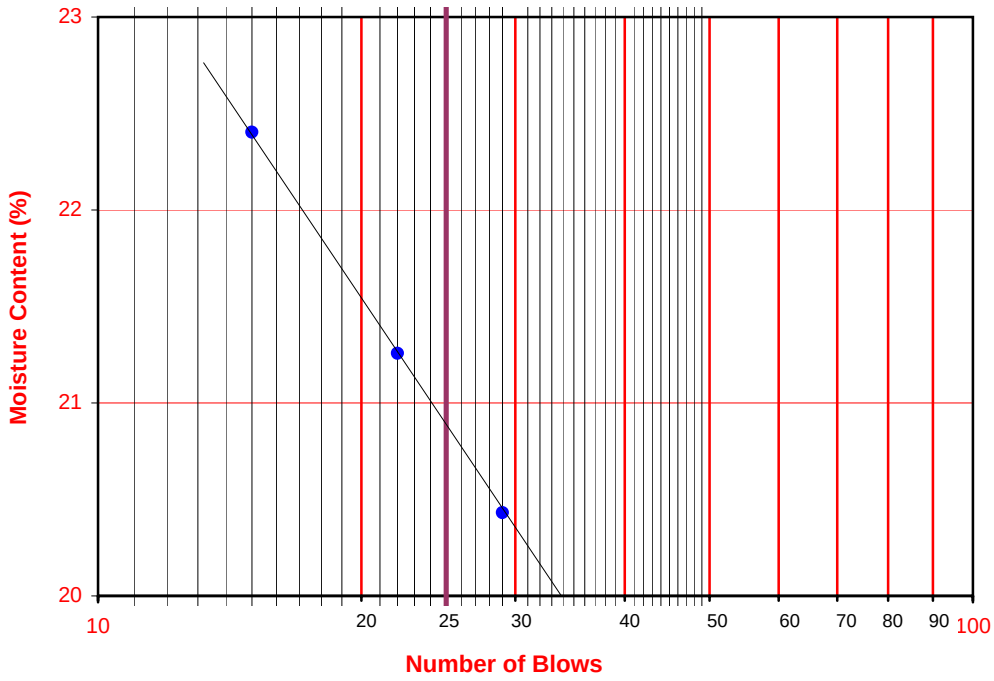
Multipoint - Dry

☒ Procedure A

Multipoint Test

☐ Procedure B

One-point Test



ATTERBERG LIMITS

ASTM D 4318

Project Name:	SR-710 Tunnel Technical Study	Tested By:	V. Juliano	Date:	05/12/09
Project No. :	378312.04.09.01	Input By:	J. Ward	Date:	05/15/09
Boring No.:	R-09-Z3-B2	Checked By:	J. Ward		
Sample No.:	S4	Depth (ft.)	11.8-12.3		
Soil Identification:	Yellowish brown poorly-graded gravel with silt and sand (GP-GM)s				

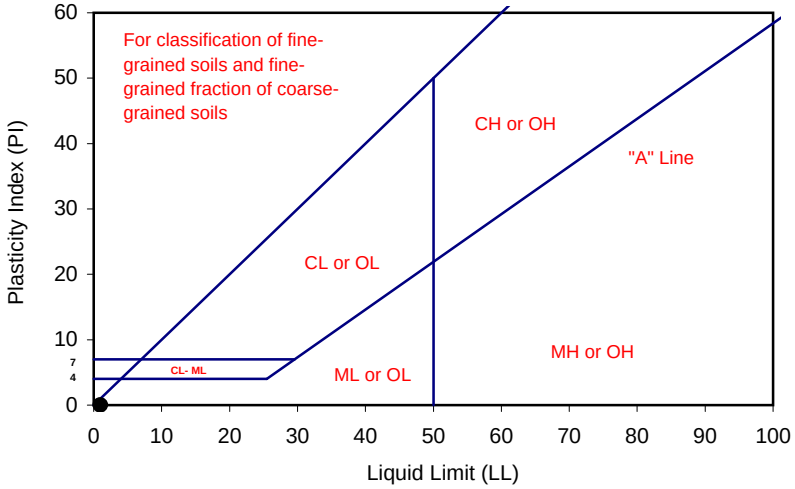
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			8			
Wet Wt. of Soil + Cont. (g)	**Cannot be rolled:**		17.57	**Cannot get more than 8 blows:**		
Dry Wt. of Soil + Cont. (g)	**NonPlastic**		14.52	**NonPlastic**		
Wt. of Container (g)			1.10			
Moisture Content (%) [Wn]			22.73			

Liquid Limit	**NP**
Plastic Limit	**NP**
Plasticity Index	**NP**
Classification	**NP**

PI at "A" - Line = 0.73(LL-20) =

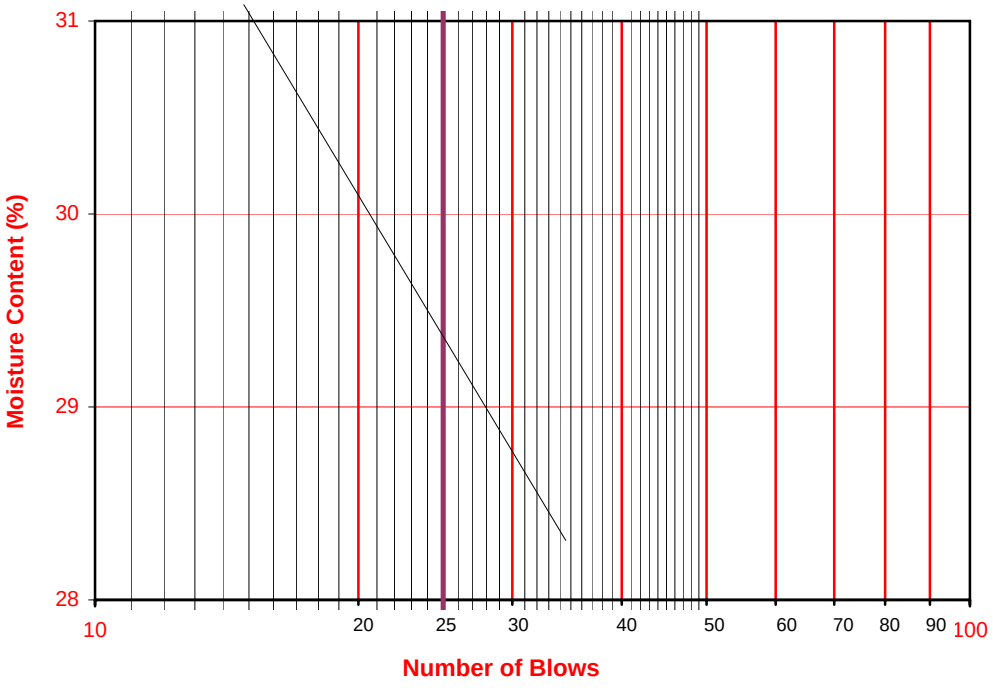
One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.12}$



PROCEDURES USED

	Wet Preparation
	Multipoint - Wet
X	Dry Preparation
	Multipoint - Dry
X	Procedure A
	Multipoint Test
	Procedure B
	One-point Test



Leighton

ATTERBERG LIMITS

ASTM D 4318

Project Name:	SR-710 Tunnel Technical Study	Tested By:	G. Bathala	Date:	05/13/09
Project No. :	378312.04.09.01	Input By:	J. Ward	Date:	05/15/09
Boring No.:	R-09-Z3-B2	Checked By:	J. Ward		
Sample No.:	C41	Depth (ft.)	116.5-120		
Soil Identification:	Yellowish brown clayey sand (SC)				

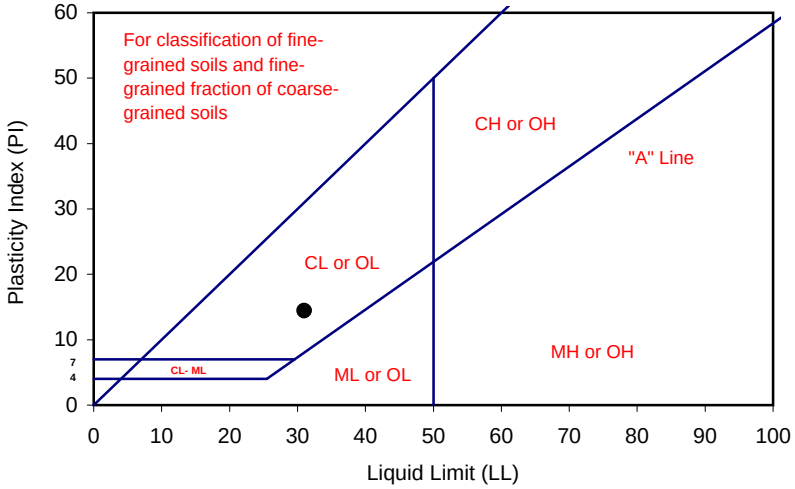
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			35	27	20	
Wet Wt. of Soil + Cont. (g)	13.16	12.54	12.92	14.70	15.49	
Dry Wt. of Soil + Cont. (g)	11.43	10.92	10.24	11.52	12.02	
Wt. of Container (g)	1.05	1.06	1.07	1.04	1.07	
Moisture Content (%) [Wn]	16.67	16.43	29.23	30.34	31.69	

Liquid Limit	**31**
Plastic Limit	**17**
Plasticity Index	**14**
Classification	**CL**

PI at "A" - Line = 0.73(LL-20) 8.03

One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.12}$



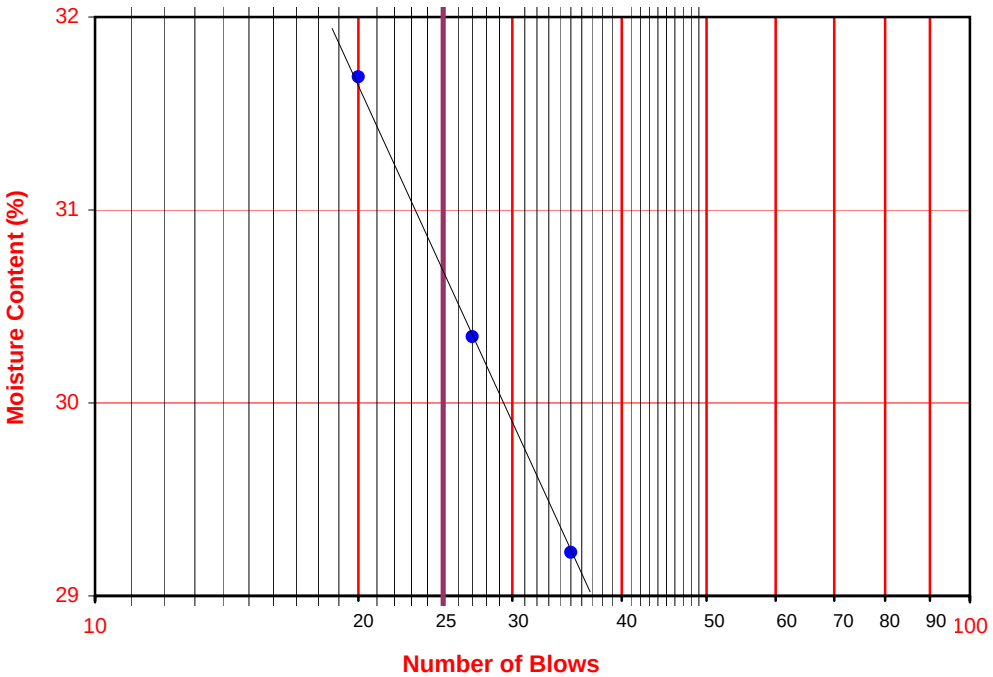
PROCEDURES USED

☐ Wet Preparation
Multipoint - Wet

☒ Dry Preparation
Multipoint - Dry

☒ Procedure A
Multipoint Test

☐ Procedure B
One-point Test



ATTERBERG LIMITS

ASTM D 4318

Project Name:	SR-710 Tunnel Technical Study	Tested By:	V. Juliano	Date:	05/06/09
Project No. :	378312.04.09.01	Input By:	J. Ward	Date:	05/12/09
Boring No.:	R-09-Z3-B4	Checked By:	J. Ward		
Sample No.:	S-3	Depth (ft.)	15.0		
Soil Identification:	Yellowish brown silty sand (SM)				

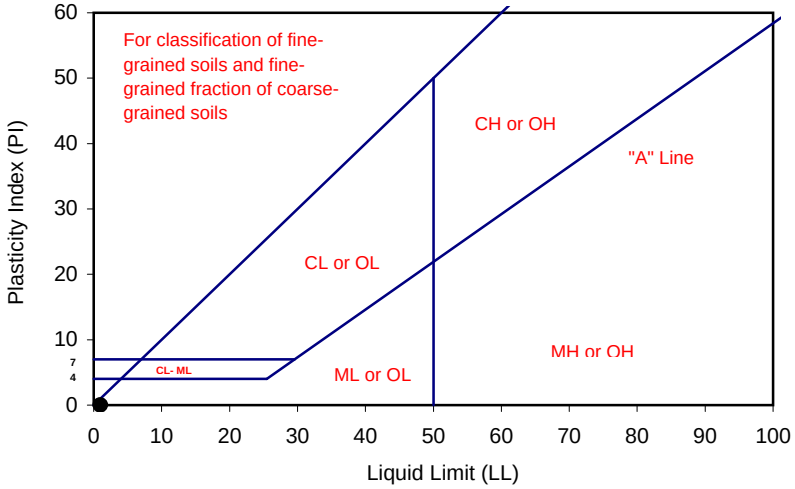
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			7			
Wet Wt. of Soil + Cont. (g)	**Cannot be rolled:**		16.51	**Cannot get more than 7 blows:**		
Dry Wt. of Soil + Cont. (g)	**NonPlastic**		13.31	**NonPlastic**		
Wt. of Container (g)			1.05			
Moisture Content (%) [Wn]			26.10			

Liquid Limit	**NP**
Plastic Limit	**NP**
Plasticity Index	**NP**
Classification	**NP**

PI at "A" - Line = 0.73(LL-20) =

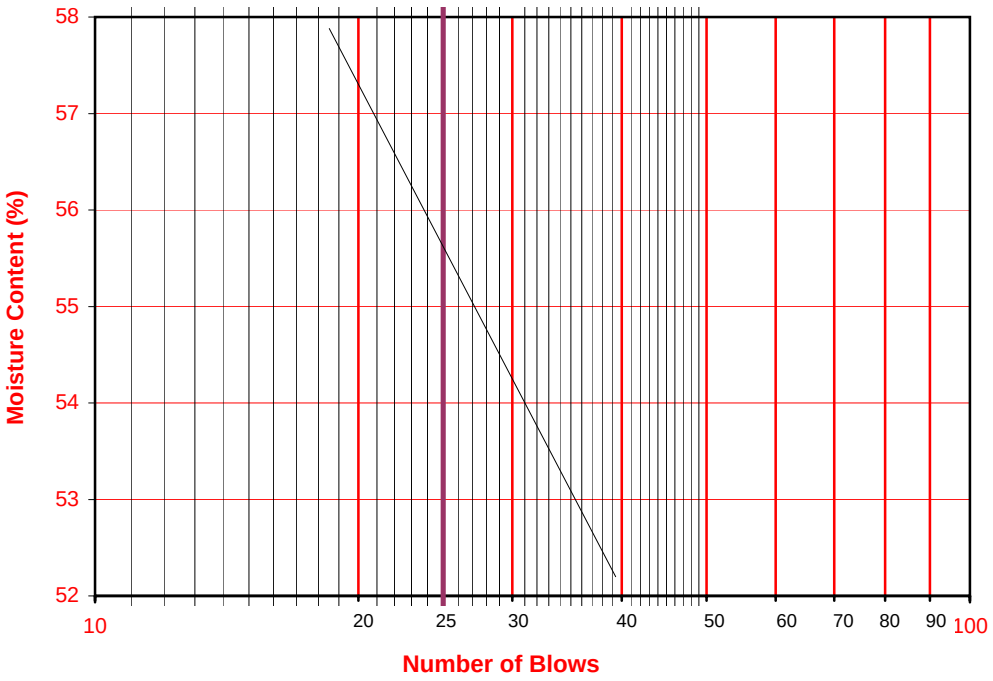
One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.12}$



PROCEDURES USED

	Wet Preparation
	Multipoint - Wet
X	Dry Preparation
	Multipoint - Dry
X	Procedure A
	Multipoint Test
	Procedure B
	One-point Test



Leighton

ATTERBERG LIMITS

ASTM D 4318

Project Name:	SR-710 Tunnel Technical Study	Tested By:	V. Juliano	Date:	05/04/09
Project No. :	378312.04.09.01	Input By:	J. Ward	Date:	05/06/09
Boring No.:	R-09-Z3-B4	Checked By:	J. Ward		
Sample No.:	S-8	Depth (ft.)	40.0		
Soil Identification:	Olive silt with sand (ML)s				

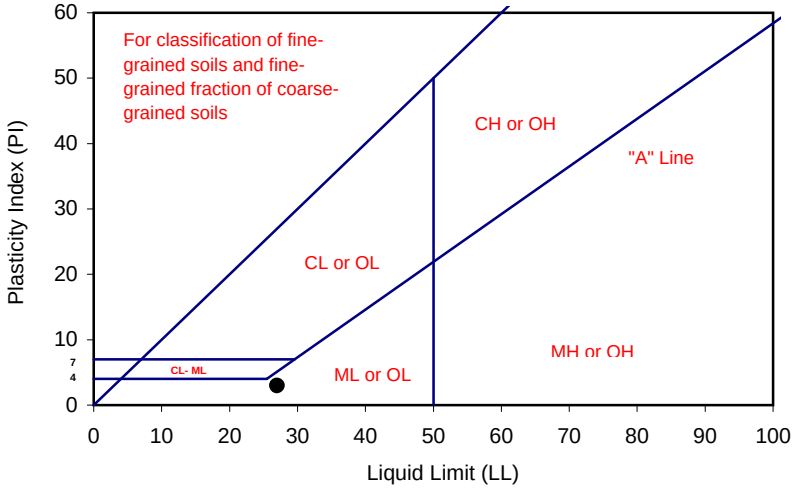
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			28	23	18	
Wet Wt. of Soil + Cont. (g)	12.57	13.20	14.86	10.40	14.17	
Dry Wt. of Soil + Cont. (g)	10.33	10.84	11.95	8.41	11.30	
Wt. of Container (g)	1.01	1.02	1.03	1.09	1.06	
Moisture Content (%) [Wn]	24.03	24.03	26.65	27.19	28.03	

Liquid Limit	**27**
Plastic Limit	**24**
Plasticity Index	**3**
Classification	**ML**

PI at "A" - Line = 0.73(LL-20) 5.11

One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.12}$



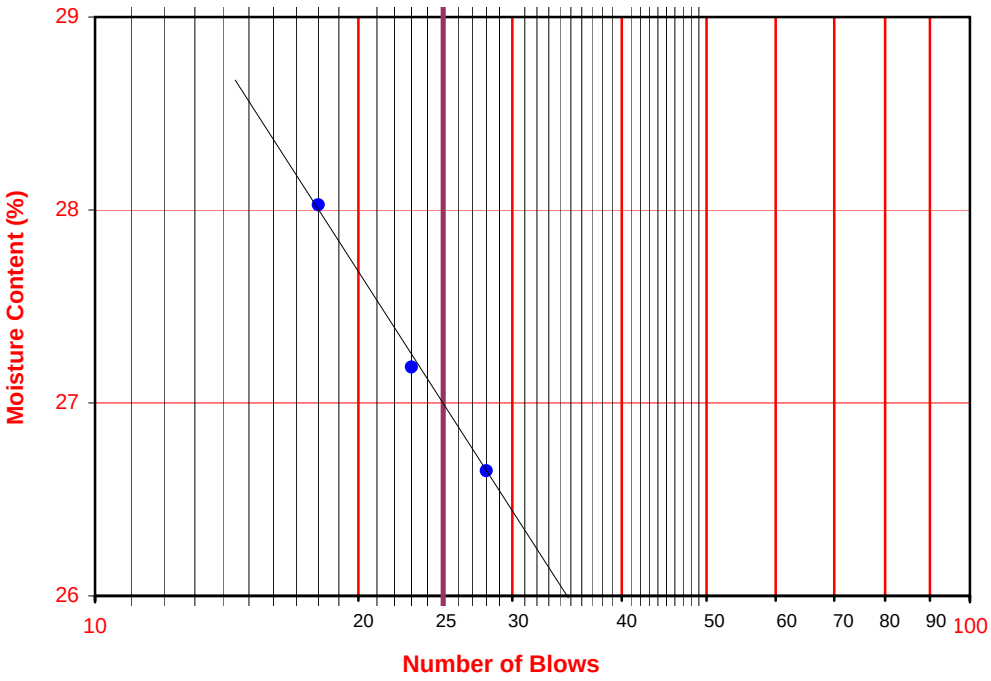
PROCEDURES USED

[ ] Wet Preparation
Multipoint - Wet

[X] Dry Preparation
Multipoint - Dry

[X] Procedure A
Multipoint Test

[ ] Procedure B
One-point Test



ATTERBERG LIMITS

ASTM D 4318

Project Name:	SR-710 Tunnel Technical Study	Tested By:	V. Juliano	Date:	05/06/09
Project No. :	378312.04.09.01	Input By:	J. Ward	Date:	05/12/09
Boring No.:	R-09-Z3-B4	Checked By:	J. Ward		
Sample No.:	S-10	Depth (ft.)	50.0		
Soil Identification:	Yellowish brown silty sand (SM)				

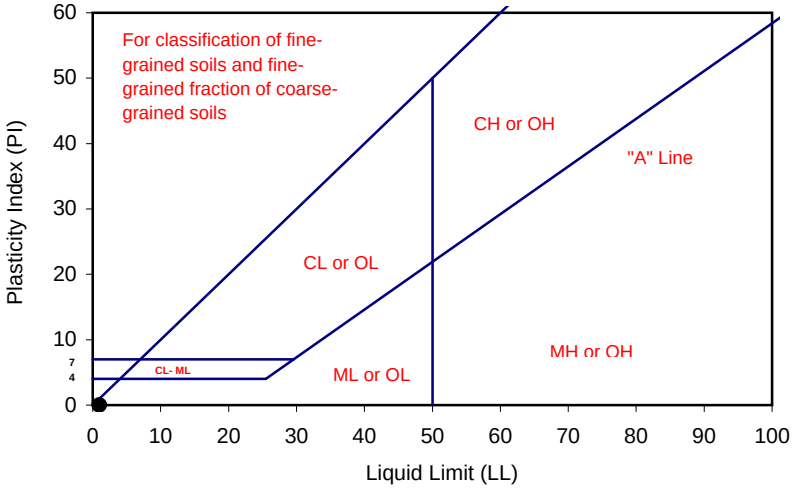
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			9			
Wet Wt. of Soil + Cont. (g)	**Cannot be rolled:**		13.44	**Cannot get more than 9 blows:**		
Dry Wt. of Soil + Cont. (g)	**NonPlastic**		10.69	**NonPlastic**		
Wt. of Container (g)			1.12			
Moisture Content (%) [Wn]			28.74			

Liquid Limit	**NP**
Plastic Limit	**NP**
Plasticity Index	**NP**
Classification	**NP**

PI at "A" - Line = 0.73(LL-20) =

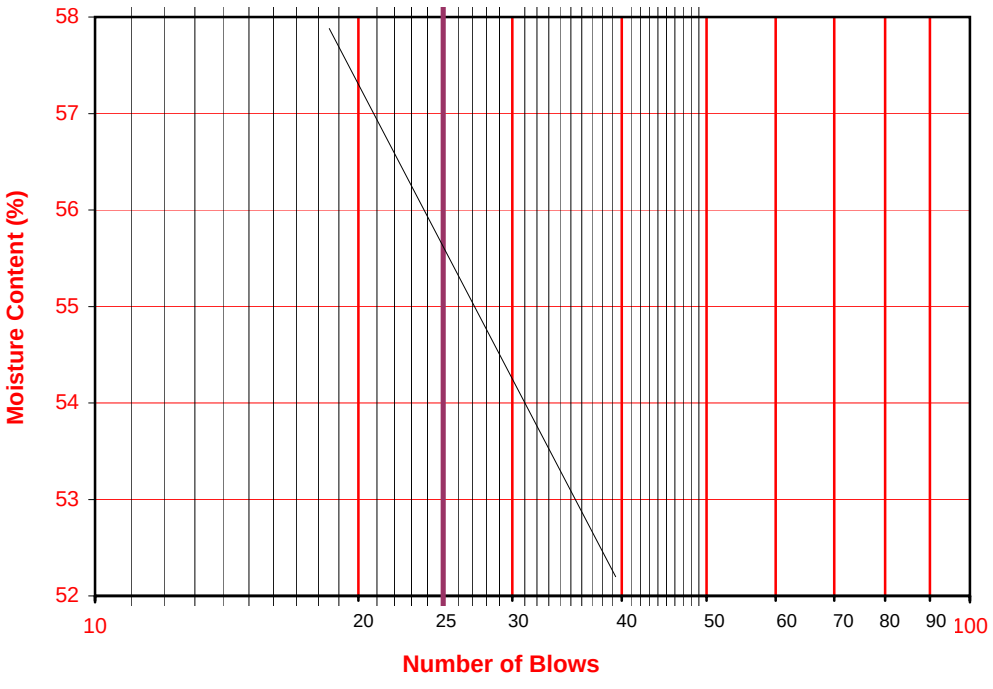
One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.12}$



PROCEDURES USED

	Wet Preparation
	Multipoint - Wet
X	Dry Preparation
	Multipoint - Dry
X	Procedure A
	Multipoint Test
	Procedure B
	One-point Test



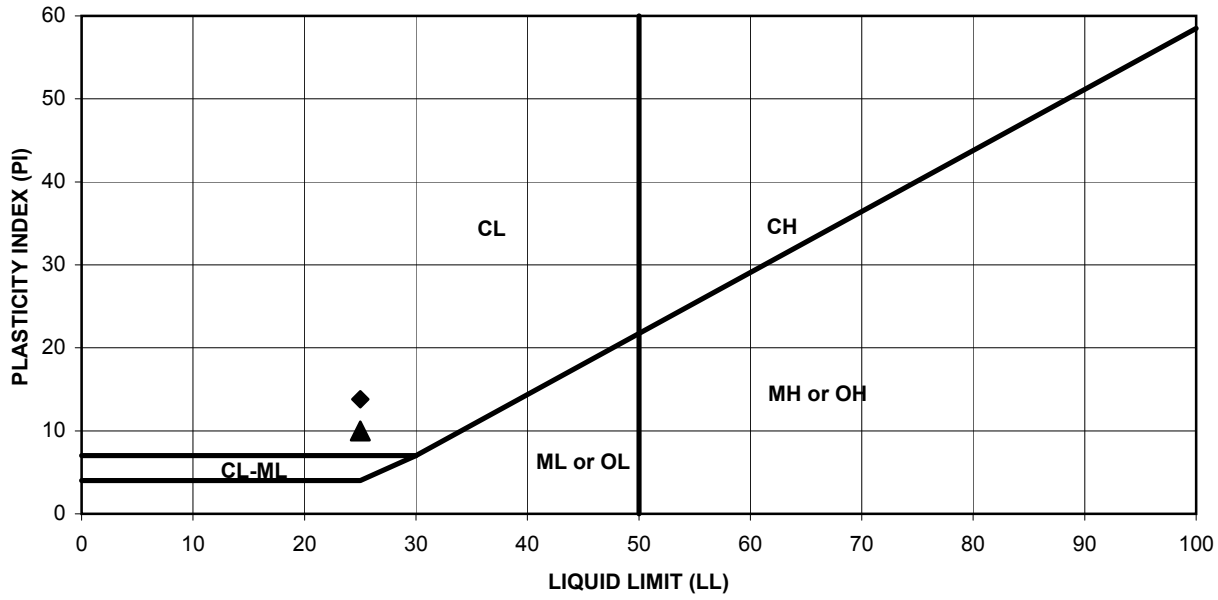
AP Engineering & Testing, Inc.

ATTERBERG LIMITS
ASTM D 4318

Project Name: SR-710 Tunnel Technical Study
Project No.: 378312.04.09.01

Tested By: DK
Checked By: AP

Date: 06/08/09
Date: 06/11/09



PROCEDURE USED

- [ ] Wet Preparation
- [X] Dry Preparation
- [X] Procedure A Multipoint Test
- [ ] Procedure B One-point Test

Symbol	Boring Number	Sample Number	Depth (feet)	LL	PL	PI	U.S.C.S Symbol
♦	R-09-Z3-B5	S-3	15-16.5	25	11	14	CL
▲	R-09-Z3-B5	S-9	45-46.5	25	15	10	CL

ATTERBERG LIMITS

ASTM D 4318

Project Name:	SR-710 Tunnel Technical Study	Tested By:	G. Bathala	Date:	05/28/09
Project No. :	378312.04.09.01	Input By:	J. Ward	Date:	05/29/09
Boring No.:	R-09-Z3-B7	Checked By:	J. Ward		
Sample No.:	C-13	Depth (ft.)	71.3-71.6		
Soil Identification:	Olive yellow lean clay'stone' with sand (CL)s				

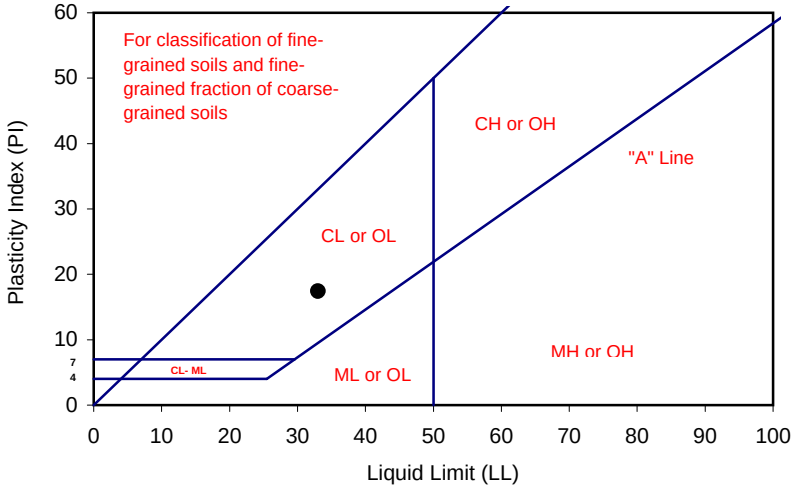
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			17	23	32	
Wet Wt. of Soil + Cont. (g)	11.98	12.59	14.36	14.41	13.49	
Dry Wt. of Soil + Cont. (g)	10.50	11.04	10.98	11.11	10.47	
Wt. of Container (g)	1.04	1.05	1.06	1.08	1.10	
Moisture Content (%) [Wn]	15.64	15.52	34.07	32.90	32.23	

Liquid Limit	**33**
Plastic Limit	**16**
Plasticity Index	**17**
Classification	**CL**

PI at "A" - Line = 0.73(LL-20) 9.49

One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.12}$



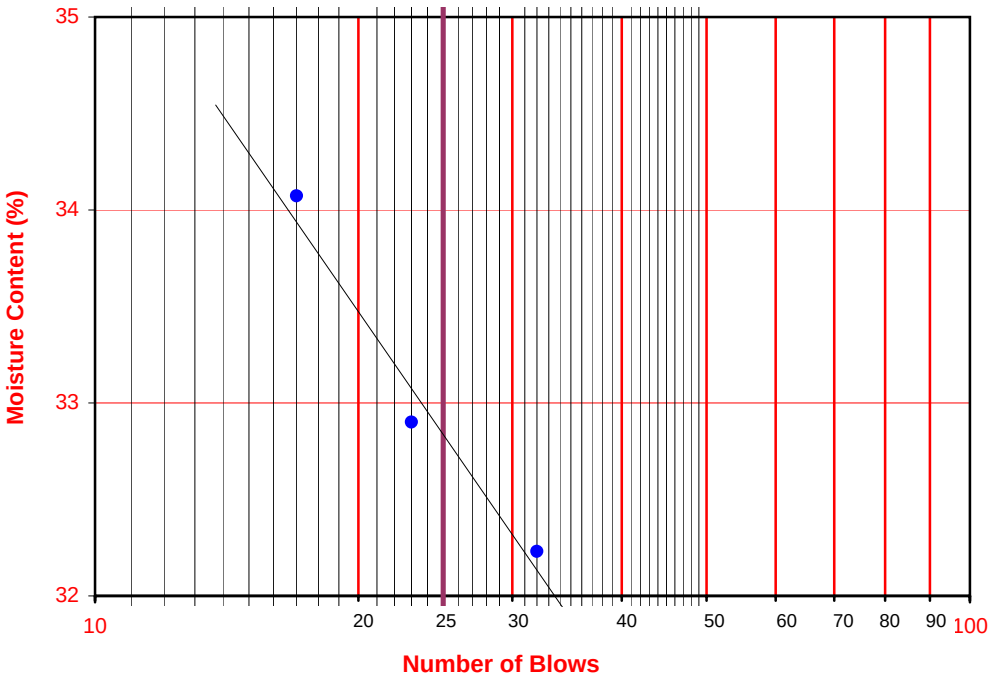
PROCEDURES USED

☐ Wet Preparation
Multipoint - Wet

☒ Dry Preparation
Multipoint - Dry

☒ Procedure A
Multipoint Test

☐ Procedure B
One-point Test



ATTERBERG LIMITS

ASTM D 4318

Project Name:	SR-710 Tunnel Technical Study	Tested By:	V. Juliano	Date:	06/08/09
Project No. :	378312.04.09.01	Input By:	J. Ward	Date:	06/09/09
Boring No.:	R-09-Z3-B8	Checked By:	J. Ward		
Sample No.:	C-12	Depth (ft.)	52.6-53.2		
Soil Identification:	Dark yellowish brown silt'stone' (ML)				

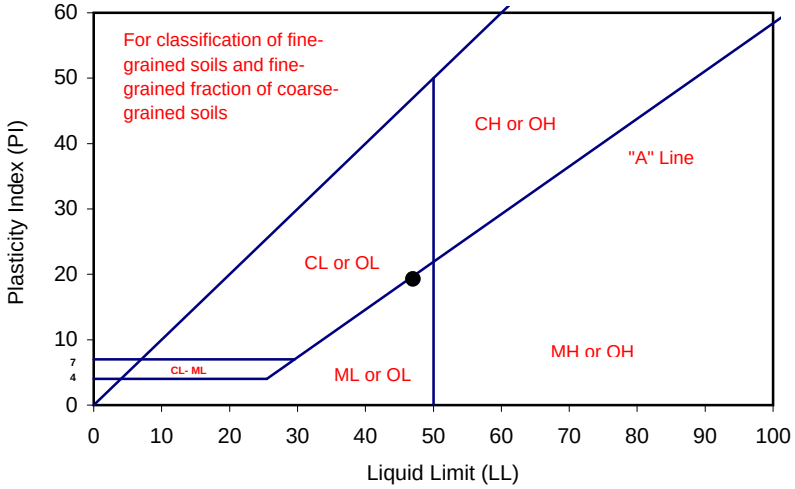
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			35	27	20	
Wet Wt. of Soil + Cont. (g)	10.23	10.35	15.65	15.09	16.02	
Dry Wt. of Soil + Cont. (g)	8.24	8.32	11.08	10.60	11.11	
Wt. of Container (g)	1.02	1.04	1.06	1.05	1.00	
Moisture Content (%) [Wn]	27.56	27.88	45.61	47.02	48.57	

Liquid Limit	**47**
Plastic Limit	**28**
Plasticity Index	**19**
Classification	**ML**

PI at "A" - Line = 0.73(LL-20) 19.71

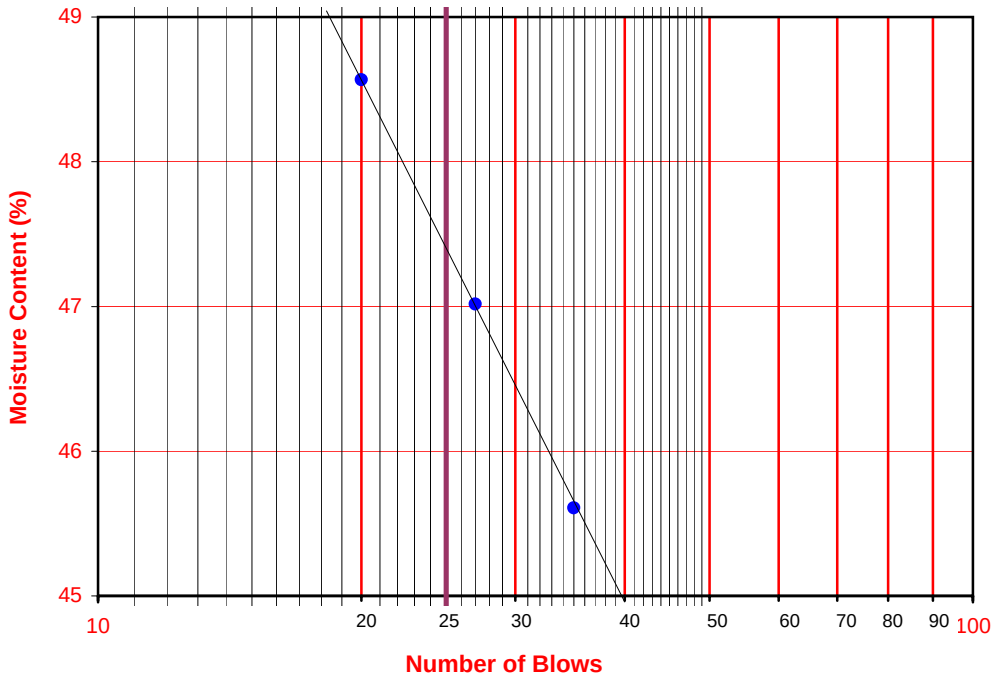
One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.12}$



PROCEDURES USED

	Wet Preparation
	Multipoint - Wet
X	Dry Preparation
	Multipoint - Dry
X	Procedure A
	Multipoint Test
	Procedure B
	One-point Test



Leighton

ATTERBERG LIMITS

ASTM D 4318

Project Name:	SR-710 Tunnel Technical Study	Tested By:	F. Tabibkhoei	Date:	06/02/09
Project No. :	378312.04.09.01	Input By:	J. Ward	Date:	06/06/09
Boring No.:	R-09-Z3-B8	Checked By:	J. Ward		
Sample No.:	C-7	Depth (ft.)	29.2-30		
Soil Identification:	Yellowish brown fat clay'stone' (CH)				

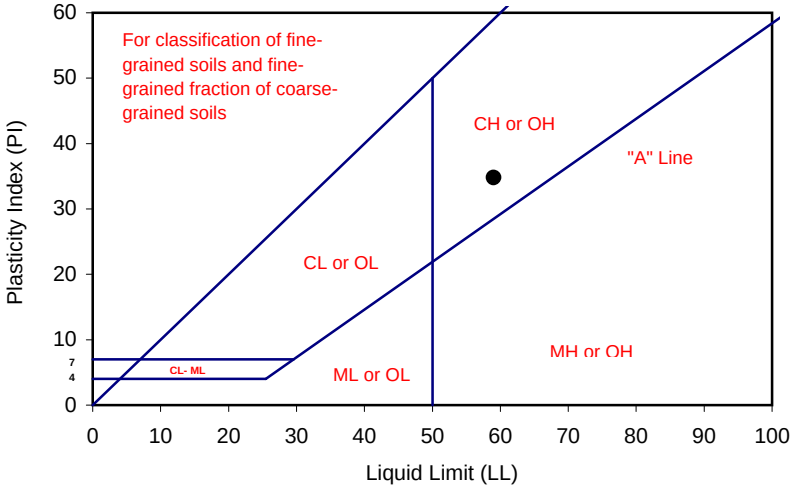
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			35	26	18	
Wet Wt. of Soil + Cont. (g)	42.27	47.72	48.30	45.84	43.60	
Dry Wt. of Soil + Cont. (g)	38.92	44.49	39.90	40.48	36.35	
Wt. of Container (g)	25.05	31.15	24.97	31.35	24.66	
Moisture Content (%) [Wn]	24.15	24.21	56.26	58.71	62.02	

Liquid Limit	**59**
Plastic Limit	**24**
Plasticity Index	**35**
Classification	**CH**

PI at "A" - Line = 0.73(LL-20) 28.47

One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.12}$



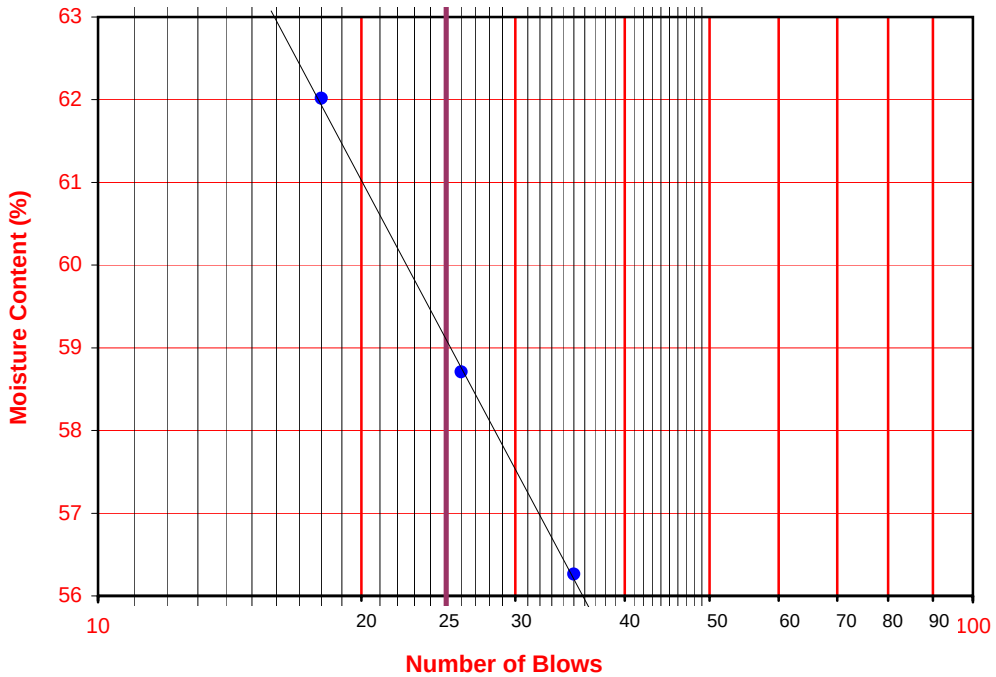
PROCEDURES USED

☐ Wet Preparation
Multipoint - Wet

☒ Dry Preparation
Multipoint - Dry

☒ Procedure A
Multipoint Test

☐ Procedure B
One-point Test



ATTERBERG LIMITS

ASTM D 4318

Project Name:	SR-710 Tunnel Technical Study	Tested By:	G. Bathala	Date:	05/27/09
Project No. :	378312.04.09.01	Input By:	J. Ward	Date:	06/06/09
Boring No.:	R-09-Z3-B8	Checked By:	J. Ward		
Sample No.:	C-5	Depth (ft.)	20-21.5		
Soil Identification:	Olive brown fat clay (CH)				

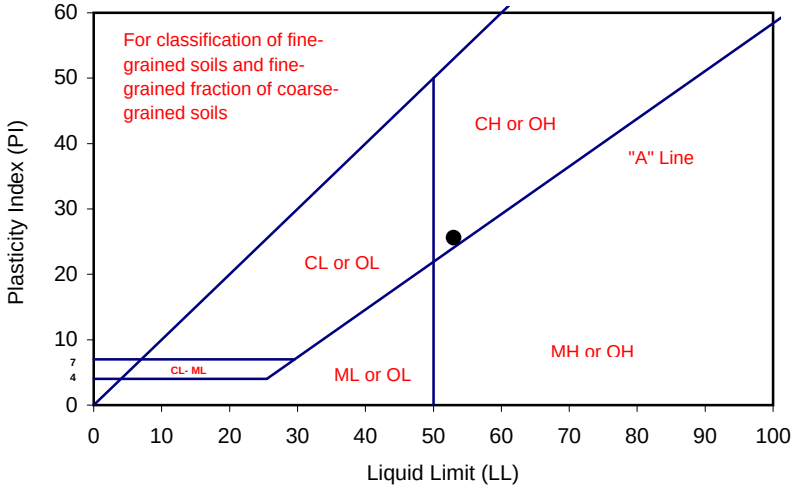
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			35	30	25	18
Wet Wt. of Soil + Cont. (g)	12.89	13.51	12.53	11.64	12.59	14.03
Dry Wt. of Soil + Cont. (g)	10.34	10.84	8.74	8.06	8.57	9.39
Wt. of Container (g)	1.06	1.07	1.05	1.09	1.06	1.07
Moisture Content (%) [Wn]	27.48	27.33	49.28	51.36	53.53	55.77

Liquid Limit	**53**
Plastic Limit	**27**
Plasticity Index	**26**
Classification	**CH**

PI at "A" - Line = 0.73(LL-20) 24.09

One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.12}$



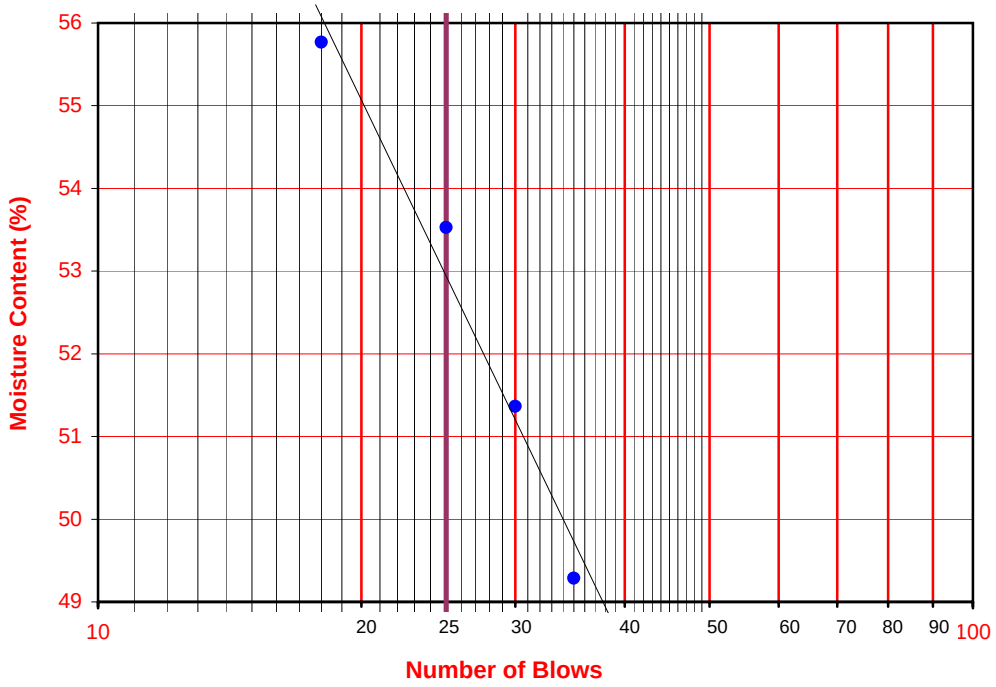
PROCEDURES USED

☐ Wet Preparation
Multipoint - Wet

☒ Dry Preparation
Multipoint - Dry

☒ Procedure A
Multipoint Test

☐ Procedure B
One-point Test



ATTERBERG LIMITS

ASTM D 4318

Project Name:	SR-710 Tunnel Technical Study	Tested By:	F. Tabibkhoei	Date:	05/27/09
Project No. :	378312.04.09.01	Input By:	J. Ward	Date:	05/28/09
Boring No.:	R-09-Z3-B9	Checked By:	J. Ward		
Sample No.:	S-19	Depth (ft.)	150.0		
Soil Identification:	Dark yellowish brown clayey sand (SC)				

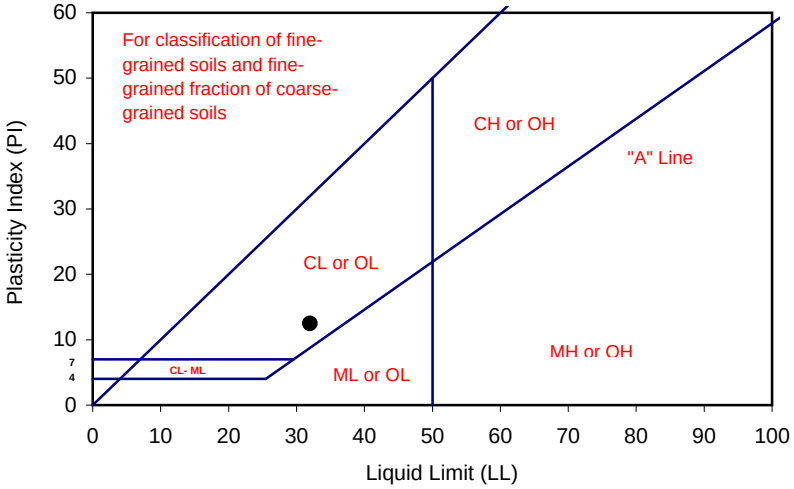
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			15	21	35	
Wet Wt. of Soil + Cont. (g)	42.23	40.39	55.63	50.53	50.76	
Dry Wt. of Soil + Cont. (g)	39.35	37.76	49.62	45.91	44.65	
Wt. of Container (g)	24.58	24.31	31.54	31.35	24.69	
Moisture Content (%) [Wn]	19.50	19.55	33.24	31.73	30.61	

Liquid Limit	**32**
Plastic Limit	**20**
Plasticity Index	**12**
Classification	**CL**

PI at "A" - Line = 0.73(LL-20) 8.76

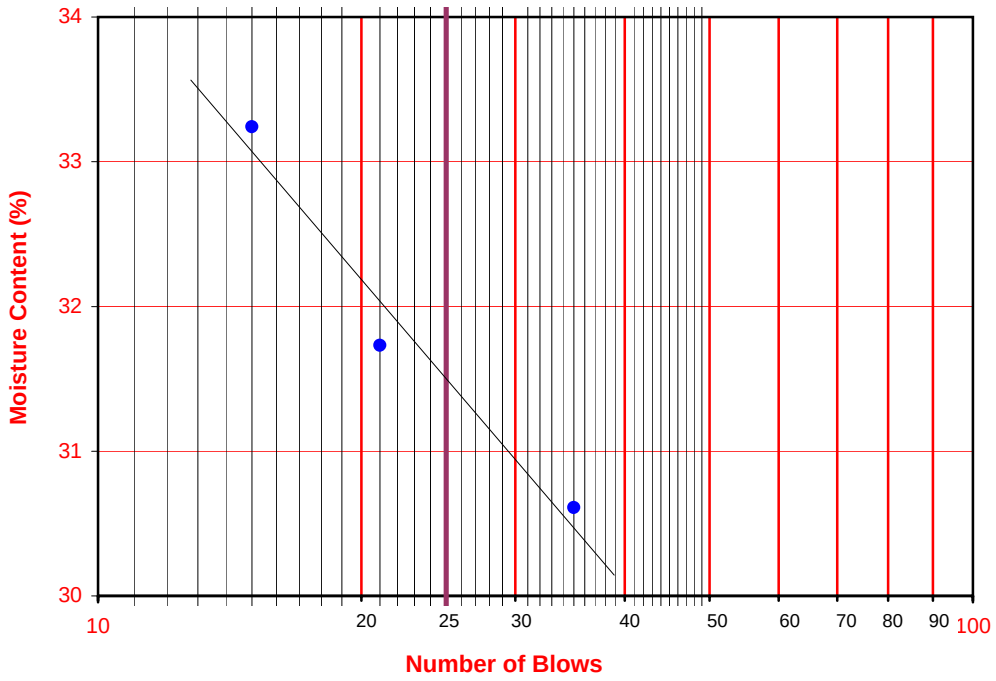
One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.12}$



PROCEDURES USED

- [ ] Wet Preparation
  Multipoint - Wet
- [X] Dry Preparation
  Multipoint - Dry
- [X] Procedure A
  Multipoint Test
- [ ] Procedure B
  One-point Test



ATTERBERG LIMITS

ASTM D 4318

Project Name:	SR-710 Tunnel Technical Study	Tested By:	F. Tabibkhoei	Date:	06/01/09
Project No. :	378312.04.09.01	Input By:	J. Ward	Date:	06/06/09
Boring No.:	R-09-Z3-B10	Checked By:	J. Ward		
Sample No.:	C16	Depth (ft.)	70.7-71.4		
Soil Identification:	Dark olive brown lean clay (CL)				

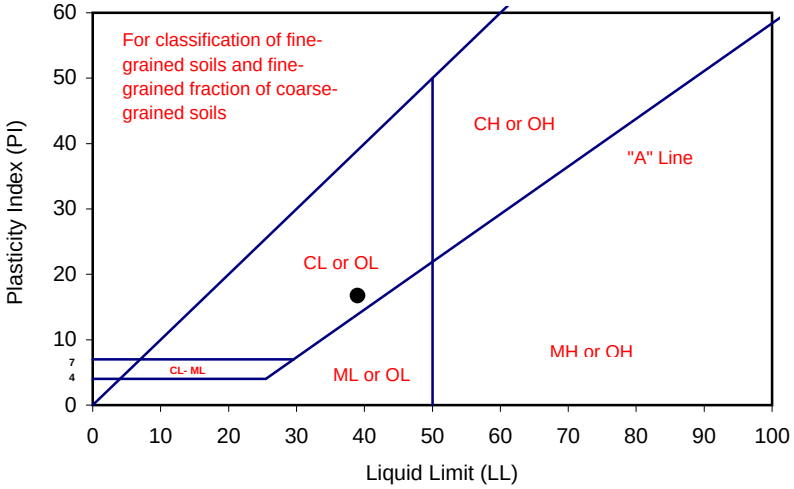
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			33	24	16	
Wet Wt. of Soil + Cont. (g)	40.32	54.46	46.80	56.86	59.68	
Dry Wt. of Soil + Cont. (g)	37.37	50.31	40.93	49.73	51.15	
Wt. of Container (g)	24.12	31.66	25.06	31.69	31.59	
Moisture Content (%) [Wn]	22.26	22.25	36.99	39.52	43.61	

Liquid Limit	**39**
Plastic Limit	**22**
Plasticity Index	**17**
Classification	**CL**

PI at "A" - Line = 0.73(LL-20) 13.87

One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.12}$



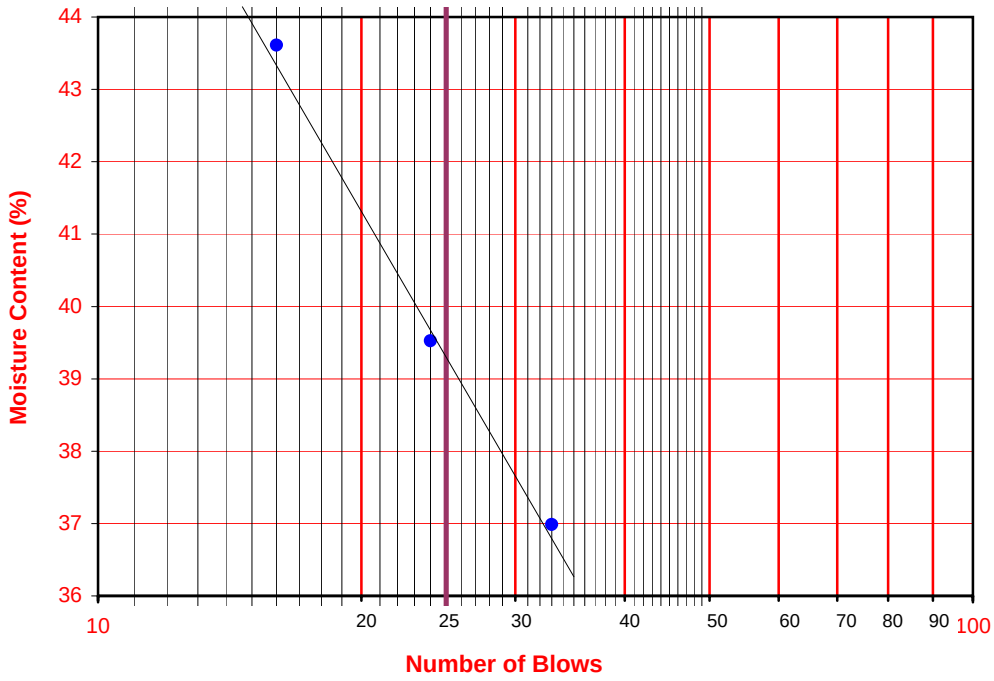
PROCEDURES USED

☐ Wet Preparation
Multipoint - Wet

☒ Dry Preparation
Multipoint - Dry

☒ Procedure A
Multipoint Test

☐ Procedure B
One-point Test



ATTERBERG LIMITS

ASTM D 4318

Project Name:	SR-710 Tunnel Technical Study	Tested By:	G. Bathala	Date:	06/04/09
Project No. :	378312.04.09.01	Input By:	J. Ward	Date:	06/06/09
Boring No.:	R-09-Z3-B10	Checked By:	J. Ward		
Sample No.:	C27	Depth (ft.)	124.2-124.8		
Soil Identification:	Dark olive fat clay'stone' (CH)				

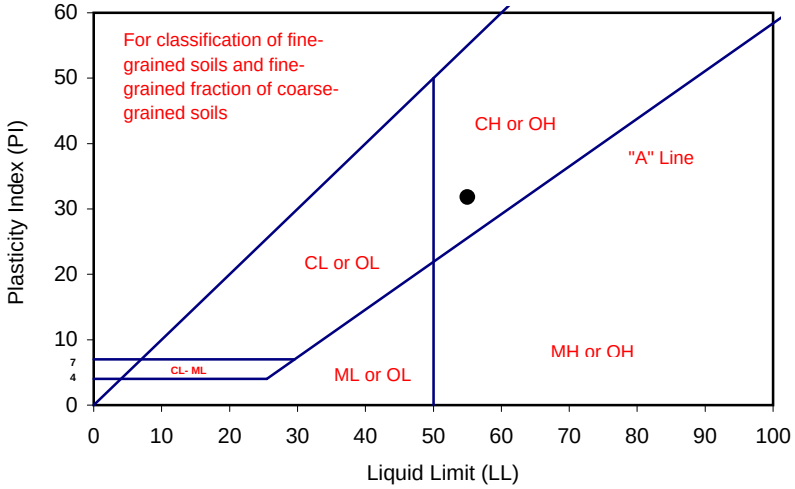
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			32	25	17	
Wet Wt. of Soil + Cont. (g)	14.24	13.54	13.34	12.73	13.68	
Dry Wt. of Soil + Cont. (g)	11.76	11.19	9.13	8.60	9.05	
Wt. of Container (g)	1.08	1.05	1.05	1.10	1.06	
Moisture Content (%) [Wn]	23.22	23.18	52.10	55.07	57.95	

Liquid Limit	**55**
Plastic Limit	**23**
Plasticity Index	**32**
Classification	**CH**

PI at "A" - Line = 0.73(LL-20) 25.55

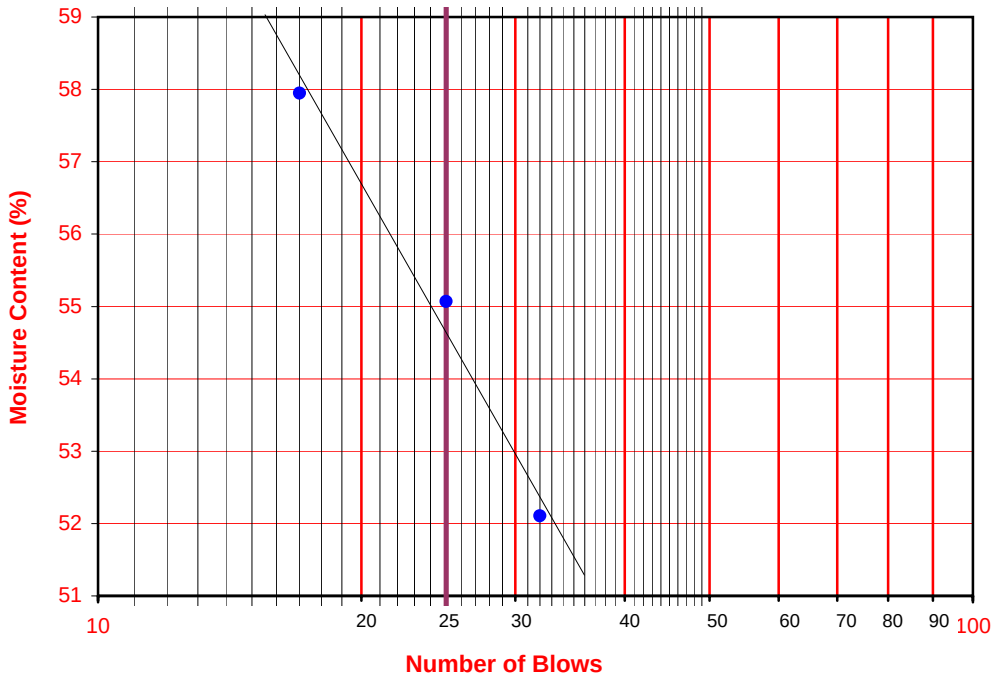
One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.12}$



PROCEDURES USED

	Wet Preparation
	Multipoint - Wet
X	Dry Preparation
	Multipoint - Dry
X	Procedure A
	Multipoint Test
	Procedure B
	One-point Test



ATTERBERG LIMITS

ASTM D 4318

Project Name:	SR-710 Tunnel Technical Study	Tested By:	F. Tabibkhoei	Date:	06/01/09
Project No. :	378312.04.09.01	Input By:	J. Ward	Date:	06/06/09
Boring No.:	R-09-Z3-B10	Checked By:	J. Ward		
Sample No.:	P11	Depth (ft.)	50-51.5		
Soil Identification:	Dark olive brown lean clay (CL)				

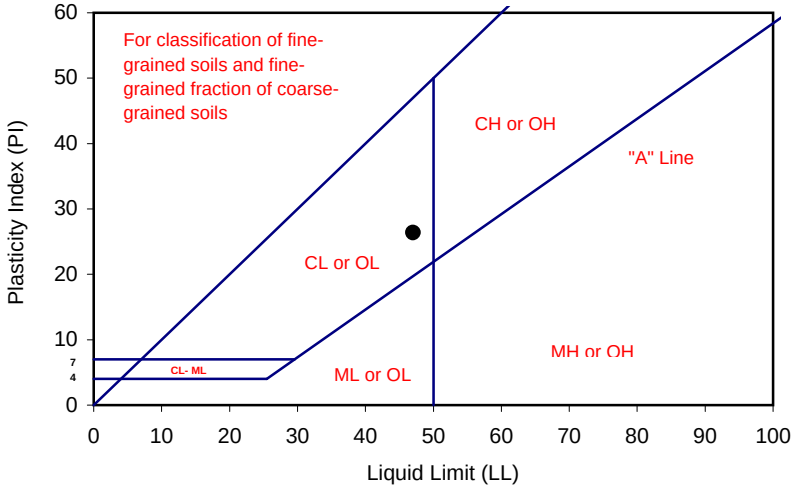
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			30	23	18	
Wet Wt. of Soil + Cont. (g)	47.39	47.49	52.98	42.97	61.60	
Dry Wt. of Soil + Cont. (g)	44.58	44.66	46.21	37.21	51.46	
Wt. of Container (g)	30.87	31.00	31.34	25.01	31.42	
Moisture Content (%) [Wn]	20.50	20.72	45.53	47.21	50.60	

Liquid Limit	**47**
Plastic Limit	**21**
Plasticity Index	**26**
Classification	**CL**

PI at "A" - Line = 0.73(LL-20) 19.71

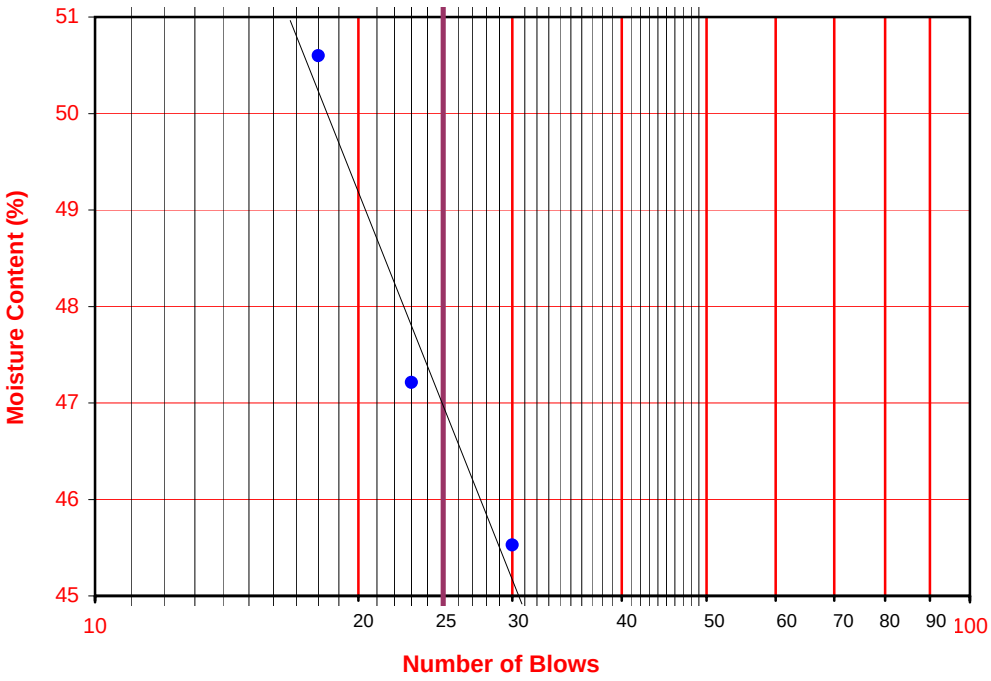
One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.12}$



PROCEDURES USED

- [ ] Wet Preparation
  Multipoint - Wet
- [X] Dry Preparation
  Multipoint - Dry
- [X] Procedure A
  Multipoint Test
- [ ] Procedure B
  One-point Test



ATTERBERG LIMITS

ASTM D 4318

Project Name:	SR-710 Tunnel Technical Study	Tested By:	F. Tabibkhoei	Date:	05/28/09
Project No. :	378312.04.09.01	Input By:	J. Ward	Date:	06/06/09
Boring No.:	R-09-Z3-B10	Checked By:	J. Ward		
Sample No.:	S6	Depth (ft.)	25-26.5		
Soil Identification:	Yellowish brown fat clay with sand (CH)s				

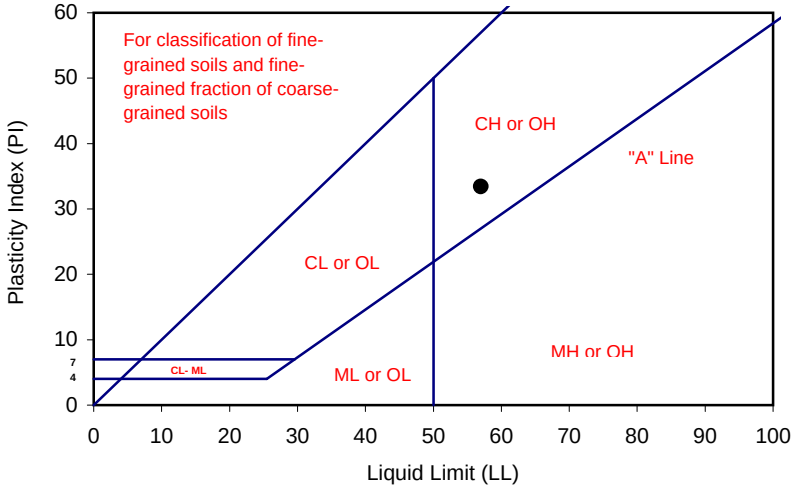
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			35	27	21	17
Wet Wt. of Soil + Cont. (g)	48.33	44.39	41.69	42.94	49.86	53.71
Dry Wt. of Soil + Cont. (g)	45.04	41.85	35.80	36.51	42.91	45.48
Wt. of Container (g)	31.20	30.98	25.04	25.01	30.85	31.68
Moisture Content (%) [Wn]	23.77	23.37	54.74	55.91	57.63	59.64

Liquid Limit	**57**
Plastic Limit	**24**
Plasticity Index	**33**
Classification	**CH**

PI at "A" - Line = 0.73(LL-20) 27.01

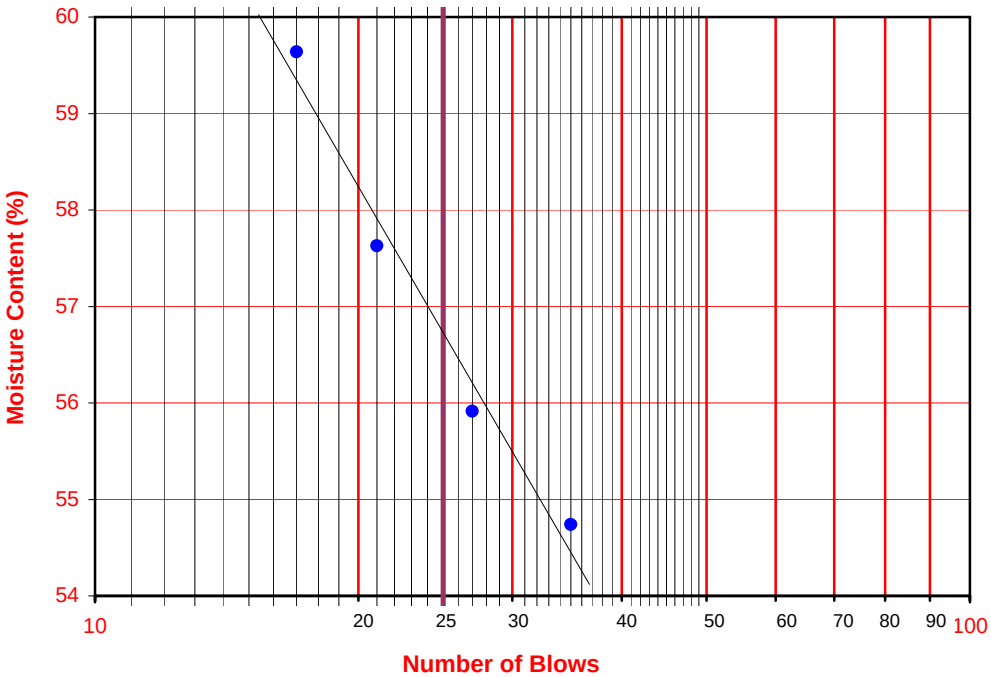
One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.12}$



PROCEDURES USED

	Wet Preparation
	Multipoint - Wet
X	Dry Preparation
	Multipoint - Dry
X	Procedure A
	Multipoint Test
	Procedure B
	One-point Test



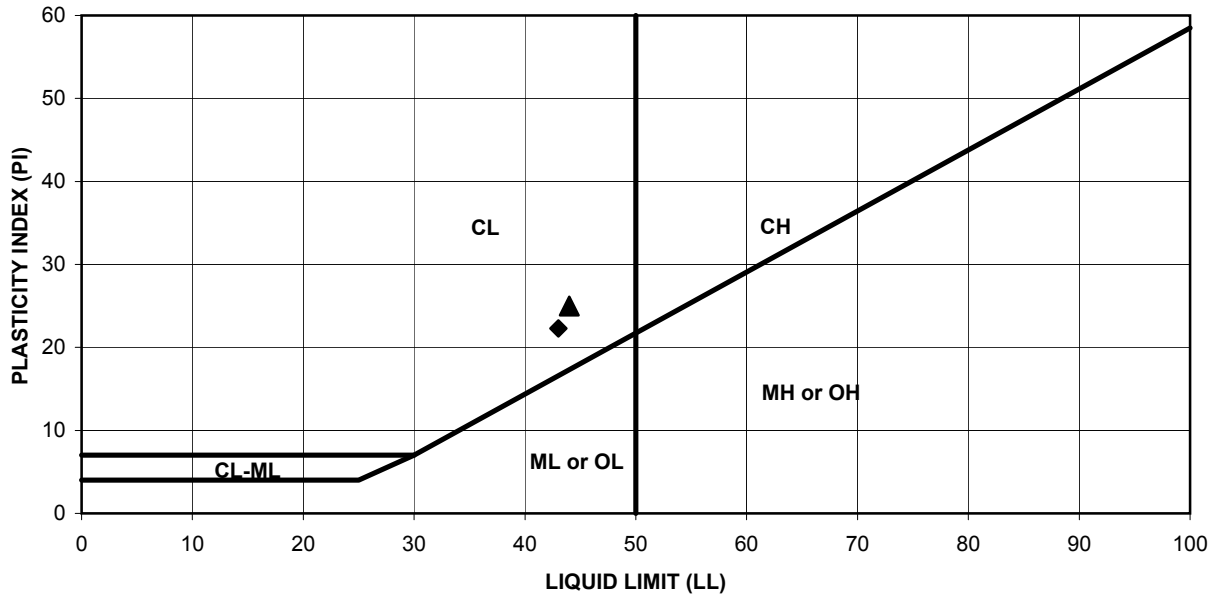
AP Engineering & Testing, Inc.

ATTERBERG LIMITS
ASTM D 4318

Project Name: SR-710 Tunnel Technical Study
Project No.: 378312.04.09.01

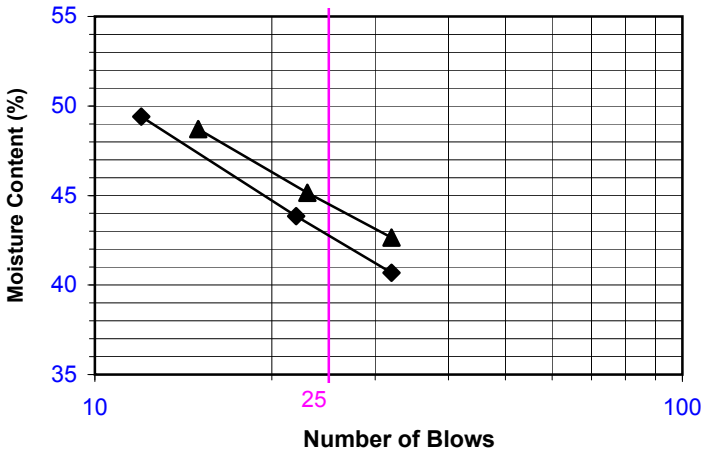
Tested By: DK
Checked By: AP

Date: 06/02/09
Date: 06/15/09



PROCEDURE USED

- [ ] Wet Preparation
- [X] Dry Preparation
- [X] Procedure A Multipoint Test
- [ ] Procedure B One-point Test



Symbol	Boring Number	Sample Number	Depth (feet)	LL	PL	PI	U.S.C.S Symbol
♦	R-09-Z3-B10	C-67	260-265	43	21	22	CL
▲	R-09-Z3-B10	C-85	340-345	44	19	25	CL

Leighton

ATTERBERG LIMITS

ASTM D 4318

Project Name:	SR-710 Tunnel Technical Study	Tested By:	V. Juliano	Date:	05/21/09
Project No. :	378312.04.09.01	Input By:	J. Ward	Date:	05/29/09
Boring No.:	R-09-Z3-B11	Checked By:	J. Ward		
Sample No.:	C-24	Depth (ft.)	116.4-116.9		
Soil Identification:	Olive yellow silty sand with gravel (SM)g				

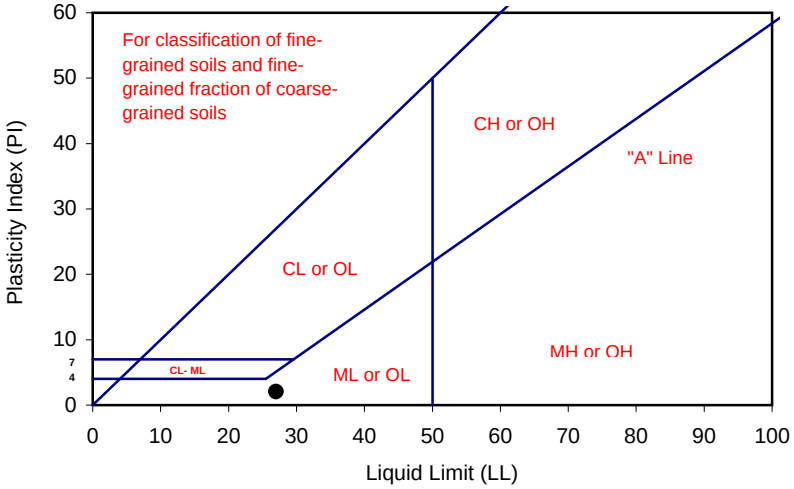
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			29	23	17	
Wet Wt. of Soil + Cont. (g)	11.23	10.83	13.51	15.81	13.04	
Dry Wt. of Soil + Cont. (g)	9.19	8.88	10.91	12.62	10.35	
Wt. of Container (g)	1.03	1.05	1.06	1.02	1.06	
Moisture Content (%) [Wn]	25.00	24.90	26.40	27.50	28.96	

Liquid Limit	**27**
Plastic Limit	**25**
Plasticity Index	**2**
Classification	**ML**

PI at "A" - Line = 0.73(LL-20) 5.11

One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.12}$



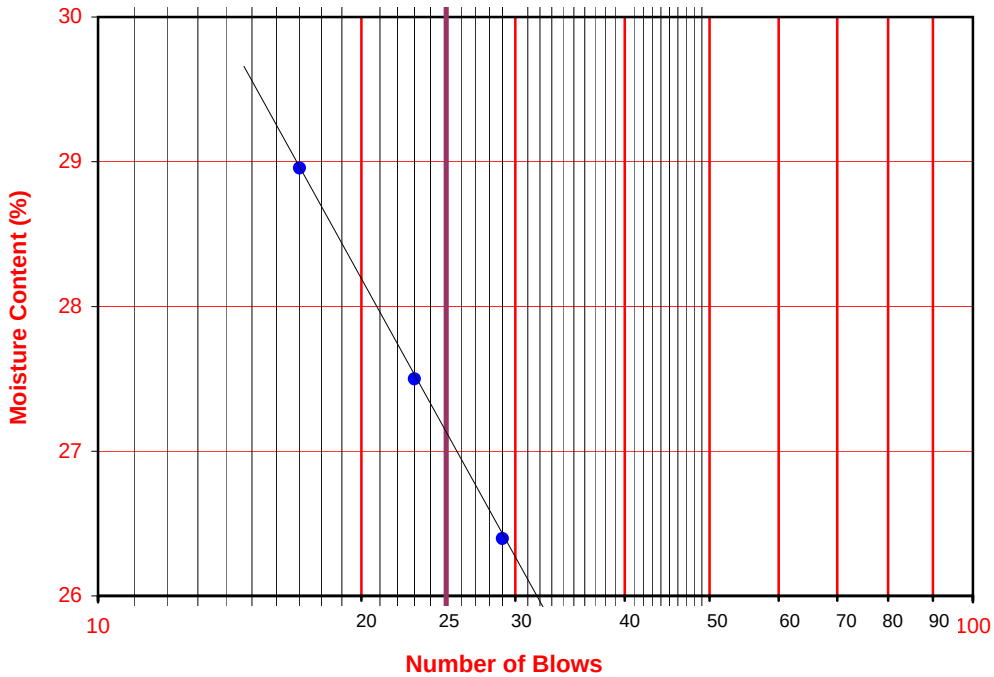
PROCEDURES USED

☐ Wet Preparation
Multipoint - Wet

☒ Dry Preparation
Multipoint - Dry

☒ Procedure A
Multipoint Test

☐ Procedure B
One-point Test



Leighton

ATTERBERG LIMITS

ASTM D 4318

Project Name:	SR-710 Tunnel Technical Study	Tested By:	F. Tabibkhoei	Date:	05/28/09
Project No. :	378312.04.09.01	Input By:	J. Ward	Date:	05/29/09
Boring No.:	R-09-Z3-B11	Checked By:	J. Ward		
Sample No.:	C-27	Depth (ft.)	131.5-132		
Soil Identification:	Dark olive brown sandy lean clay s(CL)				

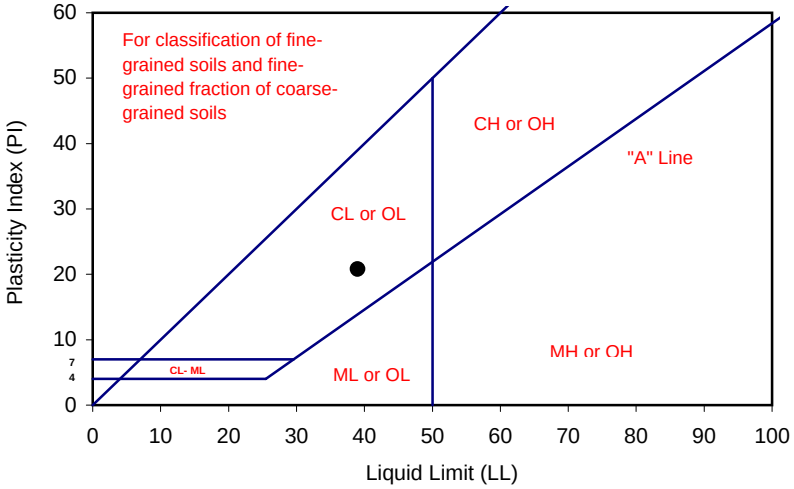
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			29	25	21	
Wet Wt. of Soil + Cont. (g)	45.60	45.91	48.90	44.61	47.16	
Dry Wt. of Soil + Cont. (g)	43.47	43.63	42.23	38.97	40.65	
Wt. of Container (g)	31.70	31.18	24.14	24.65	24.97	
Moisture Content (%) [Wn]	18.10	18.31	36.87	39.39	41.52	

Liquid Limit	**39**
Plastic Limit	**18**
Plasticity Index	**21**
Classification	**CL**

PI at "A" - Line = 0.73(LL-20) 13.87

One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.12}$



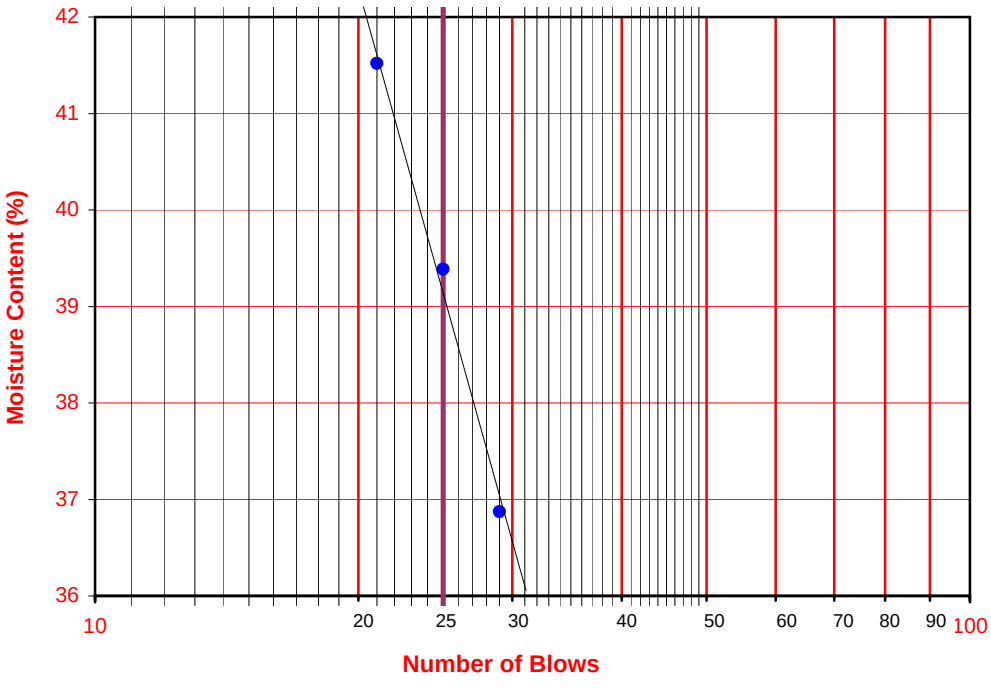
PROCEDURES USED

☐ Wet Preparation
Multipoint - Wet

☒ Dry Preparation
Multipoint - Dry

☒ Procedure A
Multipoint Test

☐ Procedure B
One-point Test



Leighton

ATTERBERG LIMITS

ASTM D 4318

Project Name:	SR-710 Tunnel Technical Study	Tested By:	G. Bathala	Date:	05/28/09
Project No. :	378312.04.09.01	Input By:	J. Ward	Date:	05/29/09
Boring No.:	R-09-Z3-B11	Checked By:	J. Ward		
Sample No.:	C-35	Depth (ft.)	171.5-172.25		
Soil Identification:	Light olive brown fat clay'stone' with sand (CH)s				

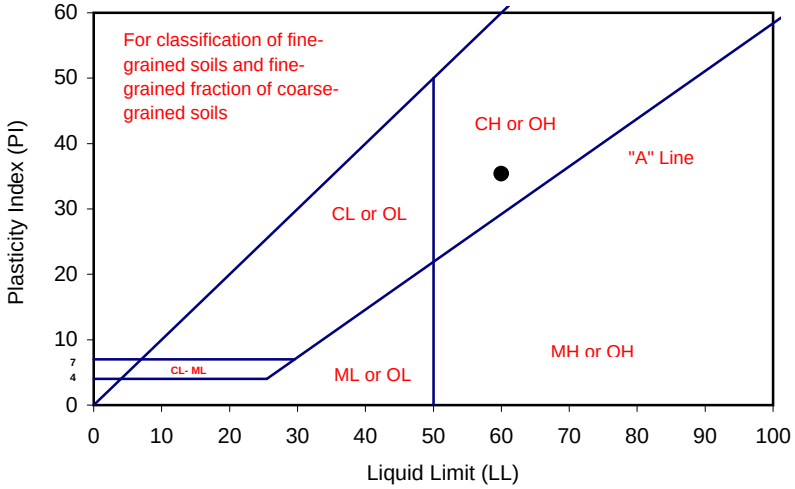
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			35	29	21	16
Wet Wt. of Soil + Cont. (g)	14.89	13.37	12.29	12.21	13.15	11.85
Dry Wt. of Soil + Cont. (g)	12.17	10.93	8.20	8.05	8.52	7.64
Wt. of Container (g)	1.08	1.04	1.04	1.05	1.05	1.07
Moisture Content (%) [Wn]	24.53	24.67	57.12	59.43	61.98	64.08

Liquid Limit	**60**
Plastic Limit	**25**
Plasticity Index	**35**
Classification	**CH**

PI at "A" - Line = 0.73(LL-20) 29.2

One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.12}$



PROCEDURES USED

☐ Wet Preparation

Multipoint - Wet

☒ Dry Preparation

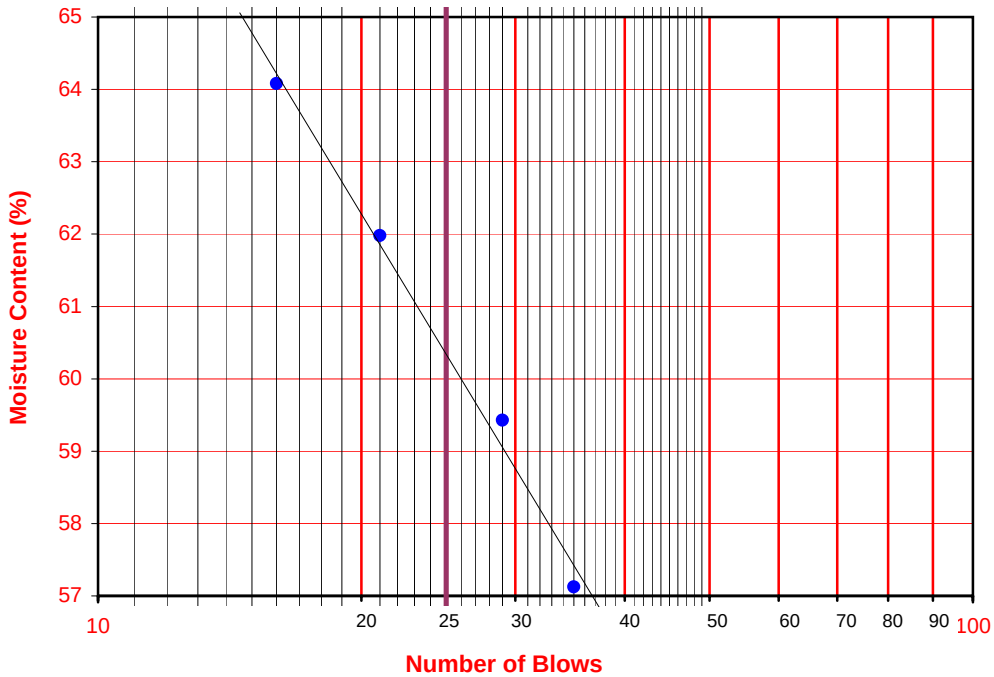
Multipoint - Dry

☒ Procedure A

Multipoint Test

☐ Procedure B

One-point Test



ATTERBERG LIMITS

ASTM D 4318

Project Name:	SR-710 Tunnel Technical Study	Tested By:	F. Tabibkhoei	Date:	06/04/09
Project No. :	378312.04.09.01	Input By:	J. Ward	Date:	06/05/09
Boring No.:	R-09-Z3-B11	Checked By:	J. Ward		
Sample No.:	C-44	Depth (ft.)	217.5-218		
Soil Identification:	Olive gray sandy fat clay'stone' s(CH) (fat clay'stone' with a diagonal layer of sand)				

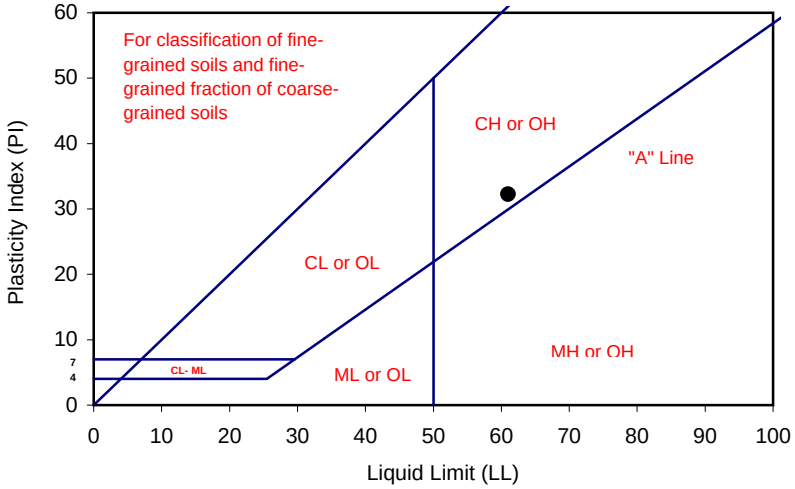
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			35	26	22	17
Wet Wt. of Soil + Cont. (g)	48.83	40.86	39.59	48.89	46.75	58.84
Dry Wt. of Soil + Cont. (g)	44.99	37.32	34.16	42.17	38.21	48.01
Wt. of Container (g)	31.59	25.03	24.74	31.18	24.53	31.21
Moisture Content (%) [Wn]	28.66	28.80	57.64	61.15	62.43	64.46

Liquid Limit	**61**
Plastic Limit	**29**
Plasticity Index	**32**
Classification	**CH**

PI at "A" - Line = 0.73(LL-20) 29.93

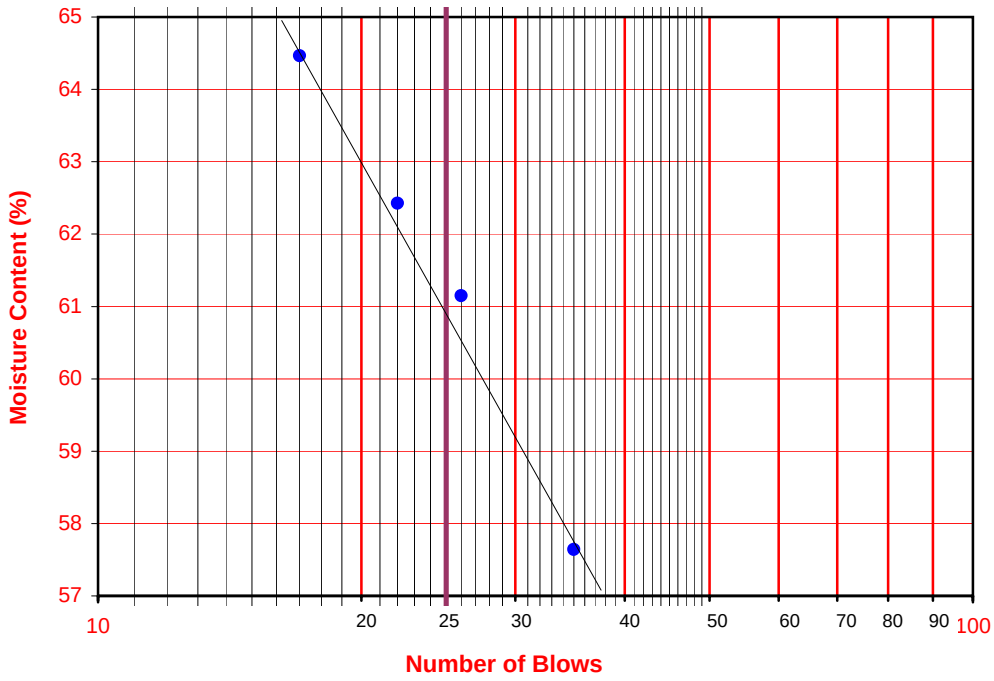
One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.12}$

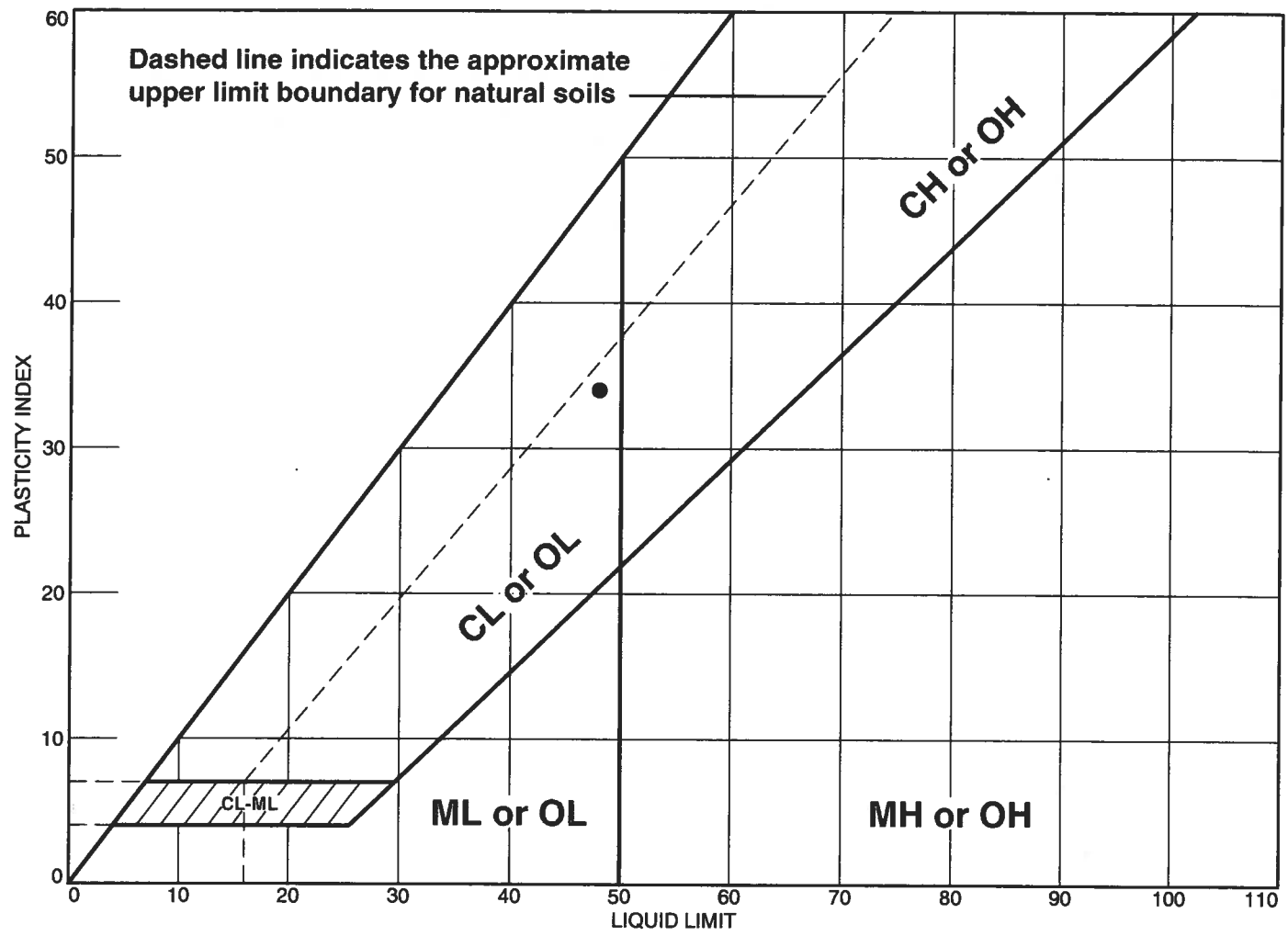


PROCEDURES USED

- [ ] Wet Preparation
  Multipoint - Wet
- [X] Dry Preparation
  Multipoint - Dry
- [X] Procedure A
  Multipoint Test
- [ ] Procedure B
  One-point Test



LIQUID AND PLASTIC LIMITS TEST REPORT



	MATERIAL DESCRIPTION	LL	PL	PI	%<#40	%<#200	USCS
●	Mudstone	48	14	34			

Project No. 09-144 **Client:** CH2MHill

Project: SR-710 Tunnel Technical Study

#378312.04.09.01

● **Loc.:** R-09-Z3-B11, C49 **Depth:** 245.25-246.0 **Sample No.:** S11037

Remarks:

SIERRA TESTING LABS, INC.

El Dorado Hills, CA

Figure

Tested By: kj/mjw **Checked By:** mn

ATTERBERG LIMITS

ASTM D 4318

Project Name:	SR-710 Tunnel Technical Study	Tested By:	V. Juliano	Date:	06/04/09
Project No. :	378312.04.09.01	Input By:	J. Ward	Date:	06/05/09
Boring No.:	R-09-Z3-B11	Checked By:	J. Ward		
Sample No.:	C-53	Depth (ft.)	259.3-260		
Soil Identification:	Dark olive lean clay'stone' (CL)				

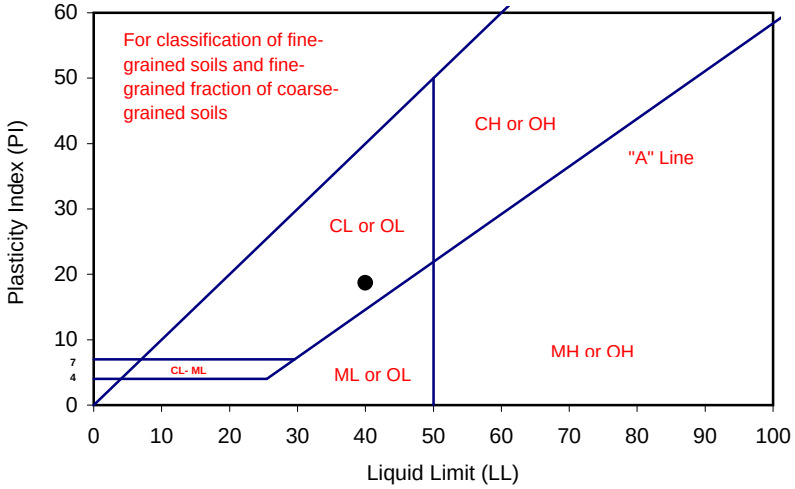
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			35	28	21	
Wet Wt. of Soil + Cont. (g)	9.33	9.09	13.47	14.11	13.90	
Dry Wt. of Soil + Cont. (g)	7.89	7.67	10.11	10.48	10.17	
Wt. of Container (g)	1.08	1.04	1.07	1.08	1.06	
Moisture Content (%) [Wn]	21.15	21.42	37.17	38.62	40.94	

Liquid Limit	**40**
Plastic Limit	**21**
Plasticity Index	**19**
Classification	**CL**

PI at "A" - Line = 0.73(LL-20) 14.6

One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.12}$



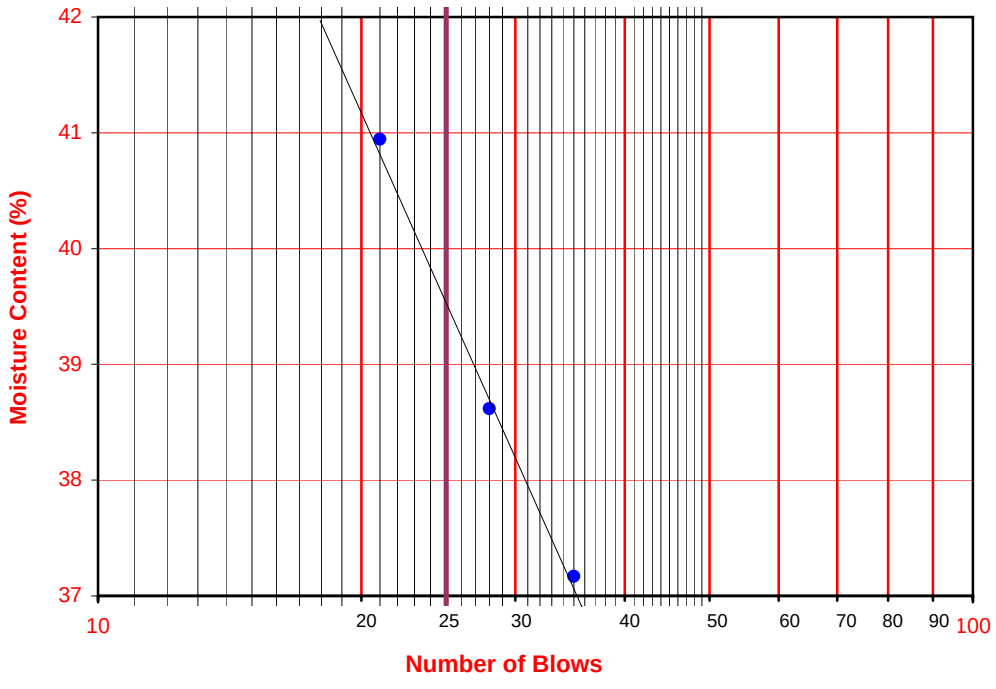
PROCEDURES USED

☐ Wet Preparation
Multipoint - Wet

☒ Dry Preparation
Multipoint - Dry

☒ Procedure A
Multipoint Test

☐ Procedure B
One-point Test



ATTERBERG LIMITS

ASTM D 4318

Project Name:	SR-710 Tunnel Technical Study	Tested By:	V. Juliano	Date:	04/06/09
Project No. :	378312.04.09.01	Input By:	J. Ward	Date:	04/29/09
Boring No.:	R-09-Z3-B11	Checked By:	J. Ward		
Sample No.:	O-5	Depth (ft.)	21-26		
Soil Identification:	Olive brown poorly-graded sand with silt and gravel (SP-SM)g				

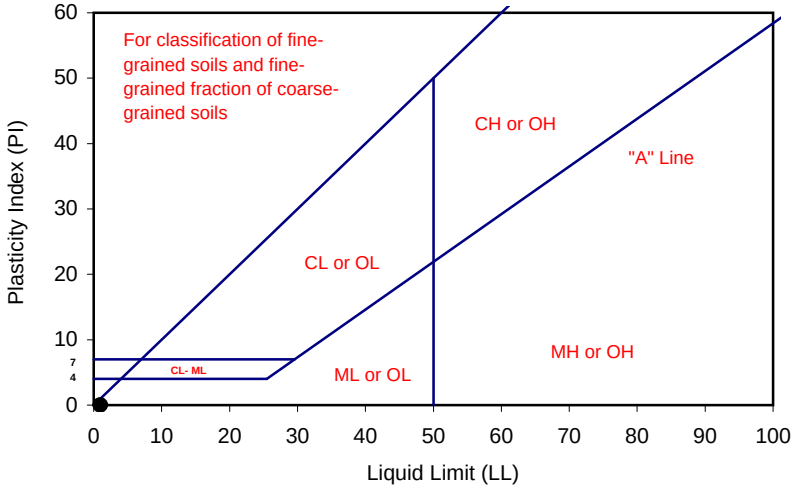
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			7			
Wet Wt. of Soil + Cont. (g)	**Cannot be rolled:**		14.59	**Cannot get more than 7 blows:**		
Dry Wt. of Soil + Cont. (g)	**NonPlastic**		11.83	**NonPlastic**		
Wt. of Container (g)			1.08			
Moisture Content (%) [Wn]			25.67			

Liquid Limit	**NP**
Plastic Limit	**NP**
Plasticity Index	**NP**
Classification	**NP**

PI at "A" - Line = 0.73(LL-20) =

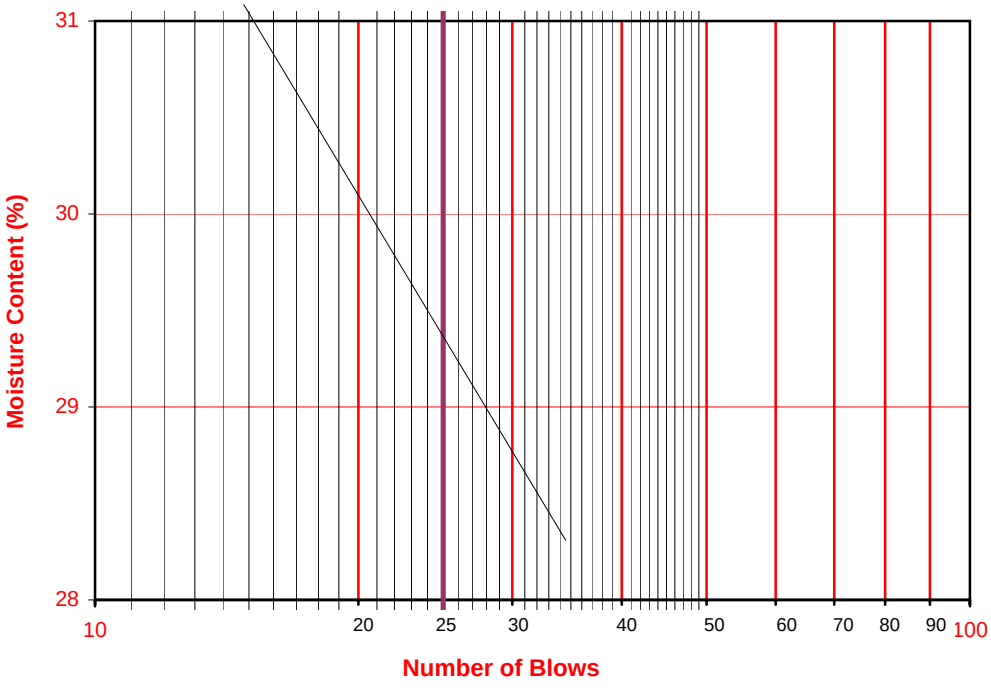
One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.12}$



PROCEDURES USED

- [ ] Wet Preparation
  Multipoint - Wet
- [X] Dry Preparation
  Multipoint - Dry
- [X] Procedure A
  Multipoint Test
- [ ] Procedure B
  One-point Test



ATTERBERG LIMITS

ASTM D 4318

Project Name:	SR-710 Tunnel Technical Study	Tested By:	F. Tabibkhoei	Date:	05/28/09
Project No. :	378312.04.09.01	Input By:	J. Ward	Date:	05/29/09
Boring No.:	R-09-Z3-B11	Checked By:	J. Ward		
Sample No.:	O-20	Depth (ft.)	101-102		
Soil Identification:	Dark olive brown clayey sand (SC)				

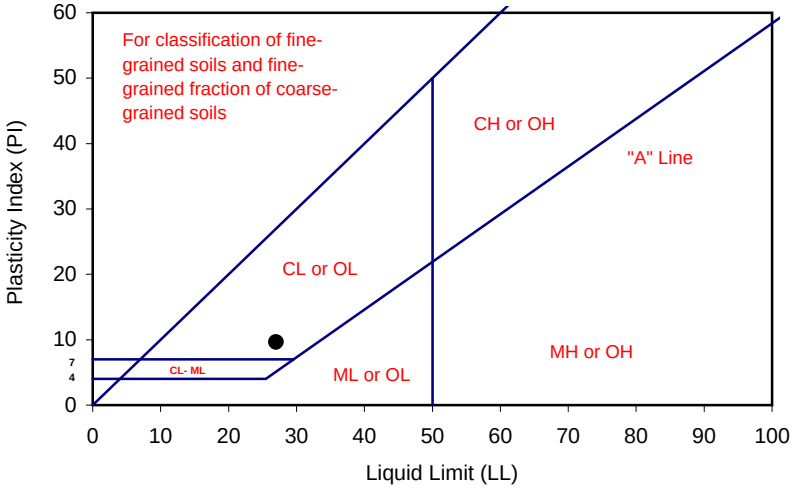
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			28	23	15	
Wet Wt. of Soil + Cont. (g)	49.18	40.16	46.38	54.52	54.35	
Dry Wt. of Soil + Cont. (g)	46.52	37.88	41.90	49.61	47.67	
Wt. of Container (g)	31.41	24.57	24.75	31.67	25.05	
Moisture Content (%) [Wn]	17.60	17.13	26.12	27.37	29.53	

Liquid Limit	**27**
Plastic Limit	**17**
Plasticity Index	**10**
Classification	**CL**

PI at "A" - Line = 0.73(LL-20) 5.11

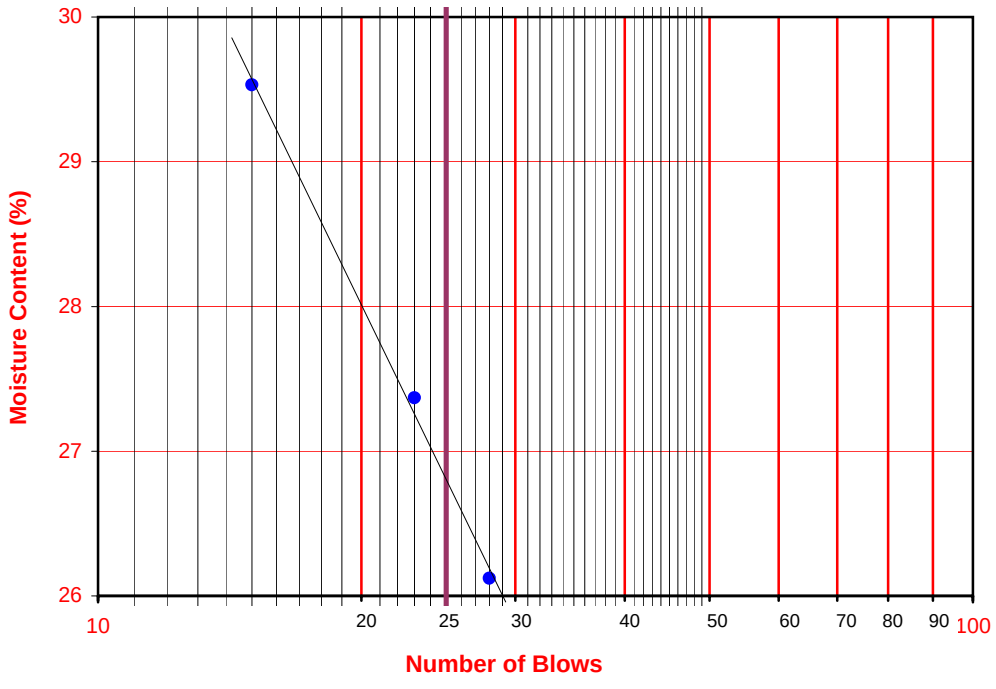
One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.12}$



PROCEDURES USED

- [ ] Wet Preparation — Multipoint - Wet
- [X] Dry Preparation — Multipoint - Dry
- [X] Procedure A — Multipoint Test
- [ ] Procedure B — One-point Test



Leighton

ATTERBERG LIMITS

ASTM D 4318

Project Name:	SR-710 Tunnel Technical Study	Tested By:	F. Tabibkhoei	Date:	05/27/09
Project No. :	378312.04.09.01	Input By:	J. Ward	Date:	05/29/09
Boring No.:	R-09-Z3-B11	Checked By:	J. Ward		
Sample No.:	S-17	Depth (ft.)	86.0		
Soil Identification:	Olive brown silty sand (SM)				

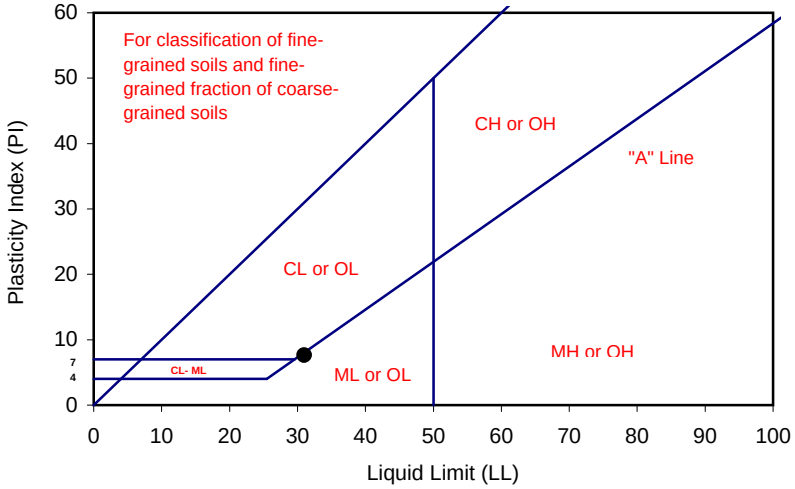
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			35	26	21	
Wet Wt. of Soil + Cont. (g)	44.69	36.82	49.02	44.04	57.21	
Dry Wt. of Soil + Cont. (g)	42.18	34.53	44.95	39.50	51.01	
Wt. of Container (g)	31.41	24.76	31.15	24.74	31.61	
Moisture Content (%) [Wn]	23.31	23.44	29.49	30.76	31.96	

Liquid Limit	**31**
Plastic Limit	**23**
Plasticity Index	**8**
Classification	**ML**

PI at "A" - Line = 0.73(LL-20) 8.03

One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.12}$



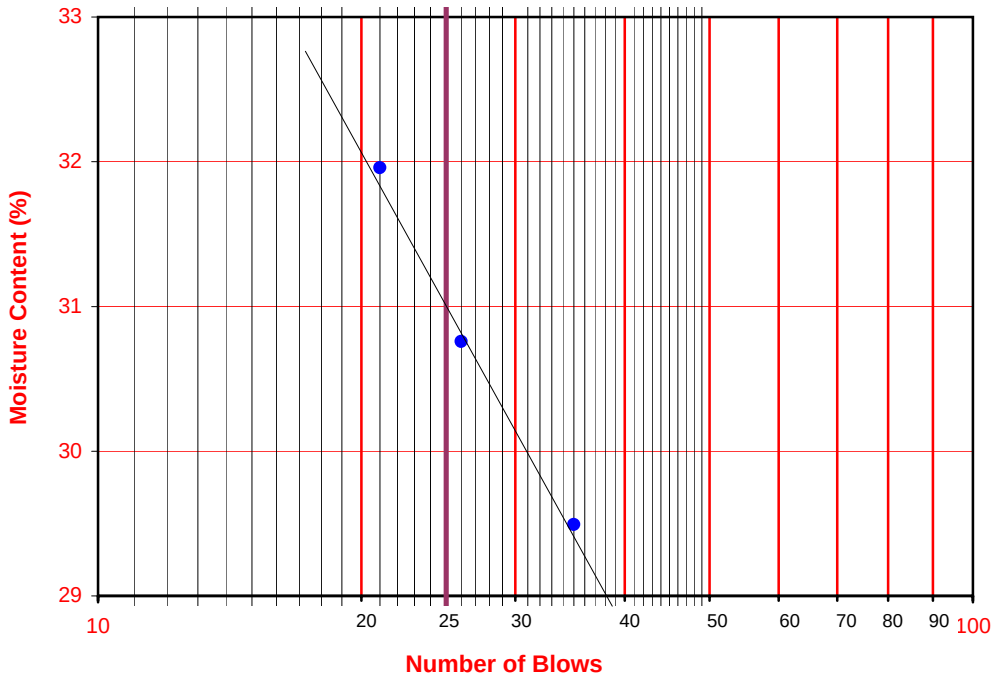
PROCEDURES USED

☐ Wet Preparation
Multipoint - Wet

☒ Dry Preparation
Multipoint - Dry

☒ Procedure A
Multipoint Test

☐ Procedure B
One-point Test



ATTERBERG LIMITS

ASTM D 4318

Project Name:	SR-710 Tunnel Technical Study	Tested By:	V. Juliano	Date:	04/28/09
Project No. :	378312.04.09.01	Input By:	J. Ward	Date:	05/11/09
Boring No.:	R-09-Z3-B12	Checked By:	J. Ward		
Sample No.:	C21	Depth (ft.)	101-101.5		
Soil Identification:	Olive lean clay with sand (CL)s				

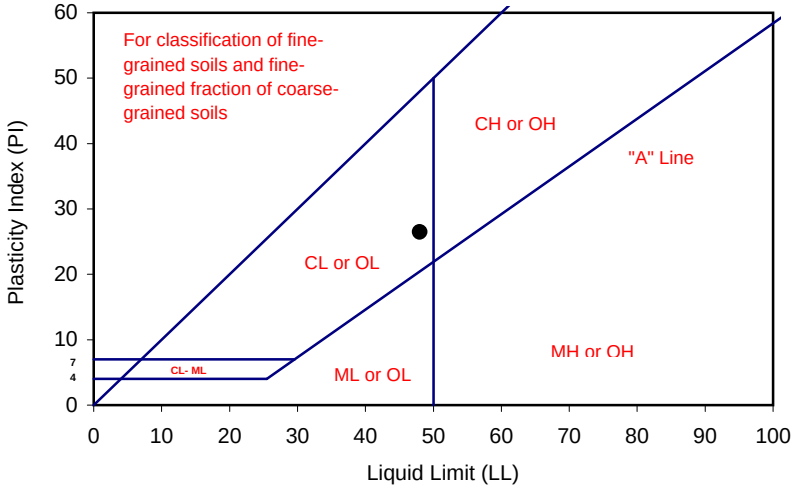
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			35	28	21	
Wet Wt. of Soil + Cont. (g)	8.68	8.31	13.66	14.08	16.69	
Dry Wt. of Soil + Cont. (g)	7.33	7.03	9.66	9.86	11.53	
Wt. of Container (g)	1.06	1.08	1.05	1.05	1.05	
Moisture Content (%) [Wn]	21.53	21.51	46.46	47.90	49.24	

Liquid Limit	**48**
Plastic Limit	**22**
Plasticity Index	**26**
Classification	**CL**

PI at "A" - Line = 0.73(LL-20) 20.44

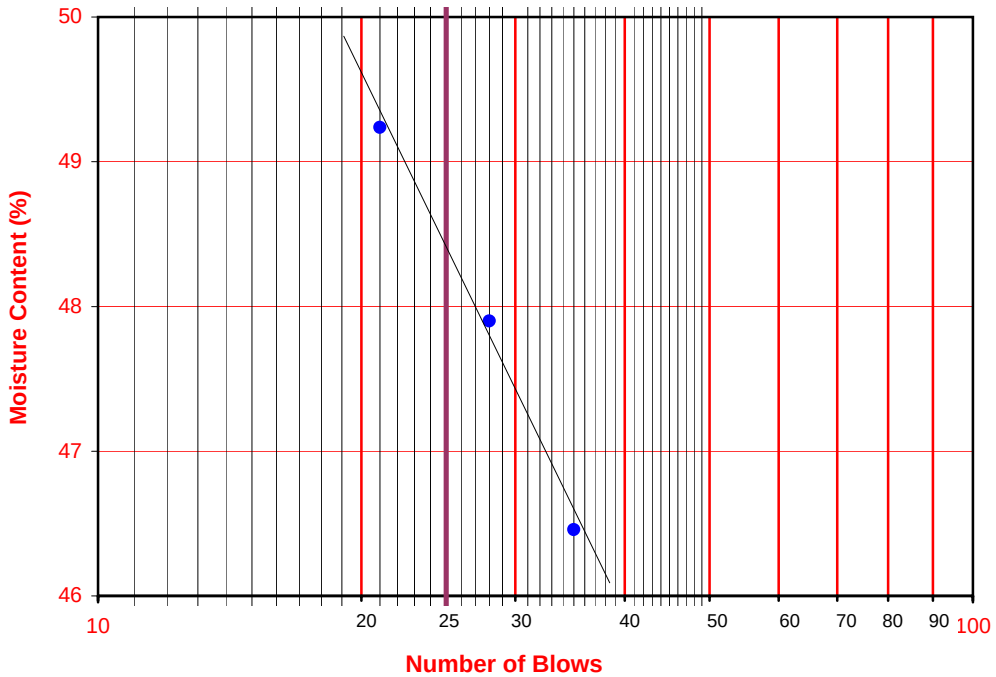
One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.12}$



PROCEDURES USED

- [ ] Wet Preparation
  Multipoint - Wet
- [X] Dry Preparation
  Multipoint - Dry
- [X] Procedure A
  Multipoint Test
- [ ] Procedure B
  One-point Test



Leighton

ATTERBERG LIMITS

ASTM D 4318

Project Name:	SR-710 Tunnel Technical Study	Tested By:	V. Juliano	Date:	04/23/09
Project No. :	378312.04.09.01	Input By:	J. Ward	Date:	05/11/09
Boring No.:	R-09-Z3-B12	Checked By:	J. Ward		
Sample No.:	C23	Depth (ft.)	109-109.8		
Soil Identification:	Yellowish brown fat clay'stone' (CH)				

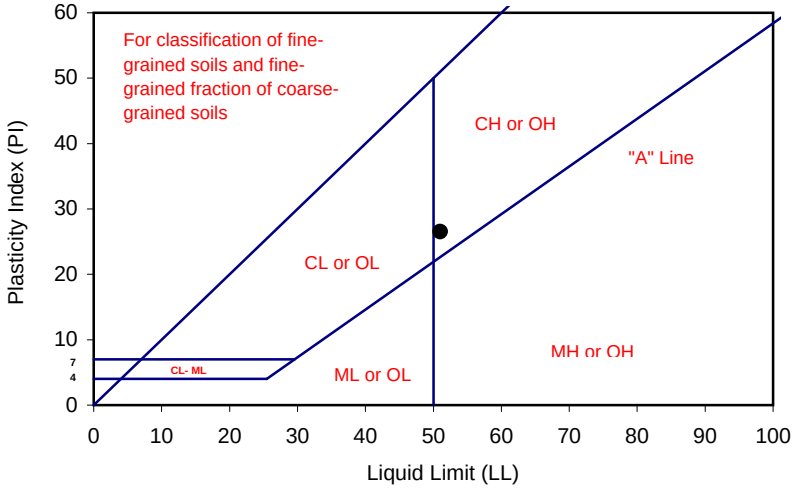
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			33	26	19	
Wet Wt. of Soil + Cont. (g)	8.65	8.48	11.42	12.07	14.56	
Dry Wt. of Soil + Cont. (g)	7.17	7.00	7.97	8.35	9.88	
Wt. of Container (g)	1.05	1.02	1.02	1.11	1.06	
Moisture Content (%) [Wn]	24.18	24.75	49.64	51.38	53.06	

Liquid Limit	**51**
Plastic Limit	**24**
Plasticity Index	**27**
Classification	**CH**

PI at "A" - Line = 0.73(LL-20) 22.63

One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.12}$



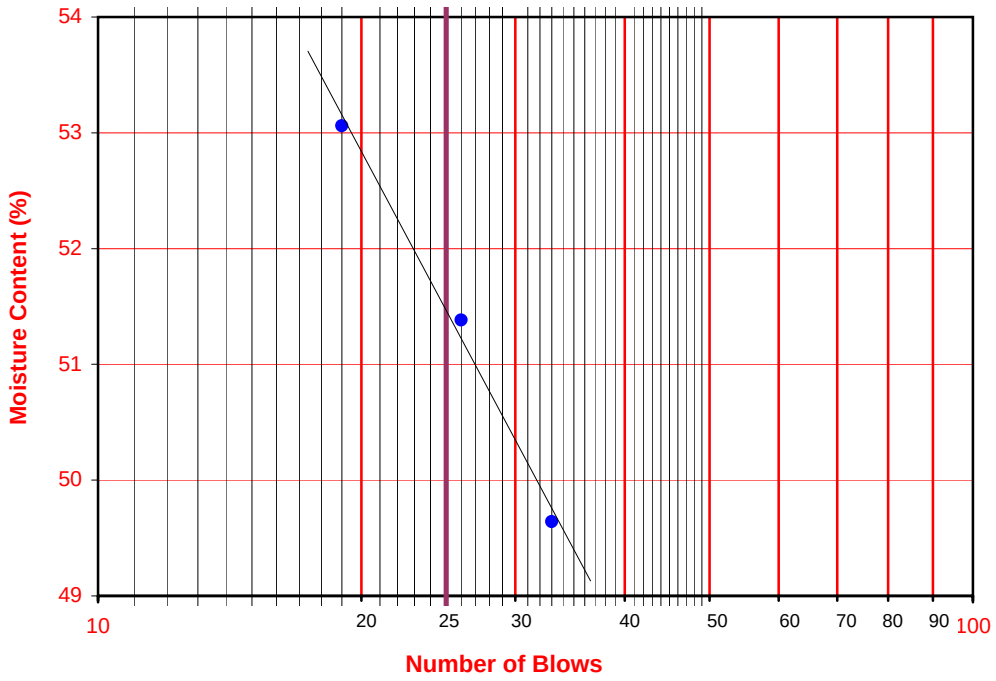
PROCEDURES USED

☐ Wet Preparation
Multipoint - Wet

☒ Dry Preparation
Multipoint - Dry

☒ Procedure A
Multipoint Test

☐ Procedure B
One-point Test



Leighton

ATTERBERG LIMITS

ASTM D 4318

Project Name:	SR-710 Tunnel Technical Study	Tested By:	V. Juliano	Date:	04/24/09
Project No. :	378312.04.09.01	Input By:	J. Ward	Date:	05/11/09
Boring No.:	R-09-Z3-B12	Checked By:	J. Ward		
Sample No.:	C27	Depth (ft.)	124.3-125.2		
Soil Identification:	Olive fat clay'stone' (CH)				

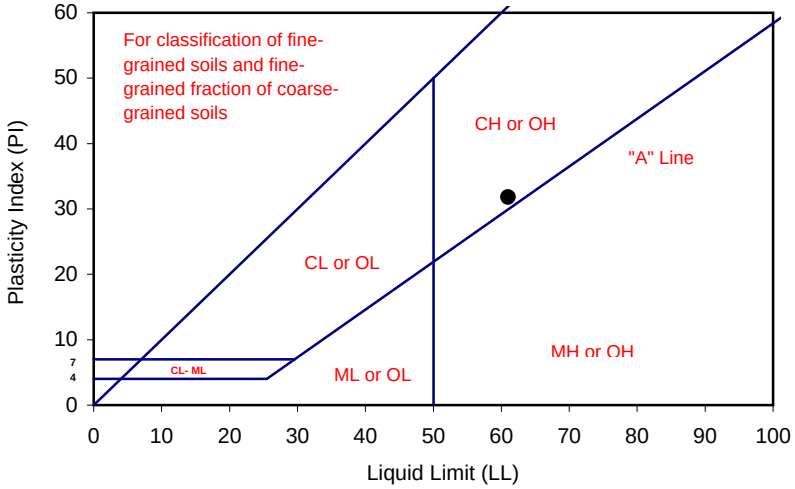
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			35	28	21	
Wet Wt. of Soil + Cont. (g)	9.92	9.51	14.05	14.37	13.55	
Dry Wt. of Soil + Cont. (g)	7.93	7.60	9.16	9.32	8.77	
Wt. of Container (g)	1.11	1.06	1.05	1.03	1.02	
Moisture Content (%) [Wn]	29.18	29.20	60.30	60.92	61.68	

Liquid Limit	**61**
Plastic Limit	**29**
Plasticity Index	**32**
Classification	**CH**

PI at "A" - Line = 0.73(LL-20) 29.93

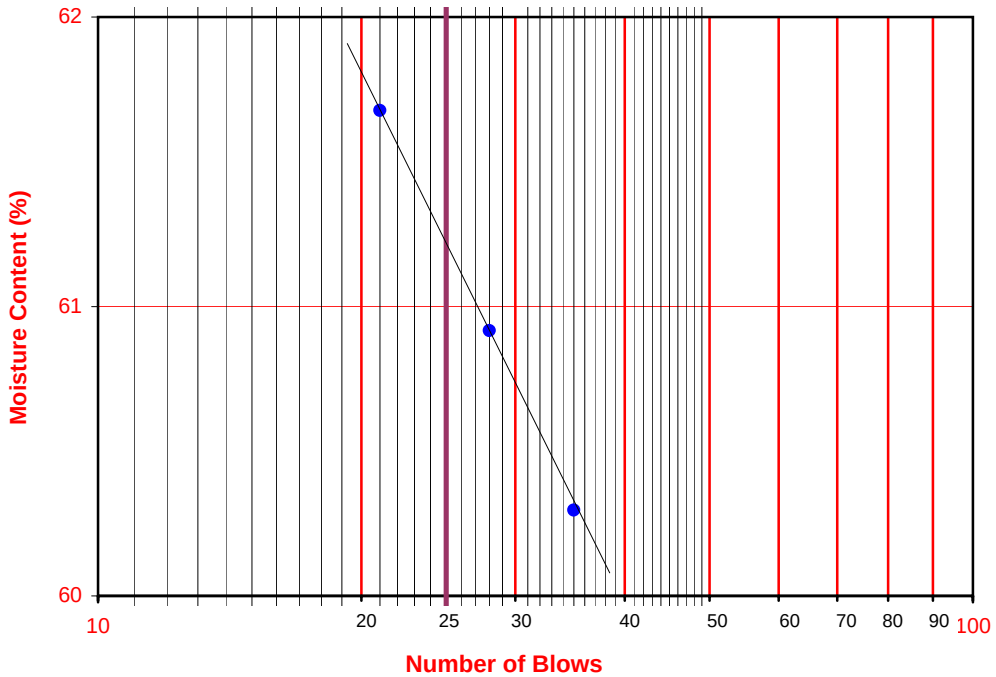
One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.12}$



PROCEDURES USED

	Wet Preparation
	Multipoint - Wet
X	Dry Preparation
	Multipoint - Dry
X	Procedure A
	Multipoint Test
	Procedure B
	One-point Test



Leighton

ATTERBERG LIMITS

ASTM D 4318

Project Name:	SR-710 Tunnel Technical Study	Tested By:	ACS/VJ	Date:	04/10/09
Project No. :	378312.04.09.01	Input By:	J. Ward	Date:	05/11/09
Boring No.:	R-09-Z3-B12	Checked By:	J. Ward		
Sample No.:	S7	Depth (ft.)	35.0		
Soil Identification:	Yellowish brown silt with sand (ML)s				

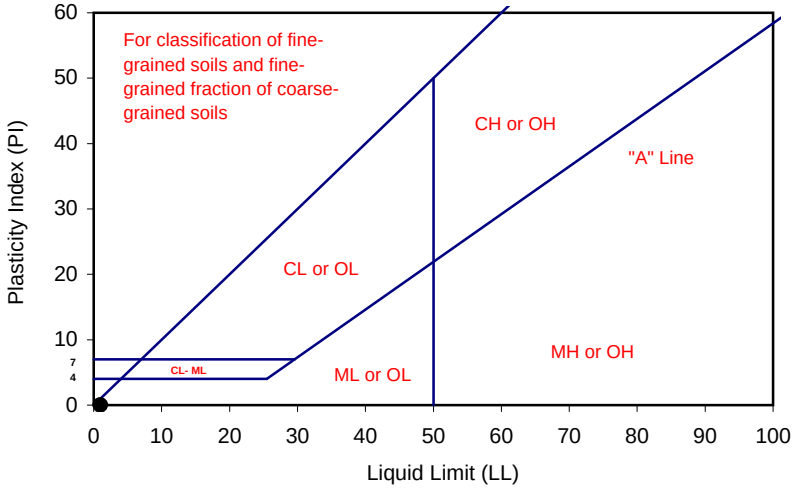
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			5			
Wet Wt. of Soil + Cont. (g)	**Cannot be rolled:**		23.49	**Cannot get more than 5 blows:**		
Dry Wt. of Soil + Cont. (g)	**NonPlastic**		18.19	**NonPlastic**		
Wt. of Container (g)			1.03			
Moisture Content (%) [Wn]			30.89			

Liquid Limit	**NP**
Plastic Limit	**NP**
Plasticity Index	**NP**
Classification	**NP**

PI at "A" - Line = 0.73(LL-20) =

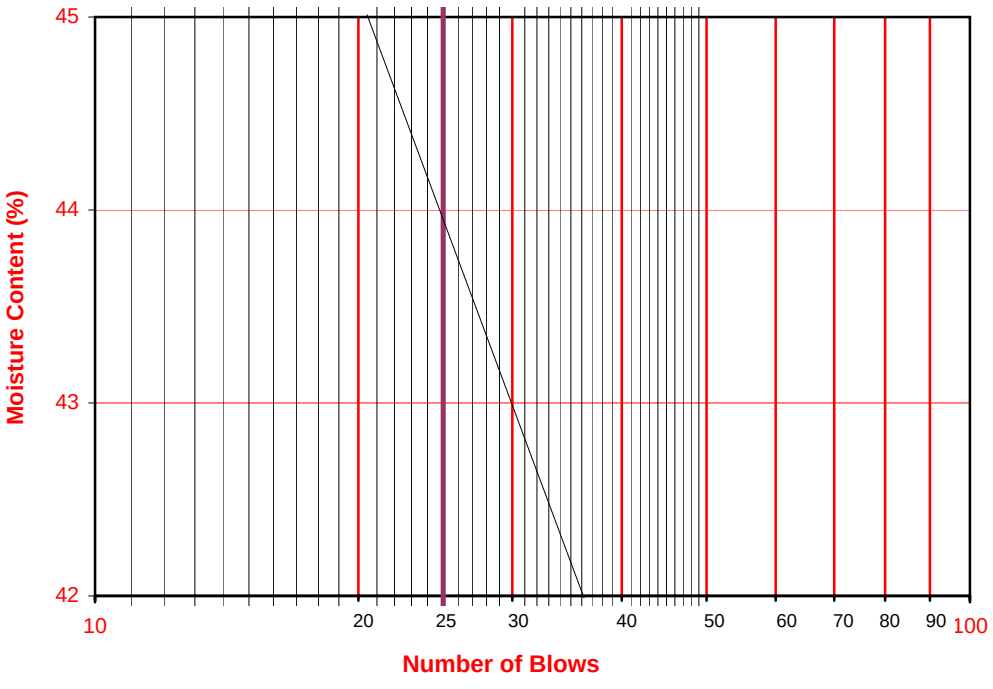
One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.12}$



PROCEDURES USED

	Wet Preparation
	Multipoint - Wet
X	Dry Preparation
	Multipoint - Dry
X	Procedure A
	Multipoint Test
	Procedure B
	One-point Test



ATTERBERG LIMITS

ASTM D 4318

Project Name:	SR-710 Tunnel Technical Study	Tested By:	A. Santos	Date:	04/02/09
Project No. :	378312.04.09.01	Input By:	J. Ward	Date:	04/08/09
Boring No.:	R-09-Z3-B12	Checked By:	J. Ward		
Sample No.:	S15	Depth (ft.)	75.0		
Soil Identification:	Olive brown lean clay with sand (CL)s				

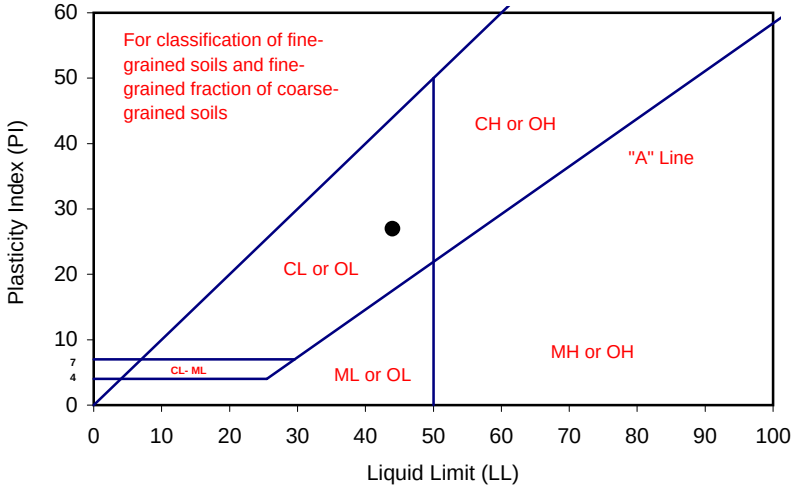
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			34	25	21	
Wet Wt. of Soil + Cont. (g)	10.10	9.26	21.50	20.53	23.09	
Dry Wt. of Soil + Cont. (g)	8.79	8.07	15.41	14.58	16.26	
Wt. of Container (g)	1.06	1.12	1.01	1.05	1.04	
Moisture Content (%) [Wn]	16.95	17.12	42.29	43.98	44.88	

Liquid Limit	**44**
Plastic Limit	**17**
Plasticity Index	**27**
Classification	**CL**

PI at "A" - Line = 0.73(LL-20) 17.52

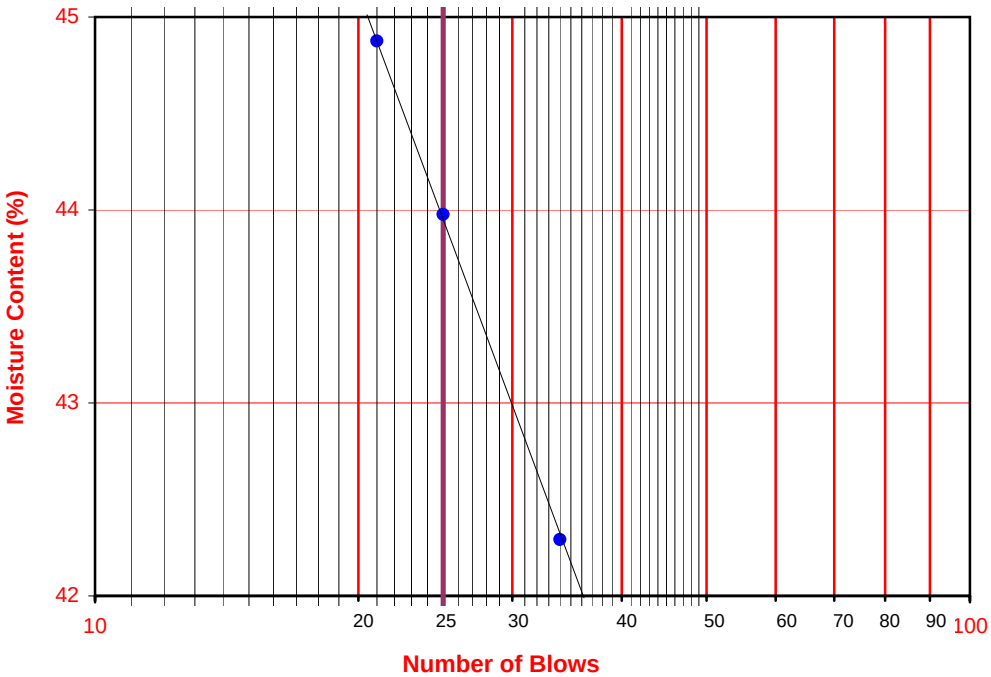
One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.12}$



PROCEDURES USED

- [ ] Wet Preparation
  Multipoint - Wet
- [X] Dry Preparation
  Multipoint - Dry
- [X] Procedure A
  Multipoint Test
- [ ] Procedure B
  One-point Test



ATTERBERG LIMITS

ASTM D 4318

Project Name:	SR-710 Tunnel Technical Study	Tested By:	V. Juliano	Date:	05/20/09
Project No. :	378312.04.09.01	Input By:	J. Ward	Date:	05/21/09
Boring No.:	R-09-Z4-B4	Checked By:	J. Ward		
Sample No.:	C-19	Depth (ft.)	97.5-98.3		
Soil Identification:	Yellow fat clay'stone' (CH)				

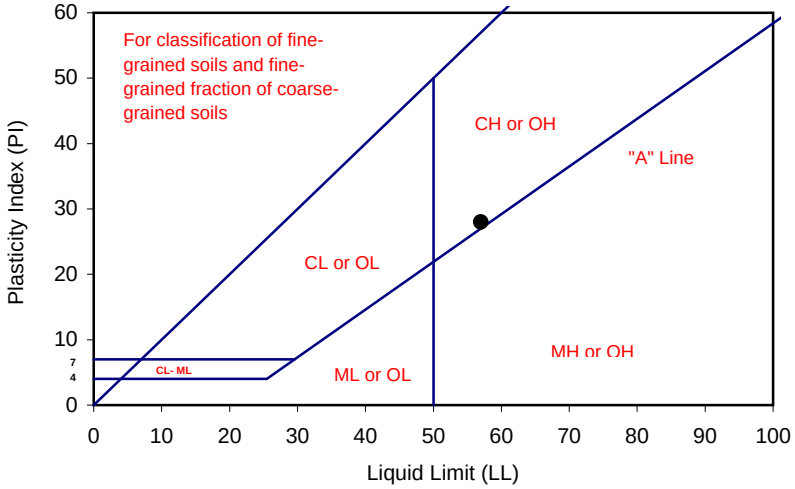
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			35	28	21	
Wet Wt. of Soil + Cont. (g)	9.21	9.15	12.36	13.44	15.70	
Dry Wt. of Soil + Cont. (g)	7.36	7.35	8.39	8.99	10.29	
Wt. of Container (g)	1.06	1.07	1.03	1.06	1.10	
Moisture Content (%) [Wn]	29.37	28.66	53.94	56.12	58.87	

Liquid Limit	**57**
Plastic Limit	**29**
Plasticity Index	**28**
Classification	**CH**

PI at "A" - Line = 0.73(LL-20) 27.01

One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.12}$



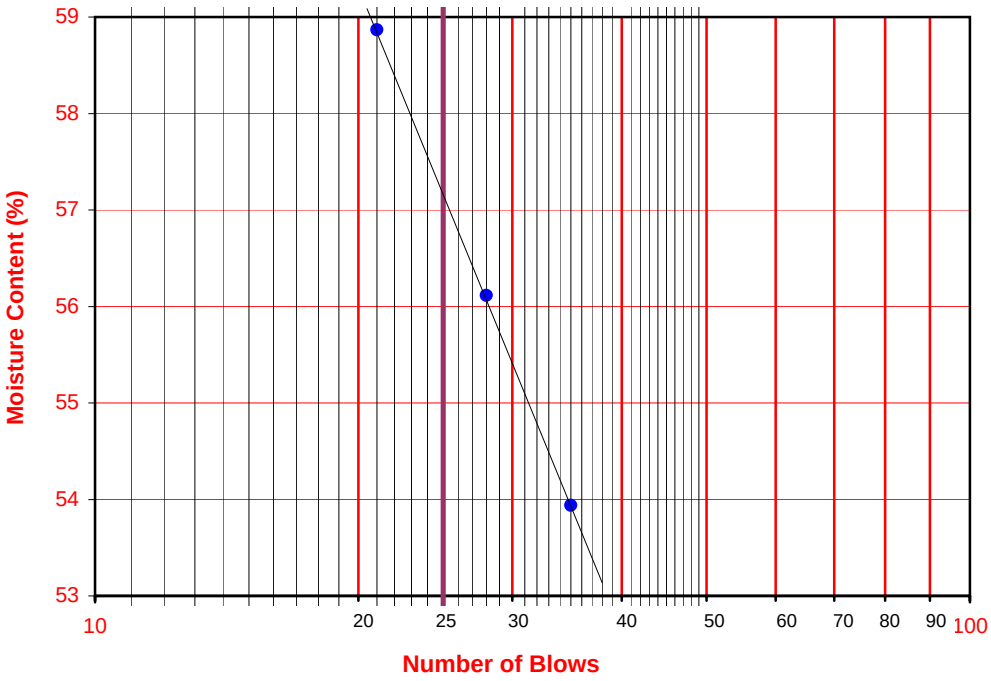
PROCEDURES USED

☐ Wet Preparation
Multipoint - Wet

☒ Dry Preparation
Multipoint - Dry

☒ Procedure A
Multipoint Test

☐ Procedure B
One-point Test



ATTERBERG LIMITS

ASTM D 4318

Project Name:	SR-710 Tunnel Technical Study	Tested By:	V. Juliano	Date:	05/20/09
Project No. :	378312.04.09.01	Input By:	J. Ward	Date:	05/21/09
Boring No.:	R-09-Z4-B4	Checked By:	J. Ward		
Sample No.:	C-24	Depth (ft.)	126.5-127.3		
Soil Identification:	Dark olive silt'stone' (ML)				

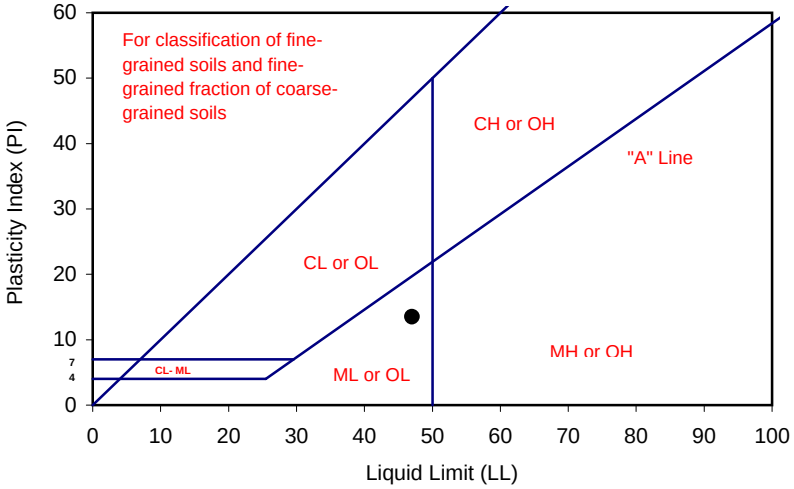
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			29	23	17	
Wet Wt. of Soil + Cont. (g)	9.98	9.61	15.49	15.37	14.48	
Dry Wt. of Soil + Cont. (g)	7.76	7.44	10.93	10.77	10.11	
Wt. of Container (g)	1.03	1.06	1.12	1.04	1.06	
Moisture Content (%) [Wn]	32.99	34.01	46.48	47.28	48.29	

Liquid Limit	**47**
Plastic Limit	**33**
Plasticity Index	**14**
Classification	**ML**

PI at "A" - Line = 0.73(LL-20) 19.71

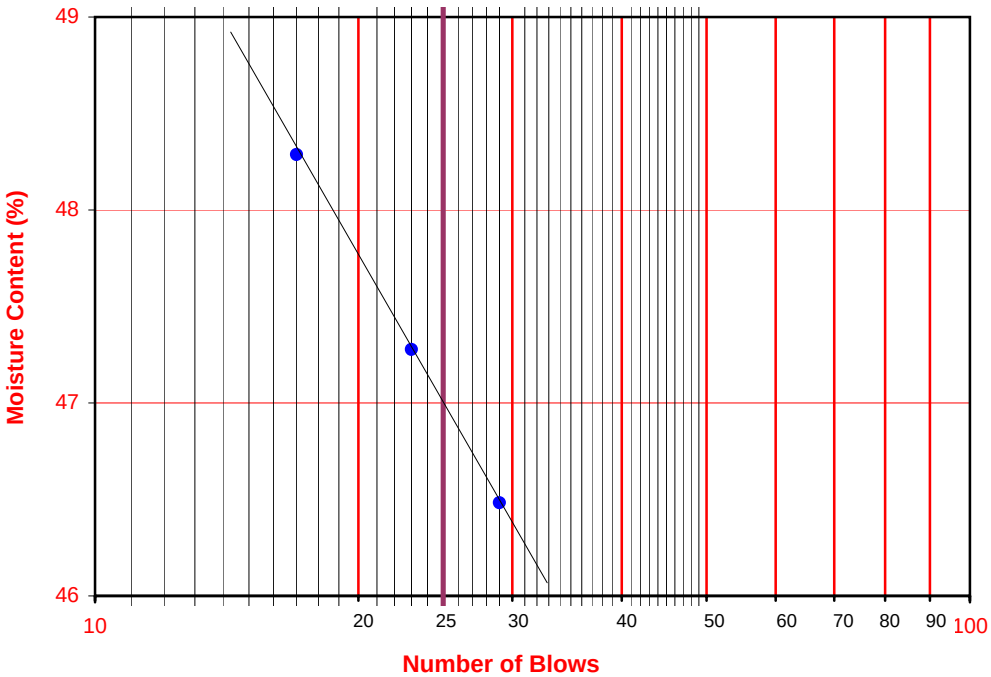
One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.12}$



PROCEDURES USED

- [ ] Wet Preparation
  Multipoint - Wet
- [X] Dry Preparation
  Multipoint - Dry
- [X] Procedure A
  Multipoint Test
- [ ] Procedure B
  One-point Test



Leighton

ATTERBERG LIMITS

ASTM D 4318

Project Name:	SR-710 Tunnel Technical Study	Tested By:	V. Juliano	Date:	05/20/09
Project No. :	378312.04.09.01	Input By:	J. Ward	Date:	05/21/09
Boring No.:	R-09-Z4-B4	Checked By:	J. Ward		
Sample No.:	C-33	Depth (ft.)	185.2-185.9		
Soil Identification:	Dark olive elastic silt'stone' (MH)				

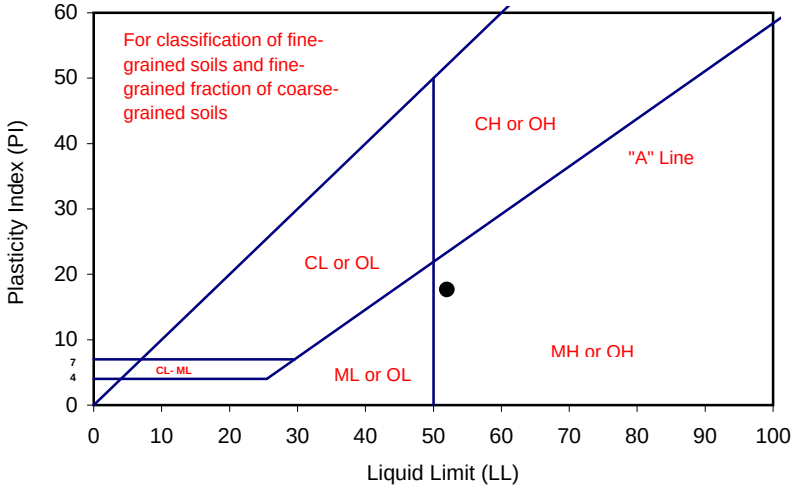
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			35	27	19	
Wet Wt. of Soil + Cont. (g)	8.58	8.99	12.95	14.07	15.48	
Dry Wt. of Soil + Cont. (g)	6.65	6.96	8.97	9.62	10.43	
Wt. of Container (g)	1.02	1.06	1.07	1.04	1.06	
Moisture Content (%) [Wn]	34.28	34.41	50.38	51.86	53.90	

Liquid Limit	**52**
Plastic Limit	**34**
Plasticity Index	**18**
Classification	**MH**

PI at "A" - Line = 0.73(LL-20) 23.36

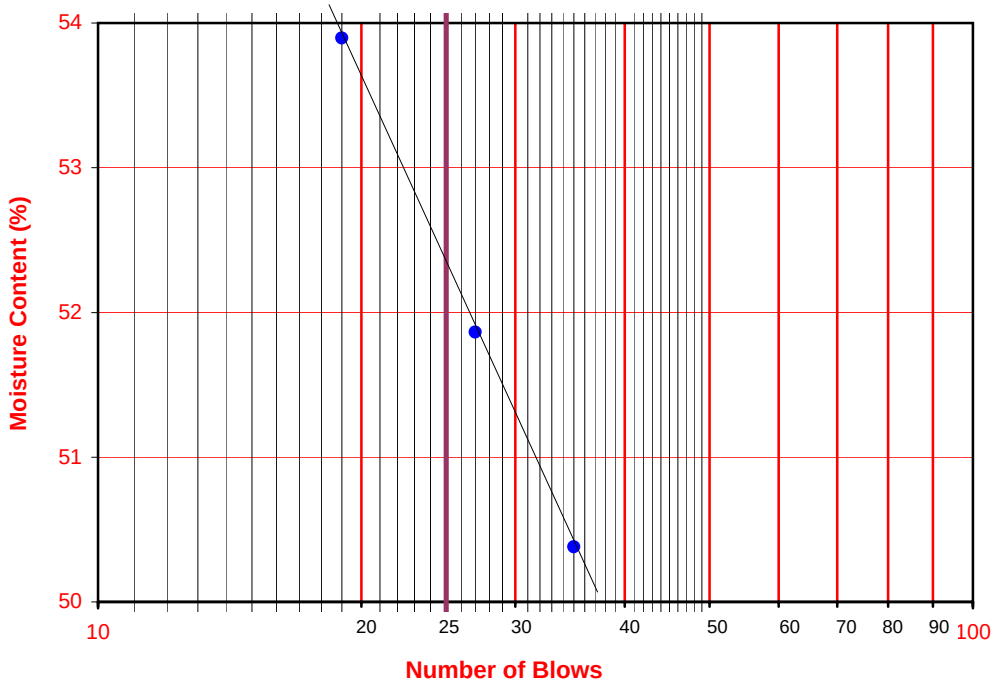
One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.12}$



PROCEDURES USED

- [ ] Wet Preparation
  Multipoint - Wet
- [X] Dry Preparation
  Multipoint - Dry
- [X] Procedure A
  Multipoint Test
- [ ] Procedure B
  One-point Test



ATTERBERG LIMITS

ASTM D 4318

Project Name:	SR-710 Tunnel Technical Study	Tested By:	V. Juliano	Date:	05/04/09
Project No. :	378312.04.09.01	Input By:	J. Ward	Date:	05/07/09
Boring No.:	R-09-Z4-B4	Checked By:	J. Ward		
Sample No.:	S-3	Depth (ft.)	15.0		
Soil Identification:	Yellowish brown sandy silty clay s(CL-ML)				

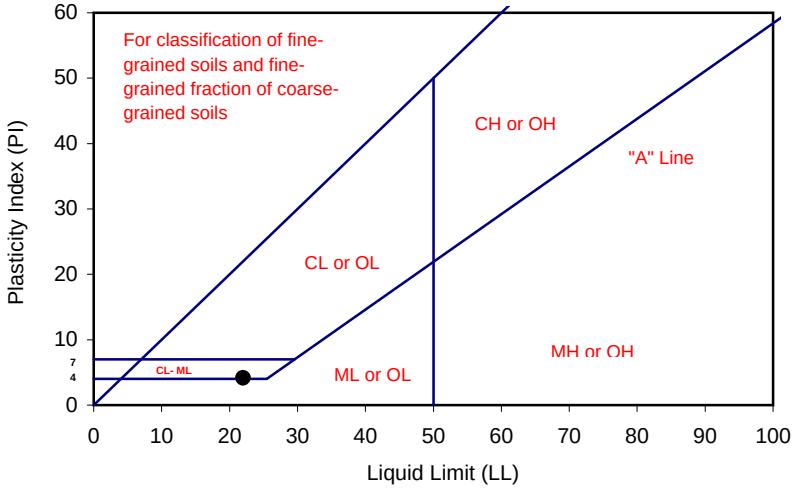
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			28	22	16	
Wet Wt. of Soil + Cont. (g)	11.02	11.03	16.60	13.65	19.74	
Dry Wt. of Soil + Cont. (g)	9.52	9.51	13.79	11.30	16.17	
Wt. of Container (g)	1.06	1.04	1.06	1.06	1.10	
Moisture Content (%) [Wn]	17.73	17.95	22.07	22.95	23.69	

Liquid Limit	**22**
Plastic Limit	**18**
Plasticity Index	**4**
Classification	**CL-ML**

PI at "A" - Line = 0.73(LL-20) 1.46

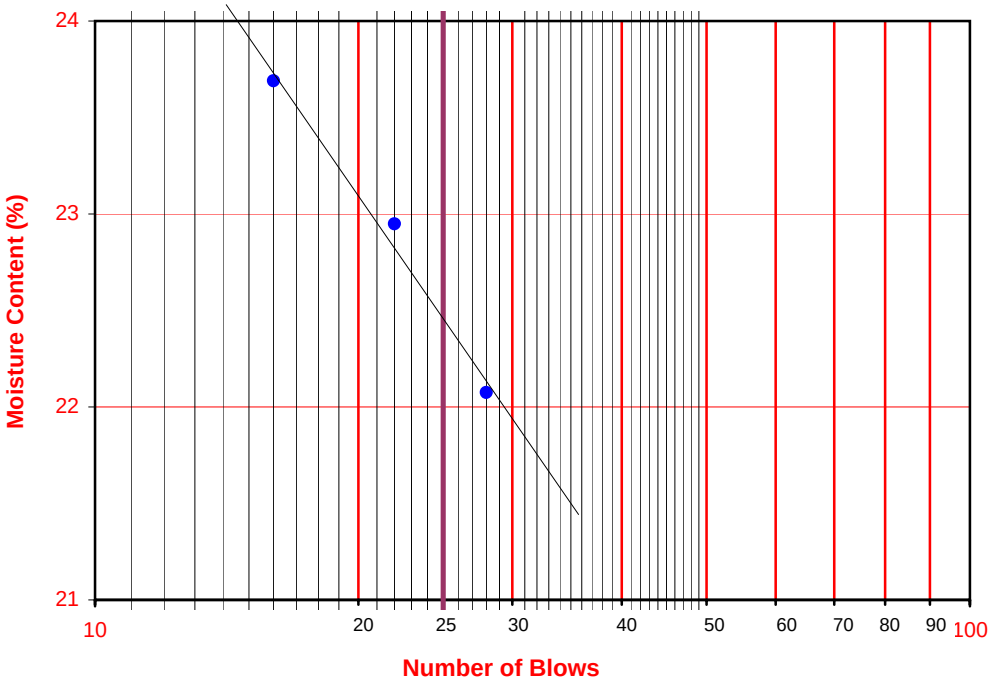
One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.12}$



PROCEDURES USED

	Wet Preparation
	Multipoint - Wet
X	Dry Preparation
	Multipoint - Dry
X	Procedure A
	Multipoint Test
	Procedure B
	One-point Test



Leighton

ATTERBERG LIMITS

ASTM D 4318

Project Name:	SR-710 Tunnel Technical Study	Tested By:	V. Juliano	Date:	04/29/09
Project No. :	378312.04.09.01	Input By:	J. Ward	Date:	05/12/09
Boring No.:	R-09-Z4-B4	Checked By:	J. Ward		
Sample No.:	S-7	Depth (ft.)	35.0		
Soil Identification:	Yellowish brown sandy silty clay s(CL-ML)				

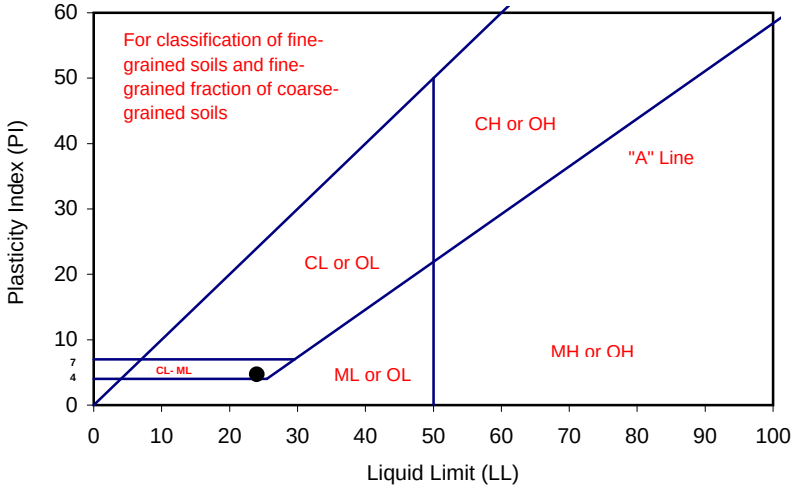
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			30	23	16	
Wet Wt. of Soil + Cont. (g)	11.08	10.49	14.67	14.98	15.19	
Dry Wt. of Soil + Cont. (g)	9.46	8.96	12.02	12.23	12.30	
Wt. of Container (g)	1.06	1.03	1.01	1.06	1.05	
Moisture Content (%) [Wn]	19.29	19.29	24.07	24.62	25.69	

Liquid Limit	**24**
Plastic Limit	**19**
Plasticity Index	**5**
Classification	**CL-ML**

PI at "A" - Line = 0.73(LL-20) 2.92

One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.12}$



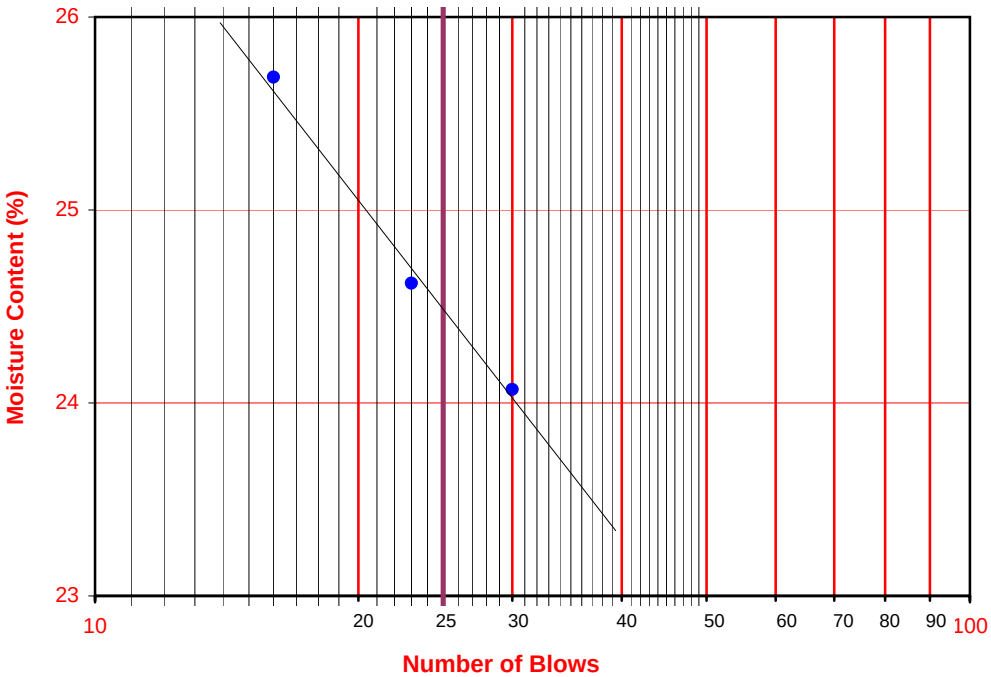
PROCEDURES USED

☐ Wet Preparation
Multipoint - Wet

☒ Dry Preparation
Multipoint - Dry

☒ Procedure A
Multipoint Test

☐ Procedure B
One-point Test



ATTERBERG LIMITS

ASTM D 4318

Project Name:	SR-710 Tunnel Technical Study	Tested By:	V. Juliano	Date:	05/04/09
Project No. :	378312.04.09.01	Input By:	J. Ward	Date:	05/12/09
Boring No.:	R-09-Z4-B4	Checked By:	J. Ward		
Sample No.:	S-17	Depth (ft.)	85.0		
Soil Identification:	Yellowish brown fat clay (CH)				

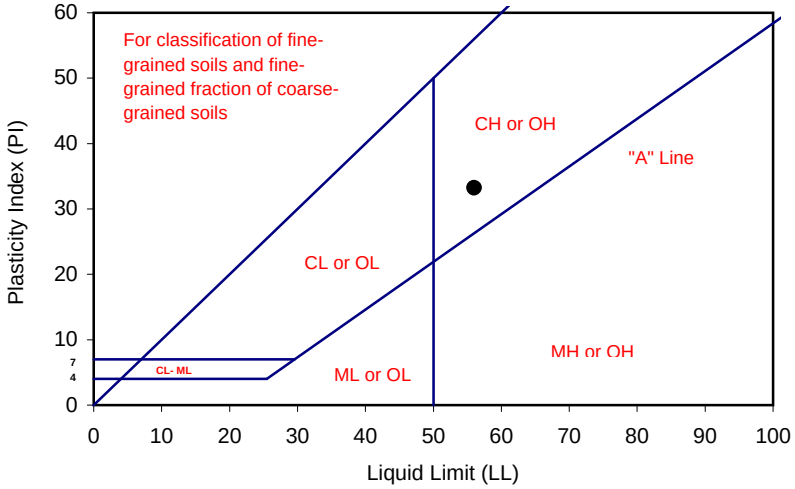
TEST	PLASTIC LIMIT		LIQUID LIMIT			
NO.	1	2	1	2	3	4
Number of Blows [N]			35	28	20	
Wet Wt. of Soil + Cont. (g)	9.73	9.84	13.61	14.56	12.67	
Dry Wt. of Soil + Cont. (g)	8.12	8.21	9.26	9.78	8.44	
Wt. of Container (g)	1.03	1.08	1.05	1.06	1.05	
Moisture Content (%) [Wn]	22.71	22.86	52.98	54.82	57.24	

Liquid Limit	**56**
Plastic Limit	**23**
Plasticity Index	**33**
Classification	**CH**

PI at "A" - Line = 0.73(LL-20) 26.28

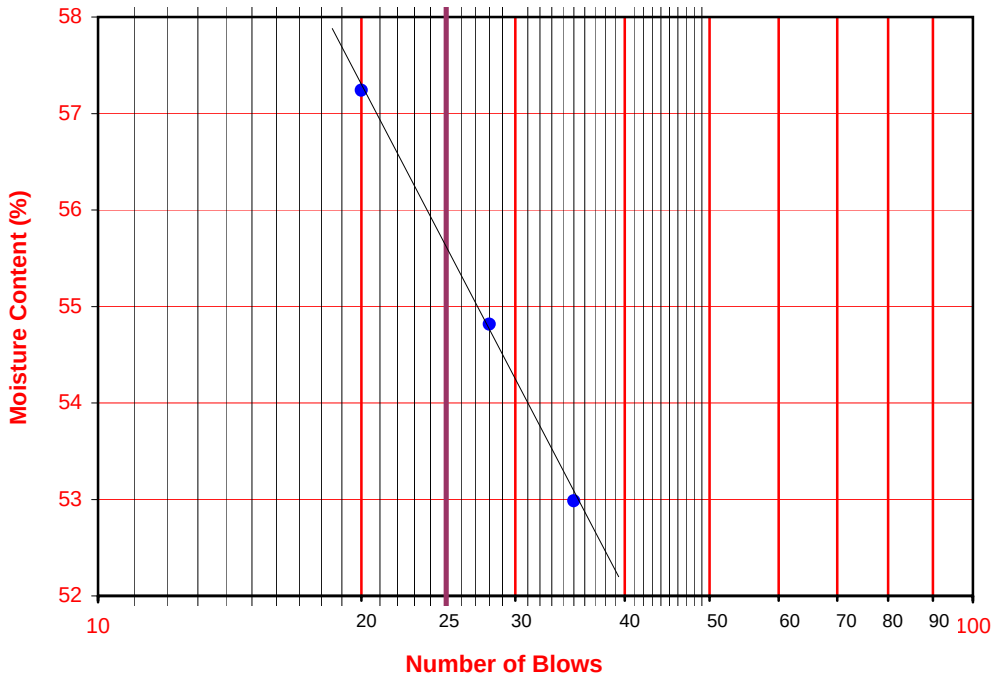
One - Point Liquid Limit Calculation

$LL = Wn(N/25)^{0.12}$



PROCEDURES USED

	Wet Preparation
	Multipoint - Wet
X	Dry Preparation
	Multipoint - Dry
X	Procedure A
	Multipoint Test
	Procedure B
	One-point Test



Leighton

TESTS for SULFATE CONTENT
CHLORIDE CONTENT and pH of SOILS

Project Name: SR-710 Tunnel Technical Study Tested By : V. Juliano Date: 06/04/09

Project No. : 378312.04.09.01 Data Input By: J. Ward Date: 06/09/09

Boring No.	R-09-Z1-B4			
Sample No.	C-40			
Sample Depth (ft)	164.4-165			
Soil Identification:	Dark olive (MH)			
Wet Weight of Soil + Container (g)	0.00			
Dry Weight of Soil + Container (g)	0.00			
Weight of Container (g)	1.00			
Moisture Content (%)	0.00			
Weight of Soaked Soil (g)	100.20			

SULFATE CONTENT, DOT California Test 417, Part II

Beaker No.	13			
Crucible No.	18			
Furnace Temperature (°C)	840			
Time In / Time Out	7:30 / 8:15			
Duration of Combustion (min)	45			
Wt. of Crucible + Residue (g)	19.7625			
Wt. of Crucible (g)	19.7361			
Wt. of Residue (g) (A)	0.0264			
PPM of Sulfate (A) x 41150	1086.36			
PPM of Sulfate, Dry Weight Basis	**1086**			

CHLORIDE CONTENT, DOT California Test 422

ml of Chloride Soln. For Titration (B)	30			
ml of AgNO3 Soln. Used in Titration (C)	0.5			
PPM of Chloride (C -0.2) * 100 * 30 / B	30			
PPM of Chloride, Dry Wt. Basis	**30**			

pH TEST, DOT California Test 532/643

pH Value	**6.64**			
Temperature °C	20.1			

Leighton

SOIL RESISTIVITY TEST

DOT CA TEST 532 / 643

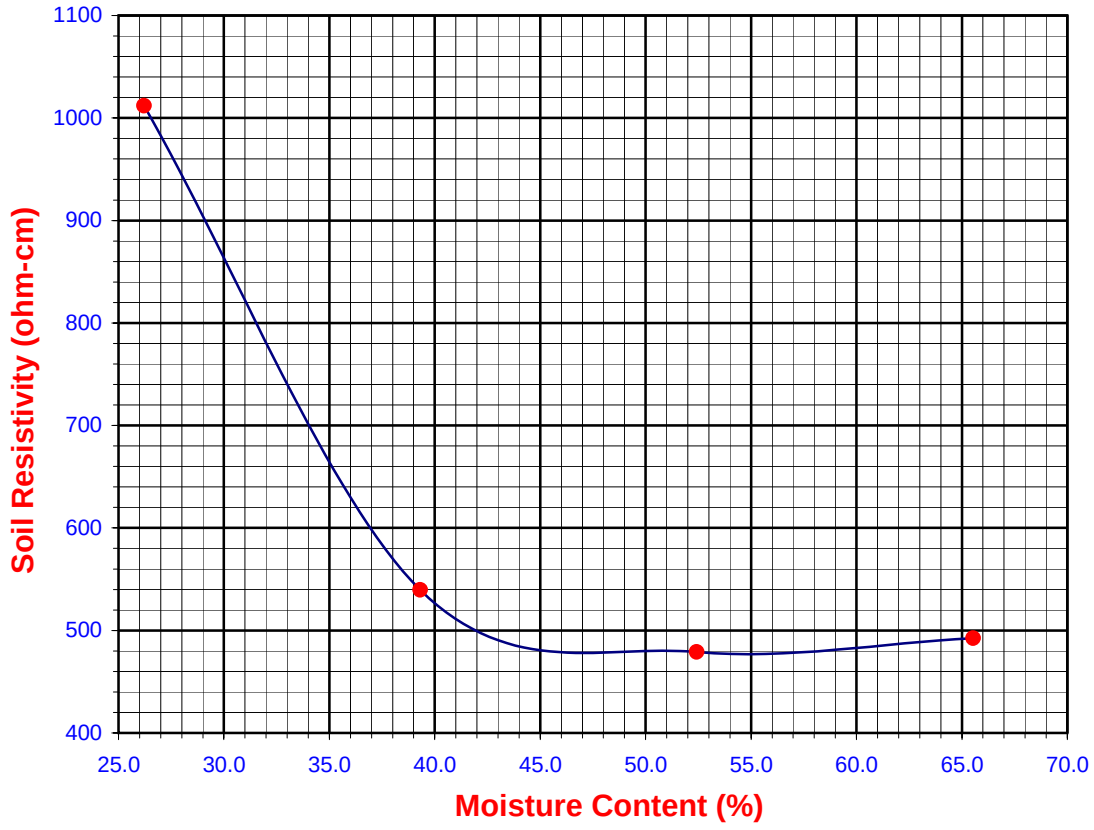
Project Name: SR-710 Tunnel Technical Study
Project No. : 378312.04.09.01
Boring No.: R-09-Z1-B4
Sample No. : C-40
Soil Identification: Dark olive (MH)

Tested By : V. Juliano Date: 06/08/09
Data Input By: J. Ward Date: 06/09/09
Depth (ft.) : 164.4-165

Specimen No.	Water Added (ml) (Wa)	Adjusted Moisture Content (MC)	Resistance Reading (ohm)	Soil Resistivity (ohm-cm)
1	200	26.21	150	1012
2	300	39.32	80	540
3	400	52.42	71	479
4	500	65.53	73	492
5				

Moisture Content (%) (MCi)	0.00
Wet Wt. of Soil + Cont. (g)	0.00
Dry Wt. of Soil + Cont. (g)	0.00
Wt. of Container (g)	1.00
Container No.	
Initial Soil Wt. (g) (Wt)	763.00
Box Constant	6.746
MC =(((1+Mci/100)x(Wa/Wt+1))-1)x100	

Min. Resistivity (ohm-cm)	Moisture Content (%)	Sulfate Content (ppm)	Chloride Content (ppm)	Soil pH	
				pH	Temp. (°C)
DOT CA Test 532 / 643		DOT CA Test 417 Part II	DOT CA Test 422	DOT CA Test 532 / 643	
479	**52.4**	**1086**	**30**	**6.64**	**20.1**



Leighton

TESTS for SULFATE CONTENT
CHLORIDE CONTENT and pH of SOILS

Project Name: SR-710 Tunnel Technical Study Tested By : V. Juliano Date: 05/11/09

Project No. : 378312.04.09.01 Data Input By: J. Ward Date: 05/14/09

Boring No.	R-09-Z1-B6			
Sample No.	C47			
Sample Depth (ft)	307.8-309			
Soil Identification:	Light olive gray silt'stone (ML)			
Wet Weight of Soil + Container (g)	0.00			
Dry Weight of Soil + Container (g)	0.00			
Weight of Container (g)	1.00			
Moisture Content (%)	0.00			
Weight of Soaked Soil (g)	100.20			

SULFATE CONTENT, DOT California Test 417, Part II

Beaker No.	16			
Crucible No.	32			
Furnace Temperature (°C)	830			
Time In / Time Out	7:40 / 8:25			
Duration of Combustion (min)	45			
Wt. of Crucible + Residue (g)	19.1996			
Wt. of Crucible (g)	19.1660			
Wt. of Residue (g) (A)	0.0336			
PPM of Sulfate (A) x 41150	1382.64			
PPM of Sulfate, Dry Weight Basis	**1383**			

CHLORIDE CONTENT, DOT California Test 422

ml of Chloride Soln. For Titration (B)	30			
ml of AgNO3 Soln. Used in Titration (C)	0.5			
PPM of Chloride (C -0.2) * 100 * 30 / B	30			
PPM of Chloride, Dry Wt. Basis	**30**			

pH TEST, DOT California Test 532/643

pH Value	**7.49**			
Temperature °C	20.5			

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SOIL RESISTIVITY TEST

DOT CA TEST 532 / 643

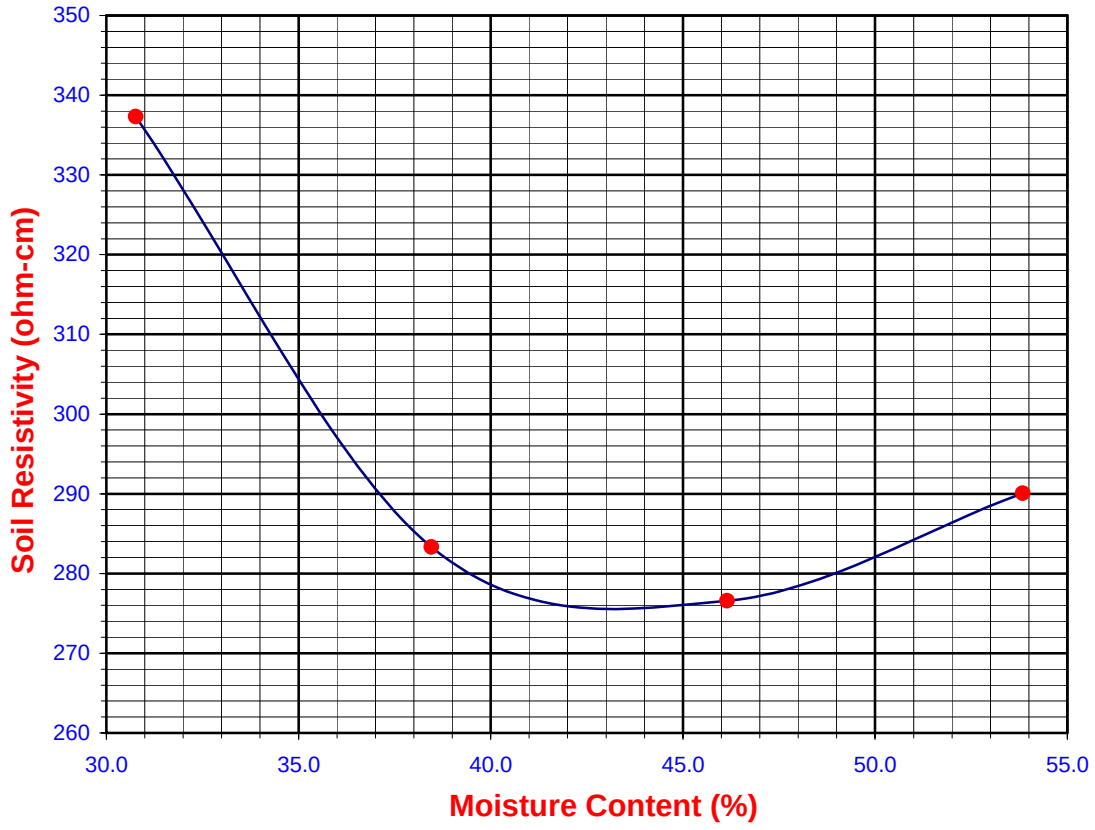
Project Name: SR-710 Tunnel Technical Study
Project No. : 378312.04.09.01
Boring No.: R-09-Z1-B6
Sample No. : C47
Soil Identification: Light olive gray silt'stone (ML)

Tested By : V. Juliano Date: 05/14/09
Data Input By: J. Ward Date: 05/14/09
Depth (ft.) : 307.8-309

Specimen No.	Water Added (ml) (Wa)	Adjusted Moisture Content (MC)	Resistance Reading (ohm)	Soil Resistivity (ohm-cm)
1	400	30.77	50	337
2	500	38.46	42	283
3	600	46.15	41	277
4	700	53.85	43	290
5				

Moisture Content (%) (MCi)	0.00
Wet Wt. of Soil + Cont. (g)	0.00
Dry Wt. of Soil + Cont. (g)	0.00
Wt. of Container (g)	1.00
Container No.	
Initial Soil Wt. (g) (Wt)	1300.00
Box Constant	6.746
MC =(((1+Mci/100)x(Wa/Wt+1))-1)x100	

Min. Resistivity (ohm-cm)	Moisture Content (%)	Sulfate Content (ppm)	Chloride Content (ppm)	Soil pH	
				pH	Temp. (°C)
DOT CA Test 532 / 643		DOT CA Test 417 Part II	DOT CA Test 422	DOT CA Test 532 / 643	
275	**43.3**	**1383**	**30**	**7.49**	**20.5**



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TESTS for SULFATE CONTENT
CHLORIDE CONTENT and pH of SOILS

Project Name: SR-710 Tunnel Technical Study Tested By : V. Juliano Date: 05/11/09

Project No. : 378312.04.09.01 Data Input By: J. Ward Date: 05/14/09

Boring No.	R-09-Z1-B8	R-09-Z1-B8		
Sample No.	C26	C33		
Sample Depth (ft)	120-120.4	159.25-160		
Soil Identification:	Dark olive lean clay'stone' (CL)	Dark olive lean clay'stone' (CL)		
Wet Weight of Soil + Container (g)	127.70	113.90		
Dry Weight of Soil + Container (g)	115.70	104.80		
Weight of Container (g)	39.10	60.60		
Moisture Content (%)	15.67	20.59		
Weight of Soaked Soil (g)	100.30	100.60		

SULFATE CONTENT, DOT California Test 417, Part II

Beaker No.	10	13		
Crucible No.	31	32		
Furnace Temperature (°C)	830	830		
Time In / Time Out	7:40 / 8:25	7:40 / 8:25		
Duration of Combustion (min)	45	45		
Wt. of Crucible + Residue (g)	19.0027	19.1792		
Wt. of Crucible (g)	18.9790	19.1653		
Wt. of Residue (g) (A)	0.0237	0.0139		
PPM of Sulfate (A) x 41150	975.26	571.99		
PPM of Sulfate, Dry Weight Basis	**1156**	**720**		

CHLORIDE CONTENT, DOT California Test 422

ml of Chloride Soln. For Titration (B)	30	30		
ml of AgNO3 Soln. Used in Titration (C)	0.7	0.8		
PPM of Chloride (C -0.2) * 100 * 30 / B	50	60		
PPM of Chloride, Dry Wt. Basis	**59**	**76**		

pH TEST, DOT California Test 532/643

pH Value	**6.18**	**6.26**		
Temperature °C	20.4	20.3		

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SOIL RESISTIVITY TEST

DOT CA TEST 532 / 643

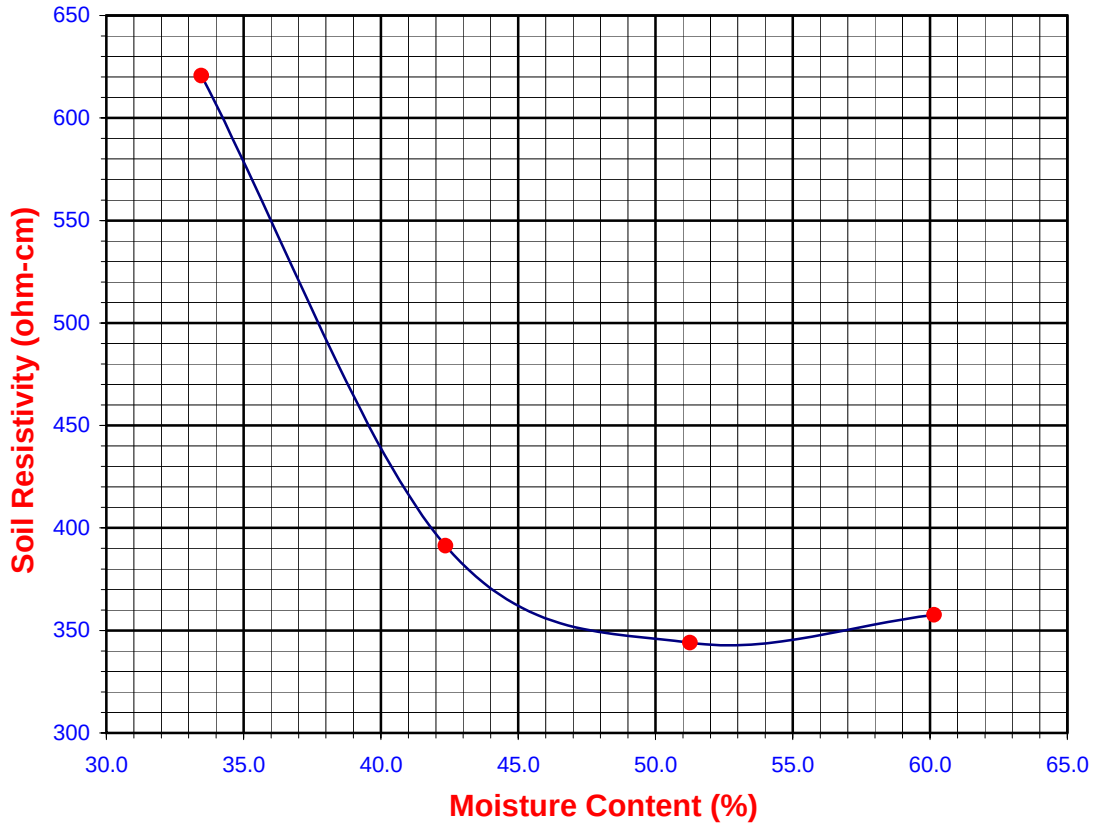
Project Name: SR-710 Tunnel Technical Study
Project No. : 378312.04.09.01
Boring No.: R-09-Z1-B8
Sample No. : C26
Soil Identification: Dark olive lean clay'stone' (CL)

Tested By : V. Juliano Date: 05/14/09
Data Input By: J. Ward Date: 05/14/09
Depth (ft.) : 120-120.4

Specimen No.	Water Added (ml) (Wa)	Adjusted Moisture Content (MC)	Resistance Reading (ohm)	Soil Resistivity (ohm-cm)
1	200	33.46	92	621
2	300	42.36	58	391
3	400	51.26	51	344
4	500	60.15	53	358
5				

Moisture Content (%) (MCi)	15.67
Wet Wt. of Soil + Cont. (g)	127.70
Dry Wt. of Soil + Cont. (g)	115.70
Wt. of Container (g)	39.10
Container No.	
Initial Soil Wt. (g) (Wt)	1300.00
Box Constant	6.746
MC =(((1+Mci/100)x(Wa/Wt+1))-1)x100	

Min. Resistivity (ohm-cm)	Moisture Content (%)	Sulfate Content (ppm)	Chloride Content (ppm)	Soil pH	
				pH	Temp. (°C)
DOT CA Test 532 / 643		DOT CA Test 417 Part II	DOT CA Test 422	DOT CA Test 532 / 643	
343	**52.6**	**1156**	**59**	**6.18**	**20.4**



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SOIL RESISTIVITY TEST

DOT CA TEST 532 / 643

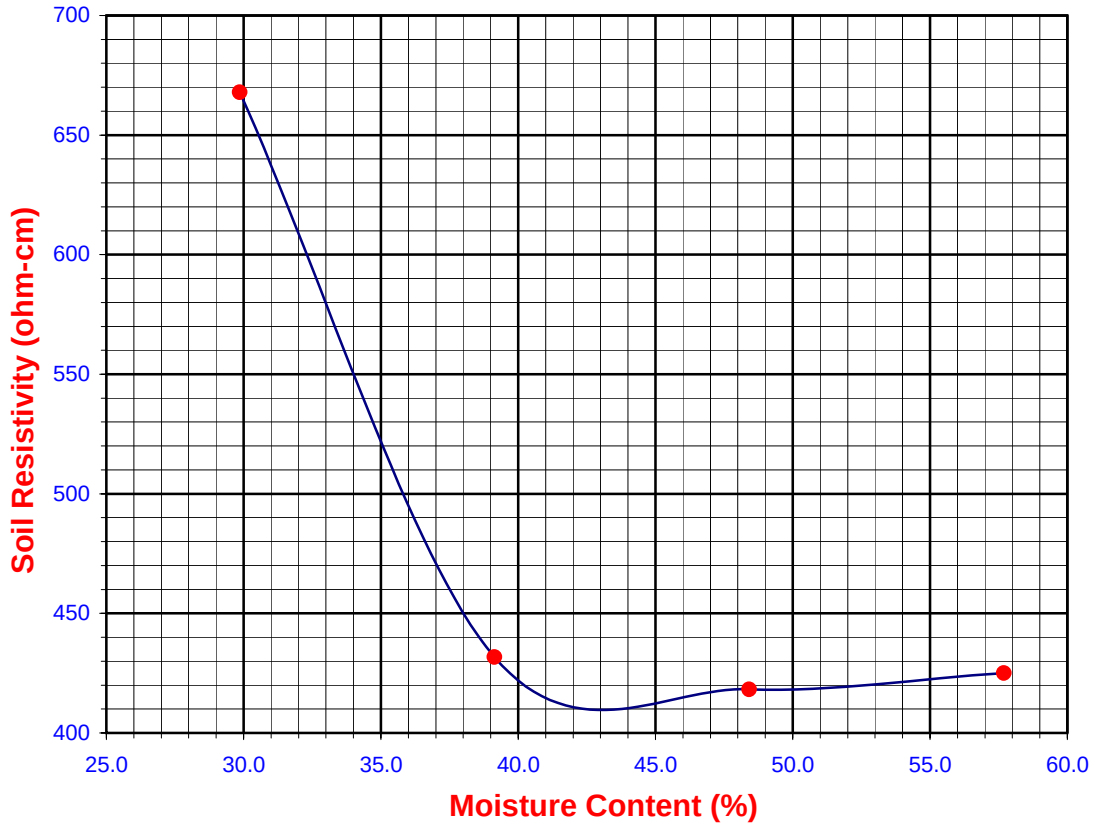
Project Name: SR-710 Tunnel Technical Study
Project No. : 378312.04.09.01
Boring No.: R-09-Z1-B8
Sample No. : C33
Soil Identification: Dark olive lean clay'stone' (CL)

Tested By : V. Juliano Date: 05/14/09
Data Input By: J. Ward Date: 05/14/09
Depth (ft.) : 159.25-160

Specimen No.	Water Added (ml) (Wa)	Adjusted Moisture Content (MC)	Resistance Reading (ohm)	Soil Resistivity (ohm-cm)
1	100	29.86	99	668
2	200	39.14	64	432
3	300	48.42	62	418
4	400	57.69	63	425
5				

Moisture Content (%) (MCi)	20.59
Wet Wt. of Soil + Cont. (g)	113.90
Dry Wt. of Soil + Cont. (g)	104.80
Wt. of Container (g)	60.60
Container No.	
Initial Soil Wt. (g) (Wt)	1300.00
Box Constant	6.746
MC =(((1+Mci/100)x(Wa/Wt+1))-1)x100	

Min. Resistivity (ohm-cm)	Moisture Content (%)	Sulfate Content (ppm)	Chloride Content (ppm)	Soil pH	
				pH	Temp. (°C)
DOT CA Test 532 / 643		DOT CA Test 417 Part II	DOT CA Test 422	DOT CA Test 532 / 643	
410	**43.0**	**720**	**76**	**6.26**	**20.3**



Leighton

TESTS for SULFATE CONTENT
CHLORIDE CONTENT and pH of SOILS

Project Name: SR-710 Tunnel Technical Study Tested By : V. Juliano Date: 05/26/09

Project No. : 378312.04.09.01 Data Input By: J. Ward Date: 06/01/09

Boring No.	R-09-Z2-B2			
Sample No.	C42			
Sample Depth (ft)	232.8-233.4			
Soil Identification:	Dark olive brown (CL)			
Wet Weight of Soil + Container (g)	0.00			
Dry Weight of Soil + Container (g)	0.00			
Weight of Container (g)	1.00			
Moisture Content (%)	0.00			
Weight of Soaked Soil (g)	100.20			

SULFATE CONTENT, DOT California Test 417, Part II

Beaker No.	14			
Crucible No.	32			
Furnace Temperature (°C)	830			
Time In / Time Out	7:35 / 8:20			
Duration of Combustion (min)	45			
Wt. of Crucible + Residue (g)	19.1673			
Wt. of Crucible (g)	19.1649			
Wt. of Residue (g) (A)	0.0024			
PPM of Sulfate (A) x 41150	98.76			
PPM of Sulfate, Dry Weight Basis	**99**			

CHLORIDE CONTENT, DOT California Test 422

ml of Chloride Soln. For Titration (B)	30			
ml of AgNO3 Soln. Used in Titration (C)	0.7			
PPM of Chloride (C -0.2) * 100 * 30 / B	50			
PPM of Chloride, Dry Wt. Basis	**50**			

pH TEST, DOT California Test 532/643

pH Value	**8.99**			
Temperature °C	19.9			

Leighton

SOIL RESISTIVITY TEST

DOT CA TEST 532 / 643

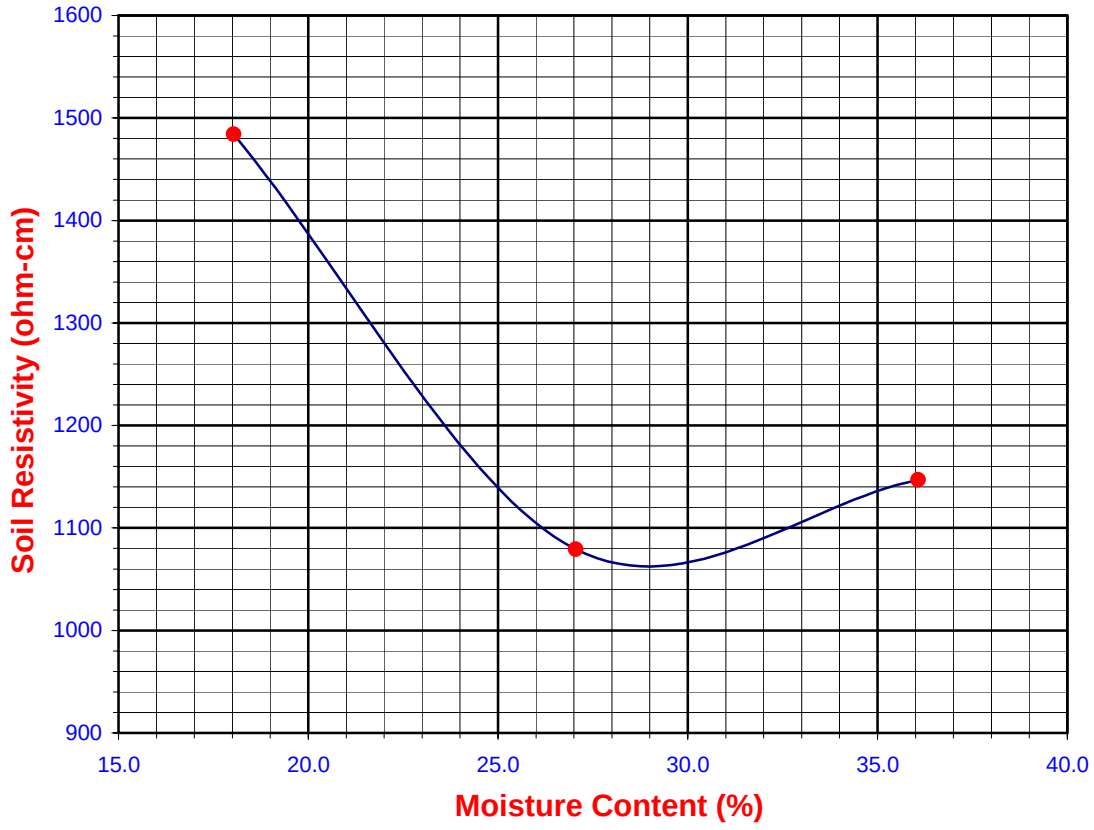
Project Name: SR-710 Tunnel Technical Study
Project No. : 378312.04.09.01
Boring No.: R-09-Z2-B2
Sample No. : C42
Soil Identification: Dark olive brown (CL)

Tested By : V. Juliano Date: 05/29/09
Data Input By: J. Ward Date: 06/01/09
Depth (ft.) : 232.8-233.4

Specimen No.	Water Added (ml) (Wa)	Adjusted Moisture Content (MC)	Resistance Reading (ohm)	Soil Resistivity (ohm-cm)
1	200	18.03	220	1484
2	300	27.05	160	1079
3	400	36.07	170	1147
4				
5				

Moisture Content (%) (MCi)	0.00
Wet Wt. of Soil + Cont. (g)	0.00
Dry Wt. of Soil + Cont. (g)	0.00
Wt. of Container (g)	1.00
Container No.	
Initial Soil Wt. (g) (Wt)	1109.00
Box Constant	6.746
MC =(((1+Mci/100)x(Wa/Wt+1))-1)x100	

Min. Resistivity (ohm-cm)	Moisture Content (%)	Sulfate Content (ppm)	Chloride Content (ppm)	Soil pH	
				pH	Temp. (°C)
DOT CA Test 532 / 643		DOT CA Test 417 Part II	DOT CA Test 422	DOT CA Test 532 / 643	
1060	**29.0**	**99**	**50**	**8.99**	**19.9**



AP Engineering & Testing, Inc.

CORROSION TEST RESULTS

Client Name: CH2M Hill
Project Name: SR-710 Tunnel Technical Study
Project No.: 378312.04.09.01

AP Job No.: 29-0603
Date 06/04/09

Boring No.	Sample No.	Depth (ft)	Soil Type	Minimum Resistivity (ohm-cm)	pH	Sulfate Content (ppm)	Chloride Content (ppm)
R-09-Z2-B3	C-65	267-267.8	Siltstone	740	7.4	1633	67

NOTES: Resistivity Test and pH: California Test Methods 532 and 643
Sulfate Content : California Test Method 417
Chloride Content : California Test Method 422
ND = Not Detectable
NA = Not Sufficient Sample
NR = Not Requested

2607 Pomona Boulevard, Pomona, CA 91768
Tel. (909) 869-6316 Fax. (909)869-6318

AP Engineering & Testing, Inc.

CORROSION TEST RESULTS

Client Name: CH2M Hill
Project Name: SR-710 Tunnel Technical Study
Project No.: 378312.04.09.01

AP Job No.: 29-0603
Date 06/04/09

Boring No.	Sample No.	Depth (ft)	Soil Type	Minimum Resistivity (ohm-cm)	pH	Sulfate Content (ppm)	Chloride Content (ppm)
R-09-Z3-B5	C-76	349.5-350.2	CL	250	7.1	5109	68

NOTES: Resistivity Test and pH: California Test Methods 532 and 643
Sulfate Content : California Test Method 417
Chloride Content : California Test Method 422
ND = Not Detectable
NA = Not Sufficient Sample
NR = Not Requested

2607 Pomona Boulevard, Pomona, CA 91768
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Leighton

TESTS for SULFATE CONTENT
CHLORIDE CONTENT and pH of SOILS

Project Name: SR-710 Tunnel Technical Study Tested By : V. Juliano Date: 05/06/09

Project No. : 378312.04.09.01 Data Input By: J. Ward Date: 05/21/09

Boring No.	R-09-Z3-B7			
Sample No.	C-56			
Sample Depth (ft)	251.1-252.2			
Soil Identification:	Light gray silty sand'stone (SM)			
Wet Weight of Soil + Container (g)	158.00			
Dry Weight of Soil + Container (g)	152.30			
Weight of Container (g)	60.30			
Moisture Content (%)	6.20			
Weight of Soaked Soil (g)	100.30			

SULFATE CONTENT, DOT California Test 417, Part II

Beaker No.	12			
Crucible No.	27			
Furnace Temperature (°C)	830			
Time In / Time Out	7:40 / 8:25			
Duration of Combustion (min)	45			
Wt. of Crucible + Residue (g)	17.6572			
Wt. of Crucible (g)	17.6397			
Wt. of Residue (g) (A)	0.0175			
PPM of Sulfate (A) x 41150	720.12			
PPM of Sulfate, Dry Weight Basis	**768**			

CHLORIDE CONTENT, DOT California Test 422

ml of Chloride Soln. For Titration (B)	30			
ml of AgNO3 Soln. Used in Titration (C)	0.5			
PPM of Chloride (C -0.2) * 100 * 30 / B	30			
PPM of Chloride, Dry Wt. Basis	**32**			

pH TEST, DOT California Test 532/643

pH Value	**7.22**			
Temperature °C	19.8			

Leighton

SOIL RESISTIVITY TEST

DOT CA TEST 532 / 643

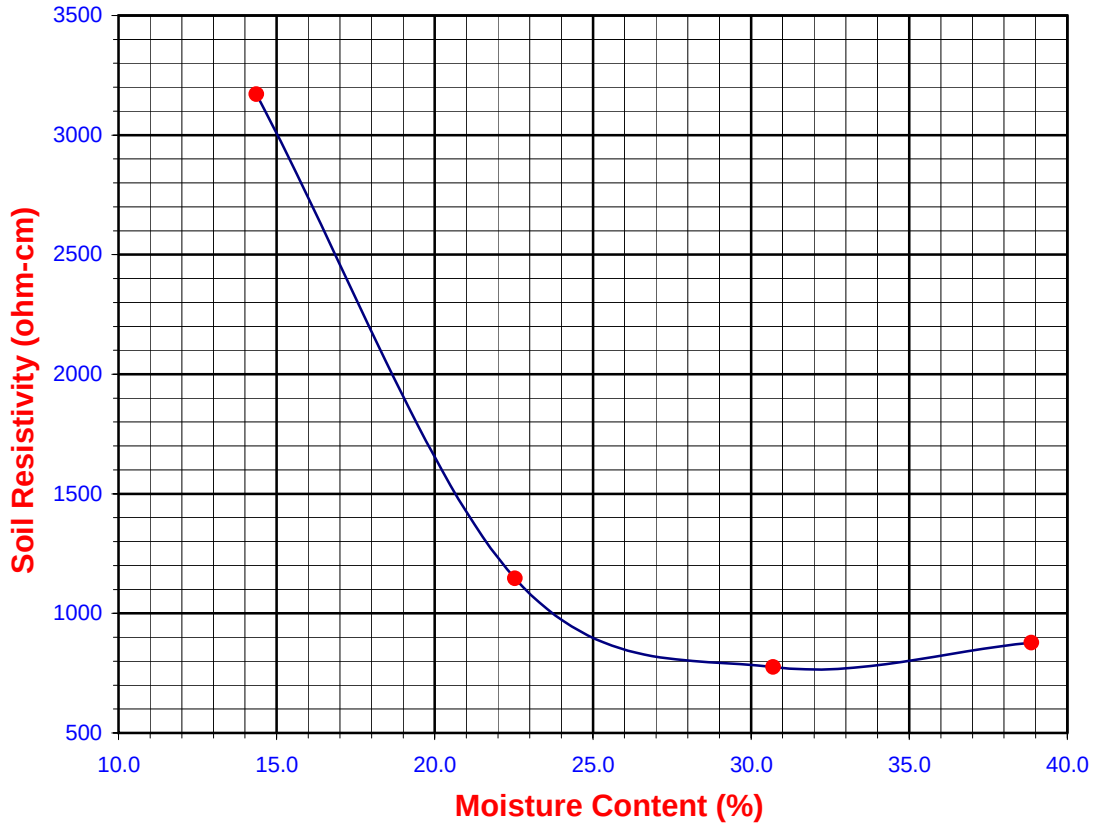
Project Name: SR-710 Tunnel Technical Study
Project No. : 378312.04.09.01
Boring No.: R-09-Z3-B7
Sample No. : C-56
Soil Identification: Light gray silty sand'stone (SM)

Tested By : V. Juliano Date: 05/15/09
Data Input By: J. Ward Date: 05/21/09
Depth (ft.) : 251.1-252.2

Specimen No.	Water Added (ml) (Wa)	Adjusted Moisture Content (MC)	Resistance Reading (ohm)	Soil Resistivity (ohm-cm)
1	100	14.36	470	3171
2	200	22.53	170	1147
3	300	30.70	115	776
4	400	38.87	130	877
5				

Moisture Content (%) (MCi)	6.20
Wet Wt. of Soil + Cont. (g)	158.00
Dry Wt. of Soil + Cont. (g)	152.30
Wt. of Container (g)	60.30
Container No.	
Initial Soil Wt. (g) (Wt)	1300.00
Box Constant	6.746
MC =(((1+Mci/100)x(Wa/Wt+1))-1)x100	

Min. Resistivity (ohm-cm)	Moisture Content (%)	Sulfate Content (ppm)	Chloride Content (ppm)	Soil pH	
				pH	Temp. (°C)
DOT CA Test 532 / 643		DOT CA Test 417 Part II	DOT CA Test 422	DOT CA Test 532 / 643	
770	**31.9**	**768**	**32**	**7.22**	**19.8**



AP Engineering & Testing, Inc.

CORROSION TEST RESULTS

Client Name: CH2M Hill
Project Name: SR-710 Tunnel Technical Study
Project No.: 378312.04.09.01

AP Job No.: 29-0603
Date 06/04/09

Boring No.	Sample No.	Depth (ft)	Soil Type	Minimum Resistivity (ohm-cm)	pH	Sulfate Content (ppm)	Chloride Content (ppm)
R-09-Z3-B8	C-54	218-221	Claystone	1600	7.5	5188	64

NOTES: Resistivity Test and pH: California Test Methods 532 and 643
Sulfate Content : California Test Method 417
Chloride Content : California Test Method 422
ND = Not Detectable
NA = Not Sufficient Sample
NR = Not Requested

2607 Pomona Boulevard, Pomona, CA 91768
Tel. (909) 869-6316 Fax. (909)869-6318

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TESTS for SULFATE CONTENT
CHLORIDE CONTENT and pH of SOILS

Project Name: SR-710 Tunnel Technical Study Tested By : V. Juliano Date: 05/26/09

Project No. : 378312.04.09.01 Data Input By: J. Ward Date: 06/06/09

Boring No.	R-09-Z3-B10			
Sample No.	C66			
Sample Depth (ft)	255.2-255.8			
Soil Identification:	Dark olive (CL)			
Wet Weight of Soil + Container (g)	0.00			
Dry Weight of Soil + Container (g)	0.00			
Weight of Container (g)	1.00			
Moisture Content (%)	0.00			
Weight of Soaked Soil (g)	100.10			

SULFATE CONTENT, DOT California Test 417, Part II

Beaker No.	12			
Crucible No.	31			
Furnace Temperature (°C)	830			
Time In / Time Out	7:35 / 8:20			
Duration of Combustion (min)	45			
Wt. of Crucible + Residue (g)	19.0252			
Wt. of Crucible (g)	18.9780			
Wt. of Residue (g) (A)	0.0472			
PPM of Sulfate (A) x 41150	1942.28			
PPM of Sulfate, Dry Weight Basis	**1942**			

CHLORIDE CONTENT, DOT California Test 422

ml of Chloride Soln. For Titration (B)	30			
ml of AgNO3 Soln. Used in Titration (C)	0.5			
PPM of Chloride (C -0.2) * 100 * 30 / B	30			
PPM of Chloride, Dry Wt. Basis	**30**			

pH TEST, DOT California Test 532/643

pH Value	**7.74**			
Temperature °C	19.4			

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SOIL RESISTIVITY TEST

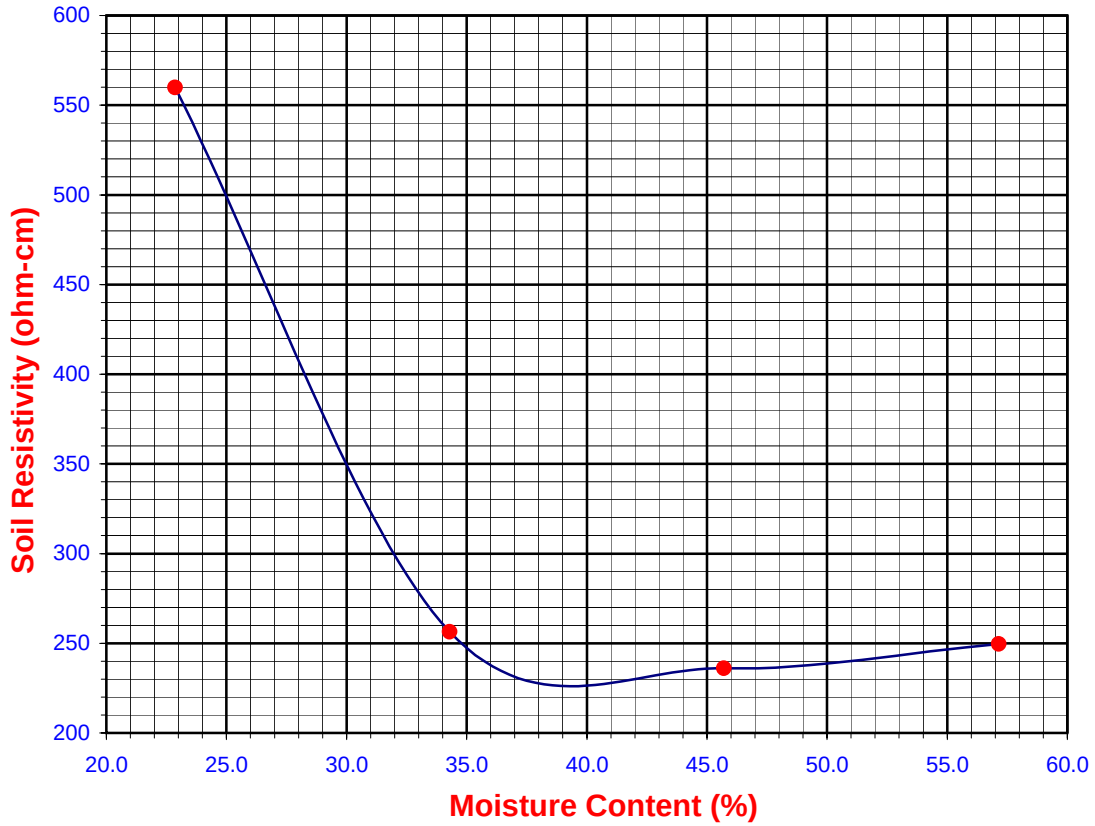
DOT CA TEST 532 / 643

Project Name:	SR-710 Tunnel Technical Study		Tested By :	V. Juliano	Date: 05/29/09
Project No. :	378312.04.09.01		Data Input By:	J. Ward	Date: 06/06/09
Boring No.:	R-09-Z3-B10		Depth (ft.) :	255.2-255.8	
Sample No. :	C66				
Soil Identification:	Dark olive (CL)				

Specimen No.	Water Added (ml) (Wa)	Adjusted Moisture Content (MC)	Resistance Reading (ohm)	Soil Resistivity (ohm-cm)
1	200	22.86	83	560
2	300	34.29	38	256
3	400	45.71	35	236
4	500	57.14	37	250
5				

Moisture Content (%) (MCi)	0.00
Wet Wt. of Soil + Cont. (g)	0.00
Dry Wt. of Soil + Cont. (g)	0.00
Wt. of Container (g)	1.00
Container No.	
Initial Soil Wt. (g) (Wt)	875.00
Box Constant	6.746
MC =(((1+Mci/100)x(Wa/Wt+1))-1)x100	

Min. Resistivity (ohm-cm)	Moisture Content (%)	Sulfate Content (ppm)	Chloride Content (ppm)	Soil pH	
				pH	Temp. (°C)
DOT CA Test 532 / 643		DOT CA Test 417 Part II	DOT CA Test 422	DOT CA Test 532 / 643	
226	**39.4**	**1942**	**30**	**7.74**	**19.4**



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TESTS for SULFATE CONTENT
CHLORIDE CONTENT and pH of SOILS

Project Name: SR-710 Tunnel Technical Study Tested By : V. Juliano Date: 05/14/09

Project No. : 378312.04.09.01 Data Input By: J. Ward Date: 05/26/09

Boring No.	R-09-Z3-B11			
Sample No.	C-35			
Sample Depth (ft)	171.5-172.25			
Soil Identification:	Light olive brown (CH)s			
Wet Weight of Soil + Container (g)	0.00			
Dry Weight of Soil + Container (g)	0.00			
Weight of Container (g)	1.00			
Moisture Content (%)	0.00			
Weight of Soaked Soil (g)	100.40			

SULFATE CONTENT, DOT California Test 417, Part II

Beaker No.	9			
Crucible No.	26			
Furnace Temperature (°C)	830			
Time In / Time Out	8:05 / 8:50			
Duration of Combustion (min)	45			
Wt. of Crucible + Residue (g)	18.8789			
Wt. of Crucible (g)	18.8767			
Wt. of Residue (g) (A)	0.0022			
PPM of Sulfate (A) x 41150	90.53			
PPM of Sulfate, Dry Weight Basis	**91**			

CHLORIDE CONTENT, DOT California Test 422

ml of Chloride Soln. For Titration (B)	30			
ml of AgNO3 Soln. Used in Titration (C)	0.5			
PPM of Chloride (C -0.2) * 100 * 30 / B	30			
PPM of Chloride, Dry Wt. Basis	**30**			

pH TEST, DOT California Test 532/643

pH Value	**6.86**			
Temperature °C	20.1			

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SOIL RESISTIVITY TEST

DOT CA TEST 532 / 643

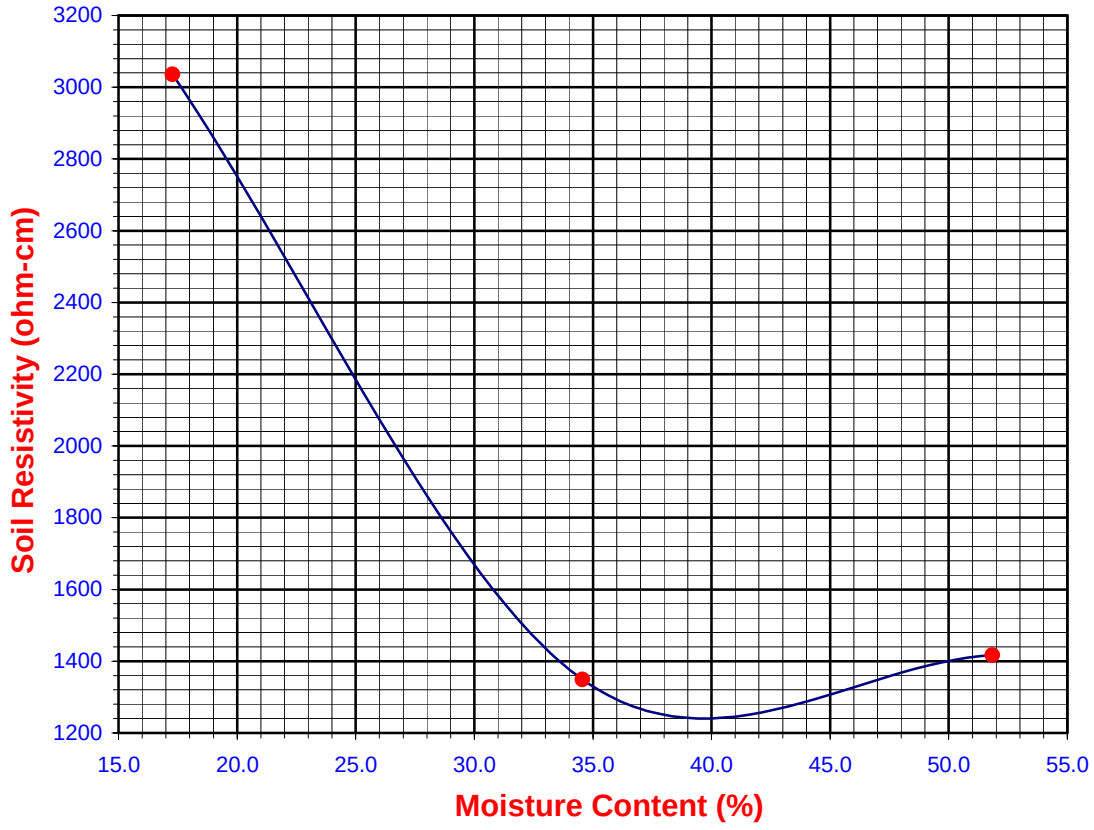
Project Name: SR-710 Tunnel Technical Study
Project No. : 378312.04.09.01
Boring No.: R-09-Z3-B11
Sample No. : C-35
Soil Identification: Light olive brown (CH)s

Tested By : V. Juliano Date: 05/15/09
Data Input By: J. Ward Date: 05/26/09
Depth (ft.) : 171.5-172.25

Specimen No.	Water Added (ml) (Wa)	Adjusted Moisture Content (MC)	Resistance Reading (ohm)	Soil Resistivity (ohm-cm)
1	150	17.28	450	3036
2	300	34.56	200	1349
3	450	51.84	210	1417
4				
5				

Moisture Content (%) (MCi)	0.00
Wet Wt. of Soil + Cont. (g)	0.00
Dry Wt. of Soil + Cont. (g)	0.00
Wt. of Container (g)	1.00
Container No.	
Initial Soil Wt. (g) (Wt)	868.00
Box Constant	6.746
MC =(((1+Mci/100)x(Wa/Wt+1))-1)x100	

Min. Resistivity (ohm-cm)	Moisture Content (%)	Sulfate Content (ppm)	Chloride Content (ppm)	Soil pH	
				pH	Temp. (°C)
DOT CA Test 532 / 643		DOT CA Test 417 Part II	DOT CA Test 422	DOT CA Test 532 / 643	
1240	**39.7**	**91**	**30**	**6.86**	**20.1**



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TESTS for SULFATE CONTENT
CHLORIDE CONTENT and pH of SOILS

Project Name: SR-710 Tunnel Technical Study Tested By : V. Juliano Date: 05/06/09

Project No. : 378312.04.09.01 Data Input By: J. Ward Date: 05/27/09

Boring No.	R-09-Z3-B12	R-09-Z3-B12		
Sample No.	C34	C51		
Sample Depth (ft)	164.9-165.5	229.2-229.7		
Soil Identification:	Olive yellow lean clay'stone' (CL)	Olive silt'stone' (ML)		
Wet Weight of Soil + Container (g)	124.50	151.00		
Dry Weight of Soil + Container (g)	110.70	140.00		
Weight of Container (g)	60.70	68.90		
Moisture Content (%)	27.60	15.47		
Weight of Soaked Soil (g)	100.20	100.20		

SULFATE CONTENT, DOT California Test 417, Part II

Beaker No.	9	11		
Crucible No.	23	25		
Furnace Temperature (°C)	830	830		
Time In / Time Out	7:40 / 8:25	7:40 / 8:25		
Duration of Combustion (min)	45	45		
Wt. of Crucible + Residue (g)	18.4160	18.8932		
Wt. of Crucible (g)	18.4145	18.8768		
Wt. of Residue (g) (A)	0.0015	0.0164		
PPM of Sulfate (A) x 41150	61.73	674.86		
PPM of Sulfate, Dry Weight Basis	**85**	**798**		

CHLORIDE CONTENT, DOT California Test 422

ml of Chloride Soln. For Titration (B)	30	30		
ml of AgNO3 Soln. Used in Titration (C)	0.5	0.7		
PPM of Chloride (C -0.2) * 100 * 30 / B	30	50		
PPM of Chloride, Dry Wt. Basis	**41**	**59**		

pH TEST, DOT California Test 532/643

pH Value	**7.76**	**7.41**		
Temperature °C	19.8	19.8		

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SOIL RESISTIVITY TEST

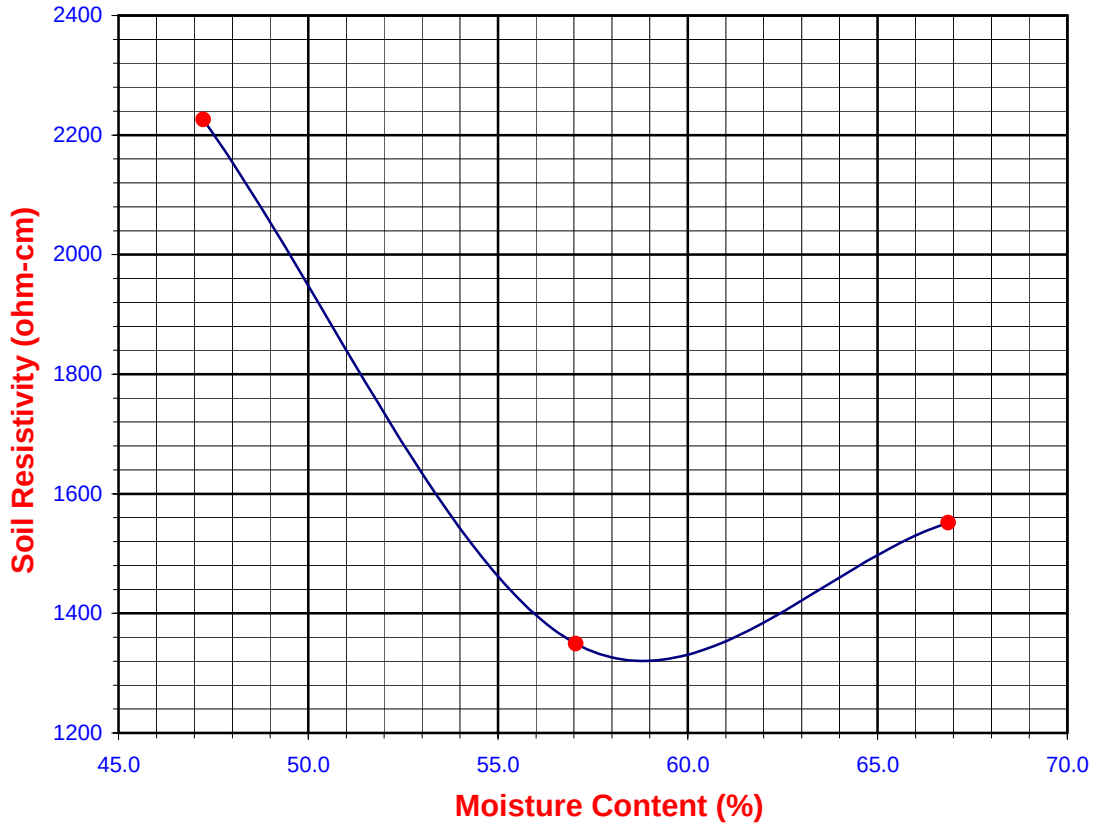
DOT CA TEST 532 / 643

Project Name:	SR-710 Tunnel Technical Study	Tested By :	V. Juliano Date: 05/13/09
Project No. :	378312.04.09.01	Data Input By:	J. Ward Date: 05/27/09
Boring No.:	R-09-Z3-B12	Depth (ft.) :	164.9-165.5
Sample No. :	C34		
Soil Identification:	Olive yellow lean clay'stone' (CL)		

Specimen No.	Water Added (ml) (Wa)	Adjusted Moisture Content (MC)	Resistance Reading (ohm)	Soil Resistivity (ohm-cm)
1	200	47.23	330	2226
2	300	57.05	200	1349
3	400	66.86	230	1552
4				
5				

Moisture Content (%) (MCi)	27.60
Wet Wt. of Soil + Cont. (g)	124.50
Dry Wt. of Soil + Cont. (g)	110.70
Wt. of Container (g)	60.70
Container No.	
Initial Soil Wt. (g) (Wt)	1300.00
Box Constant	6.746
MC =(((1+Mci/100)x(Wa/Wt+1))-1)x100	

Min. Resistivity (ohm-cm)	Moisture Content (%)	Sulfate Content (ppm)	Chloride Content (ppm)	Soil pH	
				pH	Temp. (°C)
DOT CA Test 532 / 643		DOT CA Test 417 Part II	DOT CA Test 422	DOT CA Test 532 / 643	
1320	**58.7**	**85**	**41**	**7.76**	**19.8**



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SOIL RESISTIVITY TEST

DOT CA TEST 532 / 643

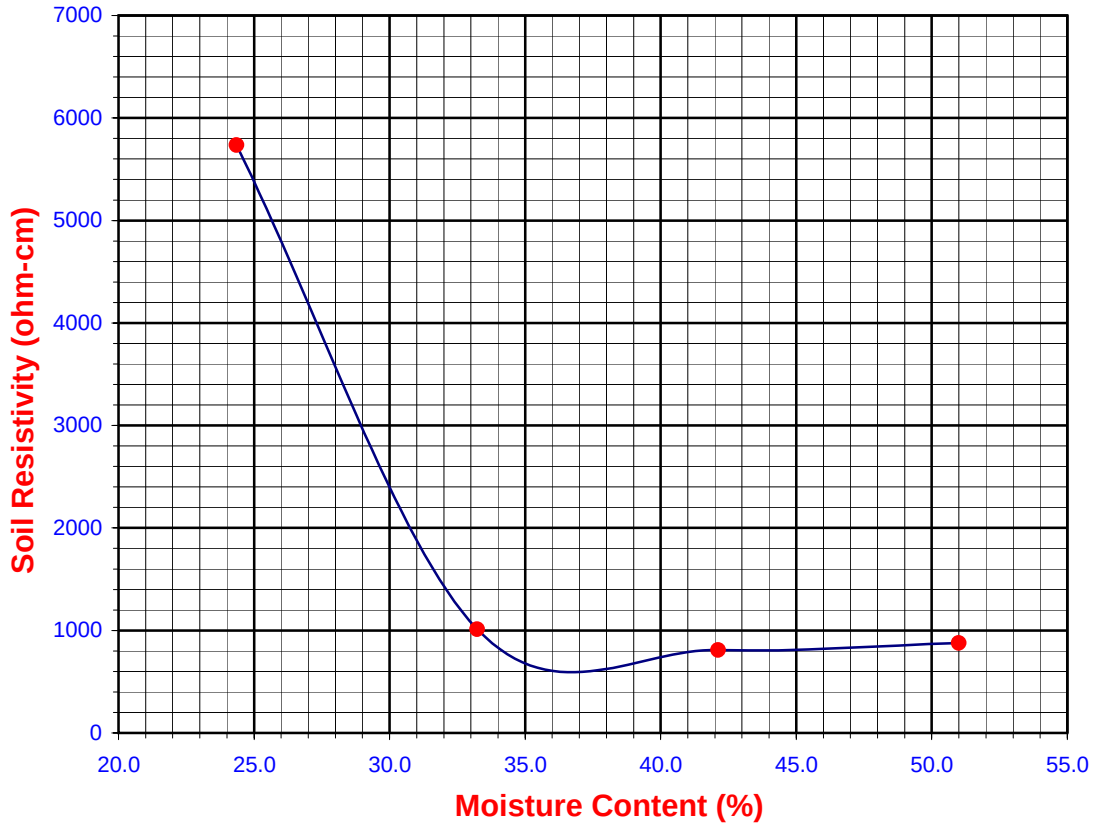
Project Name: SR-710 Tunnel Technical Study
Project No. : 378312.04.09.01
Boring No.: R-09-Z3-B12
Sample No. : C51
Soil Identification: Olive silt'stone' (ML)

Tested By : V. Juliano Date: 05/13/09
Data Input By: J. Ward Date: 05/27/09
Depth (ft.) : 229.2-229.7

Specimen No.	Water Added (ml) (Wa)	Adjusted Moisture Content (MC)	Resistance Reading (ohm)	Soil Resistivity (ohm-cm)
1	100	24.35	850	5734
2	200	33.24	150	1012
3	300	42.12	120	810
4	400	51.00	130	877
5				

Moisture Content (%) (MCi)	15.47
Wet Wt. of Soil + Cont. (g)	151.00
Dry Wt. of Soil + Cont. (g)	140.00
Wt. of Container (g)	68.90
Container No.	
Initial Soil Wt. (g) (Wt)	1300.00
Box Constant	6.746
MC =(((1+Mci/100)x(Wa/Wt+1))-1)x100	

Min. Resistivity (ohm-cm)	Moisture Content (%)	Sulfate Content (ppm)	Chloride Content (ppm)	Soil pH	
				pH	Temp. (°C)
DOT CA Test 532 / 643		DOT CA Test 417 Part II	DOT CA Test 422	DOT CA Test 532 / 643	
600	**36.7**	**798**	**59**	**7.41**	**19.8**



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TESTS for SULFATE CONTENT
CHLORIDE CONTENT and pH of SOILS

Project Name: SR-710 Tunnel Technical Study Tested By : V. Juliano Date: 05/06/09

Project No. : 378312.04.09.01 Data Input By: J. Ward Date: 05/21/09

Boring No.	R-09-Z4-B4	R-09-Z4-B4		
Sample No.	C-19	C-38		
Sample Depth (ft)	97.5-98.3	220.5-221.5		
Soil Identification:	Yellow fat clay'stone' (CH)	Dark olive silt'stone' (ML)		
Wet Weight of Soil + Container (g)	0.00	0.00		
Dry Weight of Soil + Container (g)	0.00	0.00		
Weight of Container (g)	1.00	1.00		
Moisture Content (%)	0.00	0.00		
Weight of Soaked Soil (g)	100.10	100.30		

SULFATE CONTENT, DOT California Test 417, Part II

Beaker No.	6	8		
Crucible No.	15	18		
Furnace Temperature (°C)	830	830		
Time In / Time Out	7:40 / 8:25	7:40 / 8:25		
Duration of Combustion (min)	45	45		
Wt. of Crucible + Residue (g)	20.3168	19.8312		
Wt. of Crucible (g)	20.3163	19.7354		
Wt. of Residue (g) (A)	0.0005	0.0958		
PPM of Sulfate (A) x 41150	20.58	3942.17		
PPM of Sulfate, Dry Weight Basis	**21**	**3942**		

CHLORIDE CONTENT, DOT California Test 422

ml of Chloride Soln. For Titration (B)	30	30		
ml of AgNO3 Soln. Used in Titration (C)	0.4	0.8		
PPM of Chloride (C -0.2) * 100 * 30 / B	20	60		
PPM of Chloride, Dry Wt. Basis	**20**	**60**		

pH TEST, DOT California Test 532/643

pH Value	**6.57**	**4.63**		
Temperature °C	20.7	20.6		

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SOIL RESISTIVITY TEST

DOT CA TEST 532 / 643

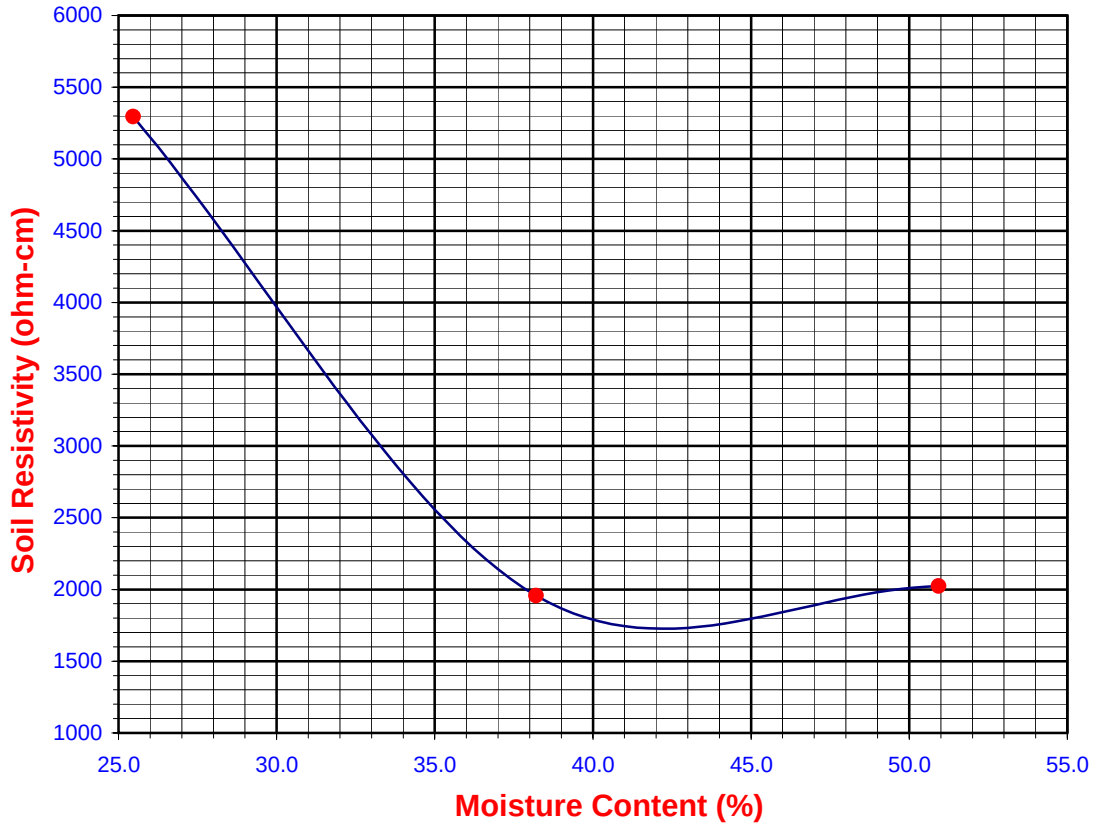
Project Name: SR-710 Tunnel Technical Study
Project No. : 378312.04.09.01
Boring No.: R-09-Z4-B4
Sample No. : C-19
Soil Identification: Yellow fat clay'stone' (CH)

Tested By : V. Juliano Date: 05/15/09
Data Input By: J. Ward Date: 05/21/09
Depth (ft.) : 97.5-98.3

Specimen No.	Water Added (ml) (Wa)	Adjusted Moisture Content (MC)	Resistance Reading (ohm)	Soil Resistivity (ohm-cm)
1	300	25.47	785	5296
2	450	38.20	290	1956
3	600	50.93	300	2024
4				
5				

Moisture Content (%) (MCi)	0.00
Wet Wt. of Soil + Cont. (g)	0.00
Dry Wt. of Soil + Cont. (g)	0.00
Wt. of Container (g)	1.00
Container No.	
Initial Soil Wt. (g) (Wt)	1178.00
Box Constant	6.746
MC =(((1+Mci/100)x(Wa/Wt+1))-1)x100	

Min. Resistivity (ohm-cm)	Moisture Content (%)	Sulfate Content (ppm)	Chloride Content (ppm)	Soil pH	
				pH	Temp. (°C)
DOT CA Test 532 / 643		DOT CA Test 417 Part II	DOT CA Test 422	DOT CA Test 532 / 643	
1720	**42.2**	**21**	**20**	**6.57**	**20.7**



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SOIL RESISTIVITY TEST

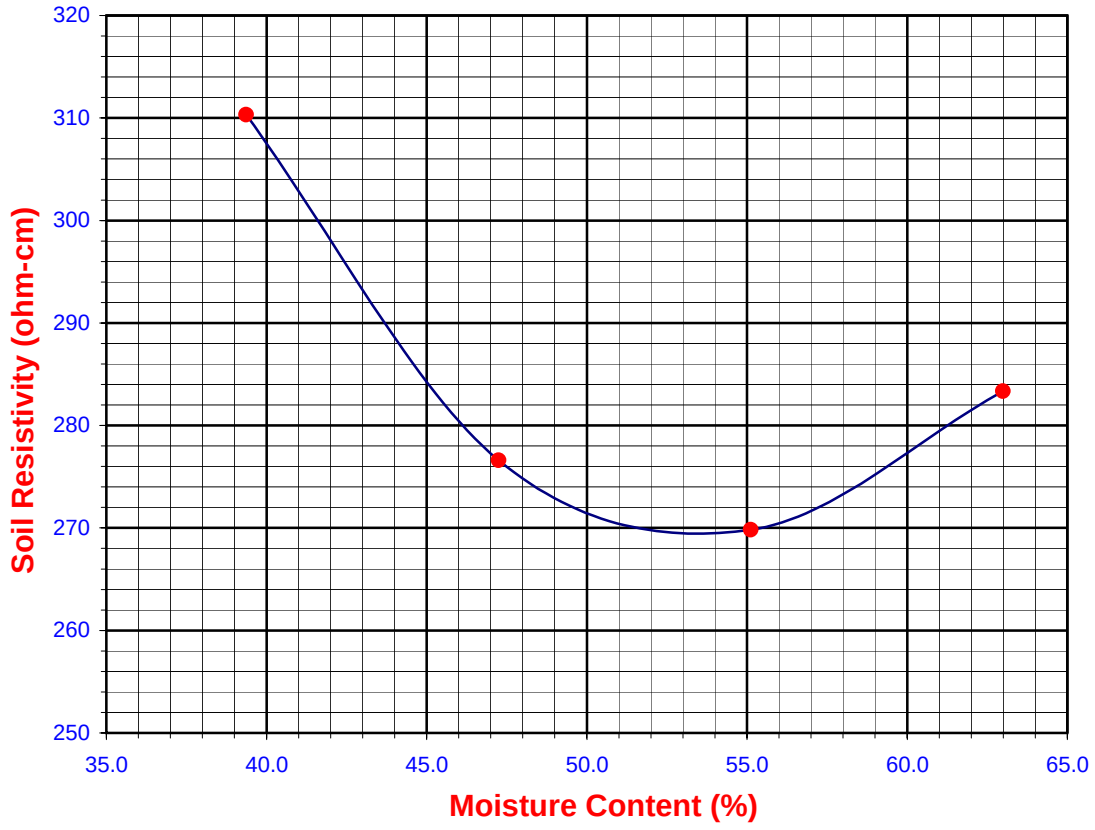
DOT CA TEST 532 / 643

Project Name:	SR-710 Tunnel Technical Study		Tested By :	V. Juliano	Date: 05/15/09
Project No. :	378312.04.09.01		Data Input By:	J. Ward	Date: 05/21/09
Boring No.:	R-09-Z4-B4		Depth (ft.) :	220.5-221.5	
Sample No. :	C-38				
Soil Identification:	Dark olive silt'stone' (ML)				

Specimen No.	Water Added (ml) (Wa)	Adjusted Moisture Content (MC)	Resistance Reading (ohm)	Soil Resistivity (ohm-cm)
1	500	39.37	46	310
2	600	47.24	41	277
3	700	55.12	40	270
4	800	62.99	42	283
5				

Moisture Content (%) (MCi)	0.00
Wet Wt. of Soil + Cont. (g)	0.00
Dry Wt. of Soil + Cont. (g)	0.00
Wt. of Container (g)	1.00
Container No.	
Initial Soil Wt. (g) (Wt)	1270.00
Box Constant	6.746
MC =(((1+Mci/100)x(Wa/Wt+1))-1)x100	

Min. Resistivity (ohm-cm)	Moisture Content (%)	Sulfate Content (ppm)	Chloride Content (ppm)	Soil pH	
				pH	Temp. (°C)
DOT CA Test 532 / 643		DOT CA Test 417 Part II	DOT CA Test 422	DOT CA Test 532 / 643	
269	**53.4**	**3942**	**60**	**4.63**	**20.6**



AP Engineering & Testing, Inc.

EXPANSION INDEX TEST RESULTS

ASTM D 4829

Project Name: SR-710 Tunnel Technical Study Tested By: DK Date: 06-09-09

Project No.: 378312.04.09.01 Checked By: AP Date: 06-15-09

Boring No.	Sample No.	Depth (ft)	Soil Description	Molded Dry Density (pcf)	Molded Moisture Content (%)	Init. Degree Saturation (%)	Measured Expansion Index	Corrected Expansion Index
R-09-Z2-B4	C49	185-189	Dark Gray Siltstone	100.1	13.3	52.4	75	77

ASTM EXPANSION CLASSIFICATION

Expansion Index	Classification
0-20	V. Low
21-50	Low
51-90	Medium
91-130	High
>130	V. High

AP Engineering & Testing, Inc.

EXPANSION INDEX TEST RESULTS

ASTM D 4829

Project Name: SR-710 Tunnel Technical Study Tested By: DK Date: 06-02-09

Project No.: 378312.04.09.01 Checked By: AP Date: 06-11-09

Boring No.	Sample No.	Depth (ft)	Soil Description	Molded Dry Density (pcf)	Molded Moisture Content (%)	Init. Degree Saturation (%)	Measured Expansion Index	Corrected Expansion Index
R-09-Z3-B10	C-67	260-265	Dark Gray Siltstone	99.4	14.1	54.7	65	69

ASTM EXPANSION CLASSIFICATION

Expansion Index	Classification
0-20	V. Low
21-50	Low
51-90	Medium
91-130	High
>130	V. High

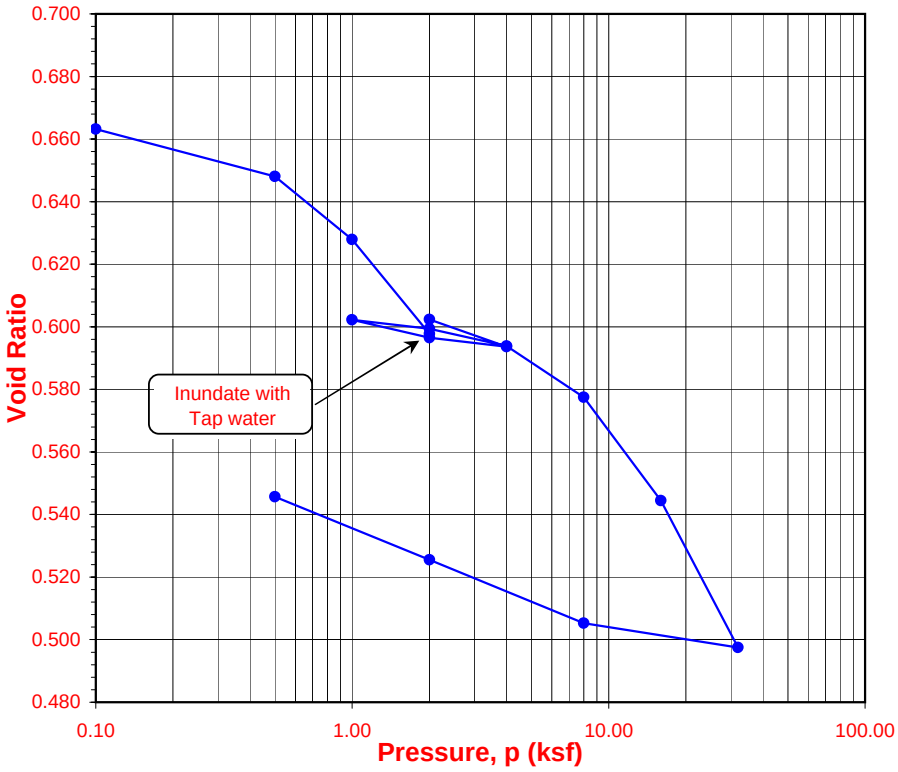
Leighton

ONE-DIMENSIONAL CONSOLIDATION PROPERTIES of SOILS

(ASTM D 2435)

Project Name:	SR-710 Tunnel Technical Study	Tested By: G. Bathala	Date: 05/26/09
Project No.:	378312.04.09.01	Checked By: J. Ward	Date: 06/17/09
Boring No.:	R-09-Z2-B5	Depth (ft.): 105.0	
Sample No.:	O21	Sample Type: Drive	
Soil Identification:	Olive brown lean clay (CL)		

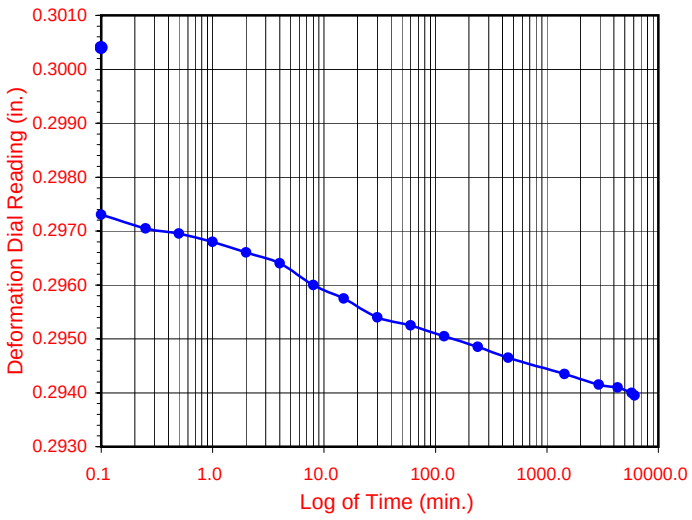
Sample Diameter (in.)	1.878
Sample Thickness (in.)	1.000
Wt. of Sample + Ring (g)	135.65
Weight of Ring (g)	42.17
Height after consol. (in.)	0.9276
Before Test	
Wt.Wet Sample+Cont. (g)	122.21
Wt.of Dry Sample+Cont. (g)	101.47
Weight of Container (g)	24.91
Initial Moisture Content (%)	27.1
Initial Dry Density (pcf)	101.2
Initial Saturation (%)	110
Initial Vertical Reading (in.)	0.3411
After Test	
Wt.of Wet Sample+Cont. (g)	172.70
Wt. of Dry Sample+Cont. (g)	156.50
Weight of Container (g)	39.56
Final Moisture Content (%)	21.67
Final Dry Density (pcf)	110.9
Final Saturation (%)	112
Final Vertical Reading (in.)	0.2650
Specific Gravity (assumed)	2.70
Water Density (pcf)	62.43

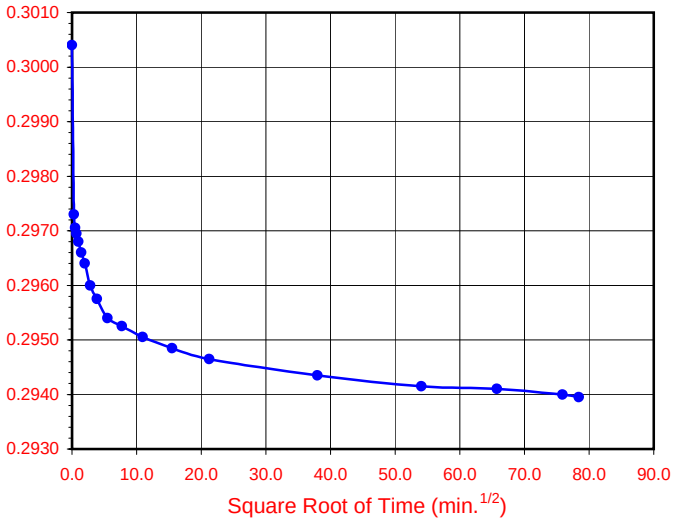


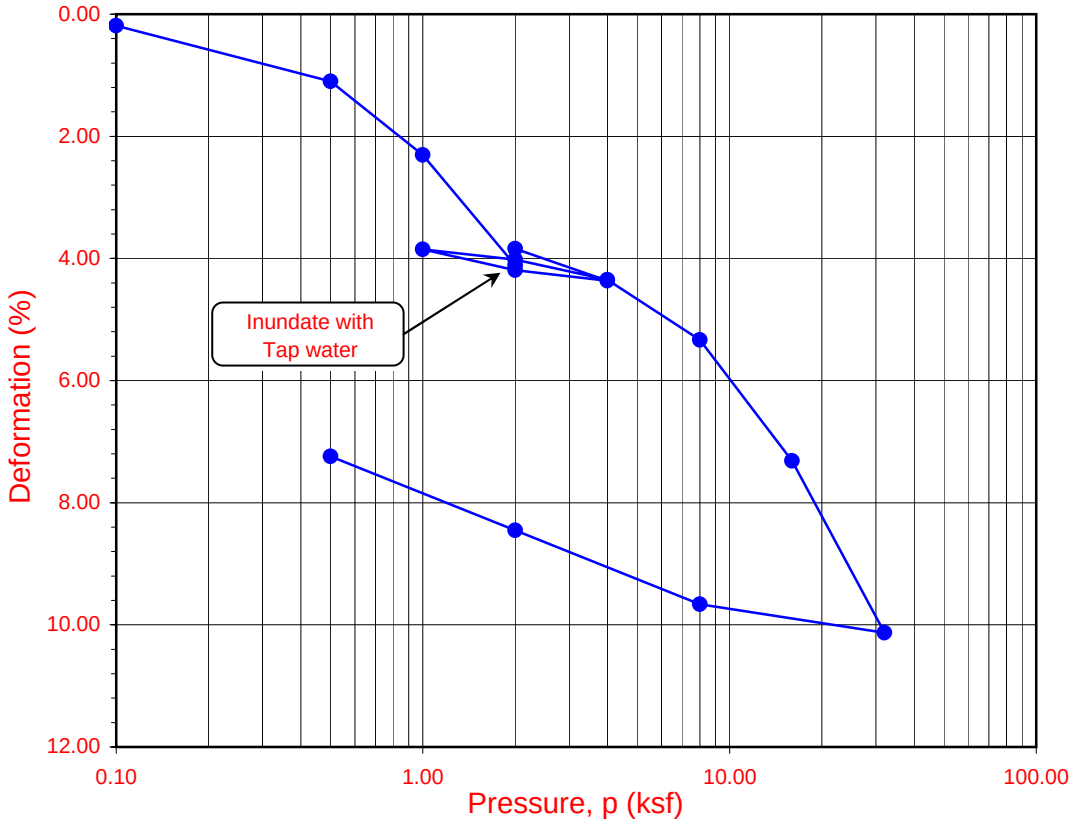
Pressure (p) (ksf)	Final Reading (in.)	Apparent Thickness (in.)	Load Compliance (%)	Deformation % of Sample Thickness	Void Ratio	Corrected Deformation (%)
0.10	0.3392	0.9981	0.00	0.19	0.663	0.19
0.50	0.3291	0.9880	0.10	1.20	0.648	1.10
1.00	0.3166	0.9755	0.15	2.46	0.628	2.31
2.00	0.2977	0.9566	0.23	4.35	0.598	4.12
2.00	0.3004	0.9593	0.23	4.07	0.602	3.84
4.00	0.2940	0.9529	0.35	4.72	0.594	4.37
2.00	0.2964	0.9553	0.28	4.47	0.597	4.19
1.00	0.3003	0.9592	0.23	4.08	0.602	3.85
2.00	0.2983	0.9572	0.26	4.28	0.599	4.02
4.00	0.2941	0.9530	0.35	4.70	0.594	4.35
8.00	0.2826	0.9415	0.52	5.86	0.577	5.34
16.00	0.2604	0.9193	0.76	8.08	0.544	7.32
32.00	0.2292	0.8881	1.06	11.19	0.498	10.13
8.00	0.2374	0.8963	0.71	10.38	0.505	9.67
2.00	0.2517	0.9106	0.49	8.94	0.526	8.45
0.50	0.2650	0.9239	0.37	7.61	0.546	7.24

Time Readings @ 4.0 ksf				
Date	Time	Elapsed Time (min)	Square Root of Time	Dial Rdgs. (in.)
6/1/09	8:30:00	0.0	0.0	0.3004
6/1/09	8:30:06	0.1	0.3	0.2973
6/1/09	8:30:15	0.2	0.5	0.2971
6/1/09	8:30:30	0.5	0.7	0.2970
6/1/09	8:31:00	1.0	1.0	0.2968
6/1/09	8:32:00	2.0	1.4	0.2966
6/1/09	8:34:00	4.0	2.0	0.2964
6/1/09	8:38:00	8.0	2.8	0.2960
6/1/09	8:45:00	15.0	3.9	0.2958
6/1/09	9:00:00	30.0	5.5	0.2954
6/1/09	9:30:00	60.0	7.7	0.2953
6/1/09	10:30:00	120.0	11.0	0.2951
6/1/09	12:30:00	240.0	15.5	0.2949
6/1/09	16:00:00	450.0	21.2	0.2947
6/2/09	8:30:00	1440.0	37.9	0.2944
6/3/09	9:10:00	2920.0	54.0	0.2942
6/4/09	8:30:00	4320.0	65.7	0.2941
6/5/09	8:30:00	5760.0	75.9	0.2940
6/5/09	15:00:00	6150.0	78.4	0.2940

Time Readings @ 4.0 ksf







Boring No.	Sample No.	Depth (ft.)	Moisture Content (%)		Dry Density (pcf)		Void Ratio		Degree of Saturation (%)	
			Initial	Final	Initial	Final	Initial	Final	Initial	Final
R-09-Z2-B5	**O21**	**105.0**	**27.1**	**21.7**	**101.2**	**110.9**	**0.666**	**0.546**	**110**	**112**

Soil Identification: Olive brown lean clay (CL)

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ONE-DIMENSIONAL CONSOLIDATION PROPERTIES of SOILS
(ASTM D 2435)

Project No.: 378312.04.09.01

SR-710 Tunnel Technical Study

06-09

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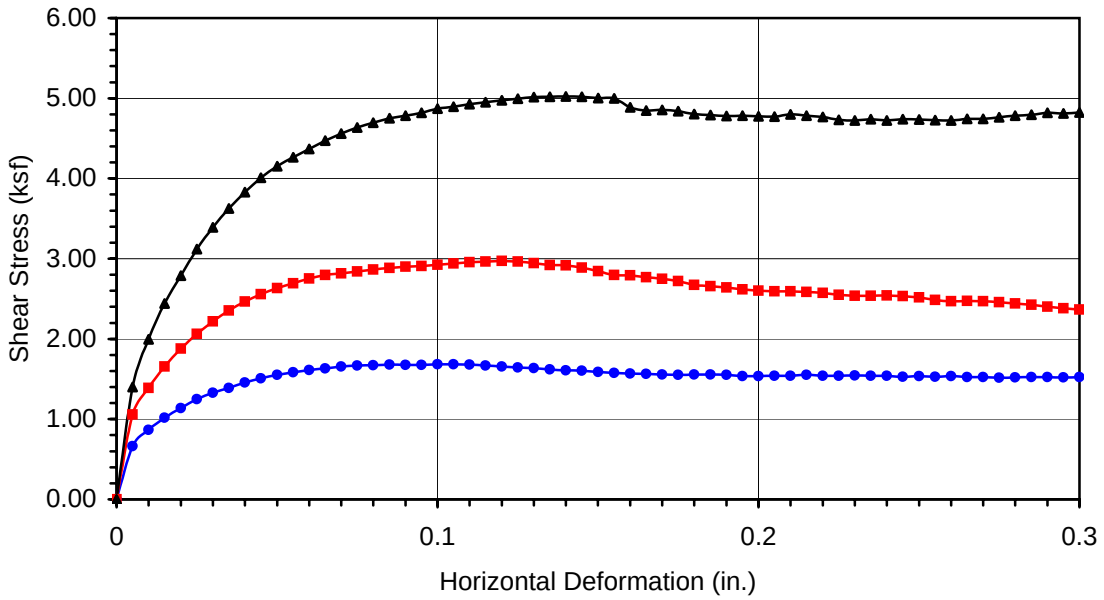
DIRECT SHEAR TEST

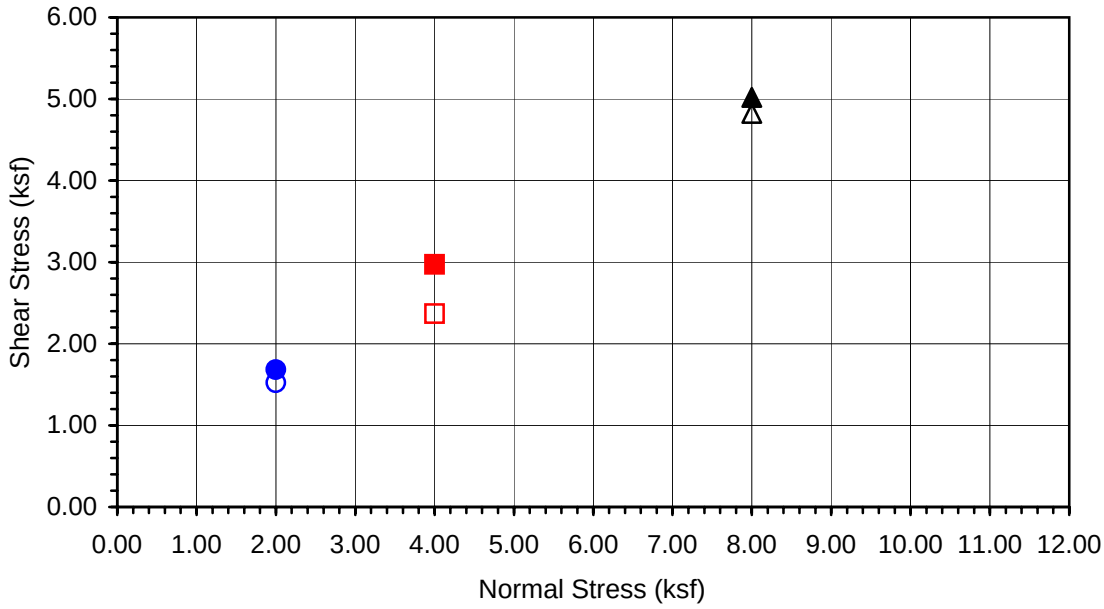
Consolidated Drained - ASTM D 3080

Project Name:	SR-710 Tunnel Technical Study	Tested By:	F. Tabibkhoei	Date:	04/02/09
Project No.:	378312.04.09.01	Checked By:	J. Ward	Date:	04/08/09
Boring No.:	R-09-Z1-B8	Sample Type:	Drive		
Sample No.:	O-9	Depth (ft.):	40-45		

Soil Identification: Olive brown silty, clayey sand (SC-SM)

Sample Diameter(in):	2.415	2.415	2.415
Sample Thickness(in.):	1.000	1.000	1.000
Weight of Sample + ring(gm):	202.64	204.45	205.29
Weight of Ring(gm):	44.95	43.17	43.41
Before Shearing			
Weight of Wet Sample+Cont.(gm):	259.61	259.61	259.61
Weight of Dry Sample+Cont.(gm):	221.30	221.30	221.30
Weight of Container(gm):	38.48	38.48	38.48
Vertical Rdg.(in): Initial	0.0000	0.2760	0.2545
Vertical Rdg.(in): Final	-0.0177	0.3023	0.2949
After Shearing			
Weight of Wet Sample+Cont.(gm):	196.12	198.66	195.96
Weight of Dry Sample+Cont.(gm):	169.26	175.24	172.96
Weight of Container(gm):	39.03	39.24	38.58
Specific Gravity (Assumed):	2.70	2.70	2.70
Water Density(pcf):	62.43	62.43	62.43





Boring No.	**R-09-Z1-B8**
Sample No.	**O-9**
Depth (ft)	**40-45**
Sample Type: Drive	
Soil Identification: Olive brown silty, clayey sand (SC-SM)	

Normal Stress (kip/ft²)	2.000	4.000	8.000
Peak Shear Stress (kip/ft²)	● 1.682	■ 2.974	▲ 5.021
Shear Stress @ End of Test (ksf)	○ 1.522	□ 2.367	△ 4.823
Deformation Rate (in./min.)	0.0025	0.0025	0.0025
Initial Sample Height (in.)	1.000	1.000	1.000
Diameter (in.)	2.415	2.415	2.415
Initial Moisture Content (%)	20.96	20.96	20.96
Dry Density (pcf)	108.4	110.9	111.3
Saturation (%)	102.0	108.8	110.0
Soil Height Before Shearing (in.)	0.9823	0.9737	0.9596
Final Moisture Content (%)	20.6	17.2	17.1

Leighton

DIRECT SHEAR TEST RESULTS

Consolidated Drained - ASTM D 3080

Project No.: 378312.04.09.01

SR-710 Tunnel Technical Study

04-09

Point Load Testing

BORING R-09-Z1B3 PQ CORE 3.25" DIA							
RUN	**DEPTH ft**	**LENGTH in**	**NOTE**	**PRESSURE psi**	**ROCK TYPE**	**LOAD lb**	**POINT LOAD INDEX (psi)**
31	298.3	11.5		275	SS	484	58.86
26	267	18		300	SS	528	64.21
26	269	11		150	SS	264	32.10
27	270.3	11.5		150	SS	264	32.10
27	272	8.5		325	SS	572	69.56
27	273.9	11.5		300	SS	528	64.21
27	274.9	5.5	Not Valid	1925	SS	3388	411.99
27	275.5	11		375	SILTST/SS	660	80.26
27	276.6	10.5		425	SS	748	90.96
28	278.2	15		500	SILTST/SS	880	107.01
29	280	8.5		100	SS	176	21.40
29	282.5	9.5		375	SILTST	660	80.26
29	283.6	14		450	SS	792	96.31
29	287	16		250	SS	440	53.51
29	288.1	10.5		400	SS	704	85.61
31	289.6	14		2525	SS	4444	540.40
31	291.3	9	Too Soft	99	SS	174	21.19
30	294.5	20		400	SS	704	85.61
30	296.3	8.5	Not Valid	875	SILTST/SS	1540	187.27
30	297.4	14		275	SS	484	58.86
31	302.1	6.5		375	SILST	660	80.26
31	300.6	10		300	SS	528	64.21
26	263.5	10		275	SS	484	58.86
26	264.4	6		375	SS	660	80.26
26	265.3	20		200	SS	352	42.80
25	259.6	10	Too Soft	99	SILTST/SS	174	21.19
27	261.6	11	Too Soft	99	SS	174	21.19
25	254.7	17	Not Valid	625	SILTST	1100	133.76
25	256.4	11.5		175	SS	308	37.45
25	257.5	14		225	SS	396	48.15
25	255.1	8		150	SS	264	32.10
25	252.4	9	Not Valid	350	SILTST/SS	616	74.91
25	253.2	9.5		300	SS	528	64.21
24	247.7	10		100	SS	176	21.40
24	248.8	14.5		200	SS	352	42.80
24	247.8	7		225	SILST/SS	396	48.15
24	247.1	7		150	SS	264	32.10
24	240.4	11		2200	SS-CEMENTED	3872	470.84
24	243.3	14		100	SS	176	21.40
23	238.8	6.5	Too Soft	99	SS	174	21.19
23	234.3	11		300	SS	528	64.21
23	236.4	15.5		250	SS	440	53.51
23	237.7	10		275	SS	484	58.86
23	231	14	Too Soft	99	SS	174	21.19
23	233.5	9.5		225	SS	396	48.15
22	227	7.5		125	SS	220	26.75
22	228.3	13.5		125	SS	220	26.75
22	229.2	9		175	SS	308	37.45
21	220.8	18		275	SS	484	58.86
21	220	9		250	SS	440	53.51
21	223.3	21		300	SS	528	64.21
21	218.7	9		100	SS	176	21.40
20	210.1	19		125	SS	220	26.75
20	211.9	9		225	SS	396	48.15
20	212.6	9	Too Soft	99	SS	174	21.19
20	206.3	15		100	SS	176	21.40
20	208.8	9		150	SS	264	32.10
17	198.2	5		350	SILTST	616	74.91
17	193.5	10		575	SILTST	1012	123.06

17	195.9	6.5		200	SS	352	42.80
17	196.5	9		225	SS	396	48.15
16	189	12		-	SILTST/SS FRACT. W/ HANDLING		
17	190.4	9		375	SS	660	80.26
17	191.7	7.5		250	SS	440	53.51
17	172.2	4.5		600	SILTST	1056	128.41
16	187.1	12		525	SILTST/SS	924	112.36
16	188	16		550	SILTST/SS	968	117.71
16	182.3	16		250	SILTST/SS	440	53.51
16	183.4	11		100	SILTST/SS	176	21.40
16	184.3	10		375	SS	660	80.26
15	177.2	13		225	SS	396	48.15
16	180.7	13.5		250	SILTST/SS	440	53.51
BORING R-09-Z2B1 PQ CORE=3.25DIAM.							
22	115	5	Too Soft	99	SS/SILTST	174	21.19
23	120	6	Too Soft	99	SILTST	174	21.19
27	140	6	Too Soft	99	SS	174	21.19
BORING R-09-Z3B3 PQ CORE=3.25DIAM.							
31	269.9	14	Too Soft	99	FAULT GOUGE	174	21.19
30	256.3	6		125	RECEMENT DIORIT	220	26.75
BORING R-09-Z1B2 HQ CORE DIAM= 2.38							
64	298	5	Too Soft	99	SS/SILTST	174	33.81
65	301.2	5		225	SS	396	76.84
65	304.1	6	Too Soft	99	SILTST	174	33.81
35	304.9	5	Too Soft	99	SILTST	174	33.81
62	286.6	7	Too Soft	99	SS	174	33.81
62	287.2	7		175	SS	308	59.77
60	278	5		125	SS	220	42.69
60	278.5	5	Too Soft	99	SS	174	33.81
60	280.3	9		125	SS	220	42.69
61	281.9	5	Too Soft	99	SS	174	33.81
61	282.5	6		175	SS	308	59.77
61	284.3	7		150	SS	264	51.23
58	269.5	7		250	SS	440	85.38
59	271.9	5		250	SILTST	440	85.38
57	261.5	7	Too Soft	99	SS/SILTST	174	33.81
57	264.2	6	Not Valid	99	SILTST	174	33.81
57	264.8	10		275	SILTST	484	93.92
57	266	5		250	SS	440	85.38
58	266.5	6		150	SS/SILTST	264	51.23
58	267.4	8		125	SS/SILTST	220	42.69
58	268	5		125	SS/SILTST	220	42.69
54	252.8	13		225	SILTST/SS	396	76.84
54	253.7	6	Not Valid	250	SS	440	85.38
54	253.9	6	Too Soft	99	SS	174	33.81
50	234.7	7		100	SS	176	34.15
51	244.3	13		200	SILTST	352	68.30
48	230.8	6	Not Valid	700	SS-CONCRETION FRACTURED ALONG HEALED JOINT PARALLEL TO AXIS	1232	239.06
49	232.3	7		100	SS	176	34.15
49	233.3	7		100	SS	176	34.15
50	236.2	6	Too Soft	99	SS	174	33.81
50	236.8	6		100	SS	176	34.15
47	222.6	6		100	SS	176	34.15
47	223.6	7		100	SS	176	34.15
48	227.6	9		2975	SS CONCRETION	5236	1016.02
48	228.8	5		150	SS	264	51.23
45	216.1	7	Too Soft	99	SILTST	174	33.81
45	216.9	9	Too Soft	99	SS	174	33.81
45	218.3	8		150	SS	264	51.23
45	217.2	12	Too Soft	99	SS	174	33.81
43	205.8	5		125	SILTST	220	42.69

43	206.3	5		100	SS	176	34.15
43	207	6		100	SS	176	34.15
4	207.7	10	Too Soft	99	SS	174	33.81
43	209	6		225	SILTST	396	76.84
44	210.4	9		175	SS/SILTST	308	59.77
44	211.3	12		225	SS	396	76.84
41	198.3	11		125	SS	220	42.69
41	199.4	7		1375	SS-CONCRETION	2420	469.59
42	200.9	6	Too Soft	99	SS	174	33.81
42	201.6	9	Too Soft	99	SS	174	33.81
42	202.8	5		100	SS	176	34.15
42	203.8	5		250	SS/SILTSTONE	440	85.38
42	204.4	7		175	SS/SILTSTONE	308	59.77
39	187.8	5		100	SS	176	34.15
39	188.9	11		150	SS	264	51.23
40	192.9	6		100	SS	176	34.15
40	193.5	7		125	SS	220	42.69
40	194.3	6		125	SS	220	42.69
37	182.4	5	Too Soft	99	SS	174	33.81
37	182.9	6	Too Soft	99	SILTST/SS	174	33.81
37	183.6	8		200	SILTSTONE	352	68.30
37	184.7	14	Too Soft	99	SS	174	33.81
38	186.6	11		150	SS/SILTSTONE	264	51.23
36	172.1	13		150	SS	264	51.23
36	173.8	9	Too Soft	99	SS	174	33.81
36	175	9		150	SS	264	51.23
36	175.5	6	Too Soft	99	SS	174	33.81
37	176.7	5		150	SS	264	51.23
37	178.4	14		150	SS	264	51.23
37	179.5	8		125	SILTST/SS	220	42.69
34	162.4	11	Too Soft	99	SS	174	33.81
34	163.9	15		125	SS	220	42.69
34	165.4	12		125	SS	220	42.69
30	147.6	15		250	SILTST/SS	440	85.38
30	150.2	5	Too Soft	99	SILTST	174	33.81

Note:
No Valid Test: Failed along existing bedding or fracture
Too Soft: Pressure is too low for the guge to measure the correct pressure

POINT LOAD STRENGTH INDEX OF ROCK

Sample Identification	Lab Sample Number	Depth, ft.	Type of Test	Point Load, lb.	Index Strength psi	Size Correction Factor	Corrected Point Load, psi	Sample Type
R-09-Z1-B7, C30	S12390	164.9 - 165.2	diametral	1882	182	1.246	227	Limestone
R-09-Z1-B7, C32	S12391	173 - 173.7	diametral	289	29	1.234	36	Sandstone
R-09-Z1-B7, C36	S12392	192.2 - 192.5	diametral	1716	167	1.245	208	Siltstone
R-09-Z1-B7, C41	S12394	210.6 - 211	diametral	612	59	1.249	73	Siltstone

Test Method: ASTM D5731

Sample Type: Rock Core

PROJECT NUMBER:	09-144	April 22, 2009	SR-710 Tunnel Technical Study

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

5040 Robert J. Mathews Blvd., El Dorado Hills, CA 95762
Phone: (916) 939-3460 FAX: (916) 939-3507

POINT LOAD STRENGTH INDEX OF ROCK

Sample Identification	Lab Sample Number	Depth, ft.	Type of Test	Point Load, lb.	Index Strength psi	Size Correction Factor	Corrected Point Load, psi	Sample Type
R-09-Z1-B7, C47	S10962	247.2-248.7	diametral	200	19	1.255	24	Sandstone
R-09-Z1-B7, C56	S10963	284.1-285.6	diametral	183	17	1.250	22	Siltstone

Test Method: ASTM D5731

Sample Type: Rock Core

PROJECT NUMBER:	09-144	April 22, 2009	SR-710 Tunnel Technical Study

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POINT LOAD STRENGTH INDEX OF ROCK

Sample Identification	Lab Sample Number	Depth, ft.	Type of Test	Point Load, lb.	Index Strength psi	Size Correction Factor	Corrected Point Load, psi	Sample Type
R-09-Z2-B3, C41	S12447	153 - 153.5	diametral	103	18	1.0900	20	Siltstone
R-09-Z2-B3, C47	S12439	180.2 - 180.7	diametral	1619	287	1.0880	312	Siltstone
R-09-Z2-B3, C70	S12443	290 - 290.8	diametral	944	167	1.0880	182	Siltstone
R-09-Z2-B3, C76	S12445	323 - 323.7	diametral	653	119	1.082	128	Siltstone

Test Method: ASTM D5731

Sample Type: Rock Core

PROJECT NUMBER:	09-144	June 1, 2009	SR-710 Tunnel Technical Study

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POINT LOAD STRENGTH INDEX OF ROCK

Sample Identification	Lab Sample Number	Depth, ft.	Type of Test	Point Load, lb.	Index Strength psi	Size Correction Factor	Corrected Point Load, psi	Sample Type
R-09-Z2-B3, C41	S12447	153 - 153.5	diametral	103	18	1.0900	20	Siltstone
R-09-Z2-B3, C47	S12439	180.2 - 180.7	diametral	1619	287	1.0880	312	Siltstone

Test Method: ASTM D5731

Sample Type: Rock Core

PROJECT NUMBER:	09-144	April 22, 2009	SR-710 Tunnel Technical Study	

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POINT LOAD STRENGTH INDEX OF ROCK

Sample Identification	Lab Sample Number	Depth, ft.	Type of Test	Point Load, lb.	Index Strength psi	Size Correction Factor	Corrected Point Load, psi	Sample Type
R-09-Z3-B1, C38	S11267	172.2 - 172.7	diametral	230	24	1.231	29	Conglom.
R-09-Z3-B1, C38	S11268	173.5 - 174	diametral	3381	327	1.247	408	Conglom.
R-09-Z3-B1, C 40	S11269	183.8 - 184.2	diametral	784	81	1.227	100	Conglom.
R-09-Z3-B1, C 42	S11271	193.5 - 193.7	diametral	5565	537	1.248	670	Diorite
R-09-Z3-B1, C 44	S11273	198.7 - 199.1	diametral	2380	227	1.250	284	Conglom.
R-09-Z3-B1, C 45	S11274	202.3 - 202.6	diametral	1152	112	1.256	139	Conglom.
R-09-Z3-B1, C 52	S11277	238.5 - 238.8	diametral	950	96	1.236	118	Diorite
R-09-Z3-B1, C 52	S11279	239.3 - 239.9	diametral	158	17	1.224	20	Conglom.
R-09-Z3-B1, C 53	S11280	241.5 - 241.9	diametral	448	49	1.212	60	Conglom.
R-09-Z3-B1, C55	S11281	253.5 - 253.8	diametral	822	81	1.240	101	Diorite
R-09-Z3-B1, C 58	S11284	270.5 - 270.9	diametral	117	13	1.218	15	Conglom.

Test Method: ASTM D5731

Sample Type: Rock Core

PROJECT NUMBER:	09-144	April 22, 2009

SR-710 Tunnel Technical Study

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POINT LOAD STRENGTH INDEX OF ROCK

Sample Identification	Lab Sample Number	Depth, ft.	Type of Test	Point Load, lb.	Index Strength psi	Size Correction Factor	Corrected Point Load, psi	Sample Type
R-09-Z3-B1, C52	S11276	236.8 - 237.2	diametral	460	45	1.244	56	Conglom.
R-09-Z3-B1, C57	S11282	257 - 257.4	diametral	447	48	1.210	59	Conglom.

Test Method: ASTM D5731

Sample Type: Rock Core

PROJECT NUMBER:	09-144	April 22, 2009

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POINT LOAD STRENGTH INDEX OF ROCK

Sample Identification	Lab Sample Number	Depth, ft.	Type of Test	Point Load, lb.	Index Strength psi	Size Correction Factor	Corrected Point Load, psi	Sample Type
R-09-Z3-B2, C49	S11029	146.75-148.0	diametral	633	112	1.0880	122	Quartzite
R-09-Z3-B2, C54	S11030	171.4-171.7	diametral	286	50	1.0930	54	Quartzite
R-09-Z3-B2, C68	S11031	227-228.1	diametral	127	22	1.0900	24	Quartzite

Test Method: ASTM D5731

Sample Type: Rock Core

PROJECT NUMBER:	09-144	April 22, 2009	SR-710 Tunnel Technical Study

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POINT LOAD STRENGTH INDEX OF ROCK

Sample Identification	Lab Sample Number	Depth, ft.	Type of Test	Point Load, lb.	Index Strength psi	Size Correction Factor	Corrected Point Load, psi	Sample Type
R-09-Z3-B4, C45	S11259	220.5 - 221.8	axial	25	5	1.046	6	Andesite
R-09-Z3-B4, C48	S11260	236.5 - 237	diametral	1557	150	1.248	187	Diorite
R-09-Z3-B4, C52	S11261	248.7 - 249.1	diametral	395	39	1.240	49	Diorite
R-09-Z3-B4, C56	S11262	270 - 270.5	diametral	873	85	1.245	106	Diorite
R-09-Z3-B4, C57	S11263	272 - 273.2	diametral	1041	103	1.240	128	Diorite

Test Method: ASTM D5731

Sample Type: Rock Core

PROJECT NUMBER:	09-144	April 22, 2009

SR-710 Tunnel Technical Study

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POINT LOAD STRENGTH INDEX OF ROCK

Sample Identification	Lab Sample Number	Depth, ft.	Type of Test	Point Load, lb.	Index Strength psi	Size Correction Factor	Corrected Point Load, psi	Sample Type
R-09-Z3-B6, C28	S11285	175.0 - 175.3	diametral	226	24	1.223	29	conglom.
R-09-Z3-B6, C32	S11286	198.3 - 198.7	diametral	129	12	1.262	15	conglom.
R-09-Z3-B6, C34	S11288	209.5 -210.0	diametral	471	45	1.248	57	conglom.
R-09-Z3-B6, C35	S11289	216.2 - 216.5	diametral	106	10	1.254	13	conglom.
R-09-Z3-B6, C36	S11291	221.0 - 222	diametral	167	16	1.256	20	conglom.
R-09-Z3-B6, C36	S11292	222.3 - 222.6	diametral	173	16	1.252	21	conglom.
R-09-Z3-B6, C37	S11293	227.0 - 228.0	irregular lump	235	25	1.216	31	conglom.
R-09-Z3-B6, C43	S11294	254.0 - 254.4	diametral	1052	106	1.235	131	diorite
R-09-Z3-B6, C52	S211298	298.0 - 298.5	diametral	33	3	1.261	4	conglom.

Test Method: ASTM D5731

Sample Type: Rock Core

PROJECT NUMBER:	09-144	April 22, 2009

SR-710 Tunnel Technical Study

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GEOTECHNICAL AND MATERIALS TESTING SERVICES

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POINT LOAD STRENGTH INDEX OF ROCK

Sample Identification	Lab Sample Number	Depth, ft.	Type of Test	Point Load, lb.	Index Strength psi	Size Correction Factor	Corrected Point Load, psi	Sample Type
R-09-Z3-B6, C44	S11296	257.5 - 257.8	diametral	1456	139	1.250	174	conglom.
R-09-Z3-B6, C49	S11738	283.8 - 284.2	diametral	163	16	1.245	20	conglom.

Test Method: ASTM D5731

Sample Type: Rock Core

PROJECT NUMBER:	09-144	April 22, 2009	SR-710 Tunnel Technical Study

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POINT LOAD STRENGTH INDEX OF ROCK

Sample Identification	Lab Sample Number	Depth, ft.	Type of Test	Point Load, lb.	Index Strength psi	Size Correction Factor	Corrected Point Load, psi	Sample Type
R-09-Z3-B7, C47	S11019	219.7-221.5	diametral	122	22	1.086	24*	Sandstone
R-09-Z3-B7, C59	S11022	262.6-264	diametral	182	32	1.093	35	Sandstone
R-09-Z3-B7, C65	S11023	281-281.9	diametral	322	32	1.238	40*	Sandstone

* Invalid failure, failure did not pas through both points of loading.

Test Method: ASTM D5731

Sample Type: Rock Core

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PROJECT NUMBER:	09-144	April 22, 2009

SR-710 Tunnel Technical Study

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POINT LOAD STRENGTH INDEX OF ROCK

Sample Identification	Lab Sample Number	Depth, ft.	Type of Test	Point Load, lb.	Index Strength psi	Size Correction Factor	Corrected Point Load, psi	Sample Type
R-09-Z3-B8, C65	S12429	265.7 - 266.4	Diametral	1488	267	1.085	290	siltstone

Test Method: ASTM D5731

Sample Type: Rock Core

PROJECT NUMBER:	09-144	May 12, 2009	SR-710 Tunnel Technical Study	

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Phone: (916) 939-3460 FAX: (916) 939-3507

POINT LOAD STRENGTH INDEX OF ROCK

Sample Identification	Lab Sample Number	Depth, ft.	Type of Test	Point Load, lb.	Index Strength psi	Size Correction Factor	Corrected Point Load, psi	Sample Type
R-09-Z3-B8, C37	S11871	156.3 - 156.5	axial	807	153	1.071	164	sandstone
R-09-Z3-B8, C40	S11872	166.4 - 166.7	diametral	856	163	1.071	174	sandstone

Test Method: ASTM D5731

Sample Type: Rock Core

PROJECT NUMBER:	09-144	May 12, 2009	SR-710 Tunnel Technical Study

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

5040 Robert J. Mathews Blvd., El Dorado Hills, CA 95762
Phone: (916) 939-3460 FAX: (916) 939-3507

POINT LOAD STRENGTH INDEX OF ROCK

Sample Identification	Lab Sample Number	Depth, ft.	Type of Test	Point Load, lb.	Index Strength psi	Size Correction Factor	Corrected Point Load, psi	Sample Type
R-09-Z3-B9, C45	S11695	271 - 271.6	diametral	220	38	1.091	42	diorite

Test Method: ASTM D5731

Sample Type: Rock Core

PROJECT NUMBER:	09-144	May 1, 2009	SR-710 Tunnel Technical Study	

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POINT LOAD STRENGTH INDEX OF ROCK

Sample Identification	Lab Sample Number	Depth, ft.	Type of Test	Point Load, lb.	Index Strength psi	Size Correction Factor	Corrected Point Load, psi	Sample Type
R-09-Z3-B9, C50	S12428	292.7 - 293	diametral	292	51	1.093	55	diorite

Test Method: ASTM D5731

Sample Type: Rock Core

PROJECT NUMBER:	09-144	May 1, 2009	SR-710 Tunnel Technical Study	

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POINT LOAD STRENGTH INDEX OF ROCK

Sample Identification	Lab Sample Number	Depth, ft.	Type of Test	Point Load, lb.	Index Strength psi	Size Correction Factor	Corrected Point Load, psi	Sample Type
R-09-Z3-B12, C62	S12431	272.5 - 273	axial	124	11	1.263	14	Shale

Test Method: ASTM D5731

Sample Type: Rock Core

PROJECT NUMBER:	09-144	May 1, 2009

SR-710 Tunnel Technical Study

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

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SLAKE DURABILITY OF SHALES AND SIMILAR WEAK ROCKS

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: May 12, 2009

Client: CH2MHill

Material Type: sandstone

Lab Sample No.: S11857

Date Received: 5/12/09

Test Method: ASTM D 4644

Test Results

Sample ID.	Sample Depth, ft.	Avg. Water Temp. @ Testing	Moisture Content @ Testing	Slake Durability Index	Description of Sample After Testing
R-09-Z1-B4, C42	171.5-171.9	20.6	13.7	**57.3**	**Type II**

Type I : Retained specimen remains virtually unchanged.
Type II : Retained specimen consists of large and small fragments.
Type III : Retained specimen is exclusively small fragments.

SLAKE DURABILITY OF SHALES AND SIMILAR WEAK ROCKS

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: May 12, 2009

Client: CH2MHill

Material Type: mudstone

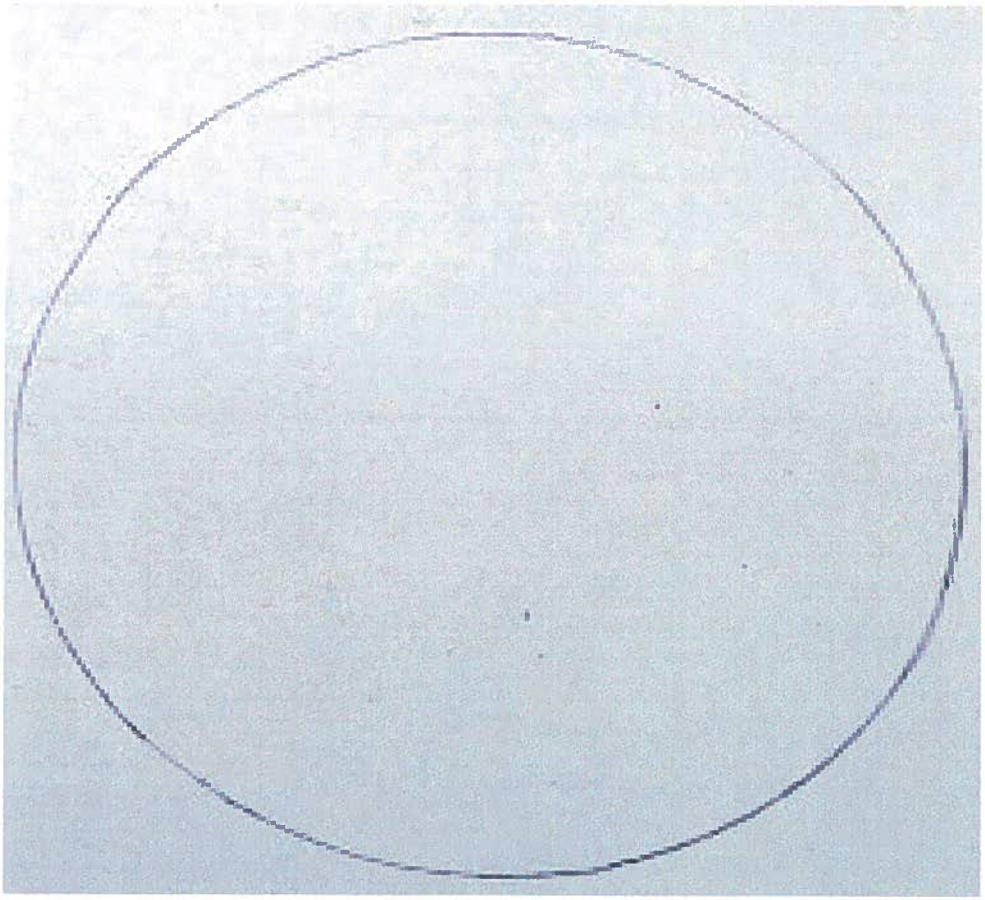
Lab Sample No.: S11859

Date Received: 5/12/09

Test Method: ASTM D 4644

Test Results

Sample ID.	Sample Depth, ft.	Avg. Water Temp. @ Testing	Moisture Content @ Testing	Slake Durability Index	Description of Sample After Testing
R-09-Z1-B4, C50	212.5-212.9	20.8	27.1	**0**	**Type III**



Type I : Retained specimen remains virtually unchanged.
Type II : Retained specimen consists of large and small fragments.
Type III : Retained specimen is exclusively small fragments.

SLAKE DURABILITY OF SHALES AND SIMILAR WEAK ROCKS

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: May 12, 2009

Client: CH2MHill

Material Type: siltstone

Lab Sample No.: S11861

Date Received: 5/12/09

Test Method: ASTM D 4644

Test Results

Sample ID.	Sample Depth, ft.	Avg. Water Temp. @ Testing	Moisture Content @ Testing	Slake Durability Index	Description of Sample After Testing
R-09-Z1-B4, C65	288.8-289.3	20.6	22.7	**31.5**	**Type II**

Type I : Retained specimen remains virtually unchanged.
Type II : Retained specimen consists of large and small fragments.
Type III : Retained specimen is exclusively small fragments.

SLAKE DURABILITY OF SHALES AND SIMILAR WEAK ROCKS

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: May 12, 2009

Client: CH2MHill

Material Type: mudstone

Lab Sample No.: S11862

Date Received: 5/12/09

Test Method: ASTM D 4644

Test Results

Sample ID.	Sample Depth, ft.	Avg. Water Temp. @ Testing	Moisture Content @ Testing	Slake Durability Index	Description of Sample After Testing
R-09-Z1-B4, C69	307-307.8	20.5	17.2	**69.1**	**Type II**

Type I : Retained specimen remains virtually unchanged.
Type II : Retained specimen consists of large and small fragments.
Type III : Retained specimen is exclusively small fragments.

SLAKE DURABILITY OF SHALES AND SIMILAR WEAK ROCKS

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: April 24, 2009

Client: CH2MHill

Material Type: Siltstone

Lab Sample No.: S11033

Date Received: 4/10/09

Test Method: ASTM D 4644

Test Results

Sample ID.	Sample Depth, ft.	Avg. Water Temp. @ Testing, C	Moisture Content @ Testing	Slake Durability Index	Description of Sample After Testing
R-09-Z1-B5, C35	230.6-231.5	21.1	15.1	**56.5**	**Type II**

Type I : Retained specimen remains virtually unchanged.
Type II : Retained specimen consists of large and small fragments.
Type III : Retained specimen is exclusively small fragments.

SLAKE DURABILITY OF SHALES AND SIMILAR WEAK ROCKS

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: April 27, 2009

Client: CH2MHill

Material Type: Siltstone

Lab Sample No.: S11256

Date Received: 4/17/09

Test Method: ASTM D 4644

Test Results

Sample ID.	Sample Depth, ft.	Avg. Water Temp. @ Testing	Moisture Content @ Testing	Slake Durability Index	Description of Sample After Testing
R-09-Z1-B5, C51	353.8-354.2	20.6	19.6	**51.5**	**Type II**

Type I : Retained specimen remains virtually unchanged.
Type II : Retained specimen consists of large and small fragments.
Type III : Retained specimen is exclusively small fragments.

SLAKE DURABILITY OF SHALES AND SIMILAR WEAK ROCKS

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: April 22, 2009

Client: CH2MHill

Material Type: Siltstone

Lab Sample No.: S10768

Date Received: 4/2/09

Test Method: ASTM D 4644

Test Results

Sample ID.	Sample Depth, ft.	Avg. Water Temp. @ Testing	Moisture Content @ Testing	Slake Durability Index	Description of Sample After Testing
R-09-Z1-B6, C39	238-239	20.7	1.1	**71.7**	**Type II**

Type I : Retained specimen remains virtually unchanged.
Type II : Retained specimen consists of large and small fragments.
Type III : Retained specimen is exclusively small fragments.

SLAKE DURABILITY OF SHALES AND SIMILAR WEAK ROCKS

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: April 22, 2009

Client: CH2MHill

Material Type: Siltstone

Lab Sample No.: S10769

Date Received: 4/2/09

Test Method: ASTM D 4644

Test Results

Sample ID.	Sample Depth, ft.	Avg. Water Temp. @ Testing	Moisture Content @ Testing	Slake Durability Index	Description of Sample After Testing
R-09-Z1-B6, C42	263-268	21.5	1.0	**74.1**	**Type II**

Type I : Retained specimen remains virtually unchanged.
Type II : Retained specimen consists of large and small fragments.
Type III : Retained specimen is exclusively small fragments.

SLAKE DURABILITY OF SHALES AND SIMILAR WEAK ROCKS

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: April 22, 2009

Client: CH2MHill

Material Type: Siltstone

Lab Sample No.: S10770

Date Received: 4/2/09

Test Method: ASTM D 4644

Test Results

Sample ID.	Sample Depth, ft.	Avg. Water Temp. @ Testing	Moisture Content @ Testing	Slake Durability Index	Description of Sample After Testing
R-09-Z1-B6, C46	293-303	21.4	1.1	**88.7**	**Type II**

Type I : Retained specimen remains virtually unchanged.
Type II : Retained specimen consists of large and small fragments.
Type III : Retained specimen is exclusively small fragments.

SLAKE DURABILITY OF SHALES AND SIMILAR WEAK ROCKS

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: April 22, 2009

Client: CH2MHill

Material Type: Siltstone

Lab Sample No.: S10771

Date Received: 4/2/09

Test Method: ASTM D 4644

Test Results

Sample ID.	Sample Depth, ft.	Avg. Water Temp. @ Testing	Moisture Content @ Testing	Slake Durability Index	Description of Sample After Testing
R-09-Z1-B6, C50	334.2-334.7	21.0	15.8	**69.4**	**Type II**

Type I : Retained specimen remains virtually unchanged.
Type II : Retained specimen consists of large and small fragments.
Type III : Retained specimen is exclusively small fragments.

SLAKE DURABILITY OF SHALES AND SIMILAR WEAK ROCKS

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: April 22, 2009

Client: CH2MHill

Material Type: Siltstone

Lab Sample No.: S10773

Date Received: 4/2/09

Test Method: ASTM D 4644

Test Results

Sample ID.	Sample Depth, ft.	Avg. Water Temp. @ Testing	Moisture Content @ Testing	Slake Durability Index	Description of Sample After Testing
R-09-Z1-B6, C57	376.3-377.1	21.0	1.1	**68.8**	**Type II**

Type I : Retained specimen remains virtually unchanged.
Type II : Retained specimen consists of large and small fragments.
Type III : Retained specimen is exclusively small fragments.

SLAKE DURABILITY OF SHALES AND SIMILAR WEAK ROCKS

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: April 22, 2009

Client: CH2MHill

Material Type: Siltstone

Lab Sample No.: S10963

Date Received: 4/2/09

Test Method: ASTM D 4644

Test Results

Sample ID.	Sample Depth, ft.	Avg. Water Temp. @ Testing, C	Moisture Content @ Testing	Slake Durability Index	Description of Sample After Testing
R-09-Z1-B7, C56	284.1-285.6	20.1	13.0	**47.9**	**Type II**

Type I : Retained specimen remains virtually unchanged.
Type II : Retained specimen consists of large and small fragments.
Type III : Retained specimen is exclusively small fragments.

SLAKE DURABILITY OF SHALES AND SIMILAR WEAK ROCKS

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: June 5, 2009

Client: CH2MHill

Material Type: shale

Lab Sample No.: S12393

Date Received: 6/1/09

Test Method: ASTM D 4644

Test Results

Sample ID.	Sample Depth, ft.	Avg. Water Temp. @ Testing	Moisture Content @ Testing	Slake Durability Index	Description of Sample After Testing
R-09-Z1-B7, C39	202-202.8	21.1	16.6	**42**	**Type II**

Type I : Retained specimen remains virtually unchanged.
Type II : Retained specimen consists of large and small fragments.
Type III : Retained specimen is exclusively small fragments.

SLAKE DURABILITY OF SHALES AND SIMILAR WEAK ROCKS

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: June 5, 2009

Client: CH2MHill

Material Type: siltstone

Lab Sample No.: S12394

Date Received: 6/1/09

Test Method: ASTM D 4644

Test Results

Sample ID.	Sample Depth, ft.	Avg. Water Temp. @ Testing	Moisture Content @ Testing	Slake Durability Index	Description of Sample After Testing
R-09-Z1-B7, C41	210.6-211	20.7	9.2	**94**	**Type II**

Type I : Retained specimen remains virtually unchanged.
Type II : Retained specimen consists of large and small fragments.
Type III : Retained specimen is exclusively small fragments.

SLAKE DURABILITY OF SHALES AND SIMILAR WEAK ROCKS

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: April 20, 2009

Client: CH2MHill

Material Type: Mudstone

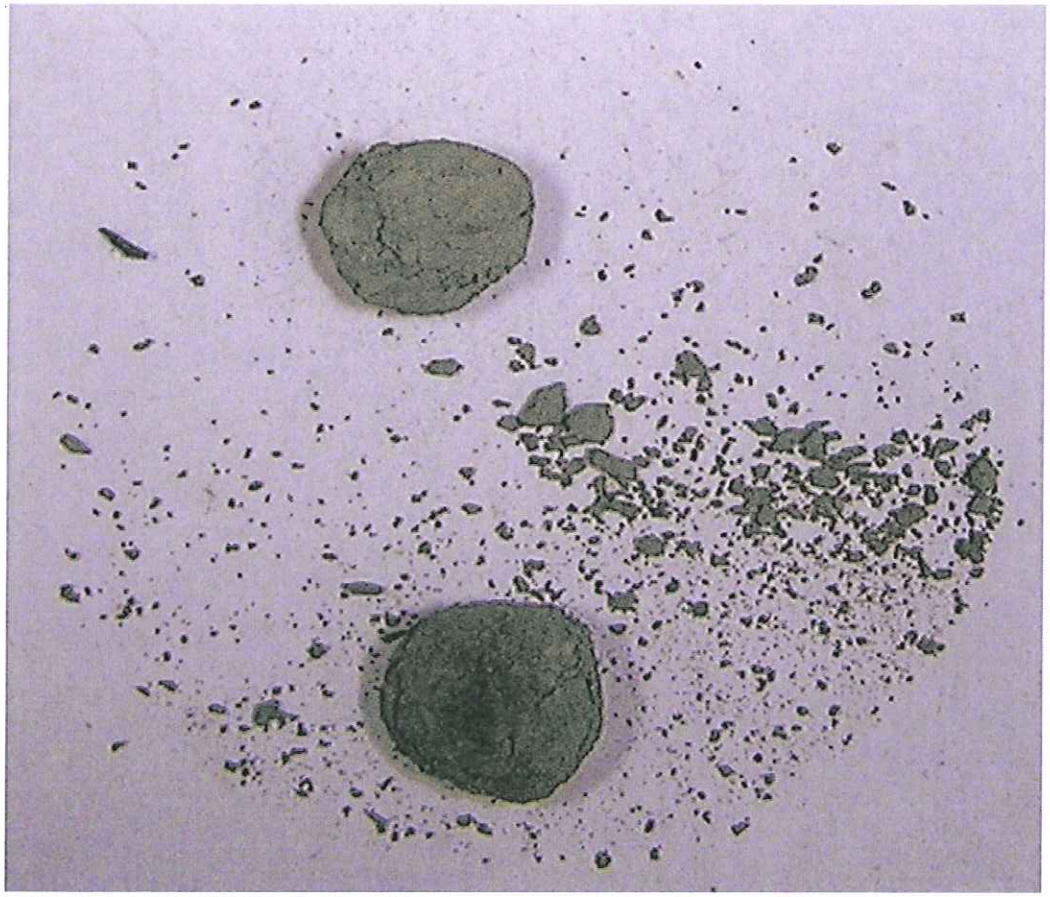
Lab Sample No.: S11025

Date Received: 4/10/09

Test Method: ASTM D 4644

Test Results

Sample ID.	Sample Depth, ft.	Avg. Water Temp. @ Testing, C	Moisture Content @ Testing	Slake Durability Index	Description of Sample After Testing
R-09-Z1-B8, C28	133.1-134	20.4	23.0	**2.0**	**Type III**



Type I : Retained specimen remains virtually unchanged.
Type II : Retained specimen consists of large and small fragments.
Type III : Retained specimen is exclusively small fragments.

SLAKE DURABILITY OF SHALES AND SIMILAR WEAK ROCKS

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: April 20, 2009

Client: CH2MHill

Material Type: Mudstone

Lab Sample No.: S11026

Date Received: 4/10/09

Test Method: ASTM D 4644

Test Results

Sample ID.	Sample Depth, ft.	Avg. Water Temp. @ Testing, C	Moisture Content @ Testing	Slake Durability Index	Description of Sample After Testing
R-09-Z1-B8, C31	147.9-148.5	20.6	21.8	**12.9**	**Type II**

Type I : Retained specimen remains virtually unchanged.
Type II : Retained specimen consists of large and small fragments.
Type III : Retained specimen is exclusively small fragments.

SLAKE DURABILITY OF SHALES AND SIMILAR WEAK ROCKS

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: April 20, 2009

Client: CH2MHill

Material Type: Mudstone

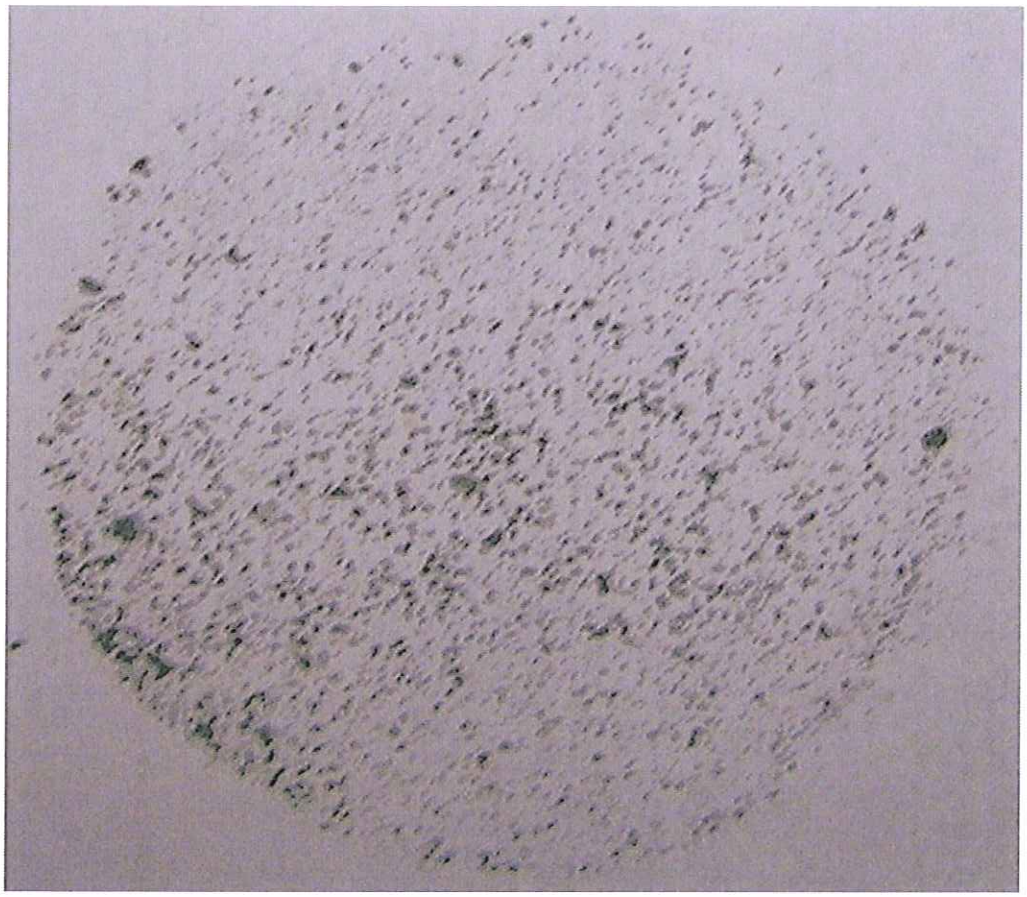
Lab Sample No.: S11027

Date Received: 4/10/09

Test Method: ASTM D 4644

Test Results

Sample ID.	Sample Depth, ft.	Avg. Water Temp. @ Testing, C	Moisture Content @ Testing	Slake Durability Index	Description of Sample After Testing
R-09-Z1-B8, C37	175-175.75	21.0	21.7	**0.0**	**Type III**



Type I : Retained specimen remains virtually unchanged.
Type II : Retained specimen consists of large and small fragments.
Type III : Retained specimen is exclusively small fragments.

SLAKE DURABILITY OF SHALES AND SIMILAR WEAK ROCKS

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: April 24, 2009

Client: CH2MHill

Material Type: Mudstone

Lab Sample No.: S11028

Date Received: 4/10/09

Test Method: ASTM D 4644

Test Results

Sample ID.	Sample Depth, ft.	Avg. Water Temp. @ Testing, C	Moisture Content @ Testing	Slake Durability Index	Description of Sample After Testing
R-09-Z1-B8, C41	195-196.25	20.8	21.7	**56.8**	**Type II**

Type I : Retained specimen remains virtually unchanged.
Type II : Retained specimen consists of large and small fragments.
Type III : Retained specimen is exclusively small fragments.

SLAKE DURABILITY OF SHALES AND SIMILAR WEAK ROCKS

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: May 1, 2009

Client: CH2MHill

Material Type: Claystone

Lab Sample No.: S11693

Date Received: 5/1/09

Test Method: ASTM D 4644

Test Results

Sample ID.	Sample Depth, ft.	Avg. Water Temp. @ Testing	Moisture Content @ Testing	Slake Durability Index	Description of Sample After Testing
R-09-Z2-B2, C34	192.4-193.1	20.7	11.7	**48.8**	**Type II**

Type I : Retained specimen remains virtually unchanged.
Type II : Retained specimen consists of large and small fragments.
Type III : Retained specimen is exclusively small fragments.

SLAKE DURABILITY OF SHALES AND SIMILAR WEAK ROCKS

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: May 1, 2009

Client: CH2MHill

Material Type: Siltstone

Lab Sample No.: S11694

Date Received: 5/1/09

Test Method: ASTM D 4644

Test Results

Sample ID.	Sample Depth, ft.	Avg. Water Temp. @ Testing	Moisture Content @ Testing	Slake Durability Index	Description of Sample After Testing
R-09-Z2-B2, C37	206-206.6	20.5	11.4	**61.1**	**Type II**

Type I : Retained specimen remains virtually unchanged.
Type II : Retained specimen consists of large and small fragments.
Type III : Retained specimen is exclusively small fragments.

SLAKE DURABILITY OF SHALES AND SIMILAR WEAK ROCKS

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: June 5, 2009

Client: CH2MHill

Material Type: siltstone

Lab Sample No.: S12438

Date Received: 6/1/09

Test Method: ASTM D 4644

Test Results

Sample ID.	Sample Depth, ft.	Avg. Water Temp. @ Testing	Moisture Content @ Testing	Slake Durability Index	Description of Sample After Testing
R-09-Z2-B3, C44	165-165.5	21.4	20.4	**98**	**Type I**

Type I : Retained specimen remains virtually unchanged.
Type II : Retained specimen consists of large and small fragments.
Type III : Retained specimen is exclusively small fragments.

SLAKE DURABILITY OF SHALES AND SIMILAR WEAK ROCKS

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: June 5, 2009

Client: CH2MHill

Material Type: siltstone

Lab Sample No.: S12440

Date Received: 6/1/09

Test Method: ASTM D 4644

Test Results

Sample ID.	Sample Depth, ft.	Avg. Water Temp. @ Testing	Moisture Content @ Testing	Slake Durability Index	Description of Sample After Testing
R-09-Z2-B3, C55	215-215.9	20.7	12.5	**96**	**Type I**

Type I : Retained specimen remains virtually unchanged.
Type II : Retained specimen consists of large and small fragments.
Type III : Retained specimen is exclusively small fragments.

SLAKE DURABILITY OF SHALES AND SIMILAR WEAK ROCKS

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: June 5, 2009

Client: CH2MHill

Material Type: siltstone

Lab Sample No.: S12448

Date Received: 6/1/09

Test Method: ASTM D 4644

Test Results

Sample ID.	Sample Depth, ft.	Avg. Water Temp. @ Testing	Moisture Content @ Testing	Slake Durability Index	Description of Sample After Testing
R-09-Z2-B3, C50	197.2-198	21.0	9.1	**98**	**Type I**

Type I : Retained specimen remains virtually unchanged.
Type II : Retained specimen consists of large and small fragments.
Type III : Retained specimen is exclusively small fragments.

SLAKE DURABILITY OF SHALES AND SIMILAR WEAK ROCKS

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: June 5, 2009

Client: CH2MHill

Material Type: siltstone

Lab Sample No.: S12444

Date Received: 6/1/09

Test Method: ASTM D 4644

Test Results

Sample ID.	Sample Depth, ft.	Avg. Water Temp. @ Testing	Moisture Content @ Testing	Slake Durability Index	Description of Sample After Testing
R-09-Z2-B3, C73	306-306.8	21.1	4.0	**98**	**Type I**

Type I : Retained specimen remains virtually unchanged.
Type II : Retained specimen consists of large and small fragments.
Type III : Retained specimen is exclusively small fragments.

SLAKE DURABILITY OF SHALES AND SIMILAR WEAK ROCKS

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: June 5, 2009

Client: CH2MHill

Material Type: siltstone

Lab Sample No.: S12442

Date Received: 6/1/09

Test Method: ASTM D 4644

Test Results

Sample ID.	Sample Depth, ft.	Avg. Water Temp. @ Testing	Moisture Content @ Testing	Slake Durability Index	Description of Sample After Testing
R-09-Z2-B3, C68	280.5-281.4	21.1	11.3	**98**	**Type I**

Type I : Retained specimen remains virtually unchanged.
Type II : Retained specimen consists of large and small fragments.
Type III : Retained specimen is exclusively small fragments.

SLAKE DURABILITY OF SHALES AND SIMILAR WEAK ROCKS

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: May 1, 2009

Client: CH2MHill

Material Type: Siltstone

Lab Sample No.: S11696

Date Received: 5/1/09

Test Method: ASTM D 4644

Test Results

Sample ID.	Sample Depth, ft.	Avg. Water Temp. @ Testing	Moisture Content @ Testing	Slake Durability Index	Description of Sample After Testing
R-09-Z2-B4, C34	138-138.7	20.6	14.5	**59.2**	**Type I**

Type I : Retained specimen remains virtually unchanged.
Type II : Retained specimen consists of large and small fragments.
Type III : Retained specimen is exclusively small fragments.

SLAKE DURABILITY OF SHALES AND SIMILAR WEAK ROCKS

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: May 1, 2009

Client: CH2MHill

Material Type: Siltstone

Lab Sample No.: S11698

Date Received: 5/1/09

Test Method: ASTM D 4644

Test Results

Sample ID.	Sample Depth, ft.	Avg. Water Temp. @ Testing	Moisture Content @ Testing	Slake Durability Index	Description of Sample After Testing
R-09-Z2-B4, C69	255.5-256	20.6	15.2	**51.9**	**Type II**

Type I : Retained specimen remains virtually unchanged.
Type II : Retained specimen consists of large and small fragments.
Type III : Retained specimen is exclusively small fragments.

SLAKE DURABILITY OF SHALES AND SIMILAR WEAK ROCKS

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: May 1, 2009

Client: CH2MHill

Material Type: Mudstone

Lab Sample No.: S11700

Date Received: 5/1/09

Test Method: ASTM D 4644

Test Results

Sample ID.	Sample Depth, ft.	Avg. Water Temp. @ Testing	Moisture Content @ Testing	Slake Durability Index	Description of Sample After Testing
R-09-Z2-B4, C78	288.5-289.3	20.6	16.0	**55.5**	**Type III**

Type I : Retained specimen remains virtually unchanged.
Type II : Retained specimen consists of large and small fragments.
Type III : Retained specimen is exclusively small fragments.

SLAKE DURABILITY OF SHALES AND SIMILAR WEAK ROCKS

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: May 1, 2009

Client: CH2MHill

Material Type: Siltstone

Lab Sample No.: S11701

Date Received: 5/1/09

Test Method: ASTM D 4644

Test Results

Sample ID.	Sample Depth, ft.	Avg. Water Temp. @ Testing	Moisture Content @ Testing	Slake Durability Index	Description of Sample After Testing
R-09-Z2-B4, C85	314.5-315	20.5	16.0	**33.8**	**Type II**

Type I : Retained specimen remains virtually unchanged.
Type II : Retained specimen consists of large and small fragments.
Type III : Retained specimen is exclusively small fragments.

SLAKE DURABILITY OF SHALES AND SIMILAR WEAK ROCKS

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: May 1, 2009

Client: CH2MHill

Material Type: Mudstone

Lab Sample No.: S11703

Date Received: 5/1/09

Test Method: ASTM D 4644

Test Results

Sample ID.	Sample Depth, ft.	Avg. Water Temp. @ Testing	Moisture Content @ Testing	Slake Durability Index	Description of Sample After Testing
R-09-Z2-B4, C110	392-392.6	20.7	14.5	**4.7**	**Type III**

Type I : Retained specimen remains virtually unchanged.
Type II : Retained specimen consists of large and small fragments.
Type III : Retained specimen is exclusively small fragments.

SLAKE DURABILITY OF SHALES AND SIMILAR WEAK ROCKS

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: May 12, 2009

Client: CH2MHill

Material Type: siltstone

Lab Sample No.: S11864

Date Received: 5/12/09

Test Method: ASTM D 4644

Test Results

Sample ID.	Sample Depth, ft.	Avg. Water Temp. @ Testing	Moisture Content @ Testing	Slake Durability Index	Description of Sample After Testing
R-09-Z2-B5, C39	188-188.8	20.4	22.0	**69**	**Type II**

Type I : Retained specimen remains virtually unchanged.
Type II : Retained specimen consists of large and small fragments.
Type III : Retained specimen is exclusively small fragments.

SLAKE DURABILITY OF SHALES AND SIMILAR WEAK ROCKS

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: May 12, 2009

Client: CH2MHill

Material Type: mudstone

Lab Sample No.: S11865

Date Received: 5/12/09

Test Method: ASTM D 4644

Test Results

Sample ID.	Sample Depth, ft.	Avg. Water Temp. @ Testing	Moisture Content @ Testing	Slake Durability Index	Description of Sample After Testing
R-09-Z2-B5, C43	203.4-204.2	20.4	22.0	**29**	**Type II**

Type I : Retained specimen remains virtually unchanged.
Type II : Retained specimen consists of large and small fragments.
Type III : Retained specimen is exclusively small fragments.

SLAKE DURABILITY OF SHALES AND SIMILAR WEAK ROCKS

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: May 12, 2009

Client: CH2MHill

Material Type: mudstone

Lab Sample No.: S11866

Date Received: 5/12/09

Test Method: ASTM D 4644

Test Results

Sample ID.	Sample Depth, ft.	Avg. Water Temp. @ Testing	Moisture Content @ Testing	Slake Durability Index	Description of Sample After Testing
R-09-Z2-B5, C53	240.5-241.2	20.5	21.1	**43**	**Type II**

Type I : Retained specimen remains virtually unchanged.
Type II : Retained specimen consists of large and small fragments.
Type III : Retained specimen is exclusively small fragments.

SLAKE DURABILITY OF SHALES AND SIMILAR WEAK ROCKS

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: May 12, 2009

Client: CH2MHill

Material Type: mudstone

Lab Sample No.: S11867

Date Received: 5/12/09

Test Method: ASTM D 4644

Test Results

Sample ID.	Sample Depth, ft.	Avg. Water Temp. @ Testing	Moisture Content @ Testing	Slake Durability Index	Description of Sample After Testing
R-09-Z2-B5, C65	291.8-292.4	20.4	30.9	**46**	**Type II**

Type I : Retained specimen remains virtually unchanged.
Type II : Retained specimen consists of large and small fragments.
Type III : Retained specimen is exclusively small fragments.

SLAKE DURABILITY OF SHALES AND SIMILAR WEAK ROCKS

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: June 5, 2009

Client: CH2MHill

Material Type: mudstone

Lab Sample No.: S12435

Date Received: 6/1/09

Test Method: ASTM D 4644

Test Results

Sample ID.	Sample Depth, ft.	Avg. Water Temp. @ Testing	Moisture Content @ Testing	Slake Durability Index	Description of Sample After Testing
R-09-Z3-B5, C64	306.5-307.3	21.0	8.5	3	Type III

Type I : Retained specimen remains virtually unchanged.
Type II : Retained specimen consists of large and small fragments.
Type III : Retained specimen is exclusively small fragments.

SLAKE DURABILITY OF SHALES AND SIMILAR WEAK ROCKS

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: June 5, 2009

Client: CH2MHill

Material Type: mudstone

Lab Sample No.: S12433

Date Received: 6/1/09

Test Method: ASTM D 4644

Test Results

Sample ID.	Sample Depth, ft.	Avg. Water Temp. @ Testing	Moisture Content @ Testing	Slake Durability Index	Description of Sample After Testing
R-09-Z3-B5, C55	270.6-271.1	21.0	9.8	**0.3**	**Type III**

Type I : Retained specimen remains virtually unchanged.
Type II : Retained specimen consists of large and small fragments.
Type III : Retained specimen is exclusively small fragments.

SLAKE DURABILITY OF SHALES AND SIMILAR WEAK ROCKS

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: April 27, 2009

Client: CH2MHill

Material Type: Rock Core

Lab Sample No.: S11295

Date Received: 4/22/09

Test Method: ASTM D 4644

Test Results

Sample ID.	Sample Depth, ft.	Avg. Water Temp. @ Testing	Moisture Content @ Testing	Slake Durability Index	Description of Sample After Testing
R-09-Z3-B6, C 43	257.2-257.5	20.6	3.1	**66.1**	**Type II**

Type I : Retained specimen remains virtually unchanged.
Type II : Retained specimen consists of large and small fragments.
Type III : Retained specimen is exclusively small fragments.

SLAKE DURABILITY OF SHALES AND SIMILAR WEAK ROCKS

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: May 12, 2009

Client: CH2MHill

Material Type: siltstone

Lab Sample No.: S11870

Date Received: 5/12/09

Test Method: ASTM D 4644

Test Results

Sample ID.	Sample Depth, ft.	Avg. Water Temp. @ Testing	Moisture Content @ Testing	Slake Durability Index	Description of Sample After Testing
R-09-Z3-B8, C33	140.4-141.1	20.5	9.2	**92.2**	**Type II**

Type I : Retained specimen remains virtually unchanged.
Type II : Retained specimen consists of large and small fragments.
Type III : Retained specimen is exclusively small fragments.

SLAKE DURABILITY OF SHALES AND SIMILAR WEAK ROCKS

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: May 12, 2009

Client: CH2MHill

Material Type: claystone

Lab Sample No.: S11874

Date Received: 5/12/09

Test Method: ASTM D 4644

Test Results

Sample ID.	Sample Depth, ft.	Avg. Water Temp. @ Testing	Moisture Content @ Testing	Slake Durability Index	Description of Sample After Testing
R-09-Z3-B8, C46	192.2-192.6	20.5	10.5	**94.7**	**Type II**

Type I : Retained specimen remains virtually unchanged.
Type II : Retained specimen consists of large and small fragments.
Type III : Retained specimen is exclusively small fragments.

SLAKE DURABILITY OF SHALES AND SIMILAR WEAK ROCKS

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: May 12, 2009

Client: CH2MHill

Material Type: siltstone

Lab Sample No.: S11876

Date Received: 5/12/09

Test Method: ASTM D 4644

Test Results

Sample ID.	Sample Depth, ft.	Avg. Water Temp. @ Testing	Moisture Content @ Testing	Slake Durability Index	Description of Sample After Testing
R-09-Z3-B8, C51	205.1-205.7	20.4	8.1	**95.1**	**Type II**

Type I : Retained specimen remains virtually unchanged.
Type II : Retained specimen consists of large and small fragments.
Type III : Retained specimen is exclusively small fragments.

SLAKE DURABILITY OF SHALES AND SIMILAR WEAK ROCKS

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: May 12, 2009

Client: CH2MHill

Material Type: siltstone

Lab Sample No.: S11877

Date Received: 5/12/09

Test Method: ASTM D 4644

Test Results

Sample ID.	Sample Depth, ft.	Avg. Water Temp. @ Testing	Moisture Content @ Testing	Slake Durability Index	Description of Sample After Testing
R-09-Z3-B8, C56	227.5-228	20.5	8.5	**98**	**Type I**

Type I : Retained specimen remains virtually unchanged.
Type II : Retained specimen consists of large and small fragments.
Type III : Retained specimen is exclusively small fragments.

SLAKE DURABILITY OF SHALES AND SIMILAR WEAK ROCKS

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: May 1, 2009

Client: CH2MHill

Material Type: Siltstone

Lab Sample No.: S11689

Date Received: 5/1/09

Test Method: ASTM D 4644

Test Results

Sample ID.	Sample Depth, ft.	Avg. Water Temp. @ Testing	Moisture Content @ Testing	Slake Durability Index	Description of Sample After Testing
R-09-Z3-B10, C73	289-289.9	20.6	10.6	**79.8**	**Type I**

Type I : Retained specimen remains virtually unchanged.
Type II : Retained specimen consists of large and small fragments.
Type III : Retained specimen is exclusively small fragments.

SLAKE DURABILITY OF SHALES AND SIMILAR WEAK ROCKS

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: May 1, 2009

Client: CH2MHill

Material Type: Siltstone

Lab Sample No.: S11691

Date Received: 5/1/09

Test Method: ASTM D 4644

Test Results

Sample ID.	Sample Depth, ft.	Avg. Water Temp. @ Testing	Moisture Content @ Testing	Slake Durability Index	Description of Sample After Testing
R-90-Z3-B10, C83	331.9-332.6	20.8	12.3	**76.3**	**Type II**

Type I : Retained specimen remains virtually unchanged.
Type II : Retained specimen consists of large and small fragments.
Type III : Retained specimen is exclusively small fragments.

SLAKE DURABILITY OF SHALES AND SIMILAR WEAK ROCKS

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: April 24, 2009

Client: CH2MHill

Material Type: Siltstone

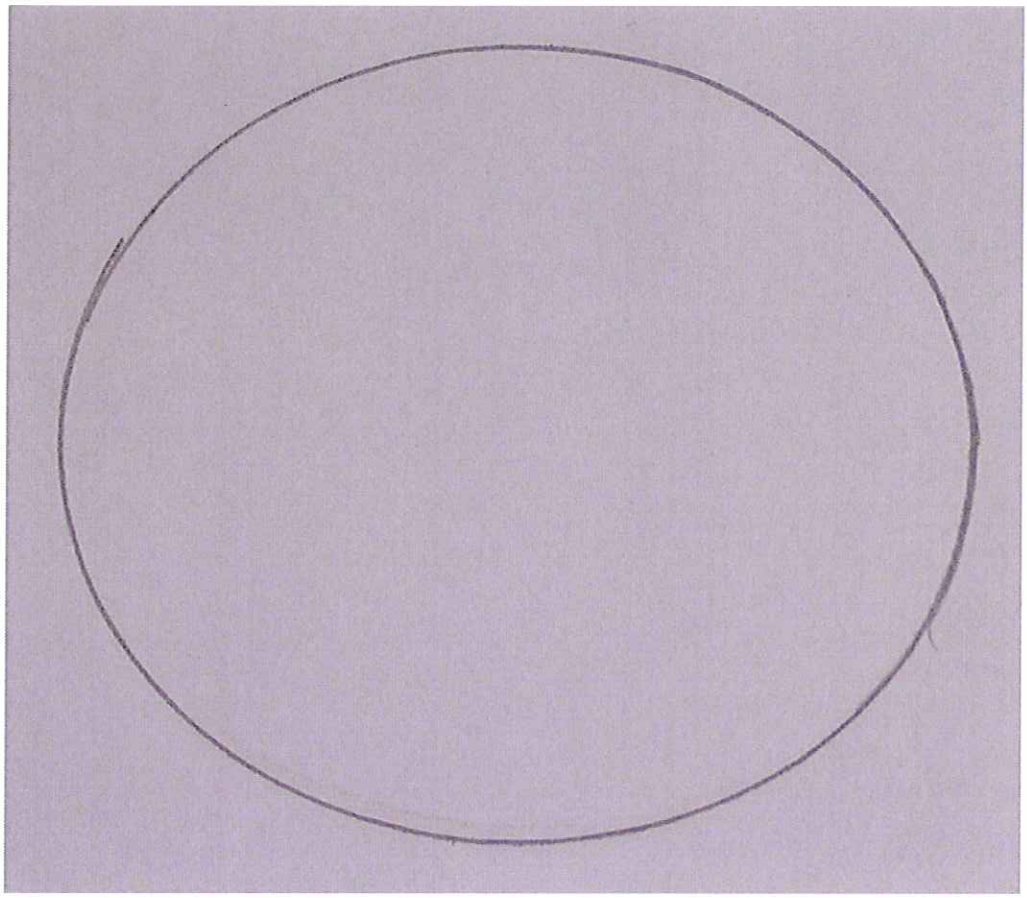
Lab Sample No.: S11035

Date Received: 4/10/09

Test Method: ASTM D 4644

Test Results

Sample ID.	Sample Depth, ft.	Avg. Water Temp. @ Testing, C	Moisture Content @ Testing	Slake Durability Index	Description of Sample After Testing
R-09-Z3-B11, C42	208.9-209.8	19.3	21.0	**0.0**	**Type III**



Type I : Retained specimen remains virtually unchanged.
Type II : Retained specimen consists of large and small fragments.
Type III : Retained specimen is exclusively small fragments.

SLAKE DURABILITY OF SHALES AND SIMILAR WEAK ROCKS

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: April 24, 2009

Client: CH2MHill

Material Type: Mudstone

Lab Sample No.: S11037

Date Received: 4/10/09

Test Method: ASTM D 4644

Test Results

Sample ID.	Sample Depth, ft.	Avg. Water Temp. @ Testing, C	Moisture Content @ Testing	Slake Durability Index	Description of Sample After Testing
R-09-Z3-B11, C49	245.25-246	21.0	12.9	**0.1**	**Type III**

Type I : Retained specimen remains virtually unchanged.
Type II : Retained specimen consists of large and small fragments.
Type III : Retained specimen is exclusively small fragments.

SLAKE DURABILITY OF SHALES AND SIMILAR WEAK ROCKS

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: April 24, 2009

Client: CH2MHill

Material Type: Mudstone

Lab Sample No.: S11038

Date Received: 4/10/09

Test Method: ASTM D 4644

Test Results

Sample ID.	Sample Depth, ft.	Avg. Water Temp. @ Testing, C	Moisture Content @ Testing	Slake Durability Index	Description of Sample After Testing
R-09-Z3-B11, C53	263-263.75	20.7	14.0	**22.4**	**Type III**

Type I : Retained specimen remains virtually unchanged.
Type II : Retained specimen consists of large and small fragments.
Type III : Retained specimen is exclusively small fragments.

SLAKE DURABILITY OF SHALES AND SIMILAR WEAK ROCKS

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: April 22, 2009

Client: CH2MHill

Material Type: Shale

Lab Sample No.: S10964

Date Received: 4/2/09

Test Method: ASTM D 4644

Test Results

Sample ID.	Sample Depth, ft.	Avg. Water Temp. @ Testing, C	Moisture Content @ Testing	Slake Durability Index	Description of Sample After Testing
R-09-Z3-B12, C41	190.8-191.3	20.2	22.0	**87.4**	**Type II**

Type I : Retained specimen remains virtually unchanged.
Type II : Retained specimen consists of large and small fragments.
Type III : Retained specimen is exclusively small fragments.

SLAKE DURABILITY OF SHALES AND SIMILAR WEAK ROCKS

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: April 22, 2009

Client: CH2MHill

Material Type: Shale

Lab Sample No.: S10965

Date Received: 4/2/09

Test Method: ASTM D 4644

Test Results

Sample ID.	Sample Depth, ft.	Avg. Water Temp. @ Testing, C	Moisture Content @ Testing	Slake Durability Index	Description of Sample After Testing
R-09-Z3-B12, C47	213.9-214.5	20.2	19.3	**84.8**	**Type II**

Type I : Retained specimen remains virtually unchanged.
Type II : Retained specimen consists of large and small fragments.
Type III : Retained specimen is exclusively small fragments.

SLAKE DURABILITY OF SHALES AND SIMILAR WEAK ROCKS

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: June 5, 2009

Client: CH2MHill

Material Type: shale

Lab Sample No.: S12430

Date Received: 6/1/09

Test Method: ASTM D 4644

Test Results

Sample ID.	Sample Depth, ft.	Avg. Water Temp. @ Testing	Moisture Content @ Testing	Slake Durability Index	Description of Sample After Testing
R-09-Z3-B12, C54	242.4-242.9	21.0	17.6	**88**	**Type II**

Type I : Retained specimen remains virtually unchanged.
Type II : Retained specimen consists of large and small fragments.
Type III : Retained specimen is exclusively small fragments.

SLAKE DURABILITY OF SHALES AND SIMILAR WEAK ROCKS

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: June 5, 2009

Client: CH2MHill

Material Type: shale

Lab Sample No.: S12431

Date Received: 6/1/09

Test Method: ASTM D 4644

Test Results

Sample ID.	Sample Depth, ft.	Avg. Water Temp. @ Testing	Moisture Content @ Testing	Slake Durability Index	Description of Sample After Testing
R-09-Z3-B12, C62	272.5-273	20.7	16.6	**90**	**Type II**

Type I : Retained specimen remains virtually unchanged.
Type II : Retained specimen consists of large and small fragments.
Type III : Retained specimen is exclusively small fragments.

SLAKE DURABILITY OF SHALES AND SIMILAR WEAK ROCKS

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: April 25, 2009

Client: CH2MHill

Material Type: Siltstone

Lab Sample No.: S11264

Date Received: 4/22/09

Test Method: ASTM D 4644

Test Results

Sample ID.	Sample Depth, ft.	Avg. Water Temp. @ Testing, C	Moisture Content @ Testing	Slake Durability Index	Description of Sample After Testing
R-09-Z4-B4, C28	150-157.5	21.0	17.4	**61.0**	**Type II**

Type I : Retained specimen remains virtually unchanged.
Type II : Retained specimen consists of large and small fragments.
Type III : Retained specimen is exclusively small fragments.

SLAKE DURABILITY OF SHALES AND SIMILAR WEAK ROCKS

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: April 25, 2009

Client: CH2MHill

Material Type: Siltstone

Lab Sample No.: S11265

Date Received: 4/22/09

Test Method: ASTM D 4644

Test Results

Sample ID.	Sample Depth, ft.	Avg. Water Temp. @ Testing, C	Moisture Content @ Testing	Slake Durability Index	Description of Sample After Testing
R-09-Z4-B4, C35	198.5-199.5	21.0	18.3	**0.6**	**Type III**

Type I : Retained specimen remains virtually unchanged.
Type II : Retained specimen consists of large and small fragments.
Type III : Retained specimen is exclusively small fragments.

SLAKE DURABILITY OF SHALES AND SIMILAR WEAK ROCKS

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: April 25, 2009

Client: CH2MHill

Material Type: Siltstone

Lab Sample No.: S11266

Date Received: 4/22/09

Test Method: ASTM D 4644

Test Results

Sample ID.	Sample Depth, ft.	Avg. Water Temp. @ Testing, C	Moisture Content @ Testing	Slake Durability Index	Description of Sample After Testing
R-09-Z4-B4, C40	234-235	21.0	13.7	**12.8**	**Type III**

Type I : Retained specimen remains virtually unchanged.
Type II : Retained specimen consists of large and small fragments.
Type III : Retained specimen is exclusively small fragments.

Unconsolidated-Undrained Triaxial Compression Test on Cohesive Soils

ASTM D 2850

Project Name:	SR-710 Tunnel Technical Study	Tested by:	A. Santos	Date:	05/27/09
Project No:	378312.04.09.01	Checked by:	J. Ward	Date:	06/01/09
Boring No.:	R-09-Z1-B4	Sample Type:	Core		
Sample No.:	C-40	Depth(ft):	164.4-165		
Sample Description:	Dark olive elastic silt'stone' (MH)				

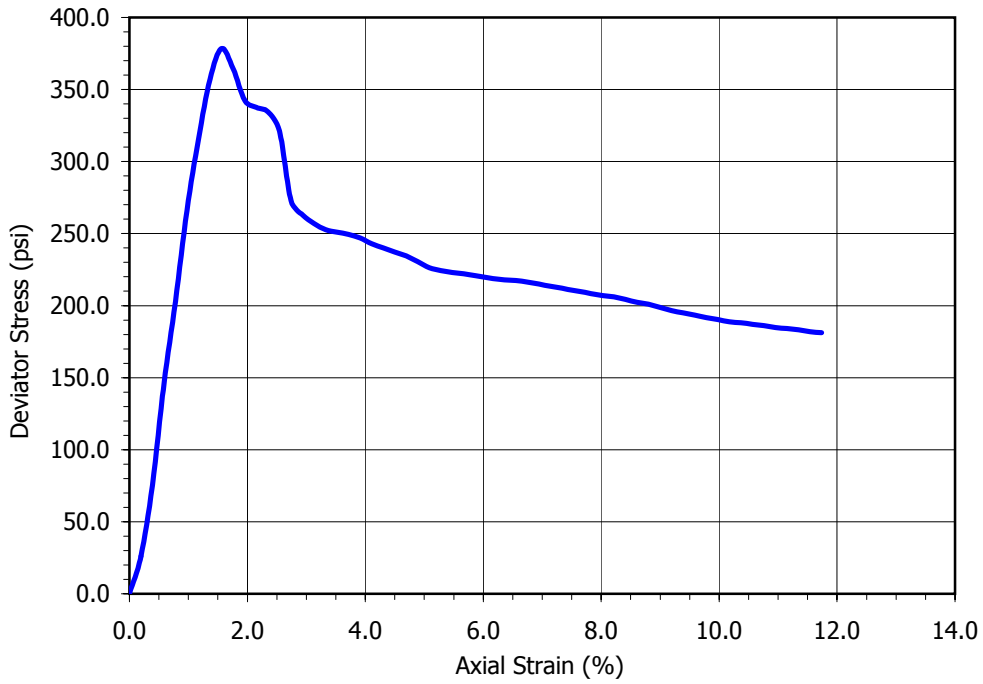
Diameter (in)	1	2.420
	2	2.426
	3	2.425
	Average	2.424
Height (in)	1	5.113
	2	5.110
	3	5.113
	Average	5.112
Weight of Sample + Tube / Rings (g)		798.50
Weight of Tube / Rings (g)		0.00
Weight of Wet Sample + Container (g)		1445.30
Weight of Dry Sample + Container (g)		1245.80
Weight of Container (g)		107.90
Specific Gravity (assumed)		2.70
Confining Pressure (psi)		107.6
Rate of Deformation (in/min)		0.012

Sample Properties	
Moisture Content (%)	17.53
Dry Density (pcf)	109.7
Void Ratio	0.535
% Saturation	88.4

At Failure*	
Deviator stress (psi)	**378.55**
Minor principal total stress (psi)	**107.60**
Major principal total stress (psi)	**486.15**
Axial strain (%)	**1.56**

* Stress values have been corrected for membrane effects

Stress - Strain Curve



Unconsolidated-Undrained Triaxial Compression Test on Cohesive Soils

ASTM D 2850

Project Name:	SR-710 Tunnel Technical Study	Tested by:	A. Santos	Date:	06/03/09
Project No:	378312.04.09.01	Checked by:	J. Ward	Date:	06/06/09
Boring No.:	R-09-Z1-B4	Sample Type:	Core		
Sample No.:	C-56	Depth(ft):	243-243.5		
Sample Description:	Olive gray silty sand'stone' (SM)				

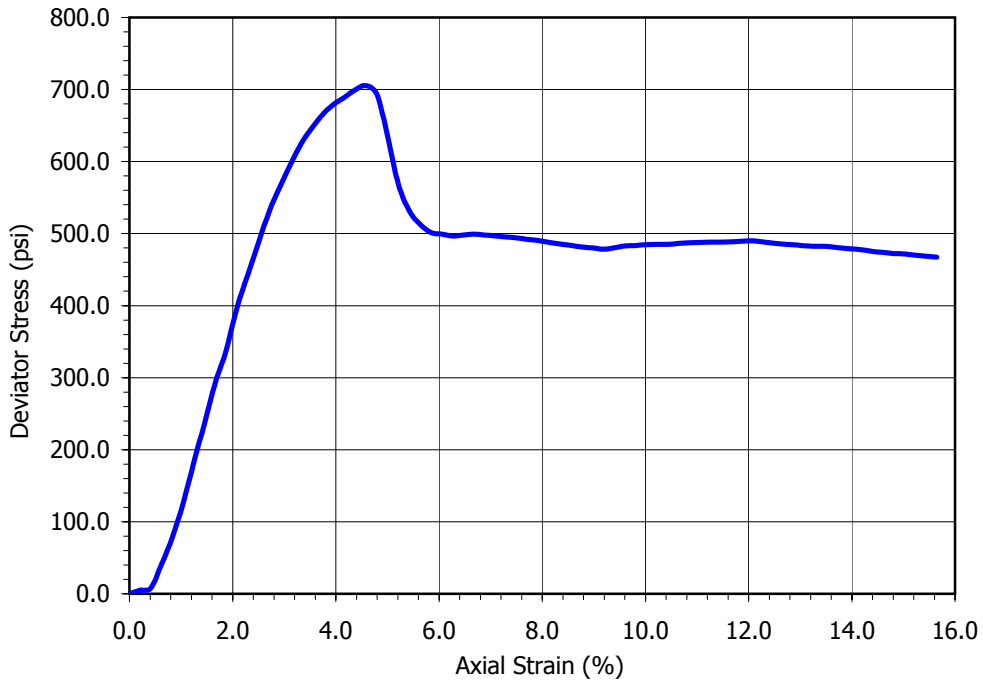
Diameter (in)	1	2.355
	2	2.350
	3	2.330
	Average	2.345
Height (in)	1	4.784
	2	4.801
	3	4.796
	Average	4.793
Weight of Sample + Tube / Rings (g)		730.60
Weight of Tube / Rings (g)		0.00
Weight of Wet Sample + Container (g)		803.00
Weight of Dry Sample + Container (g)		721.70
Weight of Container (g)		76.10
Specific Gravity (assumed)		2.70
Confining Pressure (psi)		153.0
Rate of Deformation (in/min)		0.012

Sample Properties	
Moisture Content (%)	12.59
Dry Density (pcf)	119.4
Void Ratio	0.411
% Saturation	82.7

At Failure*	
Deviator stress (psi)	**705.50**
Minor principal total stress (psi)	**153.00**
Major principal total stress (psi)	**858.50**
Axial strain (%)	**4.59**

* Stress values have been corrected for membrane effects

Stress - Strain Curve



Unconsolidated-Undrained Triaxial Compression Test on Cohesive Soils

ASTM D 2850

Project Name:	SR-710 Tunnel Technical Study	Tested by:	A. Santos	Date:	04/30/09
Project No:	378312.04.09.01	Checked by:	J. Ward	Date:	05/12/09
Boring No.:	R-09-Z1-B5	Sample Type:	Core		
Sample No.:	C28	Depth(ft):	171.2-171.9		
Sample Description:	Dark gray silty sand'stone' (SM)				

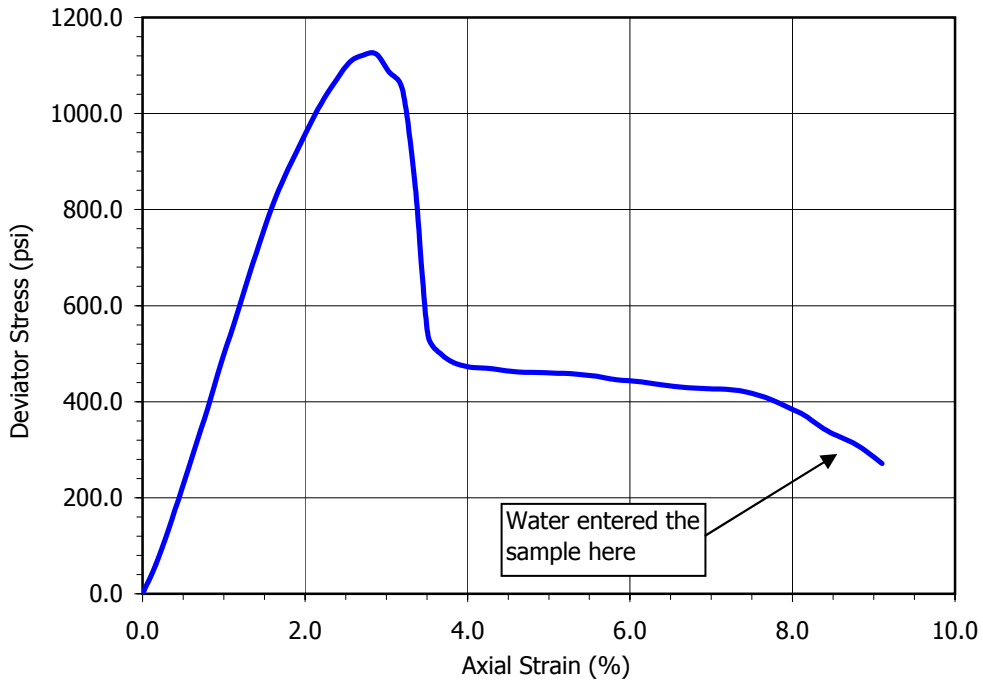
Diameter (in)	1	3.235
	2	3.240
	3	3.240
	Average	3.238
Height (in)	1	6.262
	2	6.268
	3	6.256
	Average	6.262
Weight of Sample + Tube / Rings (g)		1745.50
Weight of Tube / Rings (g)		0.00
Weight of Wet Sample + Container (g)		1453.20
Weight of Dry Sample + Container (g)		1331.40
Weight of Container (g)		108.40
Specific Gravity (assumed)		2.70
Confining Pressure (psi)		111.1
Rate of Deformation (in/min)		0.012

Sample Properties	
Moisture Content (%)	9.96
Dry Density (pcf)	117.3
Void Ratio	0.437
% Saturation	61.5

At Failure*	
Deviator stress (psi)	**1123.93**
Minor principal total stress (psi)	**111.10**
Major principal total stress (psi)	**1235.03**
Axial strain (%)	**2.87**

* Stress values have been corrected for membrane effects

Stress - Strain Curve



Unconsolidated-Undrained Triaxial Compression Test on Cohesive Soils

ASTM D 2850

Project Name:	SR-710 Tunnel Technical Study		Tested by:	A. Santos	Date: 04/28/09
Project No:	378312.04.09.01		Checked by:	J. Ward	Date: 04/29/09
Boring No.:	R-09-Z1-B5		Sample Type:	Core	
Sample No.:	C32		Depth(ft):	201-201.8	
Sample Description:	Gray silty sand'stone' (SM)				

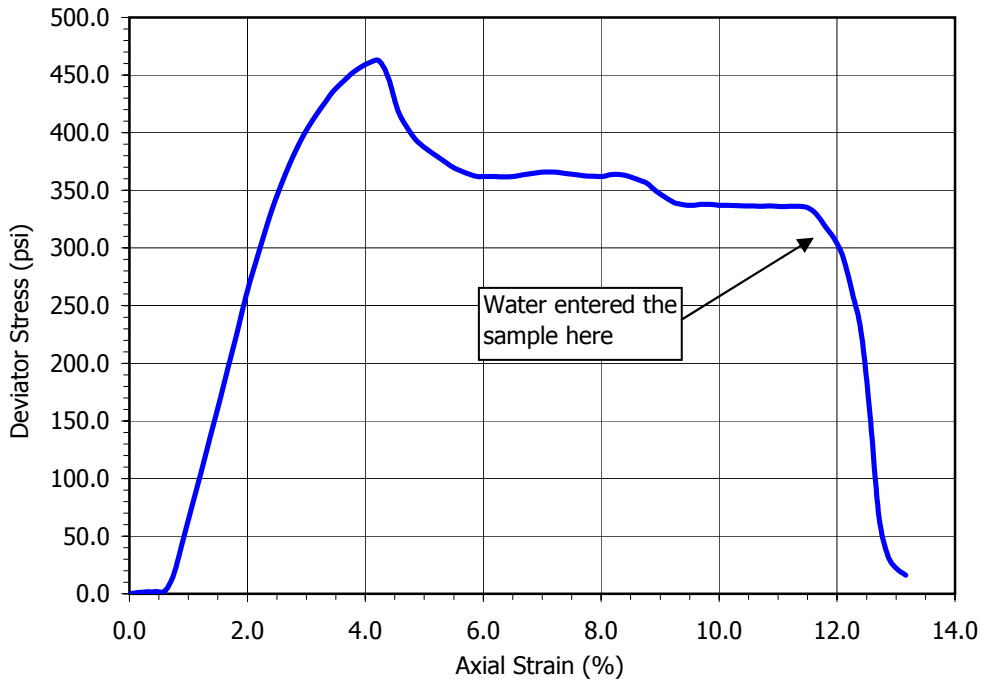
Diameter (in)	1	3.310
	2	3.275
	3	3.285
	Average	3.290
Height (in)	1	6.620
	2	6.607
	3	6.599
	Average	6.608
Weight of Sample + Tube / Rings (g)		1895.00
Weight of Tube / Rings (g)		0.00
Weight of Wet Sample + Container (g)		2020.80
Weight of Dry Sample + Container (g)		1792.40
Weight of Container (g)		110.70
Specific Gravity (assumed)		2.70
Confining Pressure (psi)		128.5
Rate of Deformation (in/min)		0.012

Sample Properties	
Moisture Content (%)	13.58
Dry Density (pcf)	113.1
Void Ratio	0.489
% Saturation	75.0

At Failure*	
Deviator stress (psi)	**462.30**
Minor principal total stress (psi)	**128.50**
Major principal total stress (psi)	**590.80**
Axial strain (%)	**4.24**

* Stress values have been corrected for membrane effects

Stress - Strain Curve



Unconsolidated-Undrained Triaxial Compression Test on Cohesive Soils

ASTM D 2850

Project Name:	SR-710 Tunnel Technical Study		Tested by:	A. Santos	Date: 04/28/09
Project No:	378312.04.09.01		Checked by:	J. Ward	Date: 04/29/09
Boring No.:	R-09-Z1-B5		Sample Type:	Core	
Sample No.:	C40		Depth(ft):	263.5-264.3	
Sample Description:	Gray silty sand'stone' (SM)				

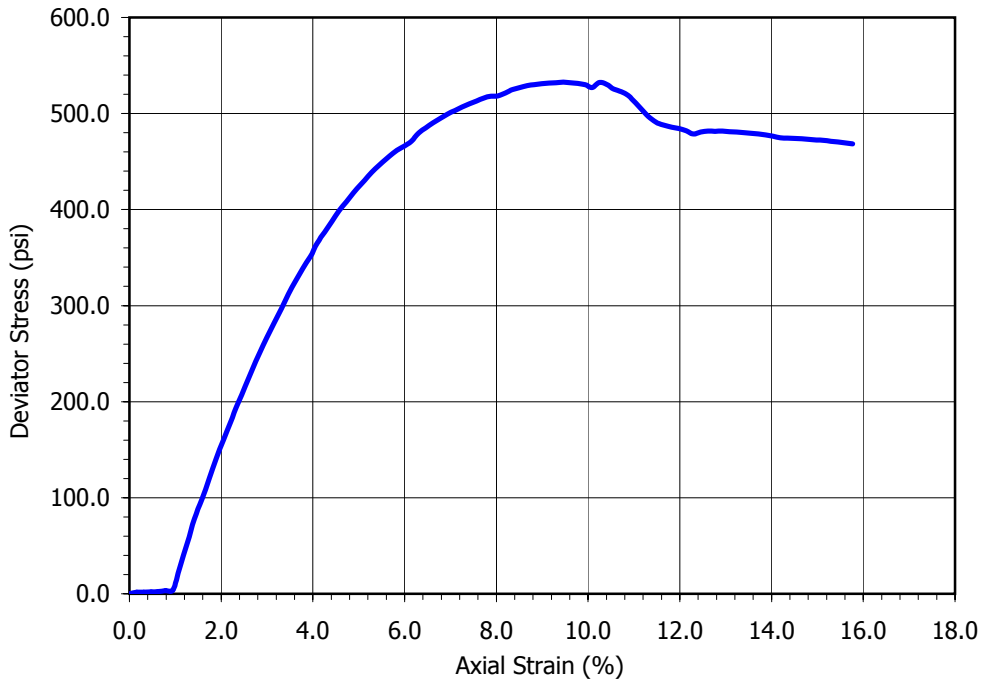
Diameter (in)	1	3.381
	2	3.390
	3	3.410
	Average	3.394
Height (in)	1	6.347
	2	6.336
	3	6.348
	Average	6.343
Weight of Sample + Tube / Rings (g)		1983.10
Weight of Tube / Rings (g)		37.60
Weight of Wet Sample + Container (g)		2049.80
Weight of Dry Sample + Container (g)		1851.10
Weight of Container (g)		109.34
Specific Gravity (assumed)		2.70
Confining Pressure (psi)		153.0
Rate of Deformation (in/min)		0.012

Sample Properties	
Moisture Content (%)	11.41
Dry Density (pcf)	115.9
Void Ratio	0.453
% Saturation	68.0

At Failure*	
Deviator stress (psi)	**532.65**
Minor principal total stress (psi)	**153.00**
Major principal total stress (psi)	**685.65**
Axial strain (%)	**9.46**

* Stress values have been corrected for membrane effects

Stress - Strain Curve



Unconsolidated-Undrained Triaxial Compression Test on Cohesive Soils

ASTM D 2850

Project Name:	SR-710 Tunnel Technical Study		Tested by:	A. Santos	Date: 04/28/09
Project No:	378312.04.09.01		Checked by:	J. Ward	Date: 04/29/09
Boring No.:	R-09-Z1-B5		Sample Type:	Core	
Sample No.:	C46		Depth(ft):	312.4-313.1	
Sample Description:	Gray silty sand'stone' (SM)				

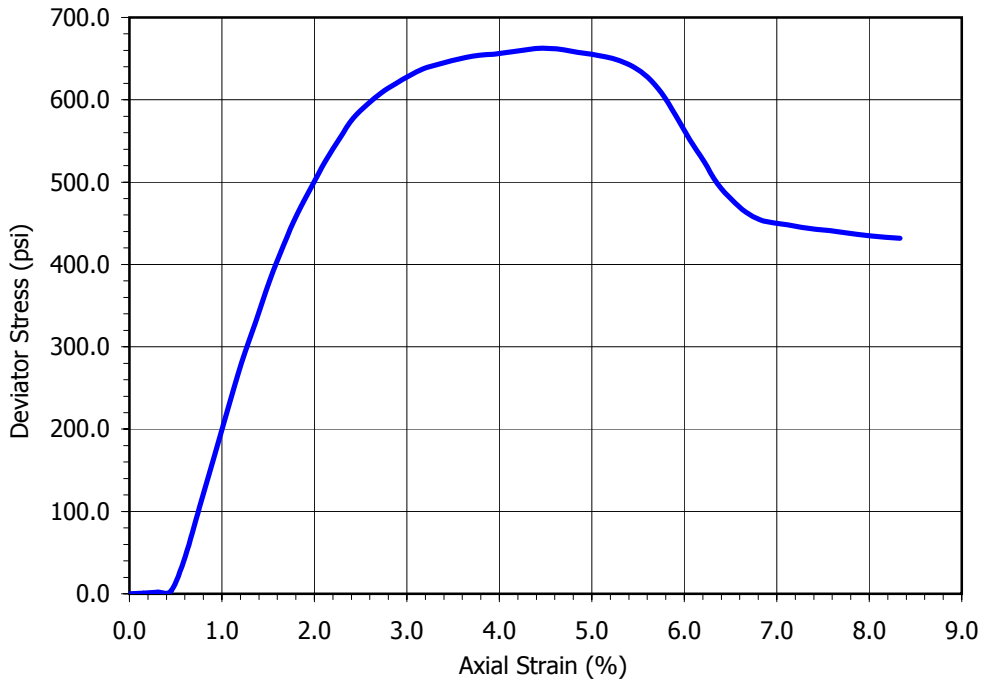
Diameter (in)	1	3.235
	2	3.250
	3	3.265
	Average	3.250
Height (in)	1	6.602
	2	6.604
	3	6.601
	Average	6.602
Weight of Sample + Tube / Rings (g)		1880.00
Weight of Tube / Rings (g)		0.00
Weight of Wet Sample + Container (g)		1989.30
Weight of Dry Sample + Container (g)		1800.60
Weight of Container (g)		110.69
Specific Gravity (assumed)		2.70
Confining Pressure (psi)		153.0
Rate of Deformation (in/min)		0.012

Sample Properties	
Moisture Content (%)	11.17
Dry Density (pcf)	117.6
Void Ratio	0.432
% Saturation	69.7

At Failure*	
Deviator stress (psi)	**662.36**
Minor principal total stress (psi)	**153.00**
Major principal total stress (psi)	**815.36**
Axial strain (%)	**4.39**

* Stress values have been corrected for membrane effects

Stress - Strain Curve



Unconsolidated-Undrained Triaxial Compression Test on Cohesive Soils

ASTM D 2850

Project Name:	SR-710 Tunnel Technical Study		Tested by:	A. Santos	Date: 04/30/09
Project No:	378312.04.09.01		Checked by:	J. Ward	Date: 05/12/09
Boring No.:	R-09-Z1-B5		Sample Type:	Core	
Sample No.:	C54		Depth(ft):	370.2-370.9	
Sample Description:	Olive silty sand'stone' (SM)				

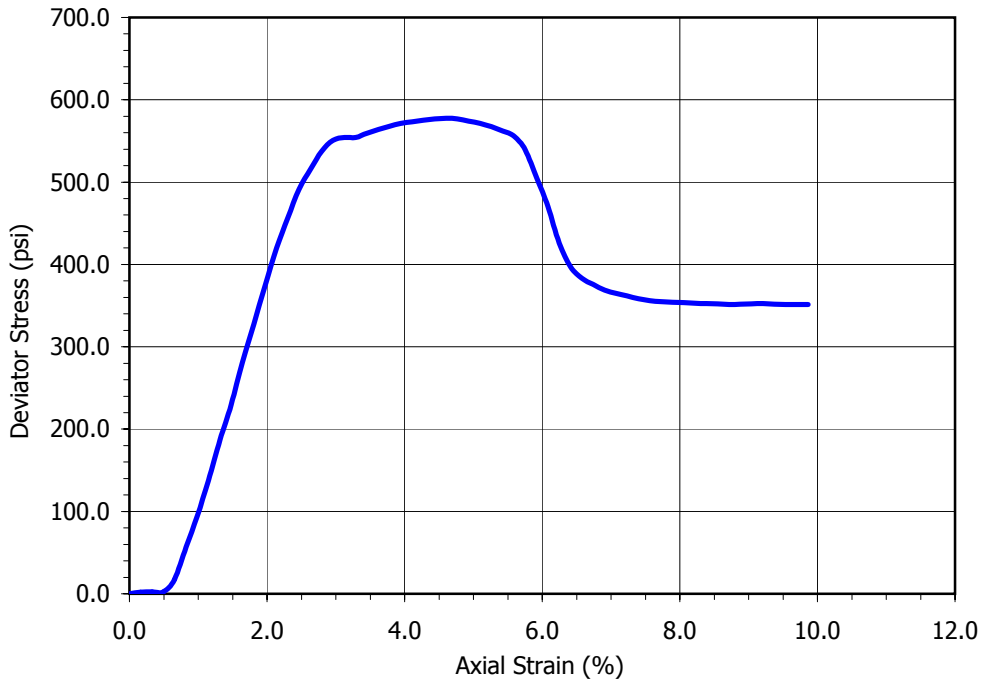
Diameter (in)	1	3.300
	2	3.300
	3	2.995
	Average	3.198
Height (in)	1	6.093
	2	6.073
	3	6.081
	Average	6.082
Weight of Sample + Tube / Rings (g)		1403.00
Weight of Tube / Rings (g)		0.00
Weight of Wet Sample + Container (g)		1509.40
Weight of Dry Sample + Container (g)		1397.30
Weight of Container (g)		108.00
Specific Gravity (assumed)		2.70
Confining Pressure (psi)		153.0
Rate of Deformation (in/min)		0.012

Sample Properties	
Moisture Content (%)	8.69
Dry Density (pcf)	100.6
Void Ratio	0.674
% Saturation	34.8

At Failure*	
Deviator stress (psi)	**577.45**
Minor principal total stress (psi)	**153.00**
Major principal total stress (psi)	**730.45**
Axial strain (%)	**4.60**

* Stress values have been corrected for membrane effects

Stress - Strain Curve



Unconsolidated-Undrained Triaxial Compression Test on Cohesive Soils

ASTM D 2850

Project Name:	SR-710 Tunnel Technical Study	Tested by:	A. Santos	Date:	04/24/09
Project No:	378312.04.09.01	Checked by:	J. Ward	Date:	04/28/09
Boring No.:	R-09-Z1-B6	Sample Type:	Core		
Sample No.:	C39	Depth(ft)	237-238		
Sample Description:	Dark gray silt'stone' (ML)				

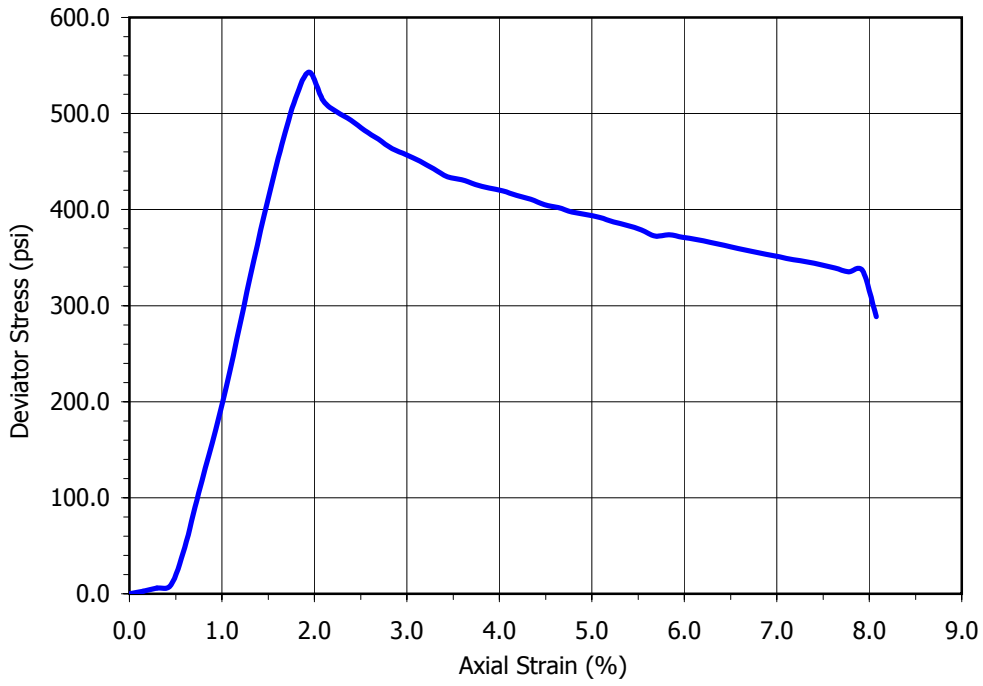
Diameter (in)	1	3.230
	2	3.225
	3	3.230
	Average	3.228
Height (in)	1	6.683
	2	6.683
	3	6.690
	Average	6.685
Weight of Sample + Tube / Rings (g)		1838.40
Weight of Tube / Rings (g)		0.00
Weight of Wet Sample + Container (g)		1815.10
Weight of Dry Sample + Container (g)		1584.90
Weight of Container (g)		107.10
Specific Gravity (assumed)		2.70
Confining Pressure (psi)		153.0
Rate of Deformation (in/min)		0.012

Sample Properties	
Moisture Content (%)	15.58
Dry Density (pcf)	110.7
Void Ratio	0.521
% Saturation	80.7

At Failure*	
Deviator stress (psi)	**542.90**
Minor principal total stress (psi)	**153.00**
Major principal total stress (psi)	**695.90**
Axial strain (%)	**1.94**

* Stress values have been corrected for membrane effects

Stress - Strain Curve



Unconsolidated-Undrained Triaxial Compression Test on Cohesive Soils

ASTM D 2850

Project Name:	SR-710 Tunnel Technical Study		Tested by:	A. Santos	Date: 05/12/09
Project No:	378312.04.09.01		Checked by:	J. Ward	Date: 05/14/09
Boring No.:	R-09-Z1-B6		Sample Type:	Core	
Sample No.:	C44		Depth(ft):	279.2-280	
Sample Description:	Dark olive gray silt'stone' (ML)				

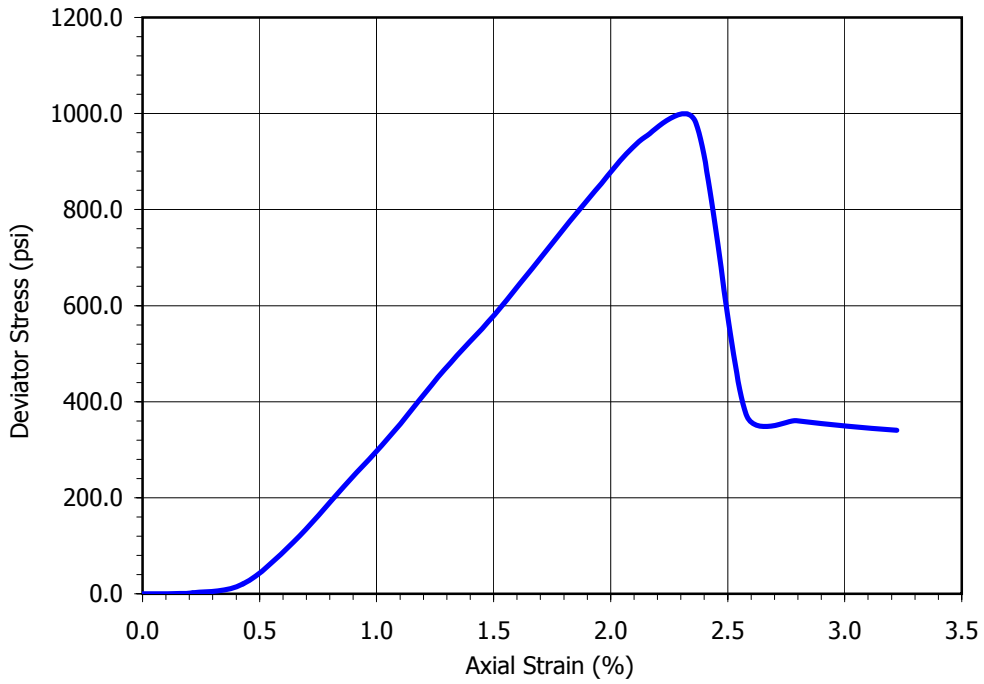
Diameter (in)	1	3.185
	2	3.160
	3	3.180
	Average	3.175
Height (in)	1	4.657
	2	4.651
	3	4.656
	Average	4.655
Weight of Sample + Tube / Rings (g)		1238.20
Weight of Tube / Rings (g)		0.00
Weight of Wet Sample + Container (g)		1348.10
Weight of Dry Sample + Container (g)		1216.00
Weight of Container (g)		111.20
Specific Gravity (assumed)		2.70
Confining Pressure (psi)		153.0
Rate of Deformation (in/min)		0.012

Sample Properties	
Moisture Content (%)	11.96
Dry Density (pcf)	114.3
Void Ratio	0.474
% Saturation	68.2

At Failure*	
Deviator stress (psi)	**980.51**
Minor principal total stress (psi)	**153.00**
Major principal total stress (psi)	**1133.51**
Axial strain (%)	**2.36**

* Stress values have been corrected for membrane effects

Stress - Strain Curve



Unconsolidated-Undrained Triaxial Compression Test on Cohesive Soils

ASTM D 2850

Project Name:	SR-710 Tunnel Technical Study		Tested by:	A. Santos	Date: 05/11/09
Project No:	378312.04.09.01		Checked by:	J. Ward	Date: 05/14/09
Boring No.:	R-09-Z1-B6		Sample Type:	Core	
Sample No.:	C47		Depth(ft):	307.8-309	
Sample Description:	Light olive gray silt'stone' (ML)				

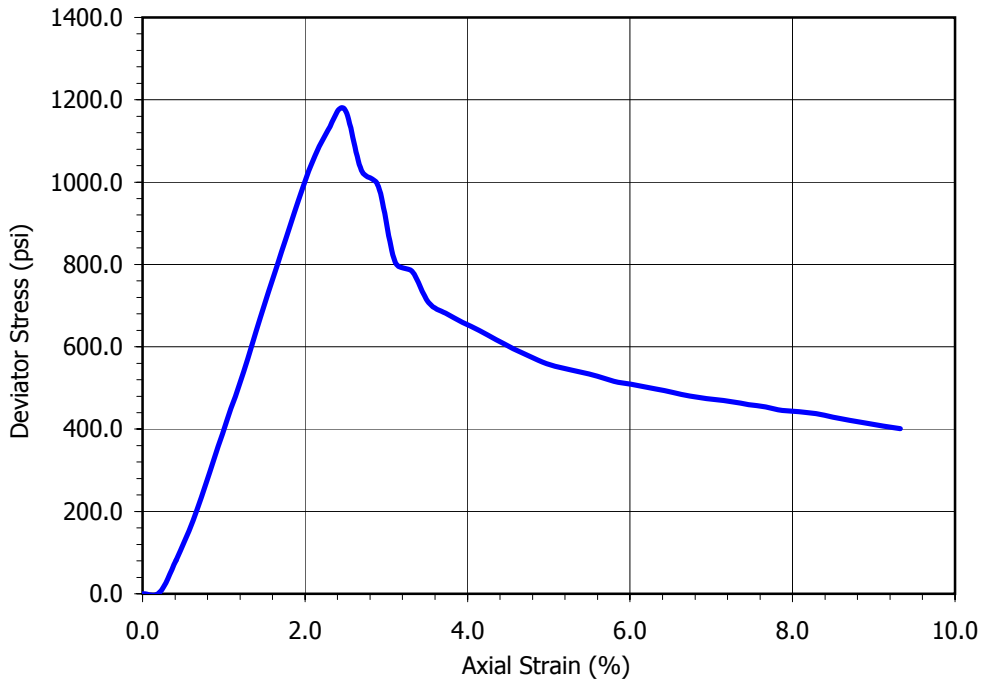
Diameter (in)	1	3.250
	2	3.225
	3	3.227
	Average	3.234
Height (in)	1	4.828
	2	4.819
	3	4.830
	Average	4.826
Weight of Sample + Tube / Rings (g)		1322.70
Weight of Tube / Rings (g)		0.00
Weight of Wet Sample + Container (g)		1425.80
Weight of Dry Sample + Container (g)		1256.40
Weight of Container (g)		109.40
Specific Gravity (assumed)		2.70
Confining Pressure (psi)		153.0
Rate of Deformation (in/min)		0.012

Sample Properties	
Moisture Content (%)	14.77
Dry Density (pcf)	110.8
Void Ratio	0.521
% Saturation	76.5

At Failure*	
Deviator stress (psi)	**1177.73**
Minor principal total stress (psi)	**153.00**
Major principal total stress (psi)	**1330.73**
Axial strain (%)	**2.49**

* Stress values have been corrected for membrane effects

Stress - Strain Curve



Unconsolidated-Undrained Triaxial Compression Test on Cohesive Soils

ASTM D 2850

Project Name:	SR-710 Tunnel Technical Study	Tested by:	A. Santos	Date:	04/27/09
Project No:	378312.04.09.01	Checked by:	J. Ward	Date:	04/28/09
Boring No.:	R-09-Z1-B7	Sample Type:	Core		
Sample No.:	C48	Depth(ft):	251.8-253.2		
Sample Description:	Dark olive gray silty sand'stone' (SM)				

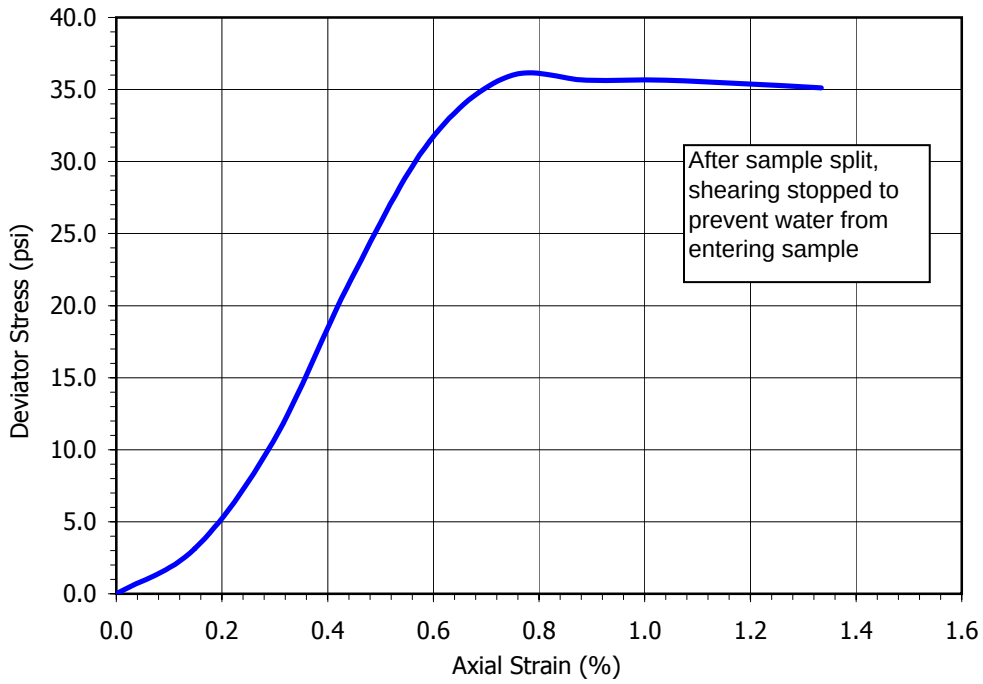
Diameter (in)	1	3.255
	2	3.252
	3	3.260
	Average	3.256
Height (in)	1	6.740
	2	6.752
	3	6.743
	Average	6.745
Weight of Sample + Tube / Rings (g)		1778.50
Weight of Tube / Rings (g)		0.00
Weight of Wet Sample + Container (g)		1571.70
Weight of Dry Sample + Container (g)		1401.70
Weight of Container (g)		110.54
Specific Gravity (assumed)		2.70
Confining Pressure (psi)		153.0
Rate of Deformation (in/min)		0.012

Sample Properties	
Moisture Content (%)	13.17
Dry Density (pcf)	106.6
Void Ratio	0.580
% Saturation	61.3

At Failure*	
Deviator stress (psi)	**35.88**
Minor principal total stress (psi)	**153.00**
Major principal total stress (psi)	**188.88**
Axial strain (%)	**0.74**

* Stress values have been corrected for membrane effects

Stress - Strain Curve



UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: June 1, 2009

Client: CH2MHill

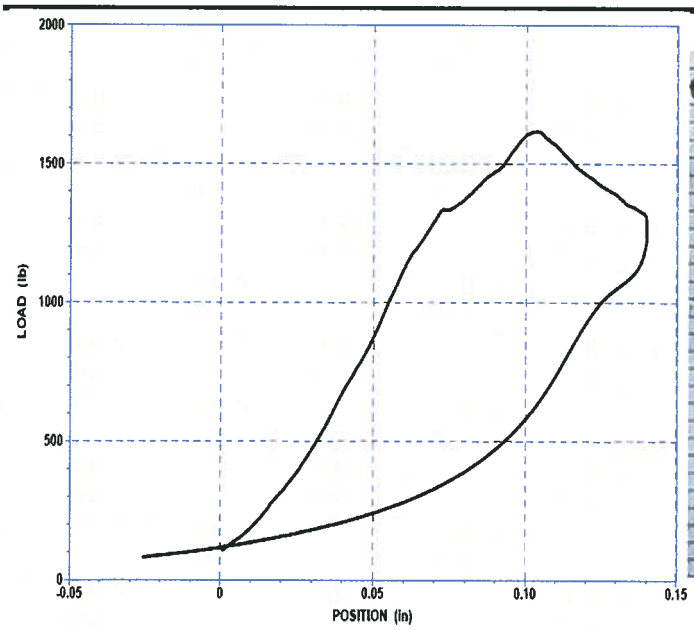
Material Type: shale
Date Cast: n/a
Date Tested: 5/29/09
Age, Days: n/a

Depth: 202-202.8

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

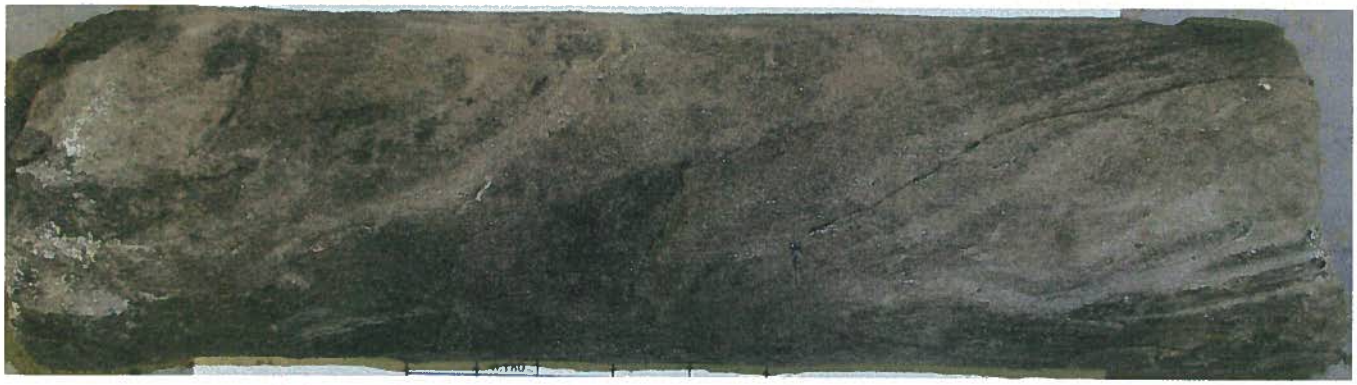
Test Results

Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z1-B7, C39		3.28	4.1	125.8	110.8	13.6	178



Elastic Modulus (psi)*:	7,042

* using secant elastic modulus formula



Unconsolidated-Undrained Triaxial Compression Test on Cohesive Soils

ASTM D 2850

Project Name:	SR-710 Tunnel Technical Study	Tested by:	A. Santos	Date:	05/08/09
Project No:	378312.04.09.01	Checked by:	J. Ward	Date:	05/12/09
Boring No.:	R-09-Z1-B8	Sample Type:	Core		
Sample No.:	C17	Depth(ft):	80-80.75		
Sample Description:	Dark olive lean clay'stone' (CL)				

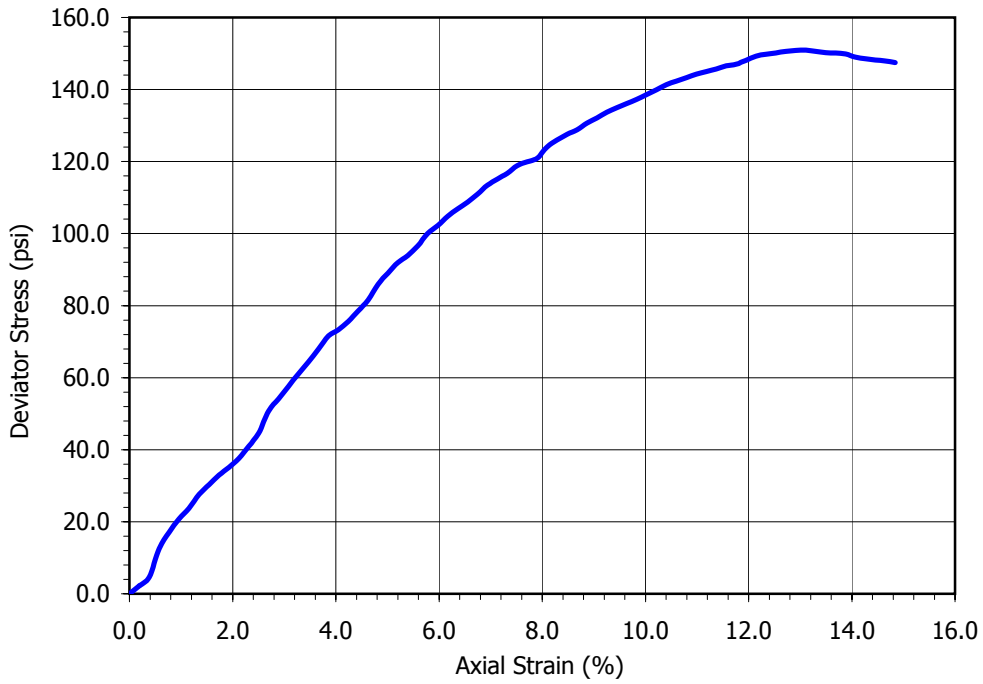
Diameter (in)	1	2.285
	2	2.305
	3	2.345
	Average	2.312
Height (in)	1	5.192
	2	5.184
	3	5.189
	Average	5.188
Weight of Sample + Tube / Rings (g)		698.10
Weight of Tube / Rings (g)		0.00
Weight of Wet Sample + Container (g)		774.30
Weight of Dry Sample + Container (g)		631.70
Weight of Container (g)		77.00
Specific Gravity (assumed)		2.70
Confining Pressure (psi)		52.1
Rate of Deformation (in/min)		0.012

Sample Properties	
Moisture Content (%)	25.71
Dry Density (pcf)	97.2
Void Ratio	0.734
% Saturation	94.6

At Failure*	
Deviator stress (psi)	**150.94**
Minor principal total stress (psi)	**52.10**
Major principal total stress (psi)	**203.04**
Axial strain (%)	**13.11**

* Stress values have been corrected for membrane effects

Stress - Strain Curve



Unconsolidated-Undrained Triaxial Compression Test on Cohesive Soils

ASTM D 2850

Project Name:	SR-710 Tunnel Technical Study	Tested by:	A. Santos	Date:	05/08/09
Project No:	378312.04.09.01	Checked by:	J. Ward	Date:	05/12/09
Boring No.:	R-09-Z1-B8	Sample Type:	Core		
Sample No.:	C23	Depth(ft):	109-109.7		
Sample Description:	Dark olive lean clay'stone' (CL)				

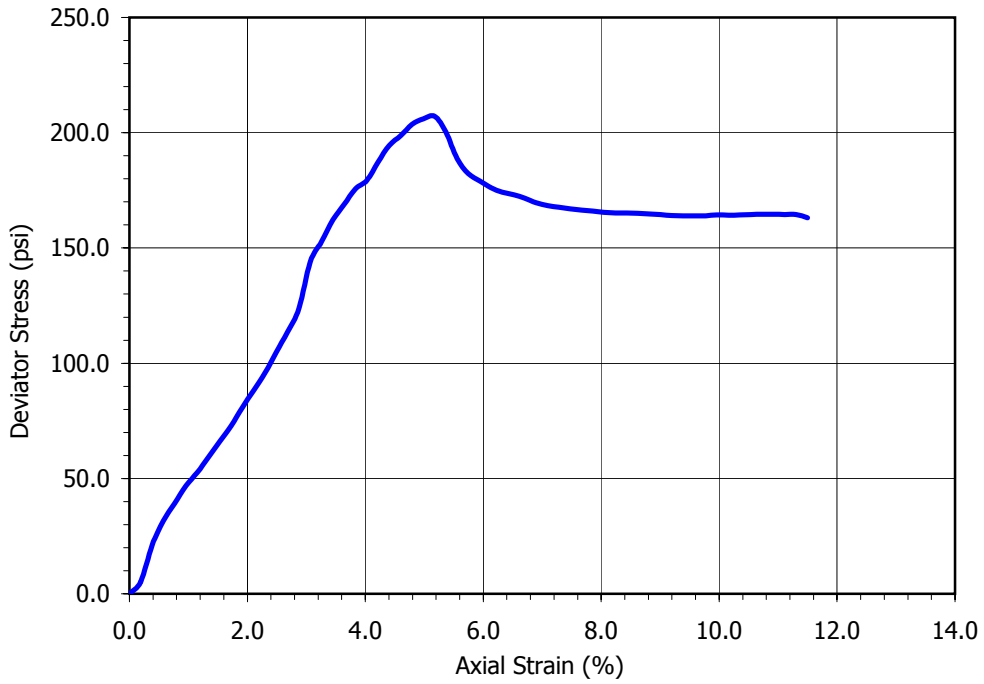
Diameter (in)	1	2.470
	2	2.473
	3	2.475
	Average	2.473
Height (in)	1	5.220
	2	5.218
	3	5.218
	Average	5.218
Weight of Sample + Tube / Rings (g)		830.20
Weight of Tube / Rings (g)		0.00
Weight of Wet Sample + Container (g)		904.10
Weight of Dry Sample + Container (g)		748.50
Weight of Container (g)		75.20
Specific Gravity (assumed)		2.70
Confining Pressure (psi)		69.5
Rate of Deformation (in/min)		0.012

Sample Properties	
Moisture Content (%)	23.11
Dry Density (pcf)	102.5
Void Ratio	0.643
% Saturation	97.0

At Failure*	
Deviator stress (psi)	**207.08**
Minor principal total stress (psi)	**69.50**
Major principal total stress (psi)	**276.58**
Axial strain (%)	**5.17**

* Stress values have been corrected for membrane effects

Stress - Strain Curve



Unconsolidated-Undrained Triaxial Compression Test on Cohesive Soils

ASTM D 2850

Project Name:	SR-710 Tunnel Technical Study		Tested by:	A. Santos	Date: 05/08/09
Project No:	378312.04.09.01		Checked by:	J. Ward	Date: 05/12/09
Boring No.:	R-09-Z1-B8		Sample Type:	Core	
Sample No.:	C26		Depth(ft):	119.5-120	
Sample Description:	Dark olive lean clay'stone' (CL)				

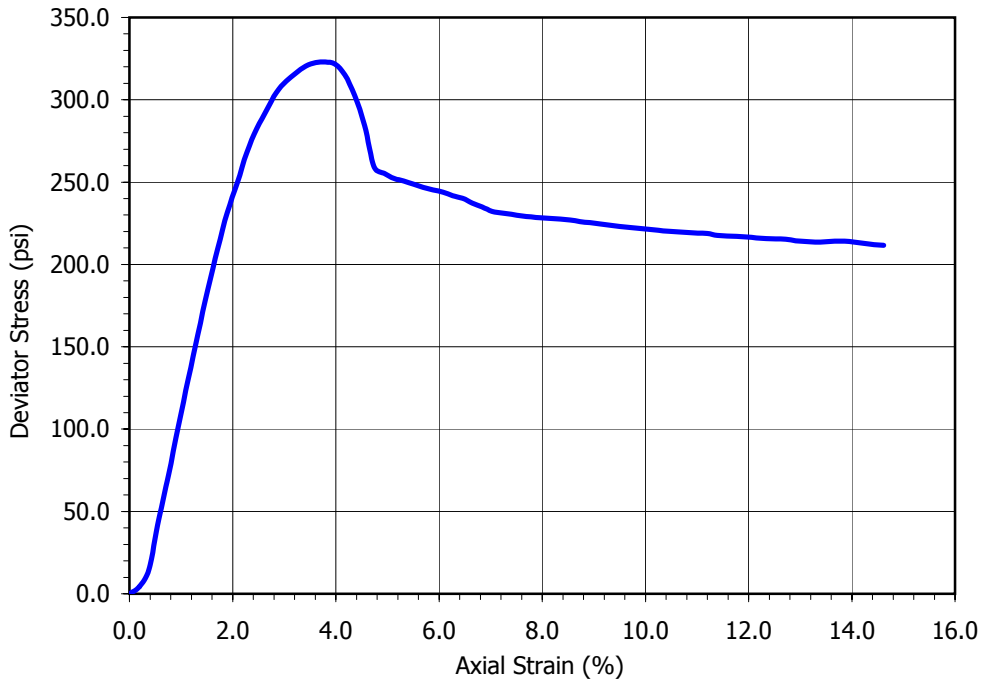
Diameter (in)	1	2.430
	2	2.431
	3	2.437
	Average	2.433
Height (in)	1	5.262
	2	5.272
	3	5.268
	Average	5.267
Weight of Sample + Tube / Rings (g)		815.00
Weight of Tube / Rings (g)		0.00
Weight of Wet Sample + Container (g)		886.50
Weight of Dry Sample + Container (g)		742.90
Weight of Container (g)		72.90
Specific Gravity (assumed)		2.70
Confining Pressure (psi)		76.4
Rate of Deformation (in/min)		0.012

Sample Properties	
Moisture Content (%)	21.43
Dry Density (pcf)	104.4
Void Ratio	0.613
% Saturation	94.4

At Failure*	
Deviator stress (psi)	**322.96**
Minor principal total stress (psi)	**76.40**
Major principal total stress (psi)	**399.36**
Axial strain (%)	**3.80**

* Stress values have been corrected for membrane effects

Stress - Strain Curve



Unconsolidated-Undrained Triaxial Compression Test on Cohesive Soils

ASTM D 2850

Project Name:	SR-710 Tunnel Technical Study		Tested by:	A. Santos	Date: 05/08/09
Project No:	378312.04.09.01		Checked by:	J. Ward	Date: 05/12/09
Boring No.:	R-09-Z1-B8		Sample Type:	Core	
Sample No.:	C39		Depth(ft):	189.25-190	
Sample Description:	Dark olive silt'stone' (ML)				

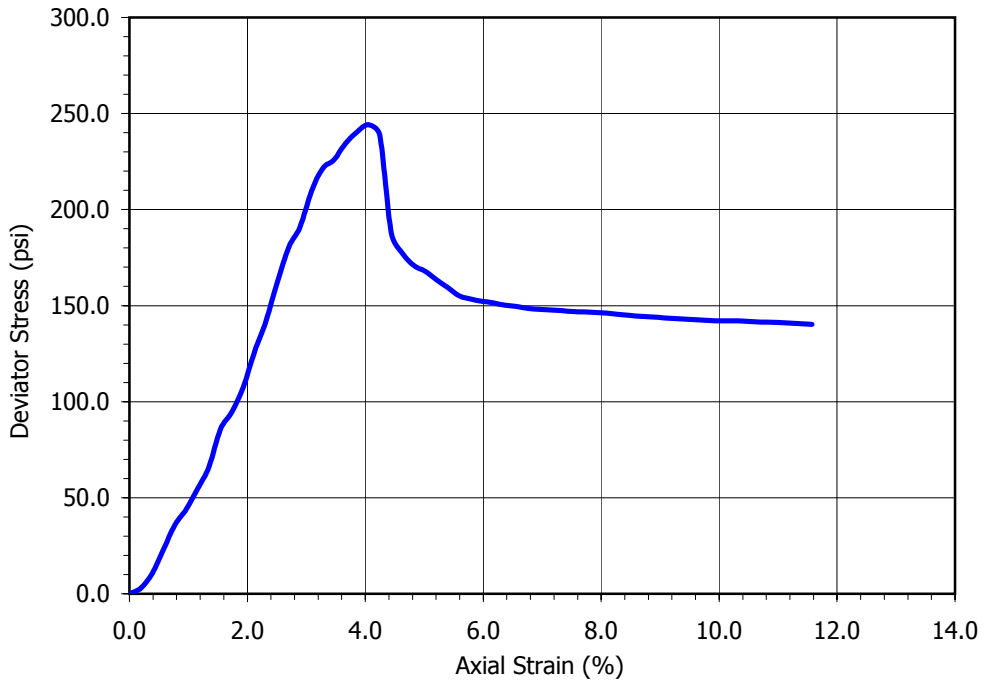
Diameter (in)	1	2.400
	2	2.402
	3	2.405
	Average	2.402
Height (in)	1	5.185
	2	5.183
	3	5.183
	Average	5.184
Weight of Sample + Tube / Rings (g)		764.00
Weight of Tube / Rings (g)		0.00
Weight of Wet Sample + Container (g)		837.30
Weight of Dry Sample + Container (g)		688.90
Weight of Container (g)		75.90
Specific Gravity (assumed)		2.70
Confining Pressure (psi)		121.5
Rate of Deformation (in/min)		0.012

Sample Properties	
Moisture Content (%)	24.21
Dry Density (pcf)	99.7
Void Ratio	0.689
% Saturation	94.8

At Failure*	
Deviator stress (psi)	**244.26**
Minor principal total stress (psi)	**121.50**
Major principal total stress (psi)	**365.76**
Axial strain (%)	**4.05**

* Stress values have been corrected for membrane effects

Stress - Strain Curve



Unconsolidated-Undrained Triaxial Compression Test on Cohesive Soils

ASTM D 2850

Project Name:	SR-710 Tunnel Technical Study	Tested by:	A. Santos	Date:	05/20/09
Project No:	378312.04.09.01	Checked by:	J. Ward	Date:	05/27/09
Boring No.:	R-09-Z2-B2	Sample Type:	Core		
Sample No.:	C24	Depth(ft):	144-144.5		
Sample Description:	Olive brown silty sand (SM)				

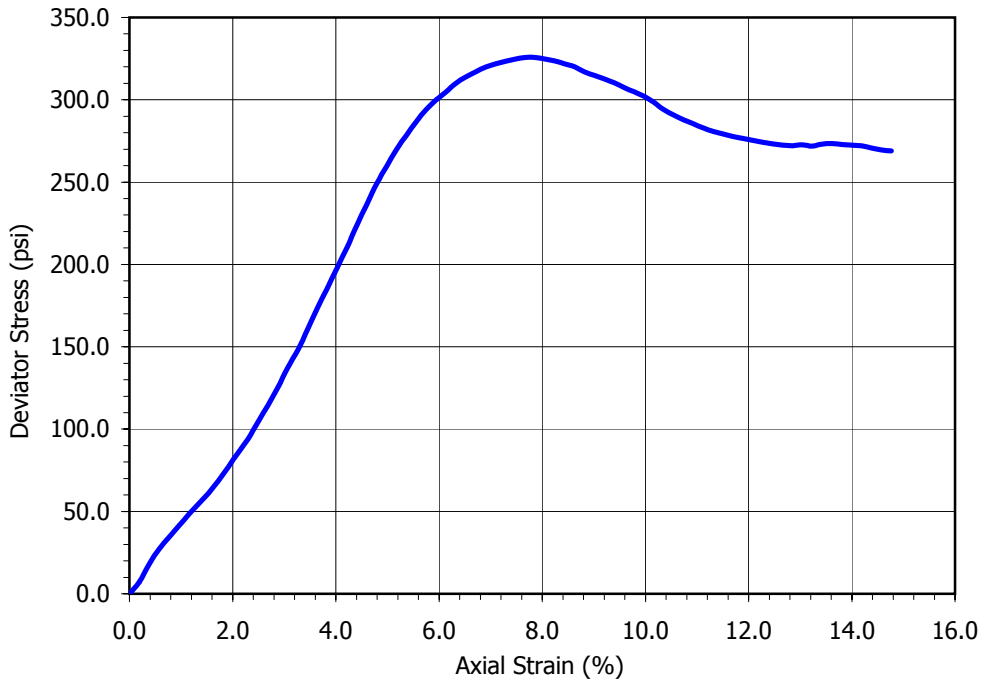
Diameter (in)	1	2.475
	2	2.470
	3	2.474
	Average	2.473
Height (in)	1	5.212
	2	5.218
	3	5.216
	Average	5.215
Weight of Sample + Tube / Rings (g)		1139.00
Weight of Tube / Rings (g)		260.30
Weight of Wet Sample + Container (g)		986.00
Weight of Dry Sample + Container (g)		883.70
Weight of Container (g)		108.32
Specific Gravity (assumed)		2.70
Confining Pressure (psi)		93.8
Rate of Deformation (in/min)		0.012

Sample Properties	
Moisture Content (%)	13.19
Dry Density (pcf)	118.1
Void Ratio	0.427
% Saturation	83.4

At Failure*	
Deviator stress (psi)	**325.76**
Minor principal total stress (psi)	**93.75**
Major principal total stress (psi)	**419.51**
Axial strain (%)	**7.86**

* Stress values have been corrected for membrane effects

Stress - Strain Curve



Unconsolidated-Undrained Triaxial Compression Test on Cohesive Soils

ASTM D 2850

Project Name:	SR-710 Tunnel Technical Study	Tested by:	A. Santos	Date:	05/17/09
Project No:	378312.04.09.01	Checked by:	J. Ward	Date:	05/27/09
Boring No.:	R-09-Z2-B2	Sample Type:	Core		
Sample No.:	C29	Depth(ft):	165-166		
Sample Description:	Light brown silty sand'stone' (SM)				

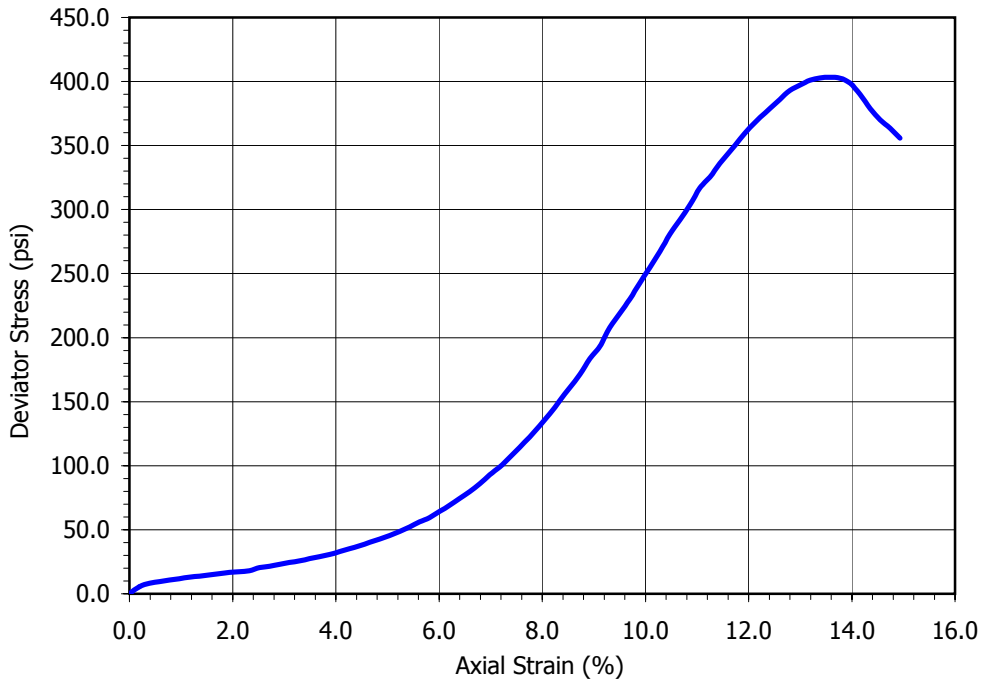
Diameter (in)	1	2.455
	2	2.450
	3	2.435
	Average	2.447
Height (in)	1	5.152
	2	5.159
	3	5.156
	Average	5.155
Weight of Sample + Tube / Rings (g)		846.30
Weight of Tube / Rings (g)		0.00
Weight of Wet Sample + Container (g)		948.60
Weight of Dry Sample + Container (g)		830.50
Weight of Container (g)		105.30
Specific Gravity (assumed)		2.70
Confining Pressure (psi)		108.0
Rate of Deformation (in/min)		0.012

Sample Properties	
Moisture Content (%)	16.29
Dry Density (pcf)	114.4
Void Ratio	0.473
% Saturation	93.0

At Failure*	
Deviator stress (psi)	**403.24**
Minor principal total stress (psi)	**108.00**
Major principal total stress (psi)	**511.24**
Axial strain (%)	**13.58**

* Stress values have been corrected for membrane effects

Stress - Strain Curve



Unconsolidated-Undrained Triaxial Compression Test on Cohesive Soils

ASTM D 2850

Project Name:	SR-710 Tunnel Technical Study	Tested by:	A. Santos	Date:	05/21/09
Project No:	378312.04.09.01	Checked by:	J. Ward	Date:	05/27/09
Boring No.:	R-09-Z2-B2	Sample Type:	Core		
Sample No.:	C38	Depth(ft):	213-213.6		
Sample Description:	Brown clayey sand'stone' (SC)				

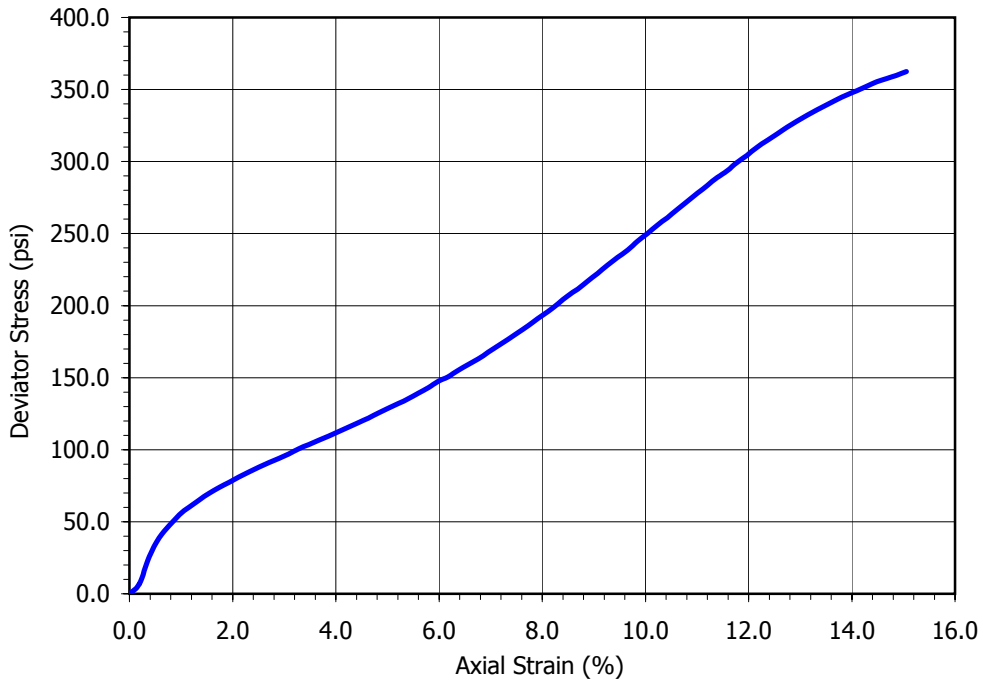
Diameter (in)	1	2.480
	2	2.445
	3	2.475
	Average	2.467
Height (in)	1	5.178
	2	5.182
	3	5.179
	Average	5.180
Weight of Sample + Tube / Rings (g)		876.20
Weight of Tube / Rings (g)		0.00
Weight of Wet Sample + Container (g)		948.90
Weight of Dry Sample + Container (g)		864.20
Weight of Container (g)		105.31
Specific Gravity (assumed)		2.70
Confining Pressure (psi)		138.9
Rate of Deformation (in/min)		0.012

Sample Properties	
Moisture Content (%)	11.16
Dry Density (pcf)	121.3
Void Ratio	0.389
% Saturation	77.5

At Failure*	
Deviator stress (psi)	**362.37**
Minor principal total stress (psi)	**138.90**
Major principal total stress (psi)	**501.27**
Axial strain (%)	**15.06**

* Stress values have been corrected for membrane effects

Stress - Strain Curve



Unconsolidated-Undrained Triaxial Compression Test on Cohesive Soils

ASTM D 2850

Project Name:	SR-710 Tunnel Technical Study		Tested by:	A. Santos	Date: 05/20/09
Project No:	378312.04.09.01		Checked by:	J. Ward	Date: 05/27/09
Boring No.:	R-09-Z2-B2		Sample Type:	Core	
Sample No.:	C48		Depth(ft):	260.5-261.1	
Sample Description:	Dark grayish brown clayey sand (SC)				

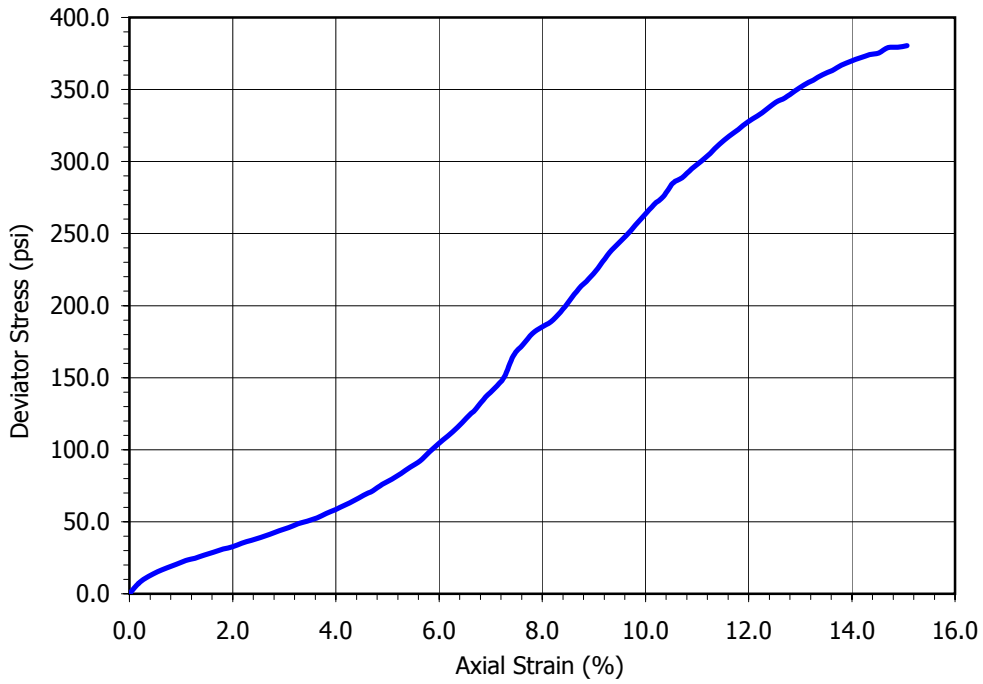
Diameter (in)	1	2.455
	2	2.460
	3	2.464
	Average	2.460
Height (in)	1	5.510
	2	5.505
	3	5.509
	Average	5.508
Weight of Sample + Tube / Rings (g)		955.80
Weight of Tube / Rings (g)		0.00
Weight of Wet Sample + Container (g)		1123.30
Weight of Dry Sample + Container (g)		1022.80
Weight of Container (g)		109.40
Specific Gravity (assumed)		2.70
Confining Pressure (psi)		153.0
Rate of Deformation (in/min)		0.012

Sample Properties	
Moisture Content (%)	11.00
Dry Density (pcf)	125.3
Void Ratio	0.344
% Saturation	86.3

At Failure*	
Deviator stress (psi)	**380.44**
Minor principal total stress (psi)	**153.00**
Major principal total stress (psi)	**533.44**
Axial strain (%)	**15.07**

* Stress values have been corrected for membrane effects

Stress - Strain Curve



Unconsolidated-Undrained Triaxial Compression Test on Cohesive Soils

ASTM D 2850

Project Name:	SR-710 Tunnel Technical Study	Tested by:	A. Santos	Date:	05/17/09
Project No:	378312.04.09.01	Checked by:	J. Ward	Date:	05/28/09
Boring No.:	R-09-Z2-B4	Sample Type:	Core		
Sample No.:	C40	Depth(ft):	157-158		
Sample Description:	Dark olive sandy silt'stone' s(ML)				

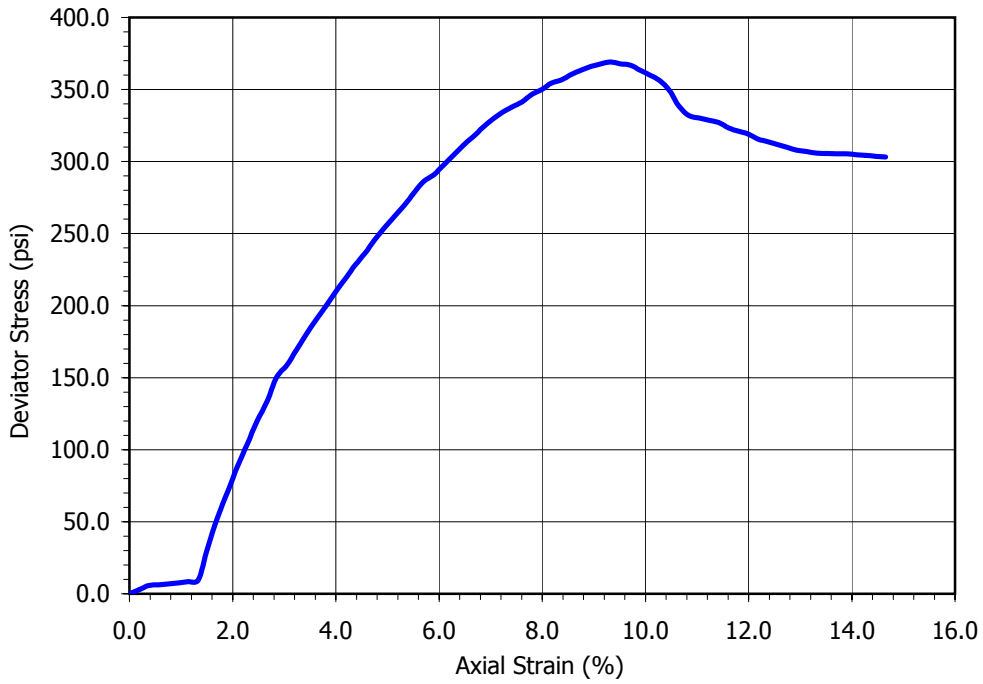
Diameter (in)	1	2.465
	2	2.445
	3	2.450
	Average	2.453
Height (in)	1	5.254
	2	5.258
	3	5.255
	Average	5.255
Weight of Sample + Tube / Rings (g)		874.40
Weight of Tube / Rings (g)		0.00
Weight of Wet Sample + Container (g)		980.70
Weight of Dry Sample + Container (g)		894.40
Weight of Container (g)		106.90
Specific Gravity (assumed)		2.70
Confining Pressure (psi)		100.7
Rate of Deformation (in/min)		0.012

Sample Properties	
Moisture Content (%)	10.96
Dry Density (pcf)	120.8
Void Ratio	0.394
% Saturation	75.1

At Failure*	
Deviator stress (psi)	**369.15**
Minor principal total stress (psi)	**100.70**
Major principal total stress (psi)	**469.85**
Axial strain (%)	**9.32**

* Stress values have been corrected for membrane effects

Stress - Strain Curve



Unconsolidated-Undrained Triaxial Compression Test on Cohesive Soils

ASTM D 2850

Project Name:	SR-710 Tunnel Technical Study	Tested by:	A. Santos	Date:	05/17/09
Project No:	378312.04.09.01	Checked by:	J. Ward	Date:	05/28/09
Boring No.:	R-09-Z2-B4	Sample Type:	Core		
Sample No.:	C48	Depth(ft):	183.4-184		
Sample Description:	Dark olive silt'stone' (ML)				

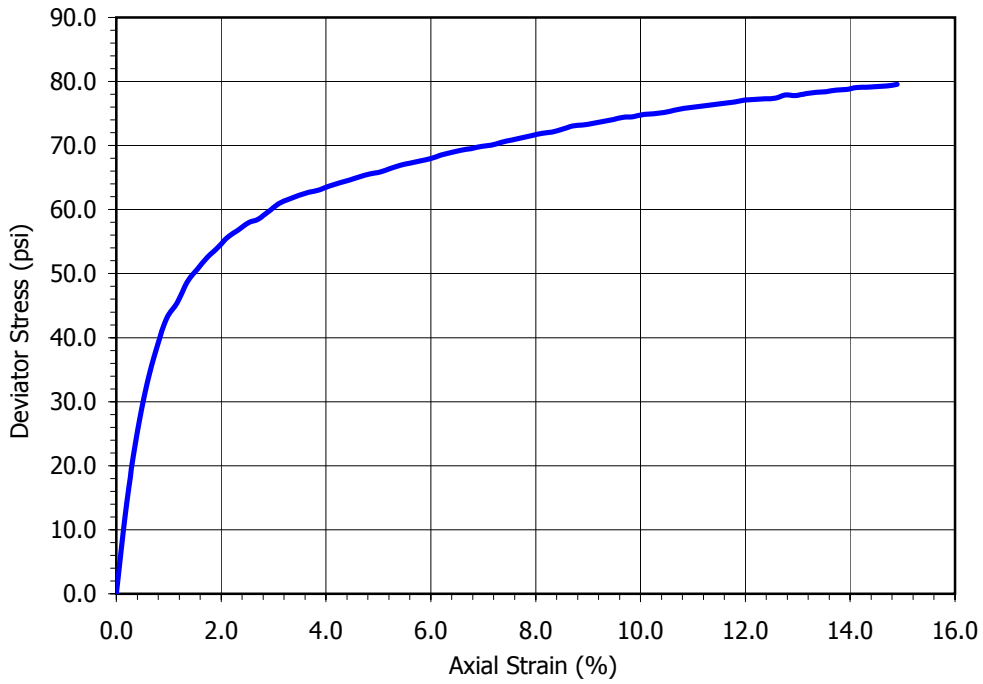
Diameter (in)	1	2.420
	2	2.426
	3	2.430
	Average	2.425
Height (in)	1	5.176
	2	5.164
	3	5.171
	Average	5.170
Weight of Sample + Tube / Rings (g)		806.00
Weight of Tube / Rings (g)		0.00
Weight of Wet Sample + Container (g)		880.90
Weight of Dry Sample + Container (g)		739.70
Weight of Container (g)		75.80
Specific Gravity (assumed)		2.70
Confining Pressure (psi)		118.0
Rate of Deformation (in/min)		0.012

Sample Properties	
Moisture Content (%)	21.27
Dry Density (pcf)	106.0
Void Ratio	0.589
% Saturation	97.4

At Failure*	
Deviator stress (psi)	**79.56**
Minor principal total stress (psi)	**118.00**
Major principal total stress (psi)	**197.56**
Axial strain (%)	**14.89**

* Stress values have been corrected for membrane effects

Stress - Strain Curve



Unconsolidated-Undrained Triaxial Compression Test on Cohesive Soils

ASTM D 2850

Project Name:	SR-710 Tunnel Technical Study	Tested by:	A. Santos	Date:	05/17/09
Project No:	378312.04.09.01	Checked by:	J. Ward	Date:	05/28/09
Boring No.:	R-09-Z2-B4	Sample Type:	Core		
Sample No.:	C98	Depth(ft):	357-357.9		
Sample Description:	Dark olive silt'stone' (ML)				

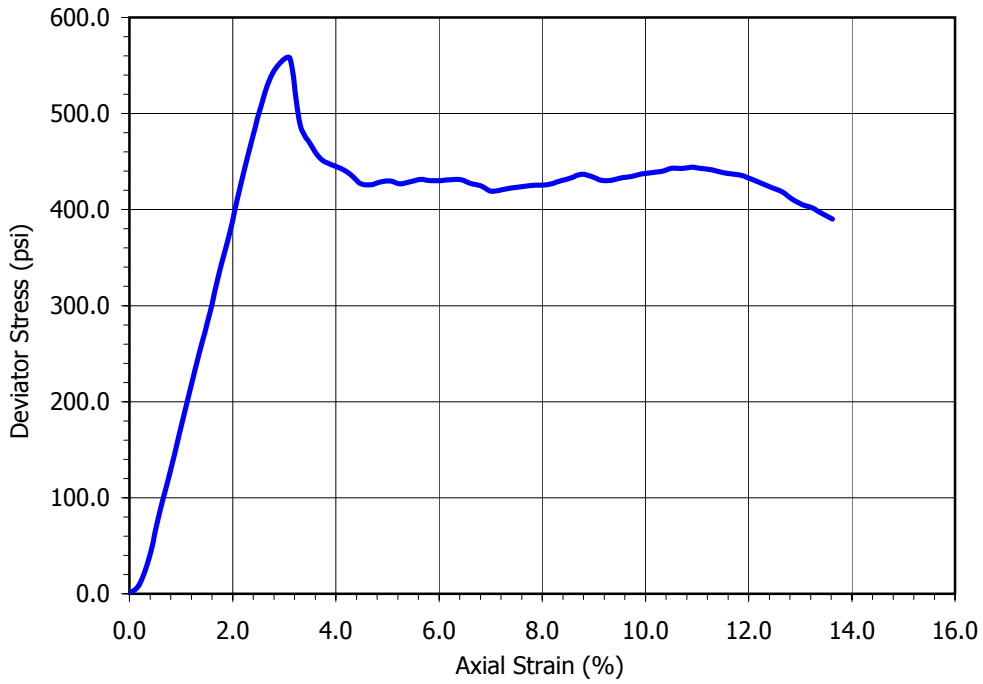
Diameter (in)	1	2.450
	2	2.456
	3	2.448
	Average	2.451
Height (in)	1	5.133
	2	5.144
	3	5.139
	Average	5.139
Weight of Sample + Tube / Rings (g)		833.70
Weight of Tube / Rings (g)		0.00
Weight of Wet Sample + Container (g)		905.70
Weight of Dry Sample + Container (g)		801.30
Weight of Container (g)		76.10
Specific Gravity (assumed)		2.70
Confining Pressure (psi)		153.0
Rate of Deformation (in/min)		0.012

Sample Properties	
Moisture Content (%)	14.40
Dry Density (pcf)	114.5
Void Ratio	0.472
% Saturation	82.4

At Failure*	
Deviator stress (psi)	**556.93**
Minor principal total stress (psi)	**153.00**
Major principal total stress (psi)	**709.93**
Axial strain (%)	**3.11**

* Stress values have been corrected for membrane effects

Stress - Strain Curve



Unconsolidated-Undrained Triaxial Compression Test on Cohesive Soils

ASTM D 2850

Project Name:	SR-710 Tunnel Technical Study	Tested by:	A. Santos	Date:	05/19/09
Project No:	378312.04.09.01	Checked by:	J. Ward	Date:	05/28/09
Boring No.:	R-09-Z2-B4	Sample Type:	Core		
Sample No.:	C106	Depth(ft):	384.3-385		
Sample Description:	Dark olive gray silty sand'stone' (SM)				

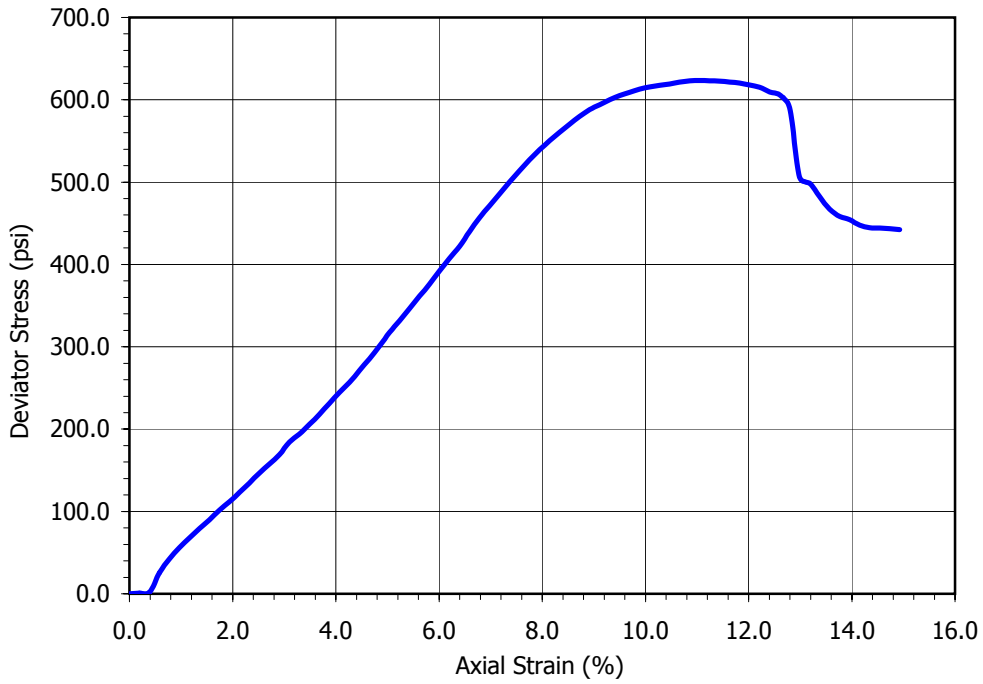
Diameter (in)	1	2.430
	2	2.427
	3	2.426
	Average	2.428
Height (in)	1	5.165
	2	5.149
	3	5.161
	Average	5.158
Weight of Sample + Tube / Rings (g)		834.00
Weight of Tube / Rings (g)		0.00
Weight of Wet Sample + Container (g)		939.70
Weight of Dry Sample + Container (g)		837.70
Weight of Container (g)		108.20
Specific Gravity (assumed)		2.70
Confining Pressure (psi)		153.0
Rate of Deformation (in/min)		0.012

Sample Properties	
Moisture Content (%)	13.98
Dry Density (pcf)	116.7
Void Ratio	0.443
% Saturation	85.2

At Failure*	
Deviator stress (psi)	**623.33**
Minor principal total stress (psi)	**153.00**
Major principal total stress (psi)	**776.33**
Axial strain (%)	**11.05**

* Stress values have been corrected for membrane effects

Stress - Strain Curve



Unconsolidated-Undrained Triaxial Compression Test on Cohesive Soils

ASTM D 2850

Project Name:	SR-710 Tunnel Technical Study	Tested by:	A. Santos	Date:	05/27/09
Project No:	378312.04.09.01	Checked by:	J. Ward	Date:	06/01/09
Boring No.:	R-09-Z2-B5	Sample Type:	Drive		
Sample No.:	C28	Depth(ft):	148-148.6		
Sample Description:	Yellowish brown fat clay (CH)				

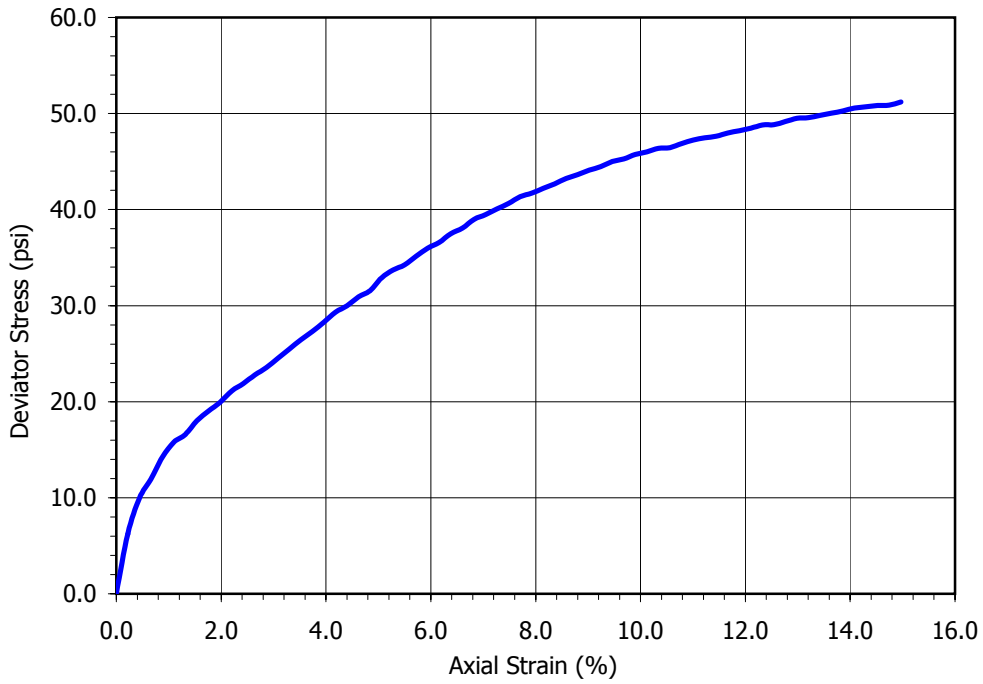
Diameter (in)	1	2.450
	2	2.430
	3	2.425
	Average	2.435
Height (in)	1	4.548
	2	4.541
	3	4.543
	Average	4.544
Weight of Sample + Tube / Rings (g)		619.30
Weight of Tube / Rings (g)		0.00
Weight of Wet Sample + Container (g)		727.60
Weight of Dry Sample + Container (g)		552.00
Weight of Container (g)		109.00
Specific Gravity (assumed)		2.70
Confining Pressure (psi)		97.2
Rate of Deformation (in/min)		0.012

Sample Properties	
Moisture Content (%)	39.64
Dry Density (pcf)	79.8
Void Ratio	1.110
% Saturation	96.4

At Failure*	
Deviator stress (psi)	**51.19**
Minor principal total stress (psi)	**97.20**
Major principal total stress (psi)	**148.39**
Axial strain (%)	**14.97**

* Stress values have been corrected for membrane effects

Stress - Strain Curve



Unconsolidated-Undrained Triaxial Compression Test on Cohesive Soils

ASTM D 2850

Project Name:	SR-710 Tunnel Technical Study		Tested by:	A. Santos	Date: 05/28/09
Project No:	378312.04.09.01		Checked by:	J. Ward	Date: 06/01/09
Boring No.:	R-09-Z2-B5		Sample Type:	Drive	
Sample No.:	C47		Depth(ft):	217.5-218.3	
Sample Description:	Dark olive silt'stone' (ML)				

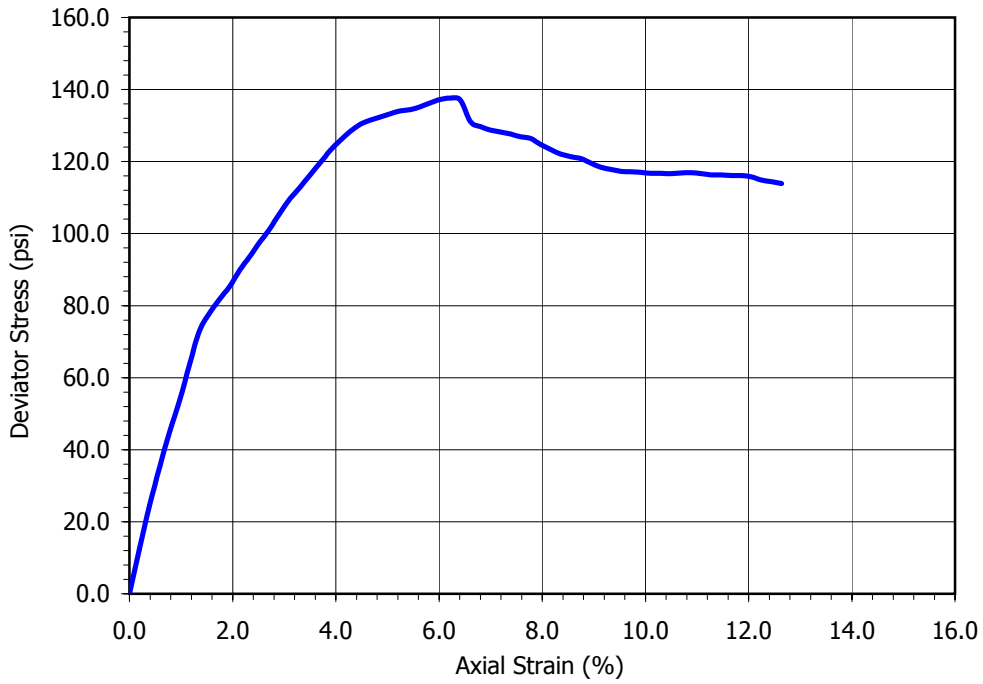
Diameter (in)	1	2.376
	2	2.375
	3	2.378
	Average	2.376
Height (in)	1	5.143
	2	5.146
	3	5.144
	Average	5.144
Weight of Sample + Tube / Rings (g)		750.60
Weight of Tube / Rings (g)		0.00
Weight of Wet Sample + Container (g)		1336.60
Weight of Dry Sample + Container (g)		1103.20
Weight of Container (g)		106.90
Specific Gravity (assumed)		2.70
Confining Pressure (psi)		142.4
Rate of Deformation (in/min)		0.012

Sample Properties	
Moisture Content (%)	23.43
Dry Density (pcf)	101.5
Void Ratio	0.659
% Saturation	96.0

At Failure*	
Deviator stress (psi)	**137.60**
Minor principal total stress (psi)	**142.40**
Major principal total stress (psi)	**280.00**
Axial strain (%)	**6.22**

* Stress values have been corrected for membrane effects

Stress - Strain Curve



Unconsolidated-Undrained Triaxial Compression Test on Cohesive Soils

ASTM D 2850

Project Name:	SR-710 Tunnel Technical Study	Tested by:	A. Santos	Date:	05/28/09
Project No:	378312.04.09.01	Checked by:	J. Ward	Date:	06/01/09
Boring No.:	R-09-Z2-B5	Sample Type:	Drive		
Sample No.:	C59	Depth(ft):	265-265.6		
Sample Description:	Dark olive silt'stone' (ML)				

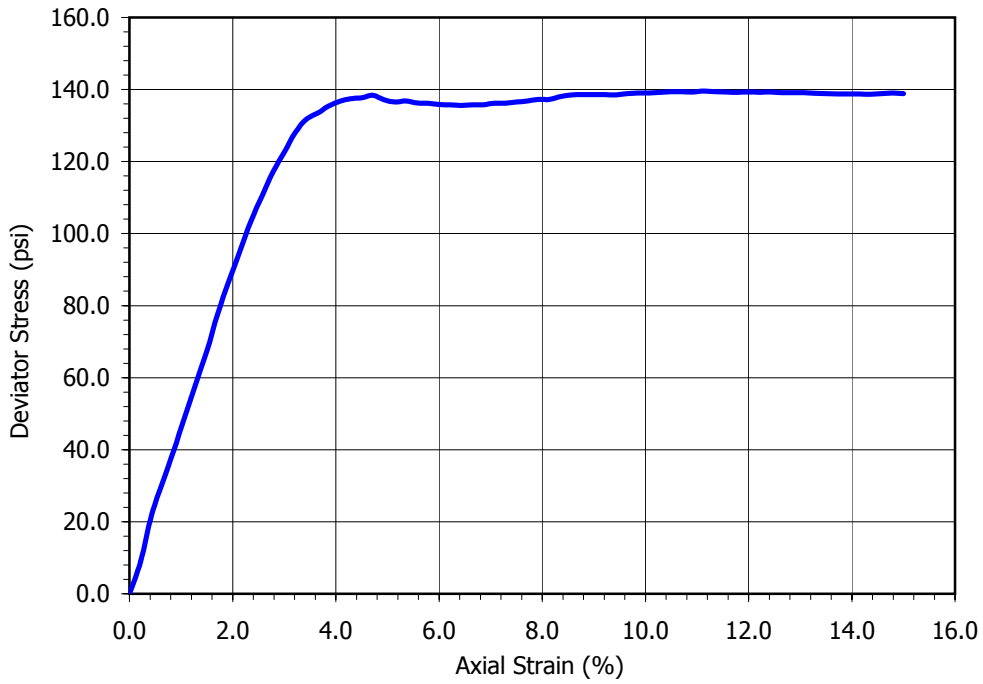
Diameter (in)	1	2.445
	2	2.425
	3	2.415
	Average	2.428
Height (in)	1	4.661
	2	4.664
	3	4.673
	Average	4.666
Weight of Sample + Tube / Rings (g)		698.70
Weight of Tube / Rings (g)		0.00
Weight of Wet Sample + Container (g)		806.70
Weight of Dry Sample + Container (g)		673.70
Weight of Container (g)		109.05
Specific Gravity (assumed)		2.70
Confining Pressure (psi)		154.0
Rate of Deformation (in/min)		0.012

Sample Properties	
Moisture Content (%)	23.55
Dry Density (pcf)	99.7
Void Ratio	0.690
% Saturation	92.2

At Failure*	
Deviator stress (psi)	**139.53**
Minor principal total stress (psi)	**154.00**
Major principal total stress (psi)	**293.53**
Axial strain (%)	**11.14**

* Stress values have been corrected for membrane effects

Stress - Strain Curve



Unconsolidated-Undrained Triaxial Compression Test on Cohesive Soils

ASTM D 2850

Project Name:	SR-710 Tunnel Technical Study	Tested by:	A. Santos	Date:	05/20/09
Project No:	378312.04.09.01	Checked by:	J. Ward	Date:	05/27/09
Boring No.:	R-09-Z2-B5	Sample Type:	Drive		
Sample No.:	O21	Depth(ft):	105		
Sample Description:	Olive brown lean clay (CL)				

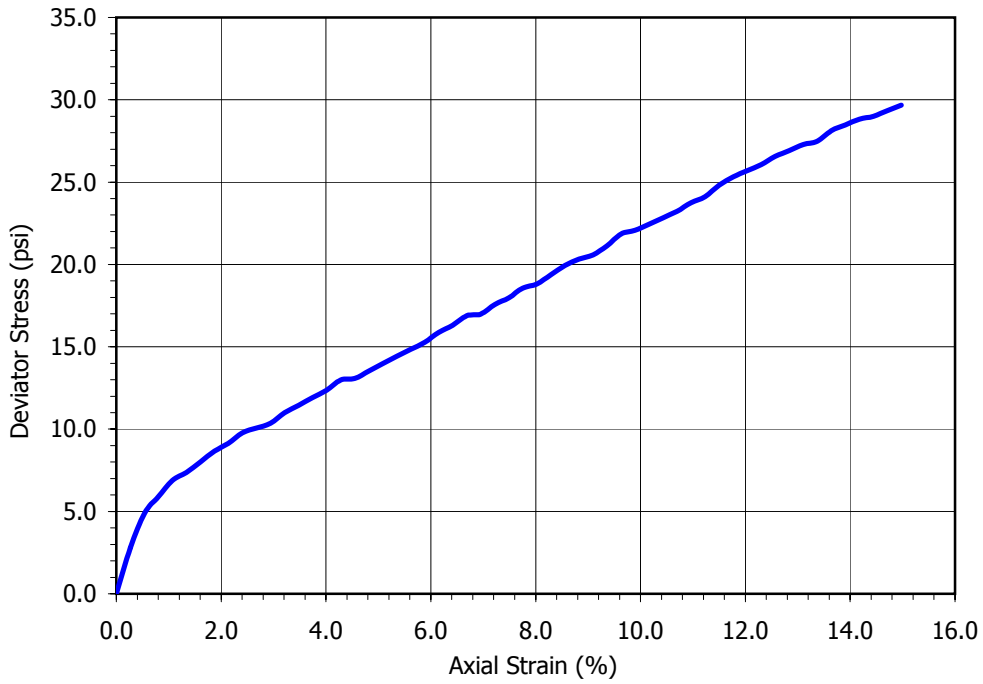
Diameter (in)	1	1.908
	2	1.906
	3	1.910
	Average	1.908
Height (in)	1	3.748
	2	3.731
	3	3.739
	Average	3.739
Weight of Sample + Tube / Rings (g)		355.40
Weight of Tube / Rings (g)		0.00
Weight of Wet Sample + Container (g)		427.80
Weight of Dry Sample + Container (g)		358.10
Weight of Container (g)		75.20
Specific Gravity (assumed)		2.70
Confining Pressure (psi)		69.5
Rate of Deformation (in/min)		0.012

Sample Properties	
Moisture Content (%)	24.64
Dry Density (pcf)	101.6
Void Ratio	0.658
% Saturation	101.1

At Failure*	
Deviator stress (psi)	**29.67**
Minor principal total stress (psi)	**69.50**
Major principal total stress (psi)	**99.17**
Axial strain (%)	**14.98**

* Stress values have been corrected for membrane effects

Stress - Strain Curve



Unconsolidated-Undrained Triaxial Compression Test on Cohesive Soils

ASTM D 2850

Project Name:	SR-710 Tunnel Technical Study	Tested by:	A. Santos	Date:	05/20/09
Project No:	378312.04.09.01	Checked by:	J. Ward	Date:	05/27/09
Boring No.:	R-09-Z2-B5	Sample Type:	Drive		
Sample No.:	O25	Depth(ft):	125		
Sample Description:	Light olive brown fat clay (CH)				

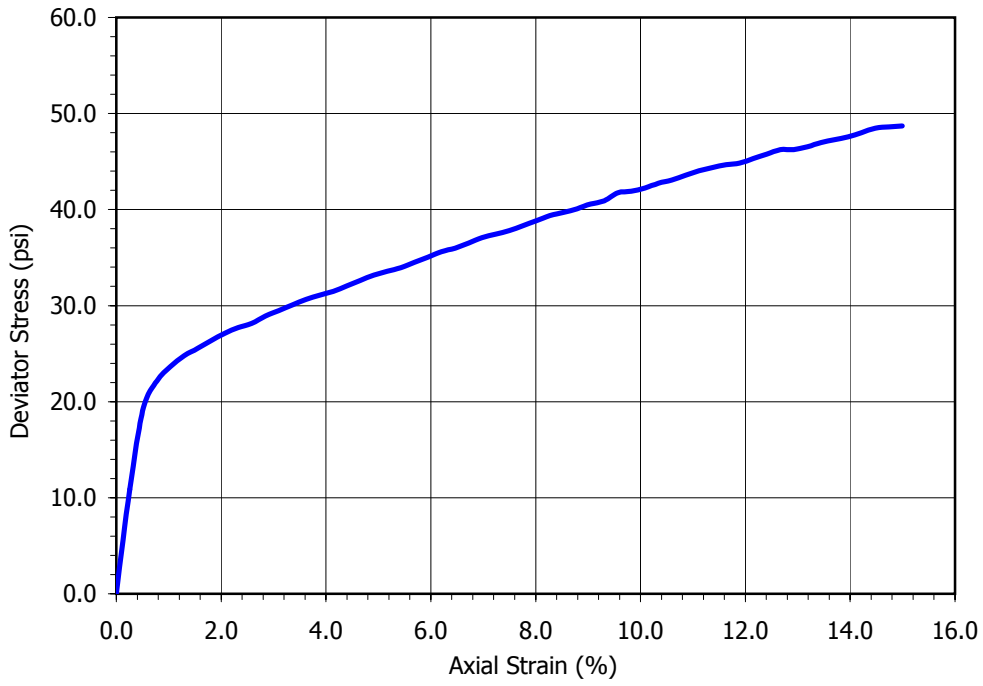
Diameter (in)	1	1.902
	2	1.900
	3	1.901
	Average	1.901
Height (in)	1	3.868
	2	3.869
	3	3.868
	Average	3.868
Weight of Sample + Tube / Rings (g)		349.50
Weight of Tube / Rings (g)		0.00
Weight of Wet Sample + Container (g)		425.50
Weight of Dry Sample + Container (g)		348.40
Weight of Container (g)		76.70
Specific Gravity (assumed)		2.70
Confining Pressure (psi)		80.0
Rate of Deformation (in/min)		0.012

Sample Properties	
Moisture Content (%)	28.38
Dry Density (pcf)	94.5
Void Ratio	0.784
% Saturation	97.8

At Failure*	
Deviator stress (psi)	**48.72**
Minor principal total stress (psi)	**80.00**
Major principal total stress (psi)	**128.72**
Axial strain (%)	**14.99**

* Stress values have been corrected for membrane effects

Stress - Strain Curve



Unconsolidated-Undrained Triaxial Compression Test on Cohesive Soils

ASTM D 2850

Project Name:	SR-710 Tunnel Technical Study		Tested by:	A. Santos	Date: 05/05/09
Project No:	378312.04.09.01		Checked by:	J. Ward	Date: 05/12/09
Boring No.:	R-09-Z3-B7		Sample Type:	Core	
Sample No.:	C-28		Depth(ft):	143.7-144.6	

Sample Description: Light gray silty sand'stone' (SM)

Note: Some diagonal cracking visible before compression

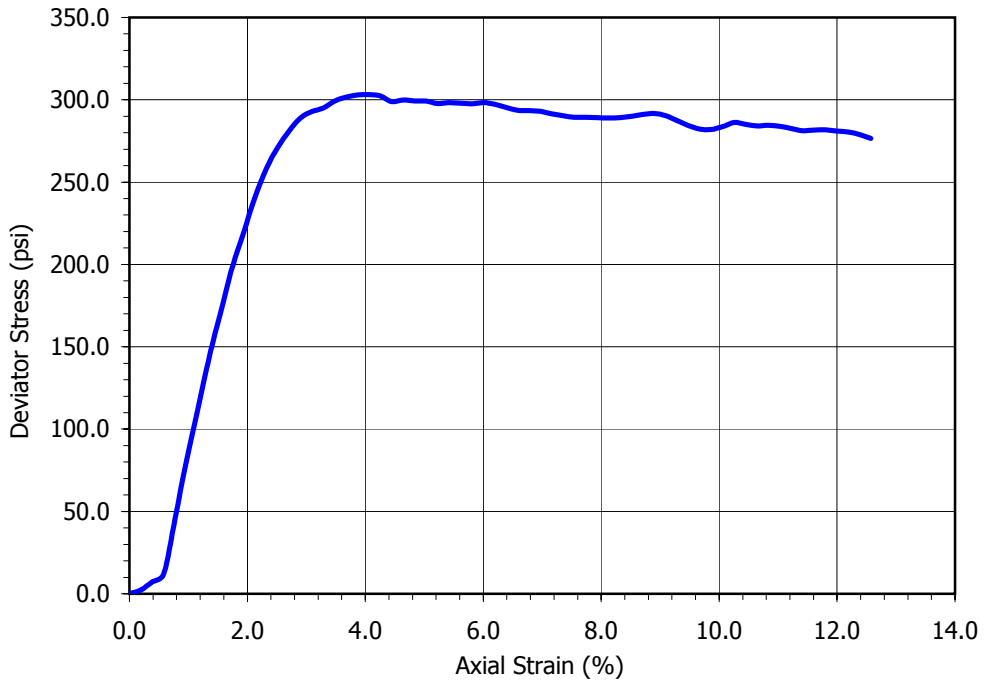
Diameter (in)	1	2.435
	2	2.430
	3	2.420
	Average	2.428
Height (in)	1	5.167
	2	5.169
	3	5.172
	Average	5.169
Weight of Sample + Tube / Rings (g)		939.20
Weight of Tube / Rings (g)		0.00
Weight of Wet Sample + Container (g)		1044.50
Weight of Dry Sample + Container (g)		1009.00
Weight of Container (g)		107.70
Specific Gravity (assumed)		2.70
Confining Pressure (psi)		93.8
Rate of Deformation (in/min)		0.012

Sample Properties	
Moisture Content (%)	3.94
Dry Density (pcf)	143.8
Void Ratio	0.172
% Saturation	62.0

At Failure*	
Deviator stress (psi)	**303.24**
Minor principal total stress (psi)	**93.75**
Major principal total stress (psi)	**396.99**
Axial strain (%)	**4.06**

* Stress values have been corrected for membrane effects

Stress - Strain Curve



Unconsolidated-Undrained Triaxial Compression Test on Cohesive Soils

ASTM D 2850

Project Name:	SR-710 Tunnel Technical Study	Tested by:	A. Santos	Date:	05/06/09
Project No:	378312.04.09.01	Checked by:	J. Ward	Date:	05/12/09
Boring No.:	R-09-Z3-B7	Sample Type:	Core		
Sample No.:	C-37	Depth(ft):	186-186.7		
Sample Description:	Light gray silty sand'stone' (SM)				

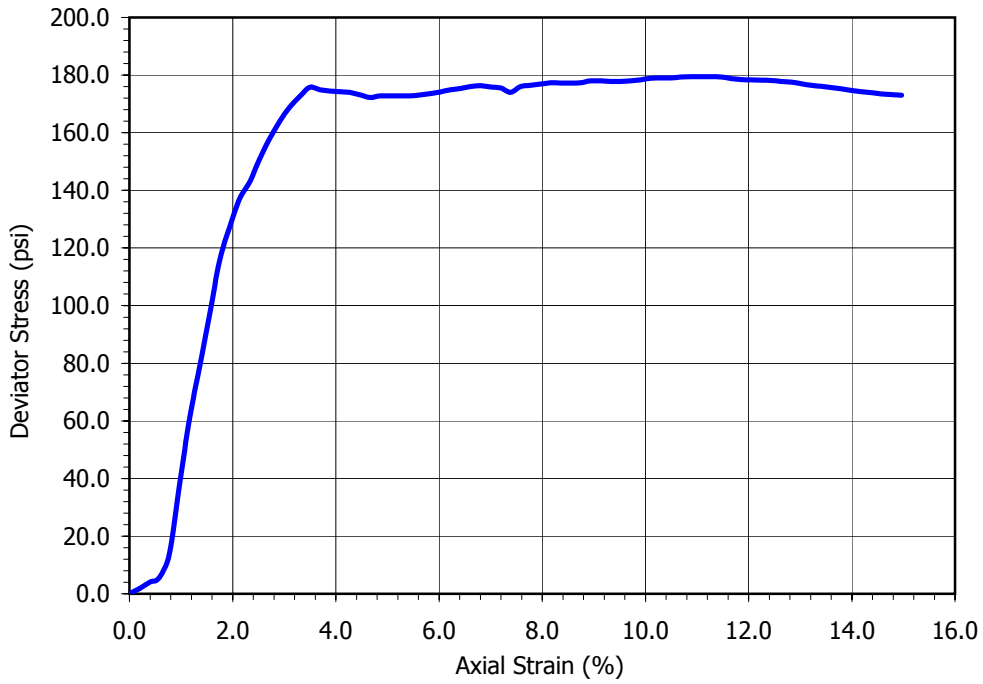
Diameter (in)	1	2.406
	2	2.426
	3	2.435
	Average	2.422
Height (in)	1	5.145
	2	5.148
	3	5.147
	Average	5.146
Weight of Sample + Tube / Rings (g)		896.60
Weight of Tube / Rings (g)		0.00
Weight of Wet Sample + Container (g)		1003.40
Weight of Dry Sample + Container (g)		948.20
Weight of Container (g)		107.68
Specific Gravity (assumed)		2.70
Confining Pressure (psi)		121.5
Rate of Deformation (in/min)		0.012

Sample Properties	
Moisture Content (%)	6.57
Dry Density (pcf)	135.1
Void Ratio	0.247
% Saturation	71.9

At Failure*	
Deviator stress (psi)	**179.47**
Minor principal total stress (psi)	**121.50**
Major principal total stress (psi)	**300.97**
Axial strain (%)	**10.88**

* Stress values have been corrected for membrane effects

Stress - Strain Curve



Unconsolidated-Undrained Triaxial Compression Test on Cohesive Soils

ASTM D 2850

Project Name:	SR-710 Tunnel Technical Study		Tested by:	A. Santos	Date: 05/06/09
Project No:	378312.04.09.01		Checked by:	J. Ward	Date: 05/13/09
Boring No.:	R-09-Z3-B7		Sample Type:	Core	
Sample No.:	C-56		Depth(ft):	251.1-252.2	
Sample Description:	Light gray silty sand'stone' (SM)				

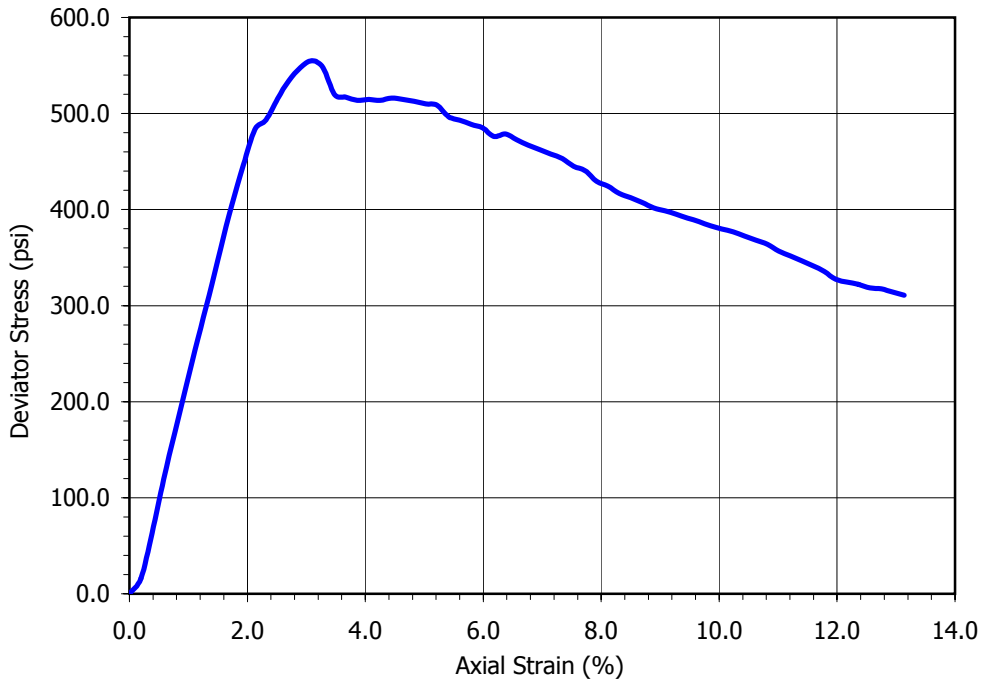
Diameter (in)	1	2.408
	2	2.423
	3	2.410
	Average	2.414
Height (in)	1	5.180
	2	5.178
	3	5.173
	Average	5.177
Weight of Sample + Tube / Rings (g)		947.60
Weight of Tube / Rings (g)		0.00
Weight of Wet Sample + Container (g)		1055.90
Weight of Dry Sample + Container (g)		1008.20
Weight of Container (g)		110.58
Specific Gravity (assumed)		2.70
Confining Pressure (psi)		153.0
Rate of Deformation (in/min)		0.012

Sample Properties	
Moisture Content (%)	5.31
Dry Density (pcf)	144.7
Void Ratio	0.164
% Saturation	87.4

At Failure*	
Deviator stress (psi)	**555.11**
Minor principal total stress (psi)	**153.00**
Major principal total stress (psi)	**708.11**
Axial strain (%)	**3.09**

* Stress values have been corrected for membrane effects

Stress - Strain Curve



Unconsolidated-Undrained Triaxial Compression Test on Cohesive Soils

ASTM D 2850

Project Name:	SR-710 Tunnel Technical Study	Tested by:	A. Santos	Date:	05/06/09
Project No:	378312.04.09.01	Checked by:	J. Ward	Date:	05/13/09
Boring No.:	R-09-Z3-B7	Sample Type:	Core		
Sample No.:	C-67	Depth(ft):	291-291.75		
Sample Description:	Light gray silty sand'stone' (SM)				

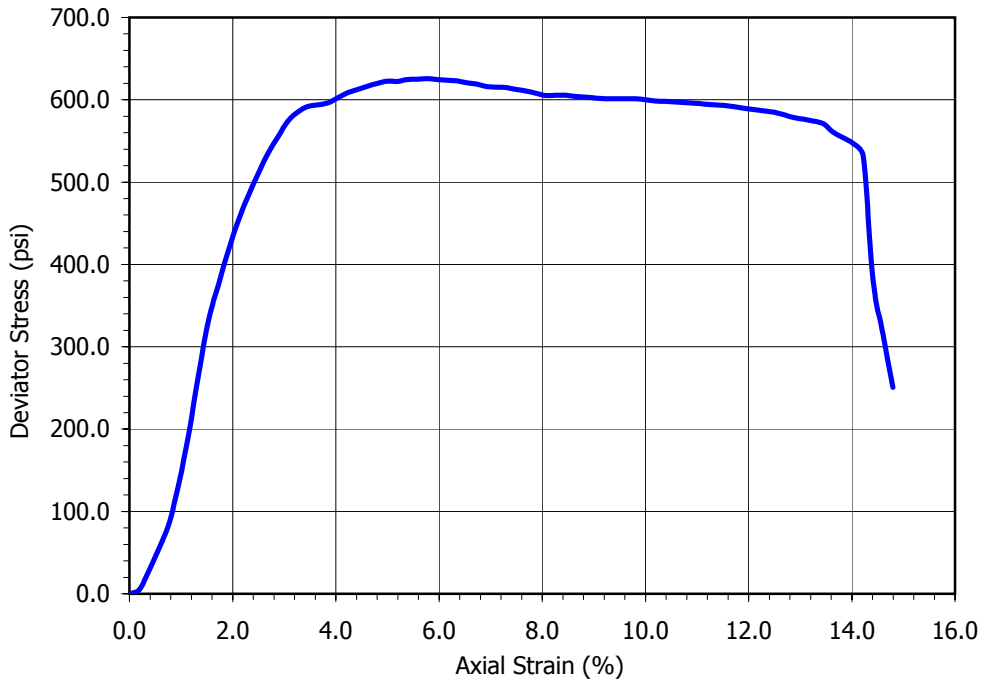
Diameter (in)	1	2.425
	2	2.435
	3	2.440
	Average	2.433
Height (in)	1	5.202
	2	5.206
	3	5.201
	Average	5.203
Weight of Sample + Tube / Rings (g)		949.00
Weight of Tube / Rings (g)		0.00
Weight of Wet Sample + Container (g)		780.00
Weight of Dry Sample + Container (g)		745.30
Weight of Container (g)		75.27
Specific Gravity (assumed)		2.70
Confining Pressure (psi)		153.0
Rate of Deformation (in/min)		0.012

Sample Properties	
Moisture Content (%)	5.18
Dry Density (pcf)	142.1
Void Ratio	0.186
% Saturation	75.2

At Failure*	
Deviator stress (psi)	**625.78**
Minor principal total stress (psi)	**153.00**
Major principal total stress (psi)	**778.78**
Axial strain (%)	**5.77**

* Stress values have been corrected for membrane effects

Stress - Strain Curve



Unconsolidated-Undrained Triaxial Compression Test on Cohesive Soils

ASTM D 2850

Project Name:	SR-710 Tunnel Technical Study	Tested by:	A. Santos	Date:	05/10/09
Project No:	378312.04.09.01	Checked by:	J. Ward	Date:	05/13/09
Boring No.:	R-09-Z3-B11	Sample Type:	Core		
Sample No.:	C-35	Depth(ft):	171.5-172.25		
Sample Description:	Light olive brown fat clay'stone' with sand (CH)s				

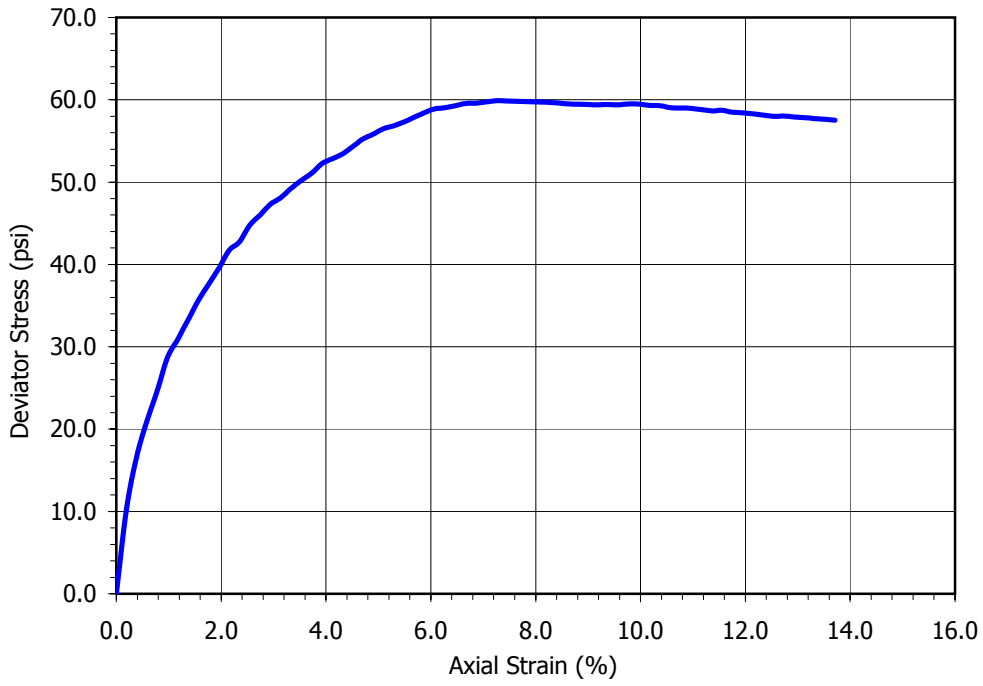
Diameter (in)	1	2.500
	2	2.475
	3	2.455
	Average	2.477
Height (in)	1	5.101
	2	5.111
	3	5.108
	Average	5.107
Weight of Sample + Tube / Rings (g)		815.90
Weight of Tube / Rings (g)		0.00
Weight of Wet Sample + Container (g)		1596.00
Weight of Dry Sample + Container (g)		1299.40
Weight of Container (g)		107.80
Specific Gravity (assumed)		2.70
Confining Pressure (psi)		111.1
Rate of Deformation (in/min)		0.012

Sample Properties	
Moisture Content (%)	24.89
Dry Density (pcf)	101.2
Void Ratio	0.665
% Saturation	101.0

At Failure*	
Deviator stress (psi)	**59.89**
Minor principal total stress (psi)	**111.10**
Major principal total stress (psi)	**170.99**
Axial strain (%)	**7.25**

* Stress values have been corrected for membrane effects

Stress - Strain Curve



Unconsolidated-Undrained Triaxial Compression Test on Cohesive Soils

ASTM D 2850

Project Name:	SR-710 Tunnel Technical Study	Tested by:	A. Santos	Date:	05/10/09
Project No:	378312.04.09.01	Checked by:	J. Ward	Date:	05/26/09
Boring No.:	R-09-Z3-B11	Sample Type:	Core		
Sample No.:	C-44	Depth(ft):	217.5-218		
Sample Description:	Olive gray sandy fat clay'stone' s(CH) (fat clay'stone' with a diagonal layer of sand)				

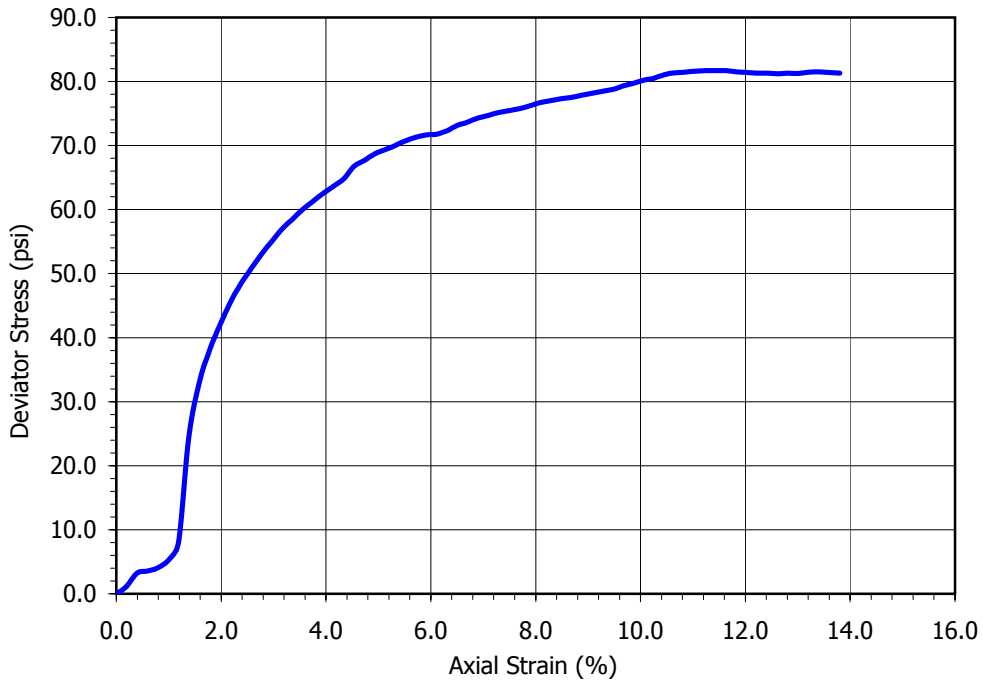
Diameter (in)	1	2.460
	2	2.445
	3	2.440
	Average	2.448
Height (in)	1	5.070
	2	5.071
	3	5.072
	Average	5.071
Weight of Sample + Tube / Rings (g)		769.30
Weight of Tube / Rings (g)		0.00
Weight of Wet Sample + Container (g)		879.60
Weight of Dry Sample + Container (g)		741.40
Weight of Container (g)		109.40
Specific Gravity (assumed)		2.70
Confining Pressure (psi)		138.9
Rate of Deformation (in/min)		0.012

Sample Properties	
Moisture Content (%)	21.87
Dry Density (pcf)	100.7
Void Ratio	0.673
% Saturation	87.8

At Failure*	
Deviator stress (psi)	**81.72**
Minor principal total stress (psi)	**138.90**
Major principal total stress (psi)	**220.62**
Axial strain (%)	**11.24**

* Stress values have been corrected for membrane effects

Stress - Strain Curve



Unconsolidated-Undrained Triaxial Compression Test on Cohesive Soils

ASTM D 2850

Project Name:	SR-710 Tunnel Technical Study	Tested by:	A. Santos	Date:	05/08/09
Project No:	378312.04.09.01	Checked by:	J. Ward	Date:	05/26/09
Boring No.:	R-09-Z3-B11	Sample Type:	Core		
Sample No.:	C-53	Depth(ft):	259.3-260		
Sample Description:	Dark olive lean clay'stone' (CL)				

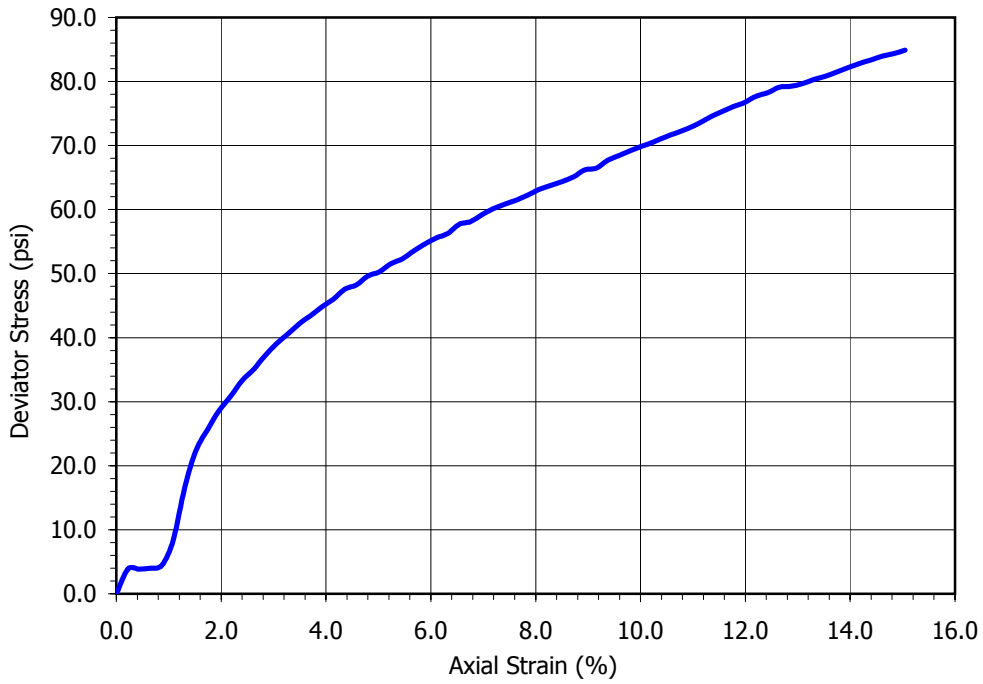
Diameter (in)	1	2.482
	2	2.480
	3	2.475
	Average	2.479
Height (in)	1	4.573
	2	4.591
	3	4.594
	Average	4.586
Weight of Sample + Tube / Rings (g)		764.80
Weight of Tube / Rings (g)		0.00
Weight of Wet Sample + Container (g)		820.50
Weight of Dry Sample + Container (g)		724.20
Weight of Container (g)		82.60
Specific Gravity (assumed)		2.70
Confining Pressure (psi)		153.0
Rate of Deformation (in/min)		0.012

Sample Properties	
Moisture Content (%)	15.01
Dry Density (pcf)	114.5
Void Ratio	0.472
% Saturation	85.8

At Failure*	
Deviator stress (psi)	**84.90**
Minor principal total stress (psi)	**153.00**
Major principal total stress (psi)	**237.90**
Axial strain (%)	**15.05**

* Stress values have been corrected for membrane effects

Stress - Strain Curve



Unconsolidated-Undrained Triaxial Compression Test on Cohesive Soils

ASTM D 2850

Project Name:	SR-710 Tunnel Technical Study	Tested by:	A. Santos	Date:	04/16/09
Project No:	378312.04.09.01	Checked by:	J. Ward	Date:	04/20/09
Boring No.:	R-09-Z3-B12	Sample Type:	Core		
Sample No.:	C23	Depth(ft):	109-109.8		
Sample Description:	Yellowish brown fat clay'stone' (CH)				

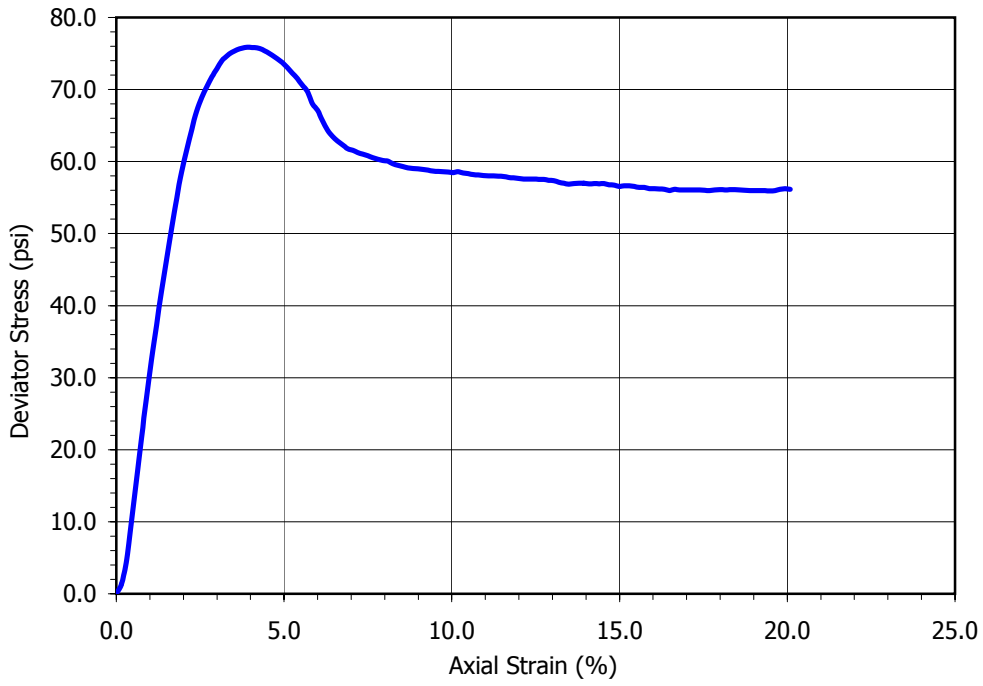
Diameter (in)	1	3.182
	2	3.185
	3	3.186
	Average	3.184
Height (in)	1	6.671
	2	6.668
	3	6.675
	Average	6.671
Weight of Sample + Tube / Rings (g)		1621.70
Weight of Tube / Rings (g)		0.00
Weight of Wet Sample + Container (g)		1728.90
Weight of Dry Sample + Container (g)		1426.80
Weight of Container (g)		108.30
Specific Gravity (assumed)		2.70
Confining Pressure (psi)		13.0
Rate of Deformation (in/min)		0.026

Sample Properties	
Moisture Content (%)	22.91
Dry Density (pcf)	94.6
Void Ratio	0.781
% Saturation	79.2

At Failure*	
Deviator stress (psi)	**75.87**
Minor principal total stress (psi)	**13.00**
Major principal total stress (psi)	**88.87**
Axial strain (%)	**3.90**

* Stress values have been corrected for membrane effects

Stress - Strain Curve



Unconsolidated-Undrained Triaxial Compression Test on Cohesive Soils

ASTM D 2850

Project Name:	SR-710 Tunnel Technical Study	Tested by:	A. Santos	Date:	04/17/09
Project No:	378312.04.09.01	Checked by:	J. Ward	Date:	04/20/09
Boring No.:	R-09-Z3-B12	Sample Type:	Core		
Sample No.:	C27	Depth(ft):	125.5-130.8		
Sample Description:	Olive fat clay'stone' (CH)				

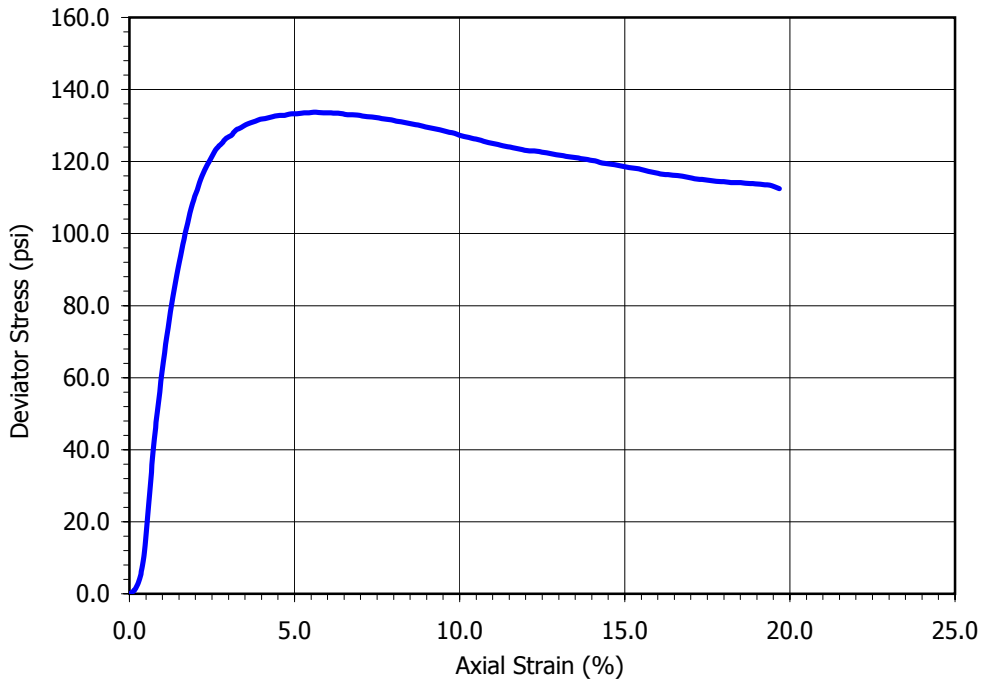
Diameter (in)	1	3.318
	2	3.310
	3	3.305
	Average	3.311
Height (in)	1	6.810
	2	6.813
	3	6.801
	Average	6.808
Weight of Sample + Tube / Rings (g)		1818.90
Weight of Tube / Rings (g)		0.00
Weight of Wet Sample + Container (g)		1927.30
Weight of Dry Sample + Container (g)		1545.20
Weight of Container (g)		108.00
Specific Gravity (assumed)		2.70
Confining Pressure (psi)		104.2
Rate of Deformation (in/min)		0.026

Sample Properties	
Moisture Content (%)	26.59
Dry Density (pcf)	93.4
Void Ratio	0.804
% Saturation	89.3

At Failure*	
Deviator stress (psi)	**133.66**
Minor principal total stress (psi)	**104.20**
Major principal total stress (psi)	**237.86**
Axial strain (%)	**5.58**

* Stress values have been corrected for membrane effects

Stress - Strain Curve



Unconsolidated-Undrained Triaxial Compression Test on Cohesive Soils

ASTM D 2850

Project Name:	SR-710 Tunnel Technical Study	Tested by:	A. Santos	Date:	04/23/09
Project No:	378312.04.09.01	Checked by:	J. Ward	Date:	04/28/09
Boring No.:	R-09-Z3-B12	Sample Type:	Core		
Sample No.:	C30	Depth(ft):	140-140.6		
Sample Description:	Olive lean clay'stone' (CL)				

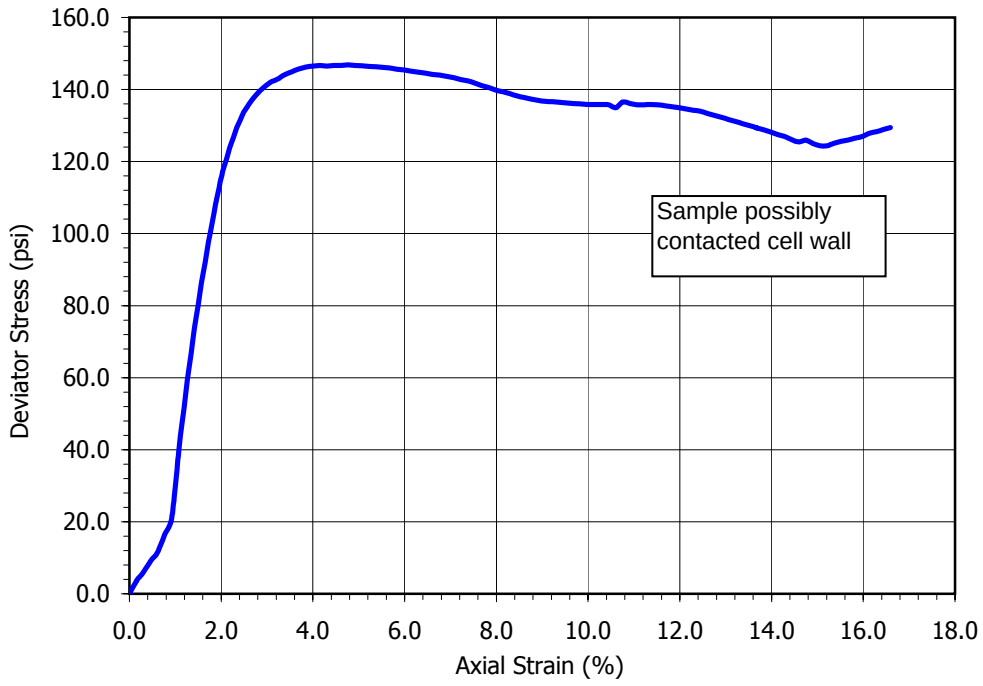
Diameter (in)	1	3.213
	2	3.205
	3	3.212
	Average	3.210
Height (in)	1	6.506
	2	6.505
	3	6.515
	Average	6.508
Weight of Sample + Tube / Rings (g)		1570.40
Weight of Tube / Rings (g)		0.00
Weight of Wet Sample + Container (g)		1687.10
Weight of Dry Sample + Container (g)		1331.30
Weight of Container (g)		108.83
Specific Gravity (assumed)		2.70
Confining Pressure (psi)		90.3
Rate of Deformation (in/min)		0.030

Sample Properties	
Moisture Content (%)	29.11
Dry Density (pcf)	88.0
Void Ratio	0.915
% Saturation	85.9

At Failure*	
Deviator stress (psi)	**146.81**
Minor principal total stress (psi)	**90.30**
Major principal total stress (psi)	**237.11**
Axial strain (%)	**4.76**

* Stress values have been corrected for membrane effects

Stress - Strain Curve



Leighton

Unconsolidated-Undrained Triaxial Compression Test on Cohesive Soils

ASTM D 2850

Project Name:	SR-710 Tunnel Technical Study	Tested by:	A. Santos	Date:	04/29/09
Project No:	378312.04.09.01	Checked by:	J. Ward	Date:	04/30/09
Boring No.:	R-09-Z4-B4	Sample Type:	Core		
Sample No.:	C-19	Depth(ft):	97.5-98.3		
Sample Description:	Yellow fat clay'stone' (CH)				

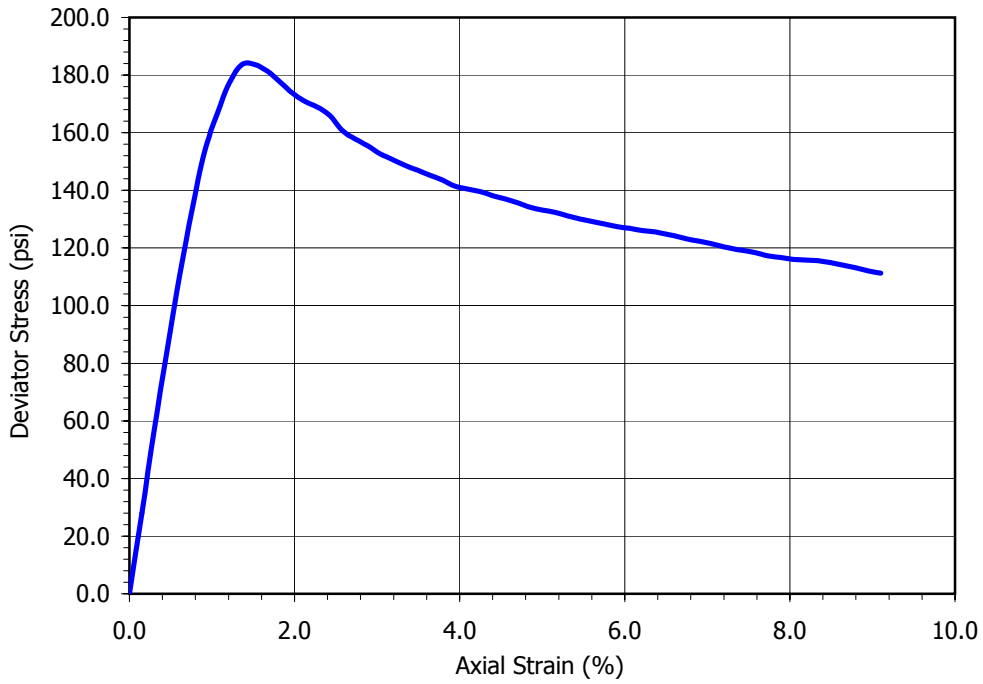
Diameter (in)	1	3.270
	2	3.250
	3	3.265
	Average	3.262
Height (in)	1	6.590
	2	6.602
	3	6.590
	Average	6.594
Weight of Sample + Tube / Rings (g)		1738.00
Weight of Tube / Rings (g)		0.00
Weight of Wet Sample + Container (g)		1843.70
Weight of Dry Sample + Container (g)		1479.70
Weight of Container (g)		108.50
Specific Gravity (assumed)		2.70
Confining Pressure (psi)		62.5
Rate of Deformation (in/min)		0.012

Sample Properties	
Moisture Content (%)	26.55
Dry Density (pcf)	95.0
Void Ratio	0.774
% Saturation	92.6

At Failure*	
Deviator stress (psi)	**183.69**
Minor principal total stress (psi)	**62.50**
Major principal total stress (psi)	**246.19**
Axial strain (%)	**1.36**

* Stress values have been corrected for membrane effects

Stress - Strain Curve



Unconsolidated-Undrained Triaxial Compression Test on Cohesive Soils

ASTM D 2850

Project Name:	SR-710 Tunnel Technical Study		Tested by:	A. Santos	Date: 04/28/09
Project No:	378312.04.09.01		Checked by:	J. Ward	Date: 04/29/09
Boring No.:	R-09-Z4-B4		Sample Type:	Core	
Sample No.:	C-26		Depth(ft):	139.2-140.2	
Sample Description:	Dark olive silt'stone' (ML)				

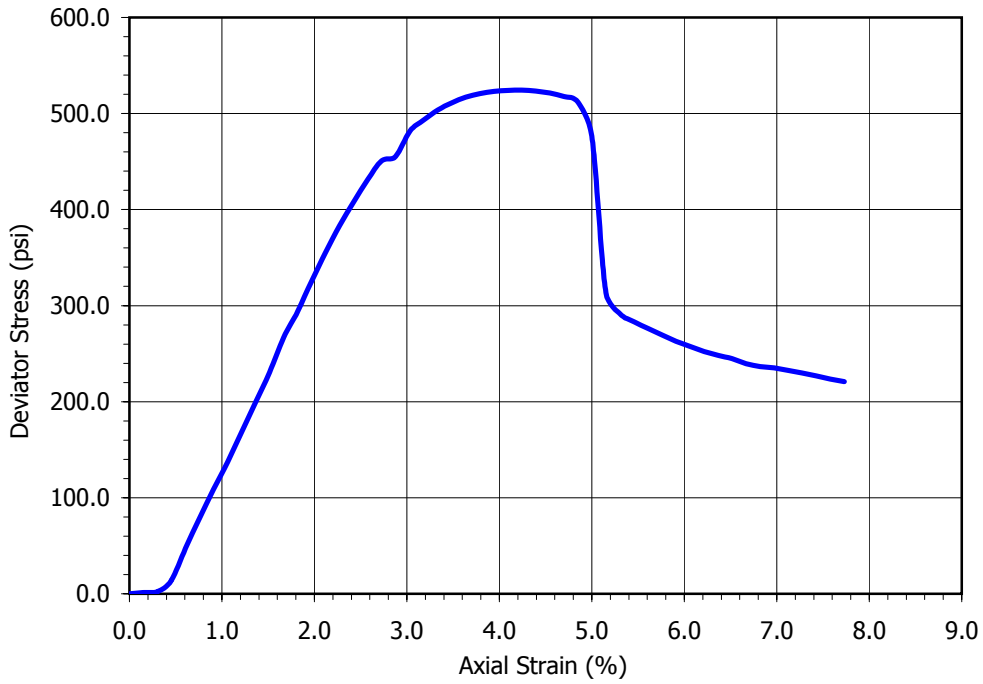
Diameter (in)	1	3.248
	2	3.250
	3	3.230
	Average	3.243
Height (in)	1	6.600
	2	6.599
	3	6.596
	Average	6.598
Weight of Sample + Tube / Rings (g)		1713.50
Weight of Tube / Rings (g)		0.00
Weight of Wet Sample + Container (g)		1819.70
Weight of Dry Sample + Container (g)		1563.80
Weight of Container (g)		109.50
Specific Gravity (assumed)		2.70
Confining Pressure (psi)		90.3
Rate of Deformation (in/min)		0.012

Sample Properties	
Moisture Content (%)	17.60
Dry Density (pcf)	101.9
Void Ratio	0.654
% Saturation	72.7

At Failure*	
Deviator stress (psi)	**524.28**
Minor principal total stress (psi)	**90.30**
Major principal total stress (psi)	**614.58**
Axial strain (%)	**4.24**

* Stress values have been corrected for membrane effects

Stress - Strain Curve



Unconsolidated-Undrained Triaxial Compression Test on Cohesive Soils

ASTM D 2850

Project Name:	SR-710 Tunnel Technical Study		Tested by:	A. Santos	Date: 04/29/09
Project No:	378312.04.09.01		Checked by:	J. Ward	Date: 04/30/09
Boring No.:	R-09-Z4-B4		Sample Type:	Core	
Sample No.:	C-38		Depth(ft):	220.5-221.5	
Sample Description:	Dark olive silt'stone' (ML)				

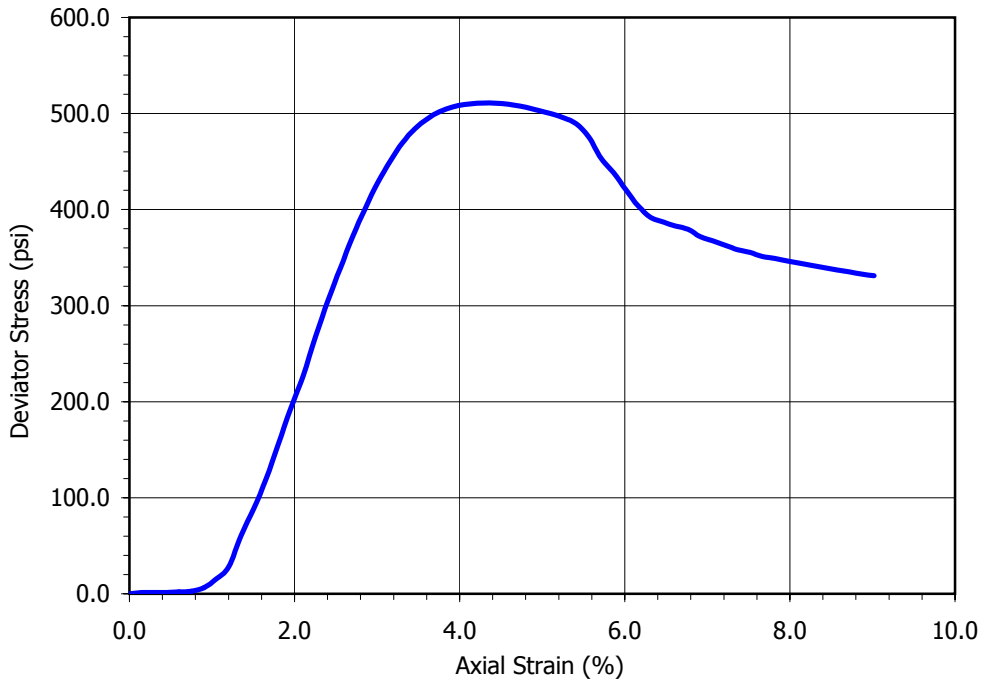
Diameter (in)	1	3.231
	2	3.230
	3	3.236
	Average	3.232
Height (in)	1	6.659
	2	6.650
	3	6.645
	Average	6.651
Weight of Sample + Tube / Rings (g)		1744.10
Weight of Tube / Rings (g)		0.00
Weight of Wet Sample + Container (g)		1848.50
Weight of Dry Sample + Container (g)		1557.90
Weight of Container (g)		106.86
Specific Gravity (assumed)		2.70
Confining Pressure (psi)		142.5
Rate of Deformation (in/min)		0.012

Sample Properties	
Moisture Content (%)	20.03
Dry Density (pcf)	101.4
Void Ratio	0.661
% Saturation	81.8

At Failure*	
Deviator stress (psi)	**511.00**
Minor principal total stress (psi)	**142.50**
Major principal total stress (psi)	**653.50**
Axial strain (%)	**4.36**

* Stress values have been corrected for membrane effects

Stress - Strain Curve



Unconsolidated-Undrained Triaxial Compression Test on Cohesive Soils

ASTM D 2850

Project Name:	SR-710 Tunnel Technical Study	Tested by:	A. Santos	Date:	04/29/09
Project No:	378312.04.09.01	Checked by:	J. Ward	Date:	04/30/09
Boring No.:	R-09-Z4-B4	Sample Type:	Core		
Sample No.:	C-44	Depth(ft):	262.5-263.4		
Sample Description:	Dark olive silt'stone' (ML)				

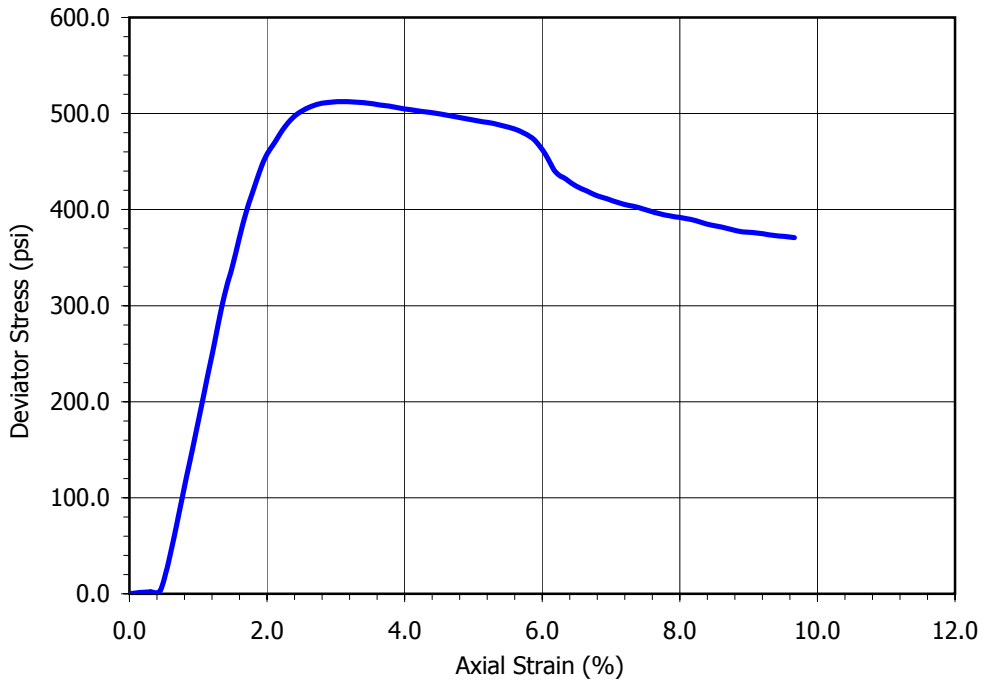
Diameter (in)	1	3.230
	2	3.235
	3	3.240
	Average	3.235
Height (in)	1	6.627
	2	6.615
	3	6.621
	Average	6.621
Weight of Sample + Tube / Rings (g)		1765.70
Weight of Tube / Rings (g)		0.00
Weight of Wet Sample + Container (g)		1871.30
Weight of Dry Sample + Container (g)		1567.80
Weight of Container (g)		108.46
Specific Gravity (assumed)		2.70
Confining Pressure (psi)		153.0
Rate of Deformation (in/min)		0.012

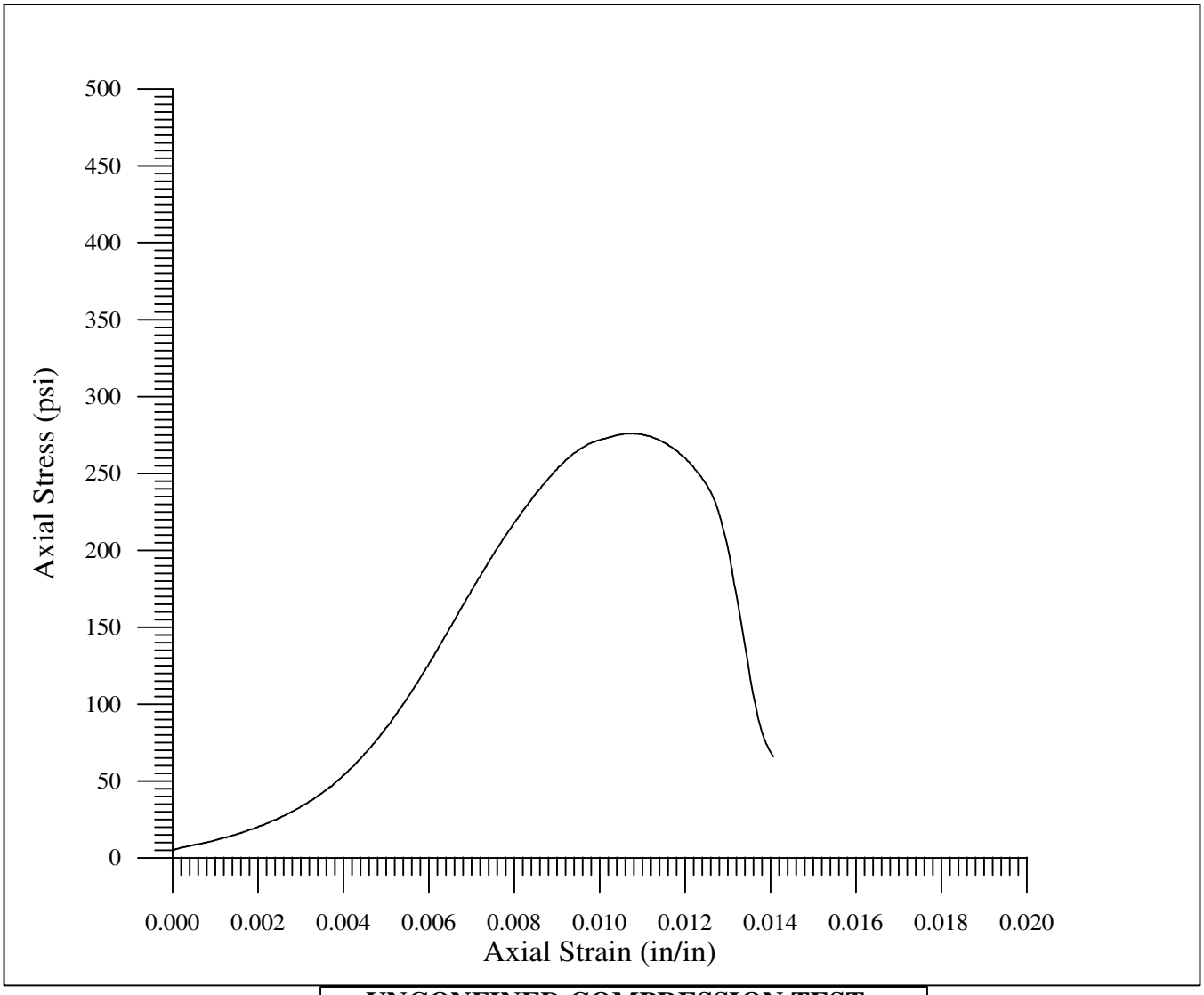
Sample Properties	
Moisture Content (%)	20.80
Dry Density (pcf)	102.3
Void Ratio	0.647
% Saturation	86.9

At Failure*	
Deviator stress (psi)	**512.41**
Minor principal total stress (psi)	**153.00**
Major principal total stress (psi)	**665.41**
Axial strain (%)	**3.17**

* Stress values have been corrected for membrane effects

Stress - Strain Curve





UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: Z1B2-284
Boring: Z1-B2
Depth: 284.6-285.4'

DESCRIPTION
Medium gray silty fine to medium grained friable sandstone.

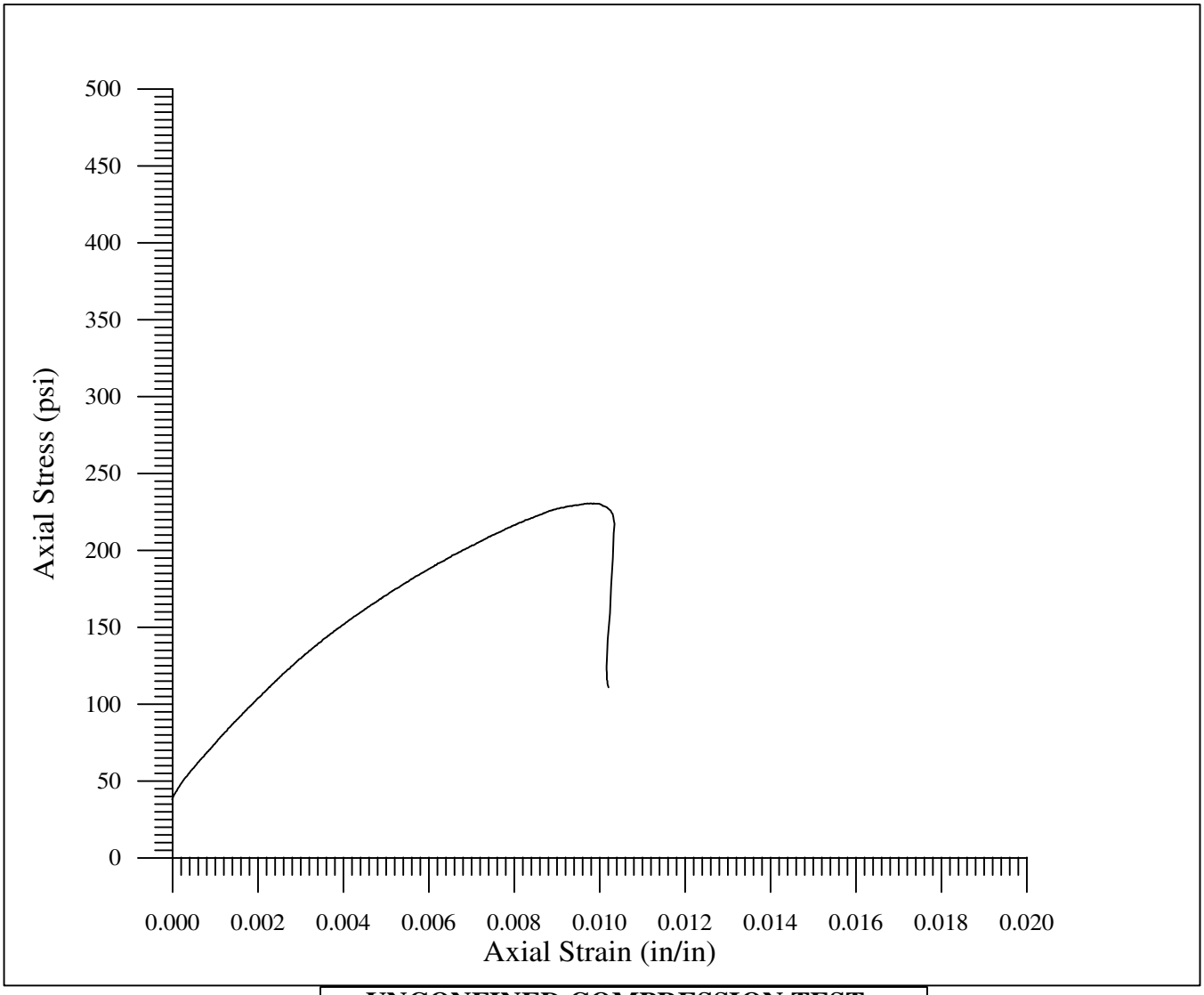
Density: 137.5 pcf
Strength: 276 psi

Geo Test G T U *Unlimited*
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: Earth Mechanics, Inc.
17660 Newhope St., Suite E
Fountain Valley, CA 92708

Project: SR-710 Tunnel
Project No: none

Test Date: April 21, 2009



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: Z1B2-122
Boring: Z1-B2
Depth: 122.8-123.5'

DESCRIPTION
Dark gray bedded siltstone and silty medium grained sandstone.

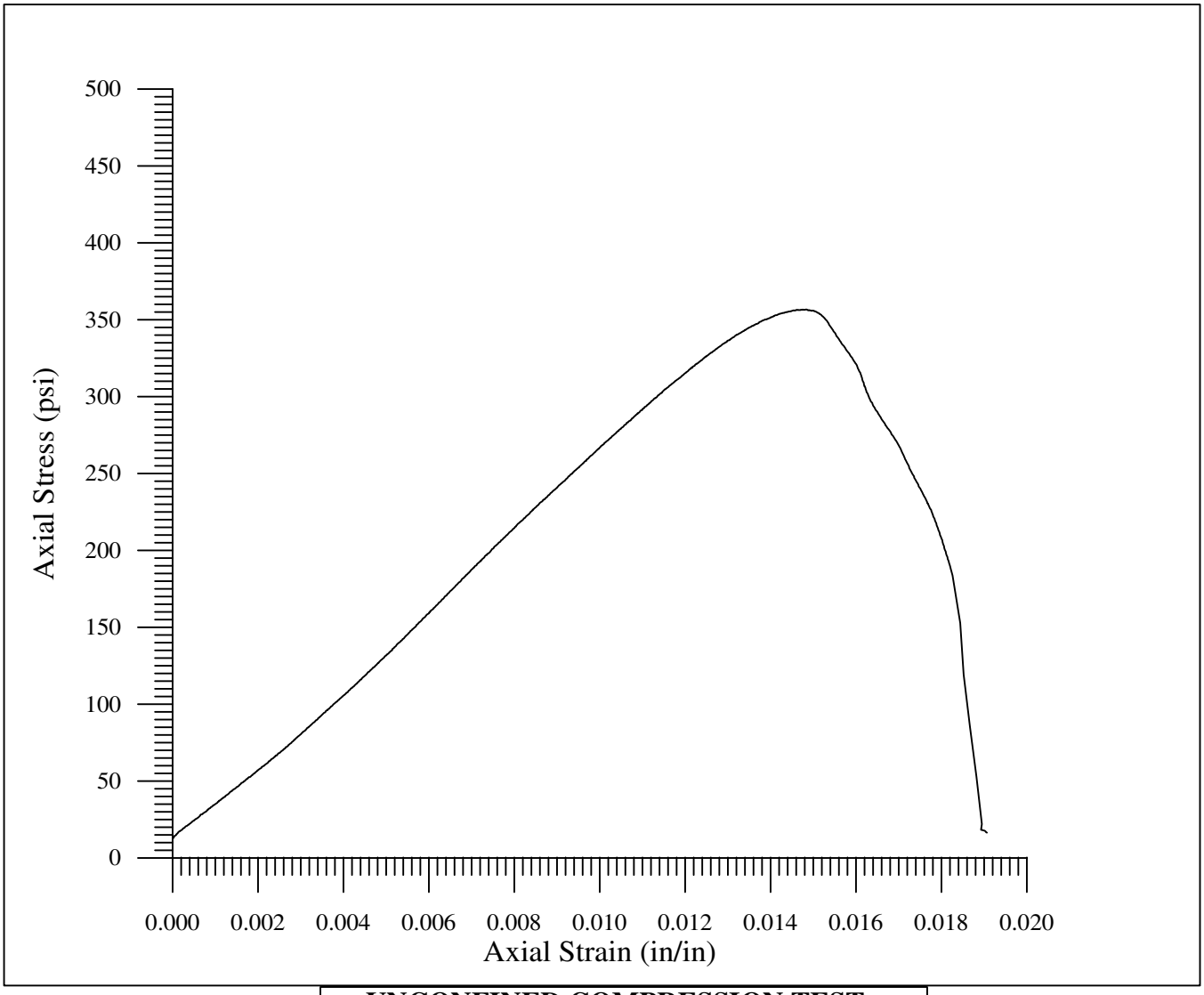
Density: 132.1 pcf
Strength: 231 psi

Geo Test G T U *Unlimited*
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: Earth Mechanics, Inc.
17660 Newhope St., Suite E
Fountain Valley, CA 92708

Project: SR-710 Tunnel
Project No: none

Test Date: April 21, 2009



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: Z1B2-124
Boring: Z1-B2
Depth: 124.0-125.0'

DESCRIPTION
Medium brown silty fine to medium grained sandstone.

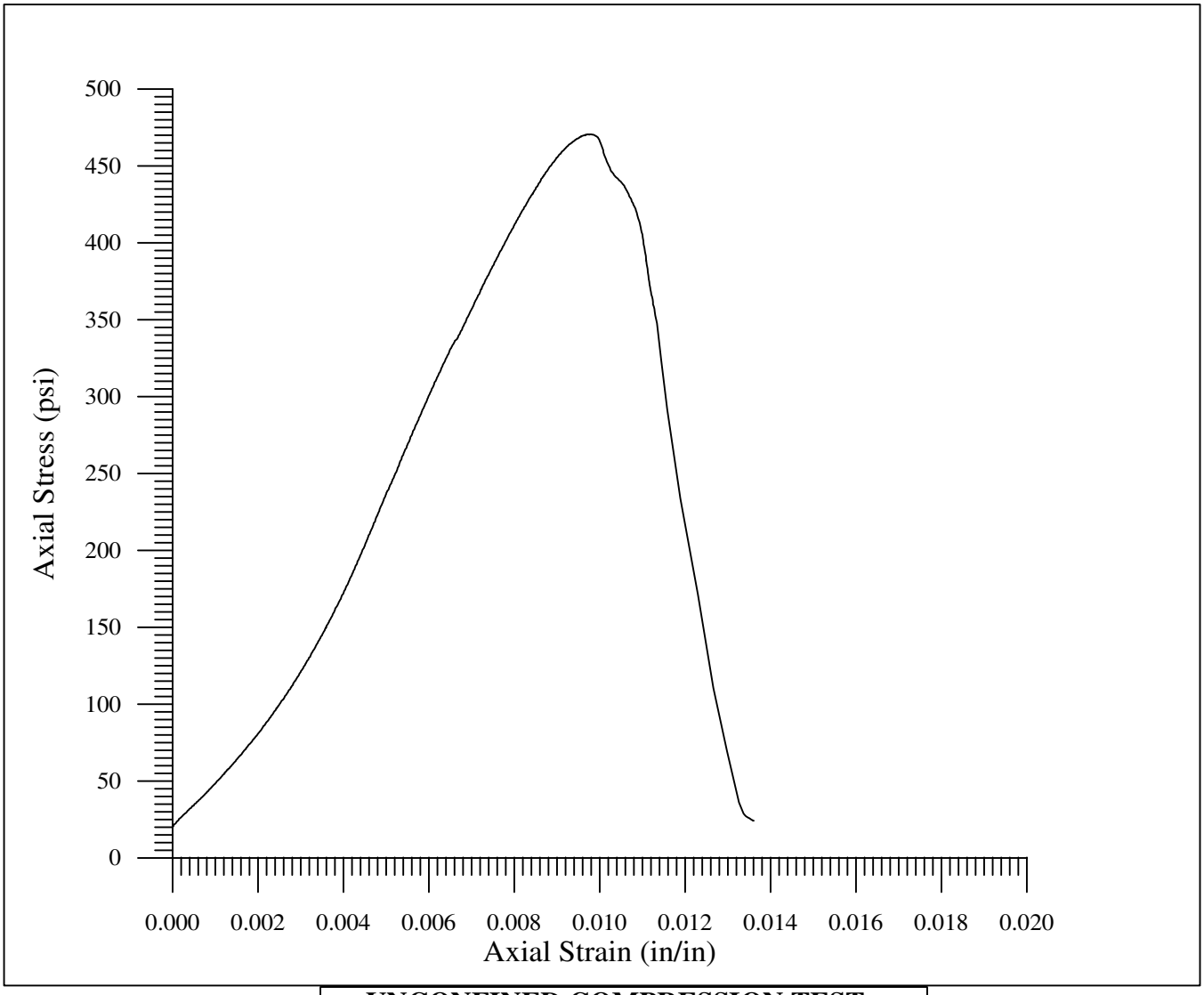
Density: 140.0 pcf
Strength: 357 psi

Geo Test G T U *Unlimited*
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: Earth Mechanics, Inc.
17660 Newhope St., Suite E
Fountain Valley, CA 92708

Project: SR-710 Tunnel
Project No: none

Test Date: April 21, 2009



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: Z1B2-148
Boring: Z1-B2
Depth: 148.1-148.9'

DESCRIPTION

Dark gray fine to medium grained sandstone with soft dark gray claystone clasts (<2")

Density: 139.4 pcf
Strength: 471 psi

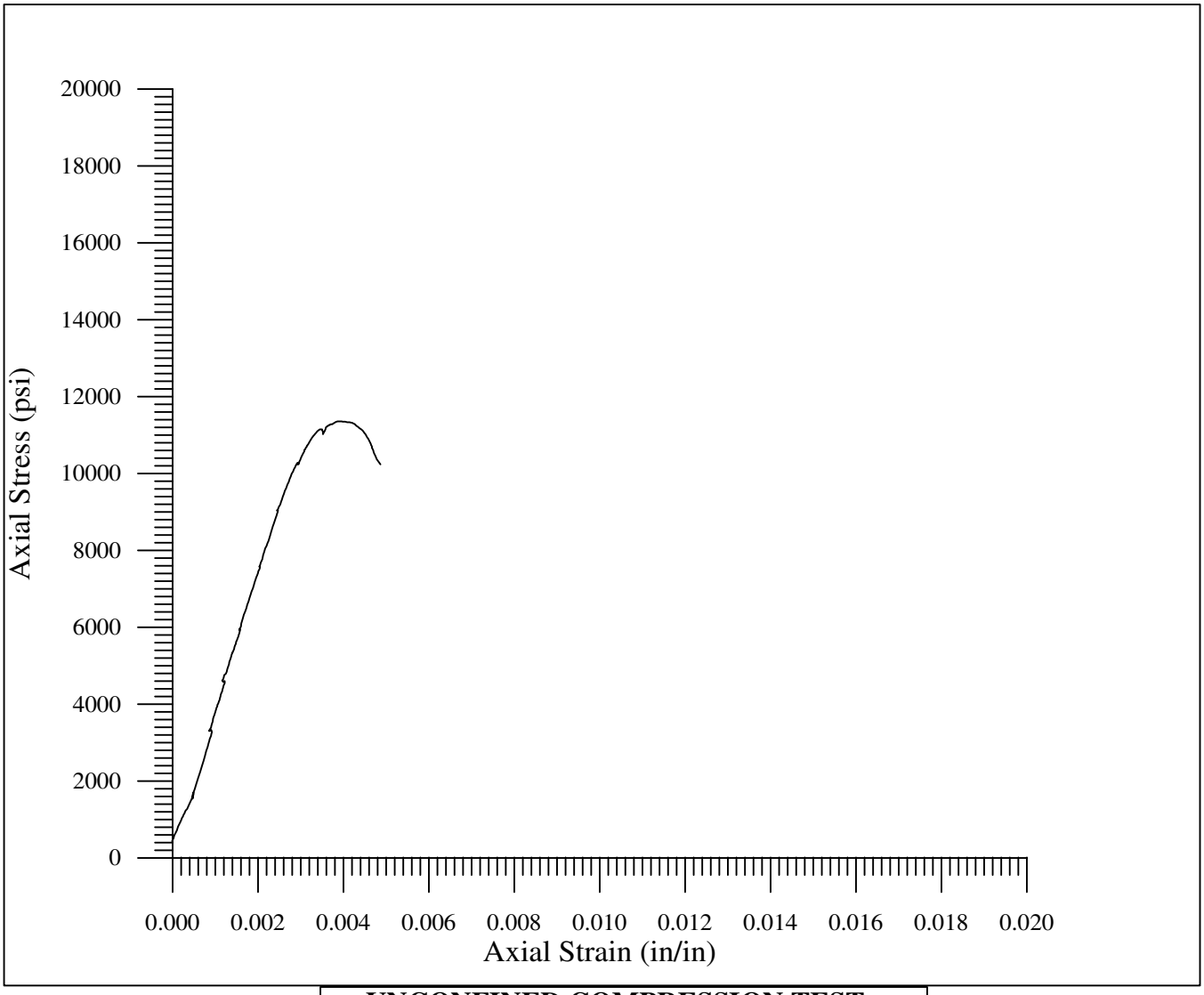
Geo Test G T U *Unlimited*
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: Earth Mechanics, Inc.
17660 Newhope St., Suite E
Fountain Valley, CA 92708

Project: SR-710 Tunnel

Project No: none

Test Date: April 21, 2009



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: Z1B2-158
Boring: Z1-B2
Depth: 158.4-159.1'

DESCRIPTION

Light gray medium grained sandstone with a diagonal oxide discolored zone.

Density: 159.4 pcf
Strength: 11,360 psi

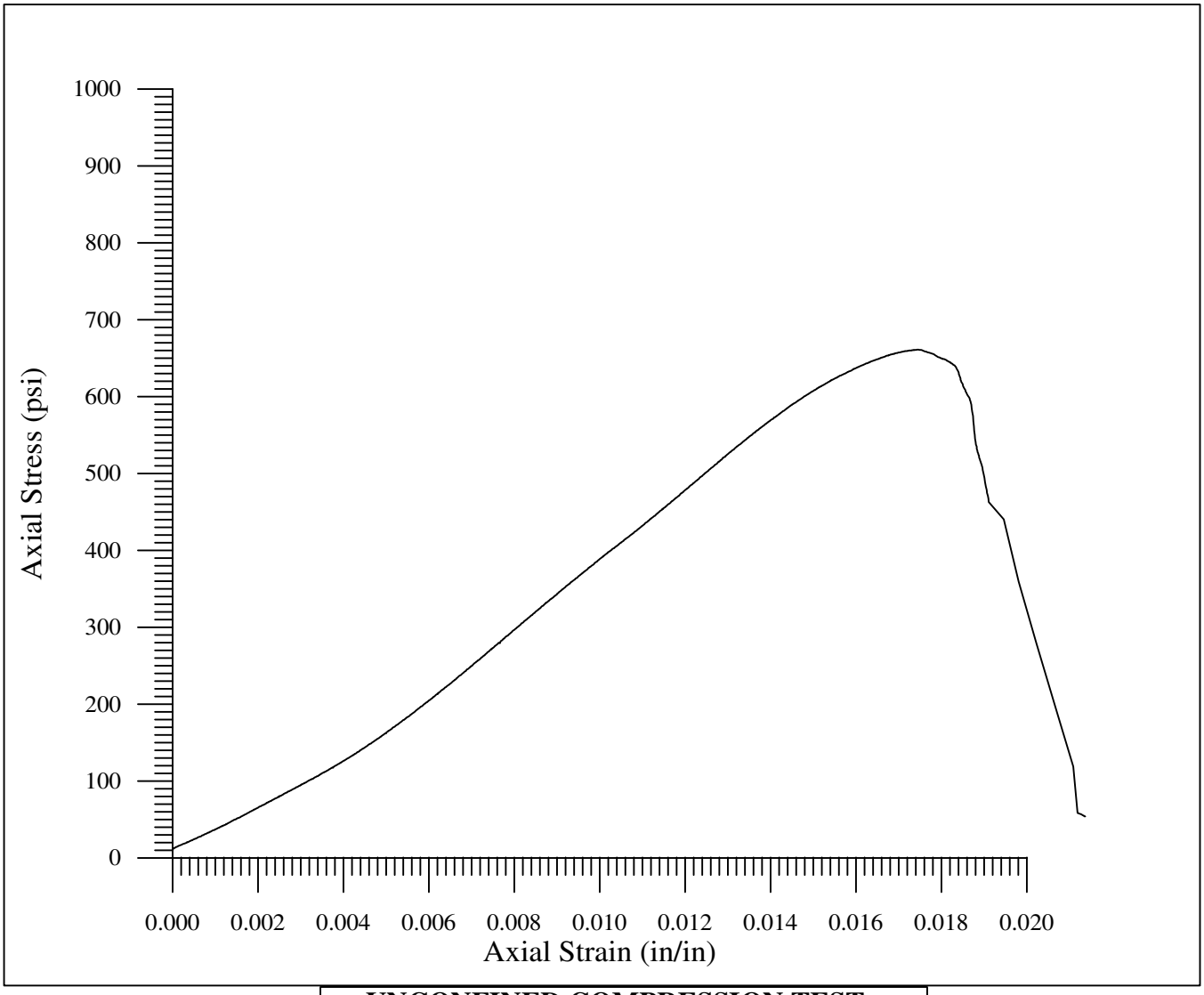
Geo Test G T U *Unlimited*
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: Earth Mechanics, Inc.
17660 Newhope St., Suite E
Fountain Valley, CA 92708

Project: SR-710 Tunnel

Project No: none

Test Date: April 21, 2009



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: Z1B2-167
Boring: Z1-B2
Depth: 167.0-167.8'

DESCRIPTION

Dark gray silty fine grained friable bedded sandstone with brown oxidation at one end.

Density: 136.4 pcf
Strength: 661 psi

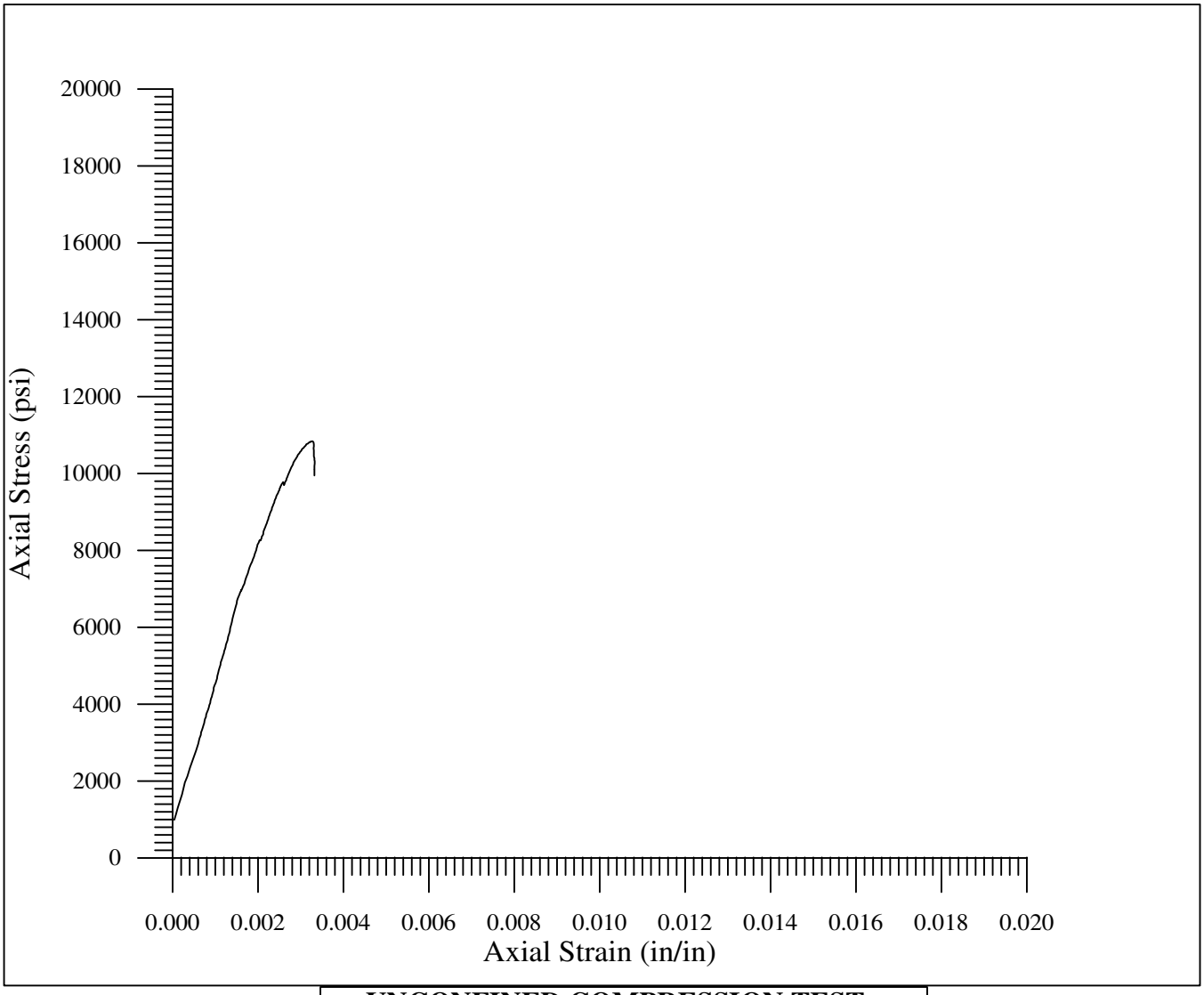
Geo Test G_TU *Unlimited*
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: Earth Mechanics, Inc.
17660 Newhope St., Suite E
Fountain Valley, CA 92708

Project: SR-710 Tunnel

Project No: none

Test Date: April 21, 2009



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: Z1B2-172
Boring: Z1-B2
Depth: 172.6-173.4'

DESCRIPTION

Light gray fine to medium grained sandstone with tan discolored zones at each end.

Density: 158.5 pcf
Strength: 10,835 psi

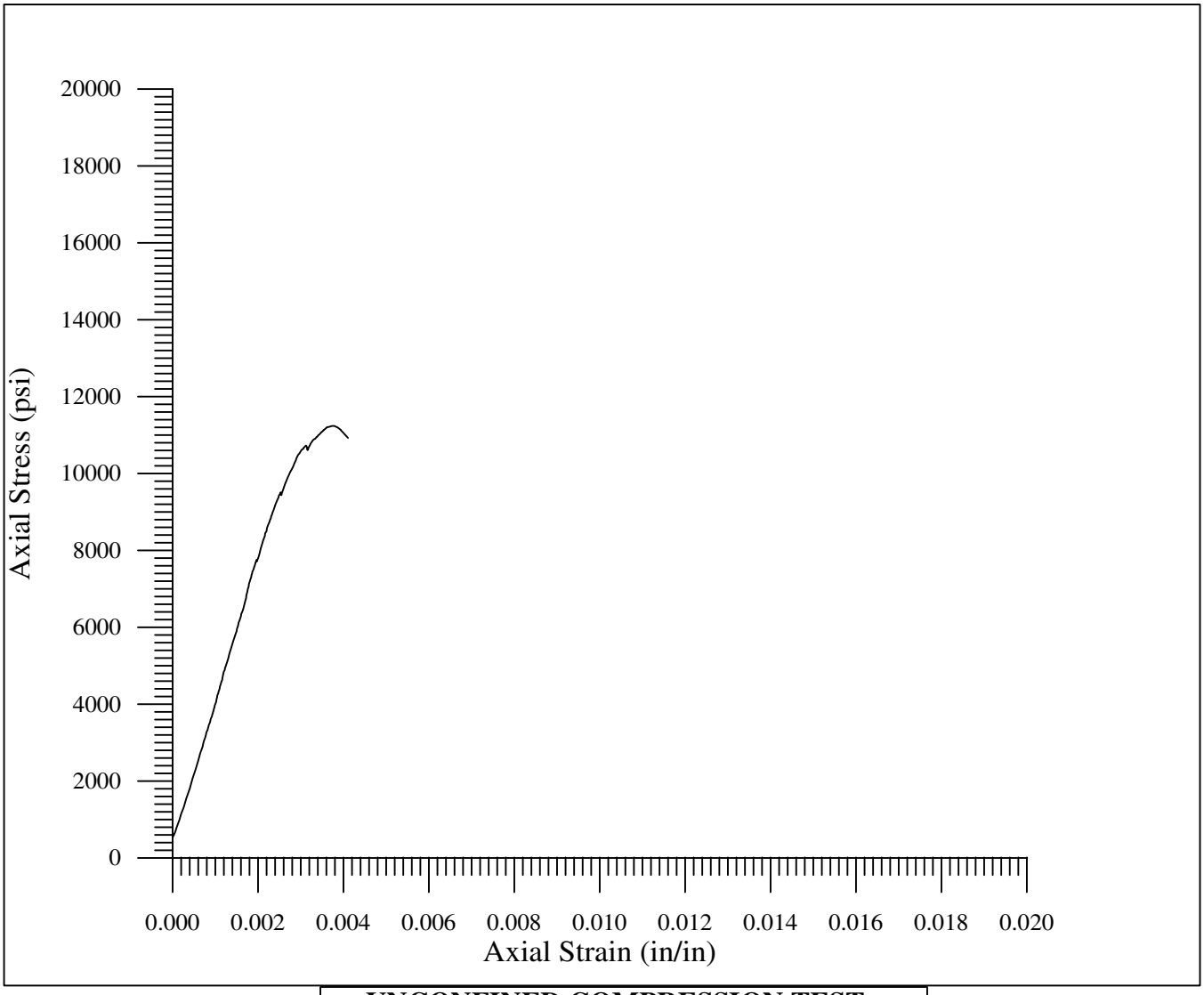
Geo Test G T U *Unlimited*
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: Earth Mechanics, Inc.
17660 Newhope St., Suite E
Fountain Valley, CA 92708

Project: SR-710 Tunnel

Project No: none

Test Date: April 21, 2009



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: Z1B2-176
Boring: Z1-B2
Depth: 176.9-177.8'

DESCRIPTION
Light gray medium grained sandstone.

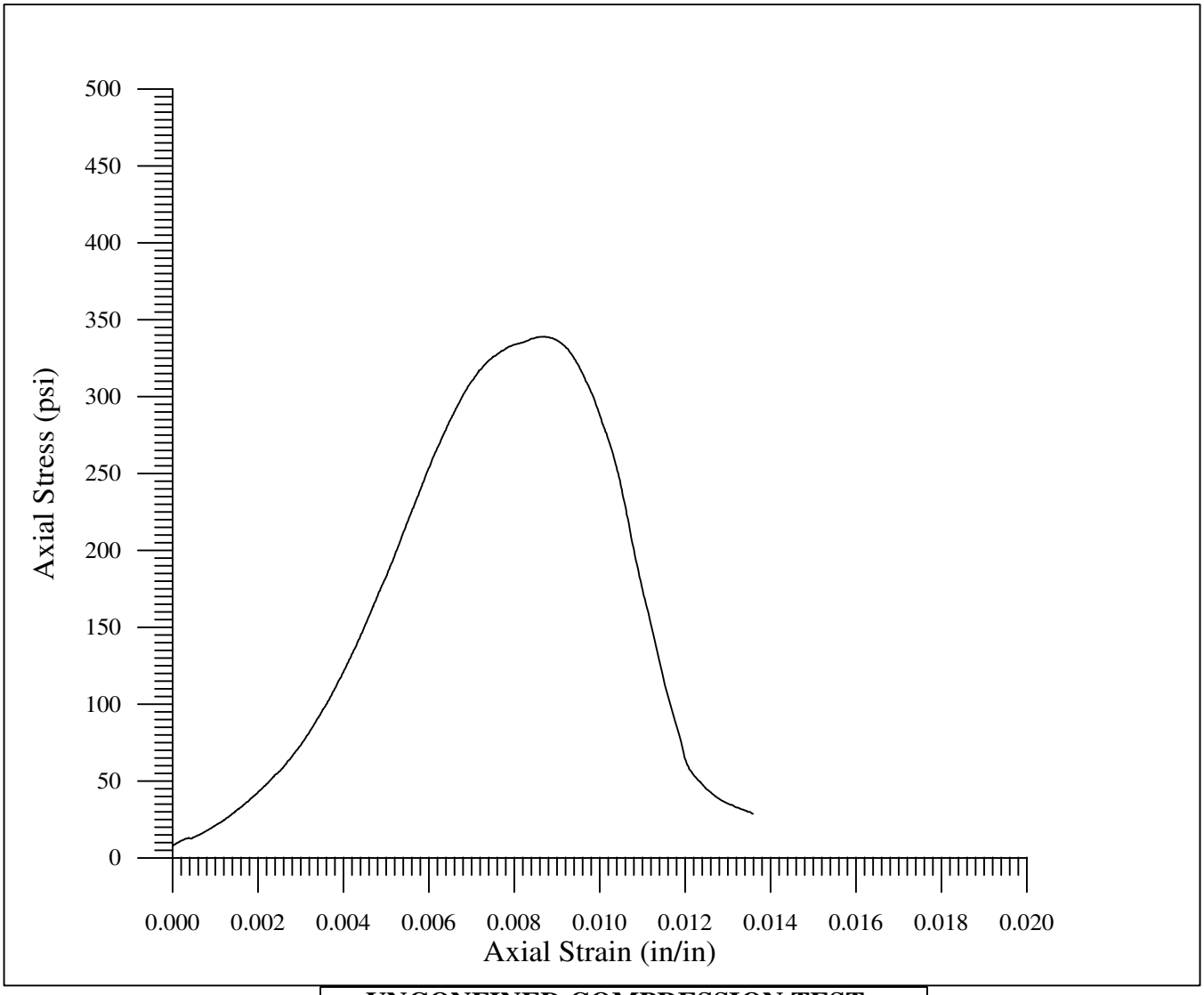
Density: 159.1 pcf
Strength: 11,238 psi

Geo Test G_TU *Unlimited*
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: Earth Mechanics, Inc.
17660 Newhope St., Suite E
Fountain Valley, CA 92708

Project: SR-710 Tunnel
Project No: none

Test Date: April 21, 2009



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: Z1B2-190
Boring: Z1-B2
Depth: 190.4-191.8'

DESCRIPTION
Medium gray silty fine to medium grained friable sandstone.

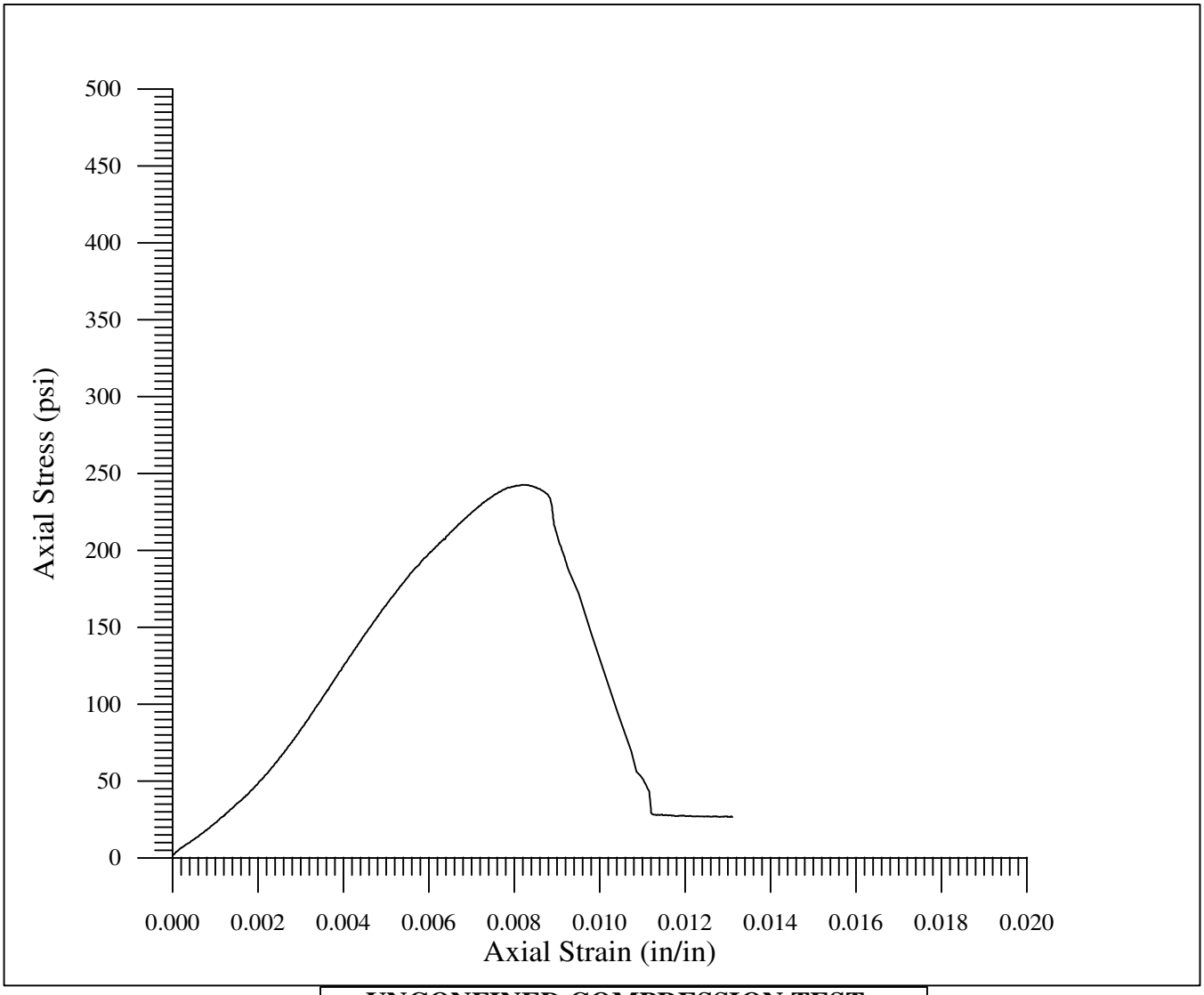
Density: 137.8 pcf
Strength: 339 psi

Geo Test GTU *Unlimited*
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: Earth Mechanics, Inc.
17660 Newhope St., Suite E
Fountain Valley, CA 92708

Project: SR-710 Tunnel
Project No: none

Test Date: April 21, 2009



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: Z1B2-205
Boring: Z1-B2
Depth: 205.0-205.6'

DESCRIPTION

Dark gray bedded siltstone and claystone capped with fine grained sandstone. Contains a non-through-going joint.

Density: 139.3 pcf
Strength: 243 psi

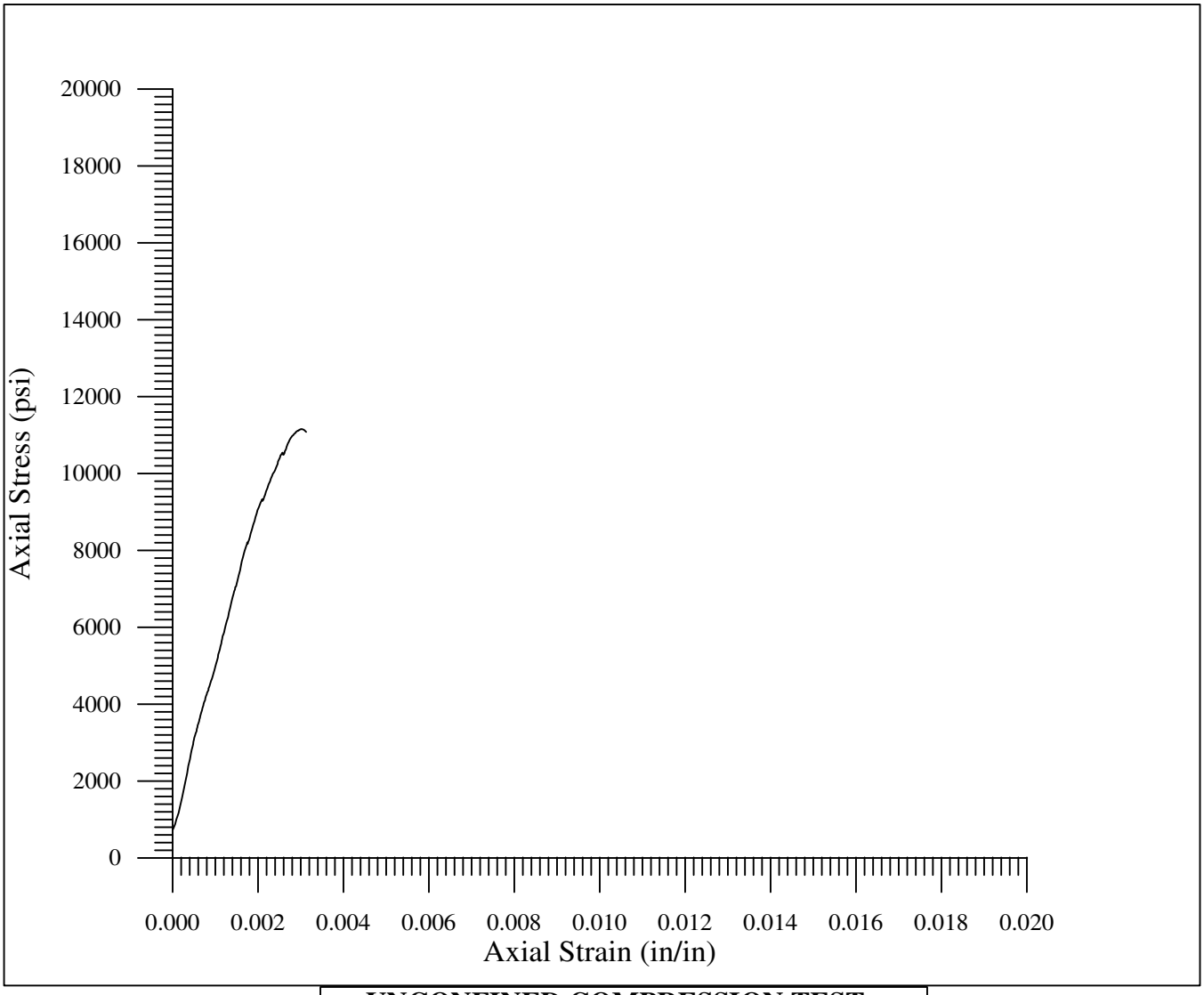
Geo Test G_TU *Unlimited*
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: Earth Mechanics, Inc.
17660 Newhope St., Suite E
Fountain Valley, CA 92708

Project: SR-710 Tunnel

Project No: none

Test Date: April 21, 2009



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: Z1B2-229
Boring: Z1-B2
Depth: 229.0-229.9'

DESCRIPTION

Medium gray fine to medium graind sandstone with a piece missing from the side.

Density: 157.3 pcf
Strength: 11,156 psi

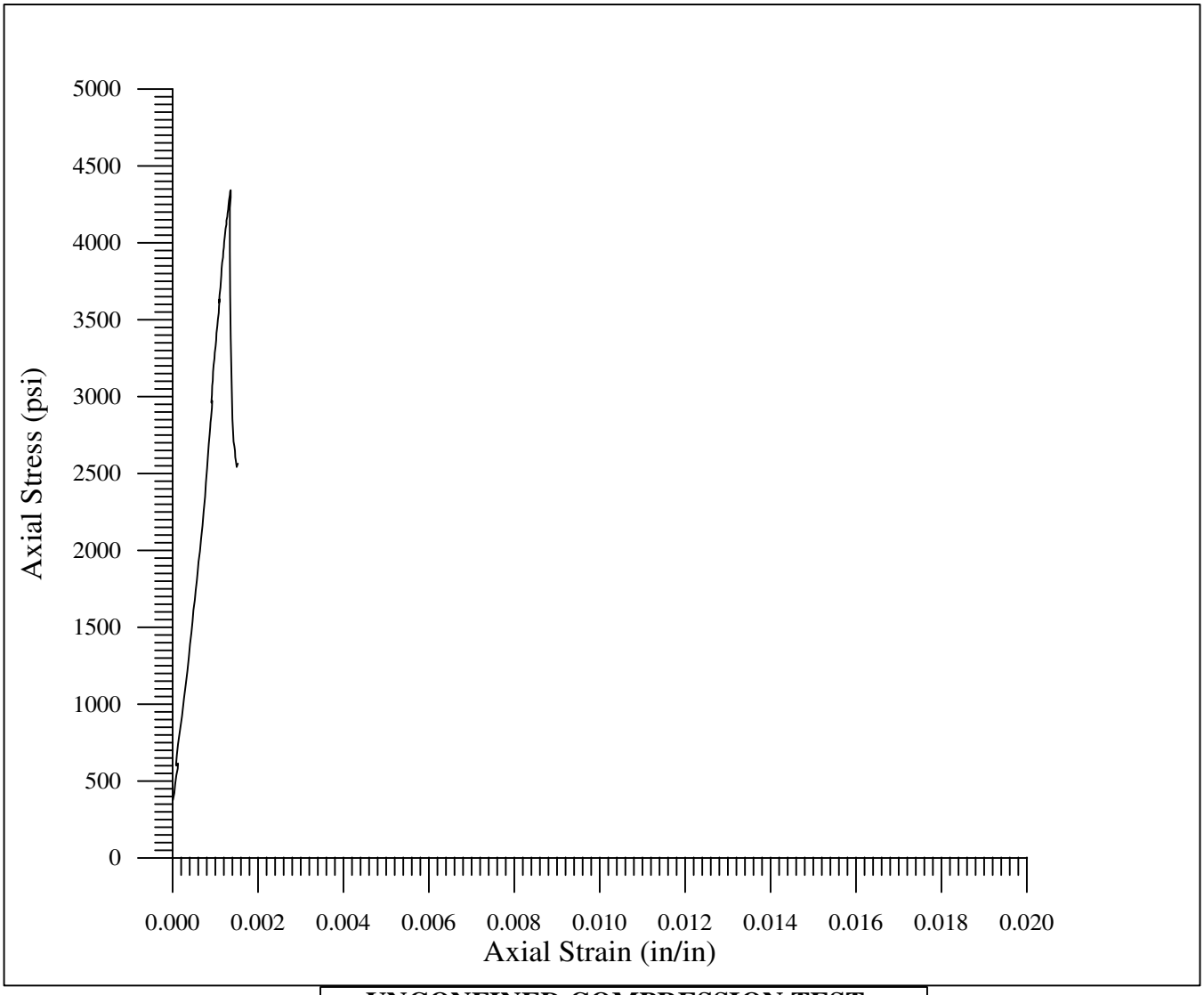
Geo Test G T U *Unlimited*
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: Earth Mechanics, Inc.
17660 Newhope St., Suite E
Fountain Valley, CA 92708

Project: SR-710 Tunnel

Project No: none

Test Date: April 21, 2009



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: Z1B2-231
Boring: Z1-B2
Depth: 231.0-232.0'

DESCRIPTION

Light gray silty fine to medium grained sandstone with a claystone clast at one end and a calcite healed diagonal joint.

Density: 156.8 pcf
Strength: 4342 psi

Geo Test Unlimited G T U

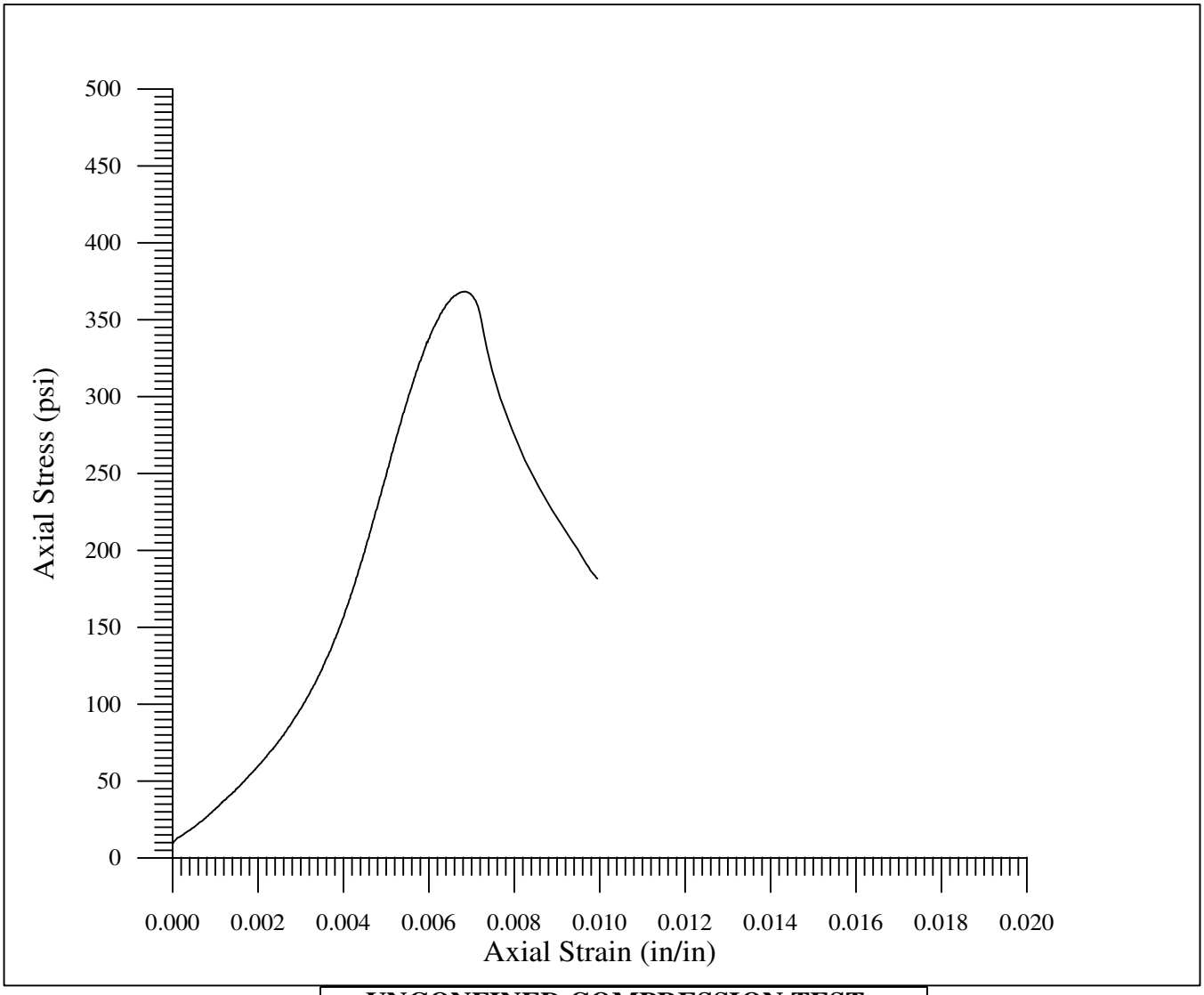
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: Earth Mechanics, Inc.
17660 Newhope St., Suite E
Fountain Valley, CA 92708

Project: SR-710 Tunnel

Project No: none

Test Date: April 21, 2009



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: Z1B2-237
Boring: Z1-B2
Depth: 237.5-238.4'

DESCRIPTION
Medium gray silty fine to medium grained friable sandstone.

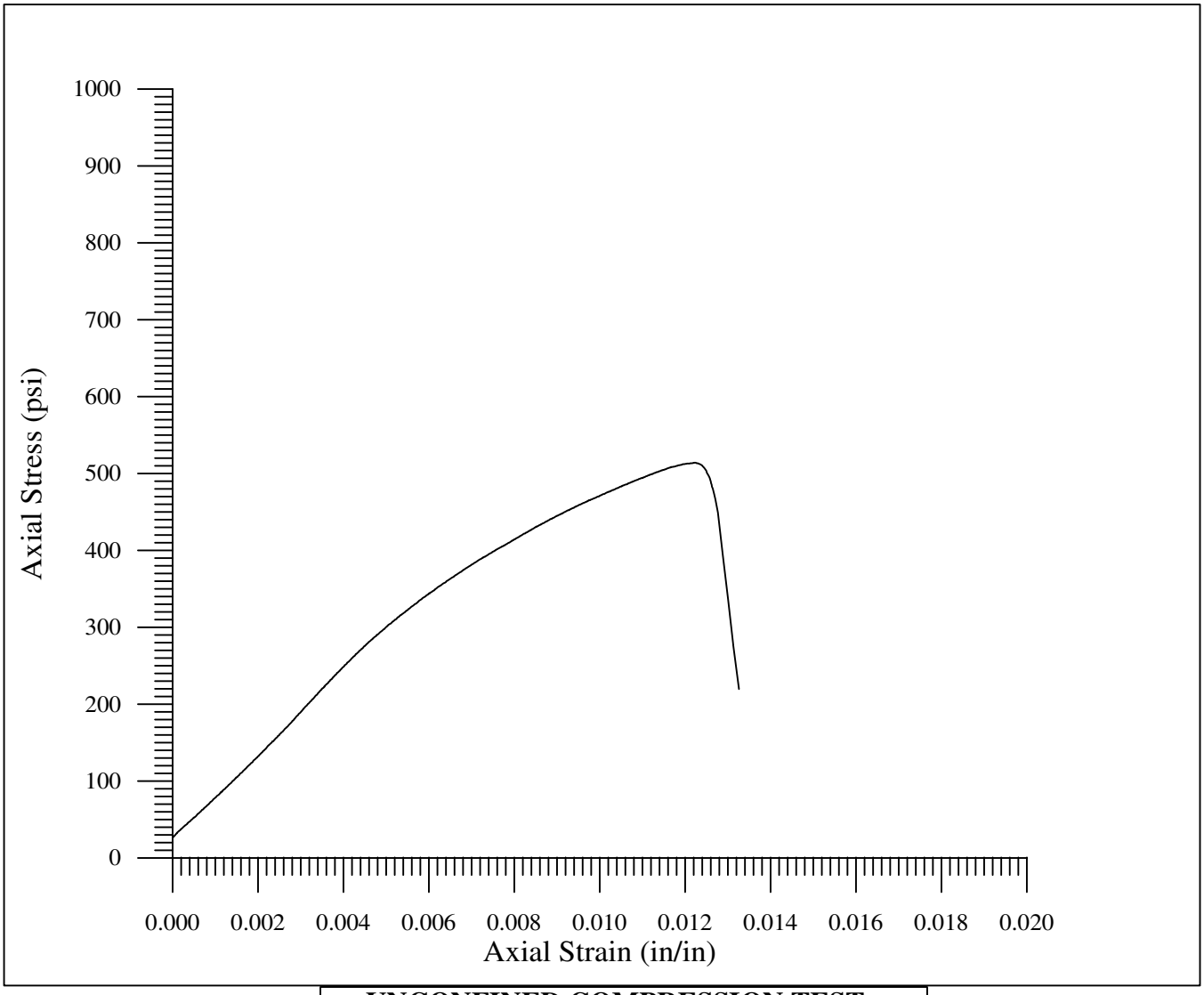
Density: 138.8 pcf
Strength: 368 psi

Geo Test G T U *Unlimited*
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: Earth Mechanics, Inc.
17660 Newhope St., Suite E
Fountain Valley, CA 92708

Project: SR-710 Tunnel
Project No: none

Test Date: April 21, 2009



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: Z1B2-242
Boring: Z1-B2
Depth: 242.7-243.3'

DESCRIPTION
Dark gray finely bedded siltstone.

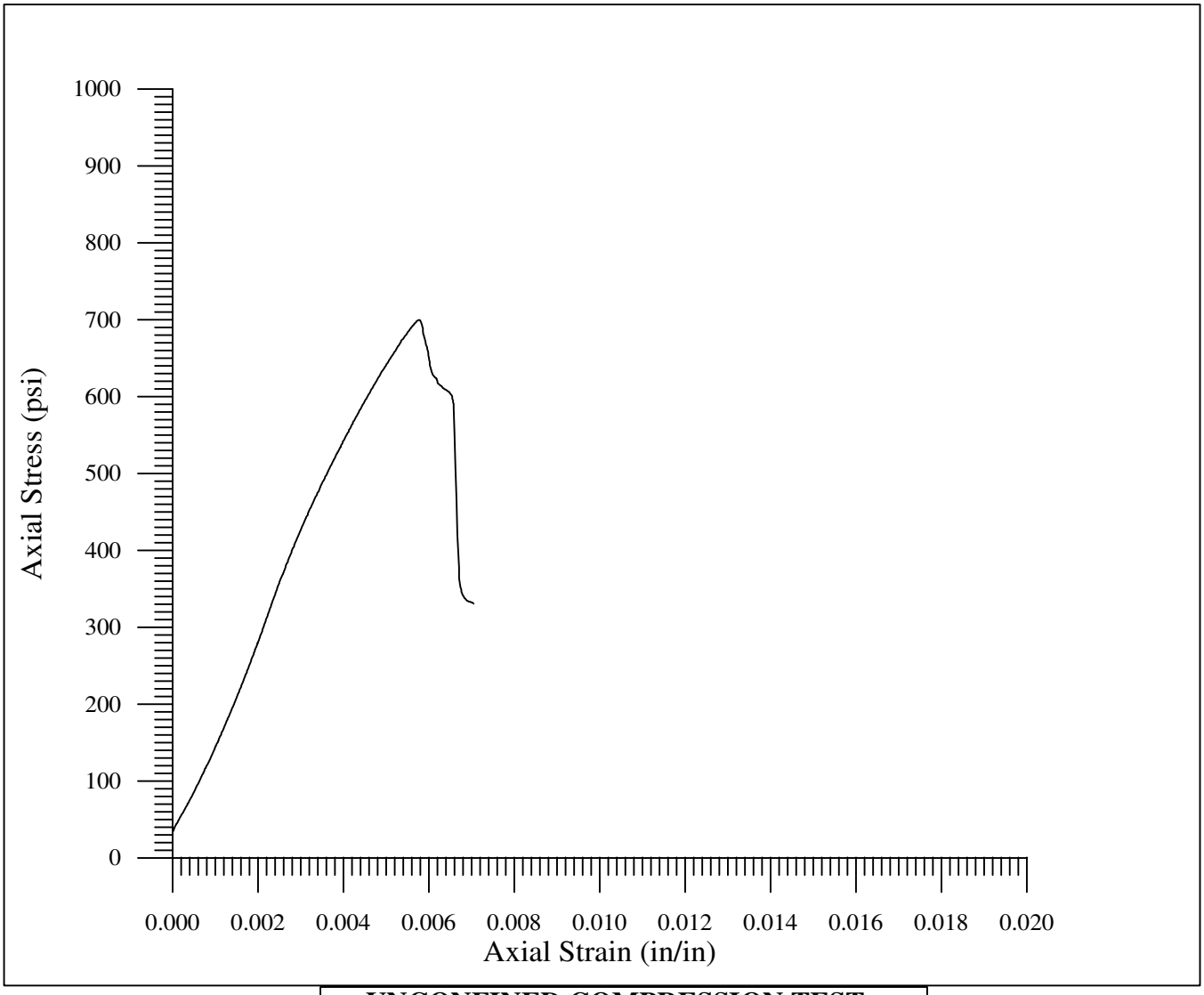
Density: 136.0 pcf
Strength: 514 psi

Geo Test G T U *Unlimited*
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: Earth Mechanics, Inc.
17660 Newhope St., Suite E
Fountain Valley, CA 92708

Project: SR-710 Tunnel
Project No: none

Test Date: April 21, 2009



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: Z1B2-262
Boring: Z1-B2
Depth: 262.5-263.3'

DESCRIPTION
Dark gray bedded siltstone and fine grained sandstone.

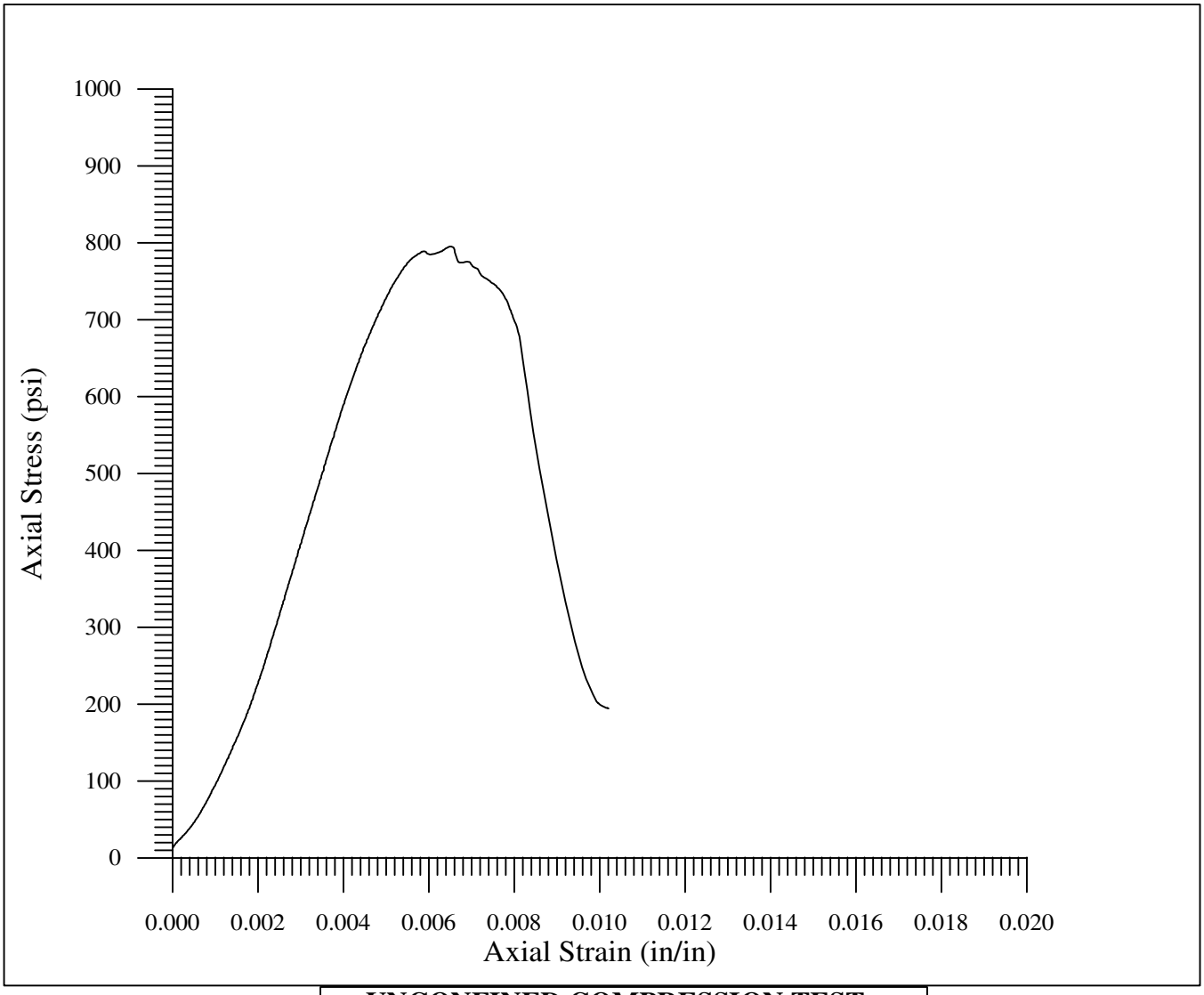
Density: 137.6 pcf
Strength: 700 psi

Geo Test Unlimited G T U
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: Earth Mechanics, Inc.
17660 Newhope St., Suite E
Fountain Valley, CA 92708

Project: SR-710 Tunnel
Project No: none

Test Date: April 21, 2009



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: Z1B2-270
Boring: Z1-B2
Depth: 270.1-270.9'

DESCRIPTION

Dark gray finely bedded claystone and siltstone.

Density: 134.1 pcf
Strength: 795 psi

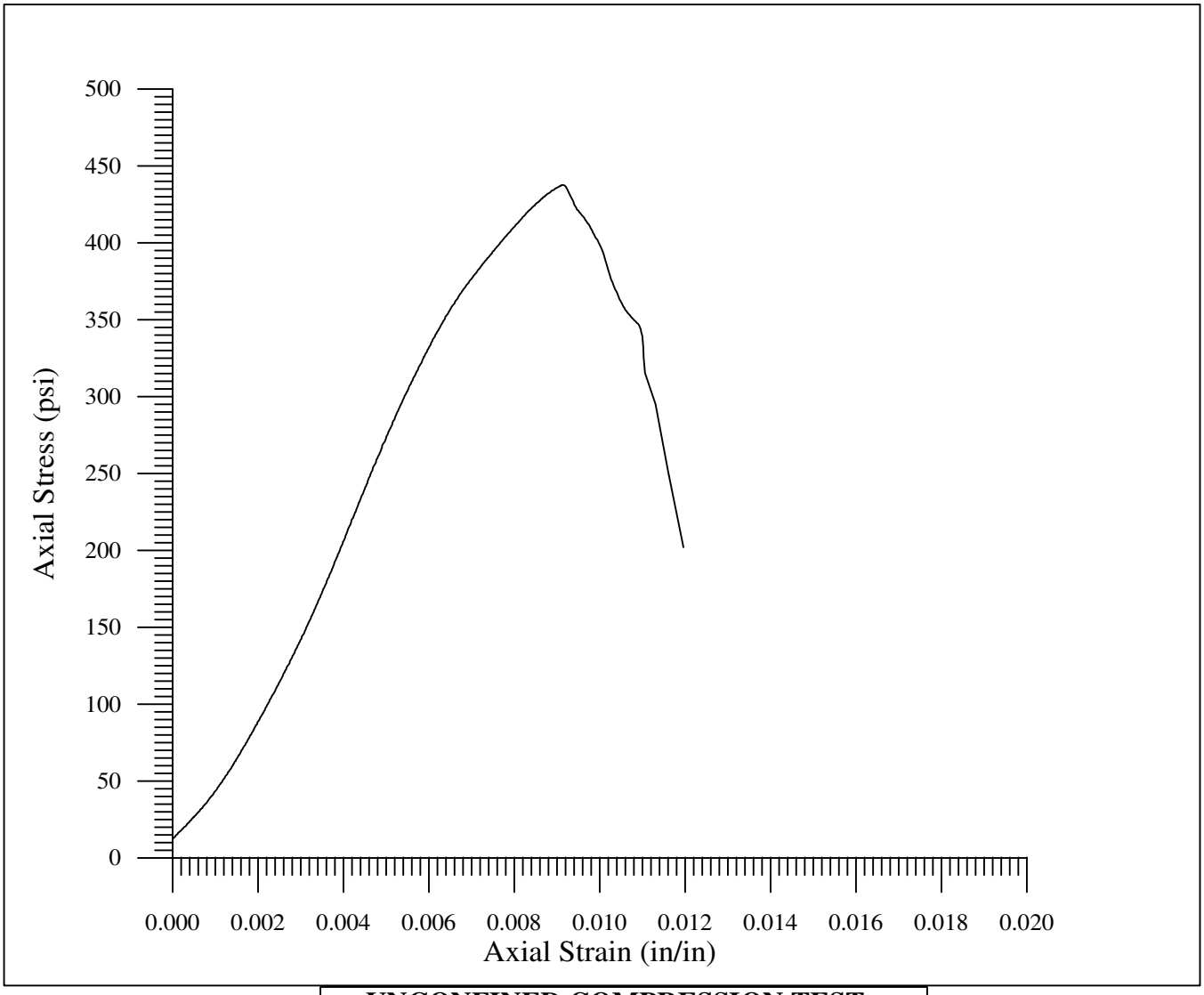
Geo Test G T U *Unlimited*
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: Earth Mechanics, Inc.
17660 Newhope St., Suite E
Fountain Valley, CA 92708

Project: SR-710 Tunnel

Project No: none

Test Date: April 21, 2009



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: Z1B2-298
Boring: Z1-B2
Depth: 298.8-299.2'

DESCRIPTION

Dark gray finely bedded claystone and siltstone.

Density: 133.2 pcf
Strength: 438 psi

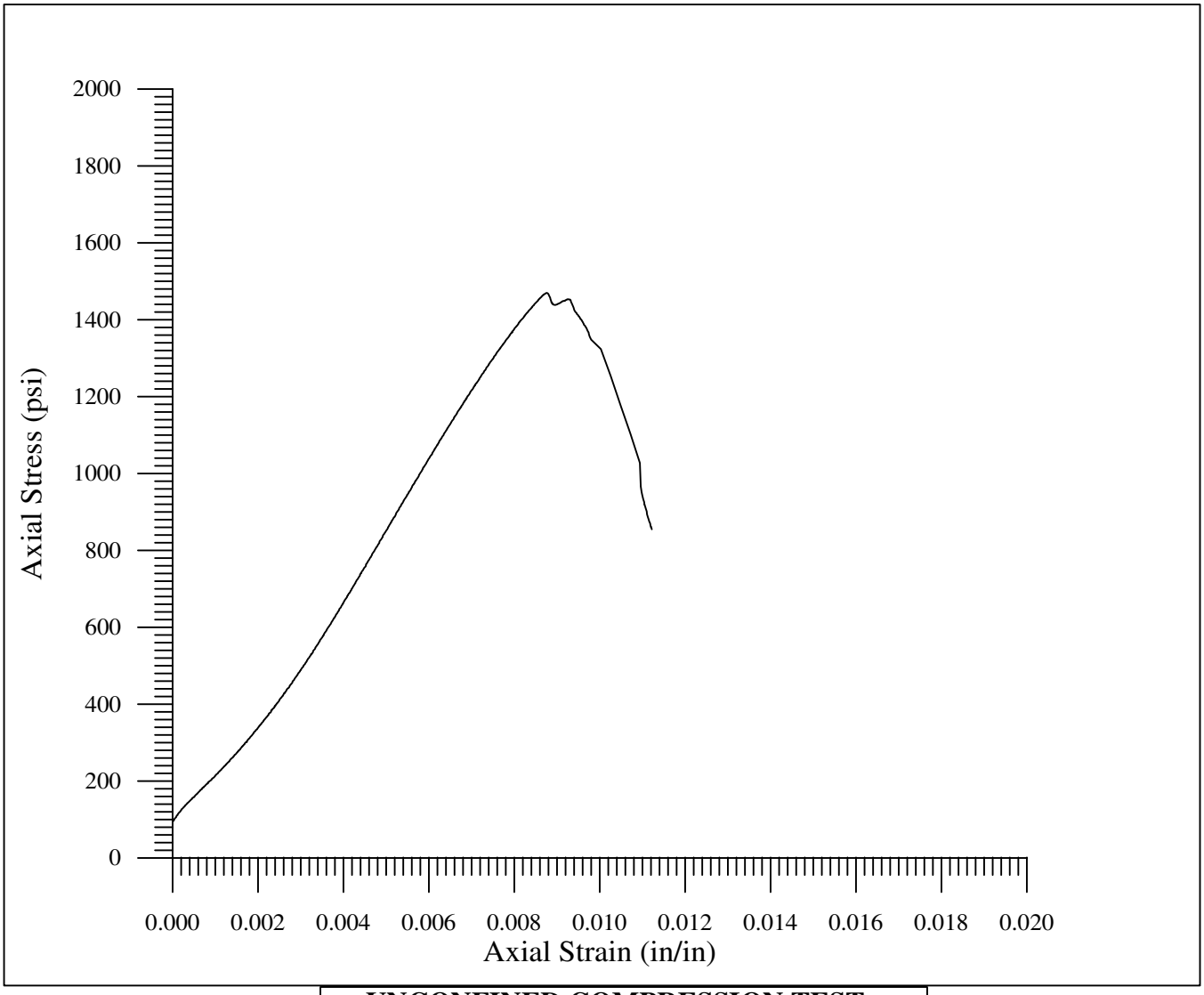
Geo Test G T U *Unlimited*
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: Earth Mechanics, Inc.
17660 Newhope St., Suite E
Fountain Valley, CA 92708

Project: SR-710 Tunnel

Project No: none

Test Date: April 21, 2009



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: Z1B3-291
Boring: Z1-B3
Depth: 291.8-293.1'

DESCRIPTION

Dark gray finely bedded siltstone with light gray fine grained sandstone lenses and fine to medium grained sandstone ends.

Density: 140.0 pcf
Strength: 1470 psi

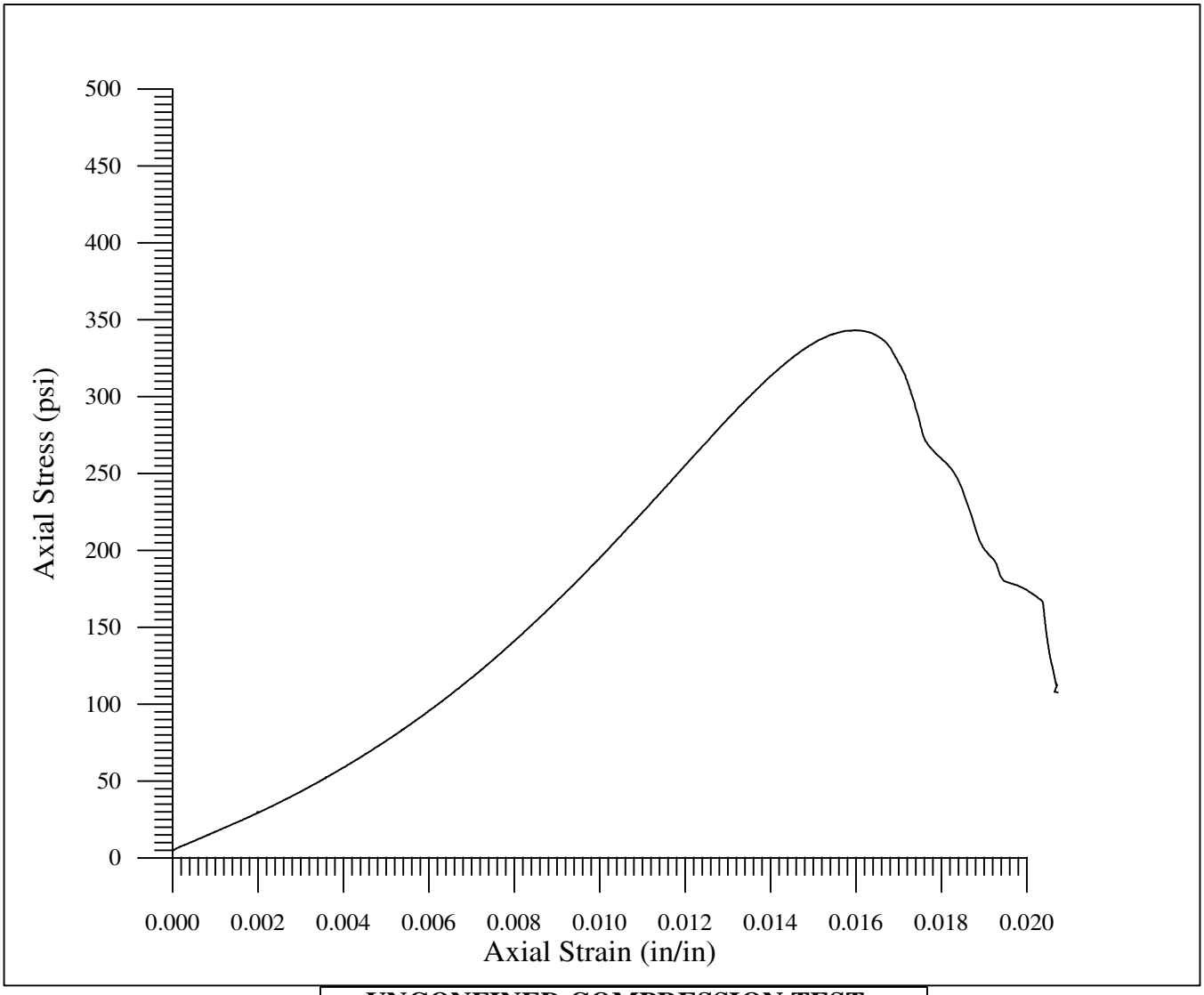
Geo Test G T U *Unlimited*
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: Earth Mechanics, Inc.
17660 Newhope St., Suite E
Fountain Valley, CA 92708

Project: SR-710 Tunnel

Project No: none

Test Date: April 8, 2009



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: Z1B3-83
Boring: Z1-B3
Depth: 83.0-84.9'

DESCRIPTION

Medium gray silty fine grained sandstone with a few dark gray claystone clasts (<1/4"typ.)

Density: 137.0 pcf
Strength: 343 psi

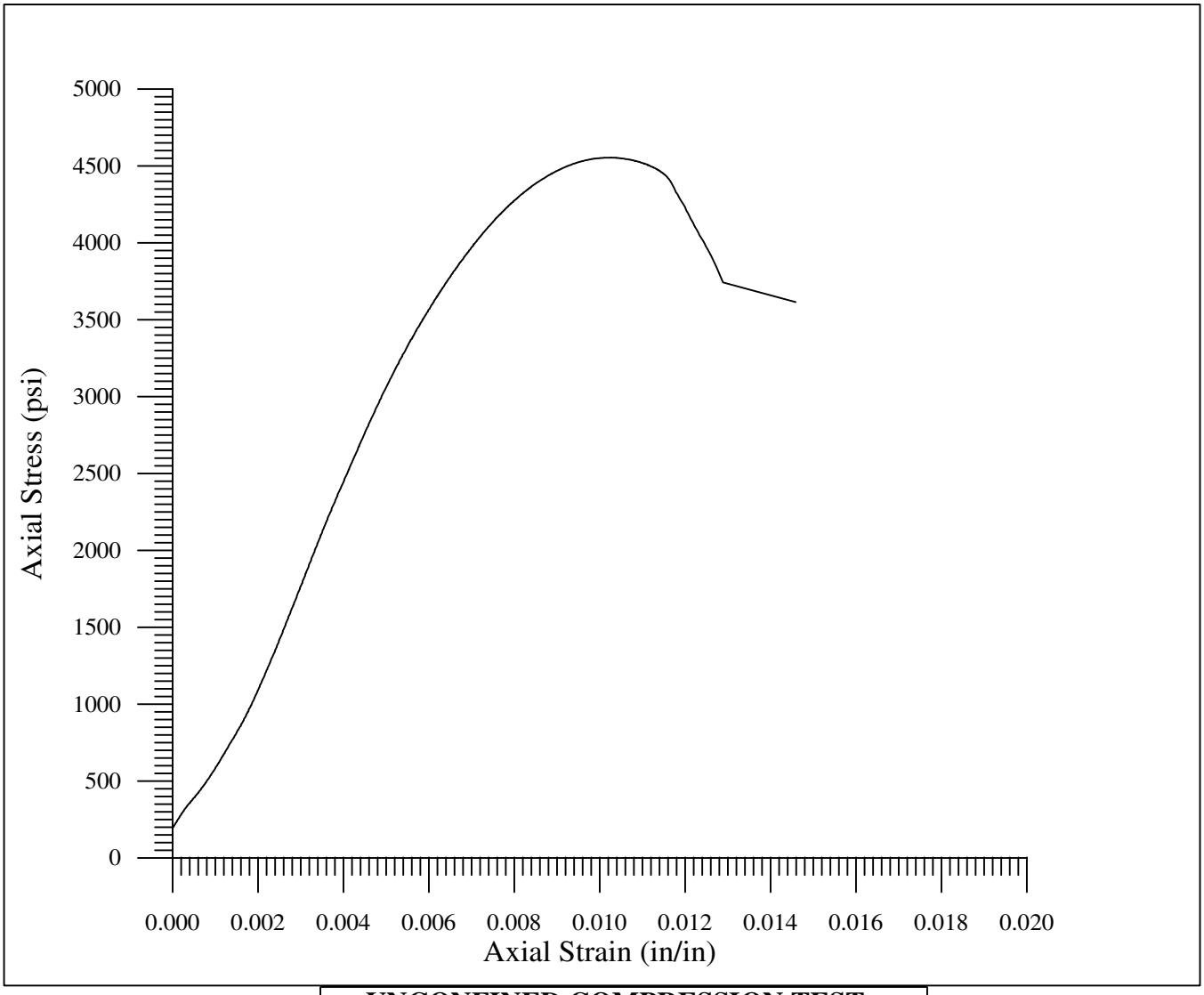
Geo Test GTU *Unlimited*
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: Earth Mechanics, Inc.
17660 Newhope St., Suite E
Fountain Valley, CA 92708

Project: SR-710 Tunnel

Project No: none

Test Date: April 11, 2009



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: Z1B3-95
Boring: Z1-B3
Depth: 95.0-96.0'

DESCRIPTION

Light gray silty fine grained sandstone, with no apparent planes of weakness.

Density: 154.9 pcf
Strength: 4555 psi

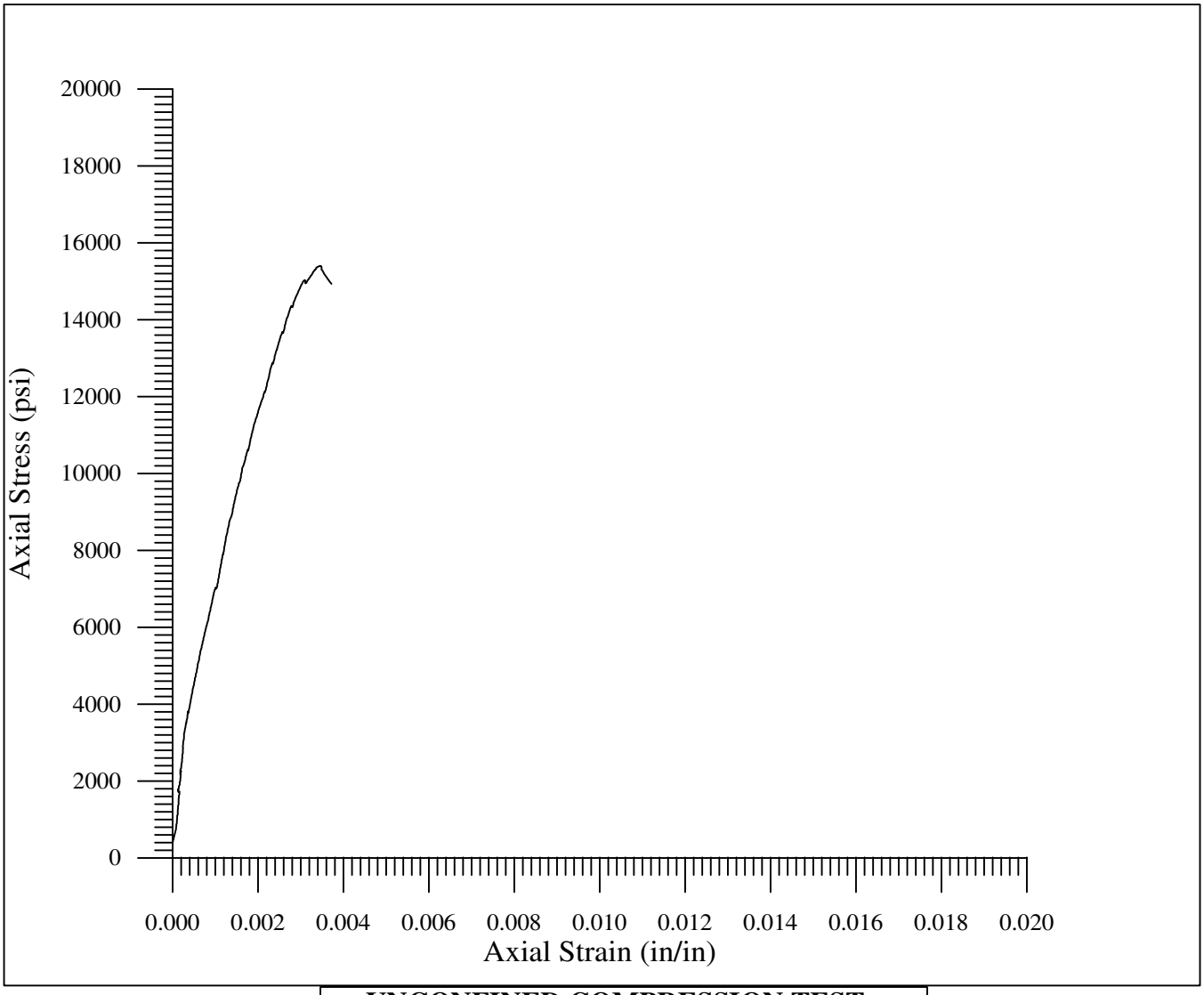
Geo Test G T U *Unlimited*
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: Earth Mechanics, Inc.
17660 Newhope St., Suite E
Fountain Valley, CA 92708

Project: SR-710 Tunnel

Project No: none

Test Date: April 8, 2009



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: Z1B3-108
Boring: Z1-B3
Depth: 108.9-110.1'

DESCRIPTION

Medium gray silty fine grained sandstone, with a slightly discolored tight discontinuity.

Density: 162.7 pcf
Strength: 15,397 psi

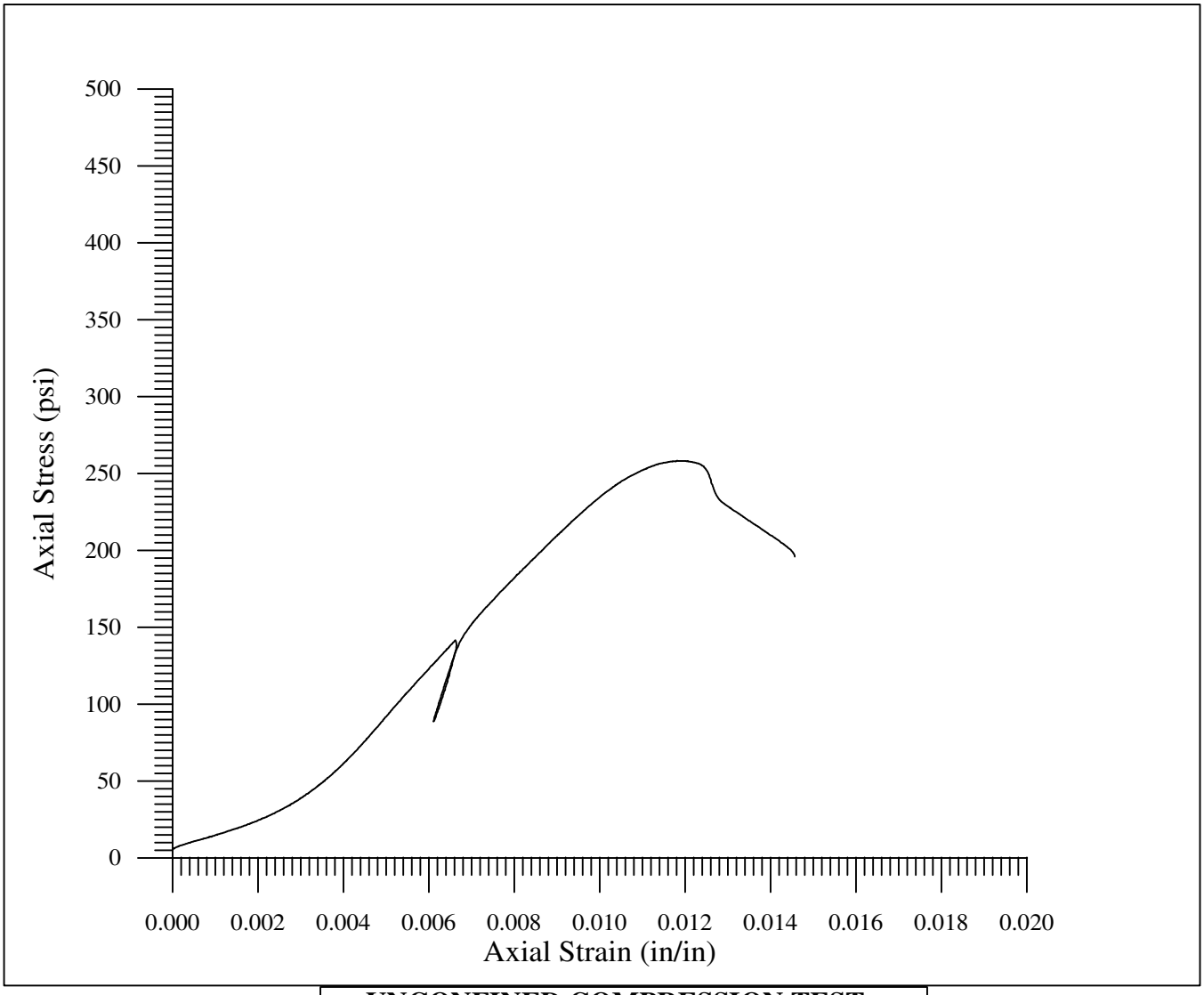
Geo Test G T U *Unlimited*
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: Earth Mechanics, Inc.
17660 Newhope St., Suite E
Fountain Valley, CA 92708

Project: SR-710 Tunnel

Project No: none

Test Date: April 8, 2009



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: Z1B3-115
Boring: Z1-B3
Depth: 115.6-116.9'

DESCRIPTION

Medium gray silty fine to medium grained friable sandstone, with no apparent planes of weakness.

Density: 137.4 pcf
Strength: 258 psi

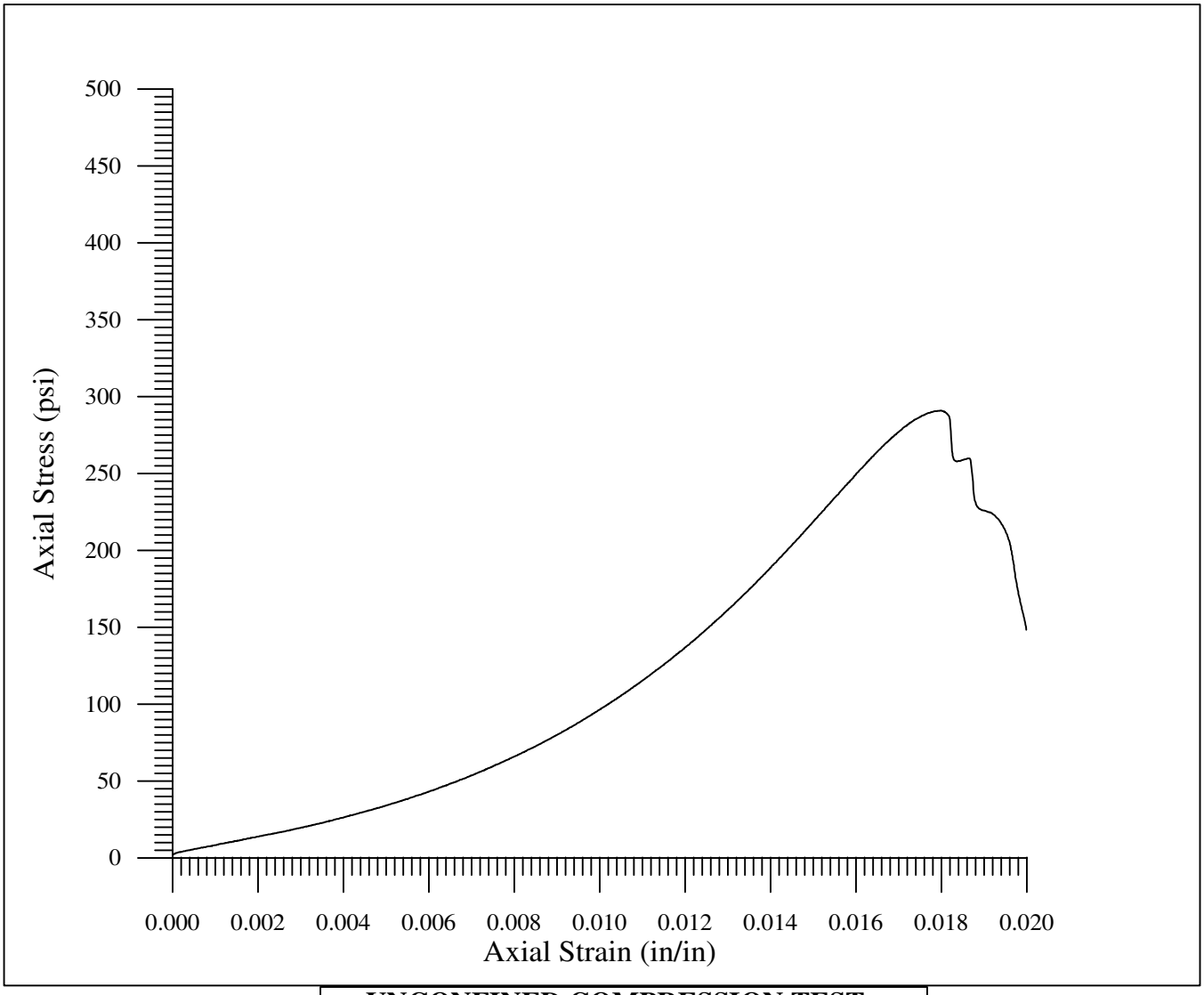
Geo Test G T U *Unlimited*
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: Earth Mechanics, Inc.
17660 Newhope St., Suite E
Fountain Valley, CA 92708

Project: SR-710 Tunnel

Project No: none

Test Date: April 7, 2009



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: Z1B3-123
Boring: Z1-B3
Depth: 123.6-124.9'

DESCRIPTION

Medium gray silty fine grained friable sandstone, with missing side pieces and a glued cross joint.

Density: 137.4 pcf
Strength: 291 psi

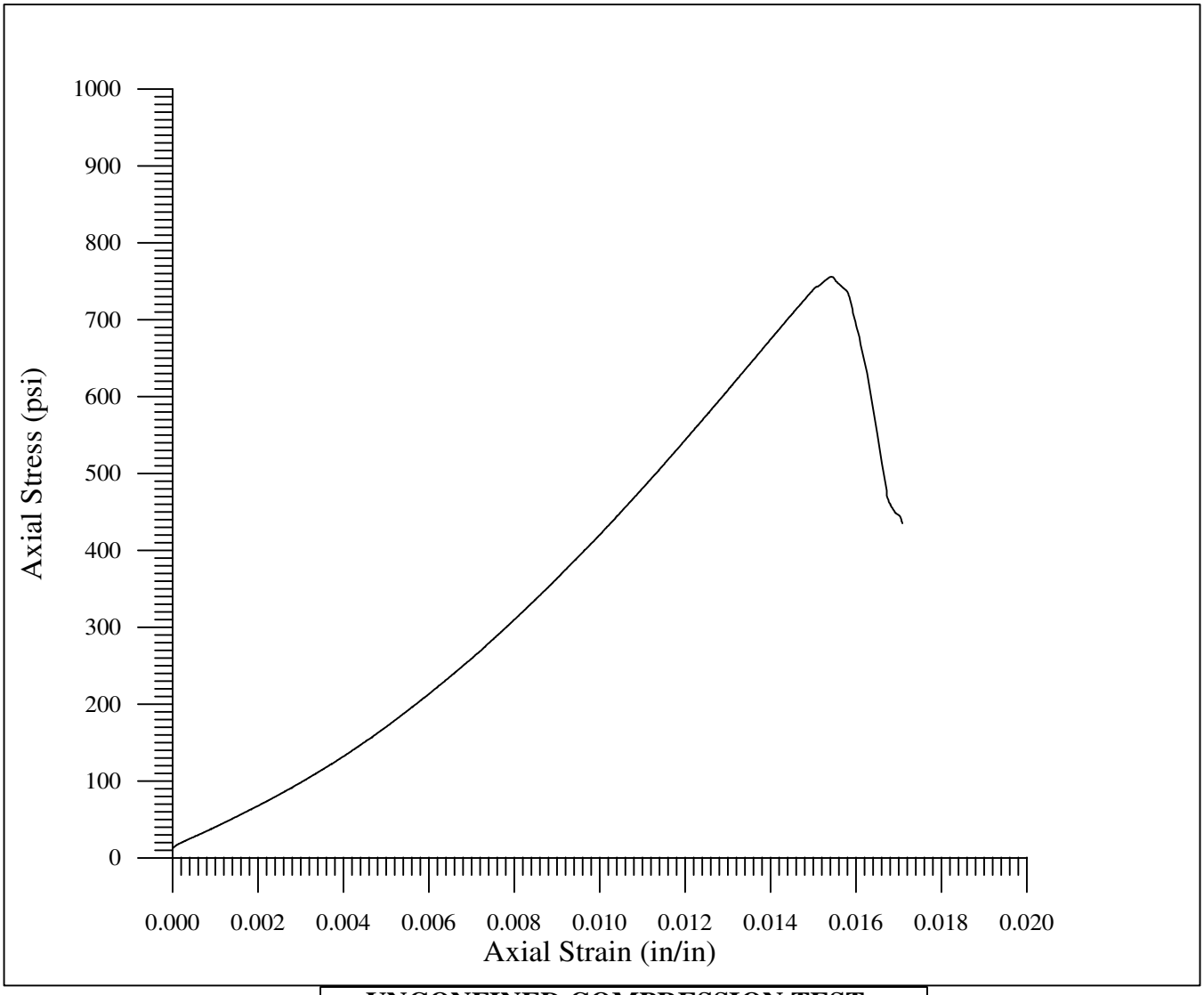
Geo Test G T U *Unlimited*
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: Earth Mechanics, Inc.
17660 Newhope St., Suite E
Fountain Valley, CA 92708

Project: SR-710 Tunnel

Project No: none

Test Date: April 7, 2009



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: Z1B3-167
Boring: Z1-B3
Depth: 167.7-169.2'

DESCRIPTION

Dark gray finely bedded silty fine grained sandstone and siltstone.

Density: 138.5 pcf
Strength: 756 psi

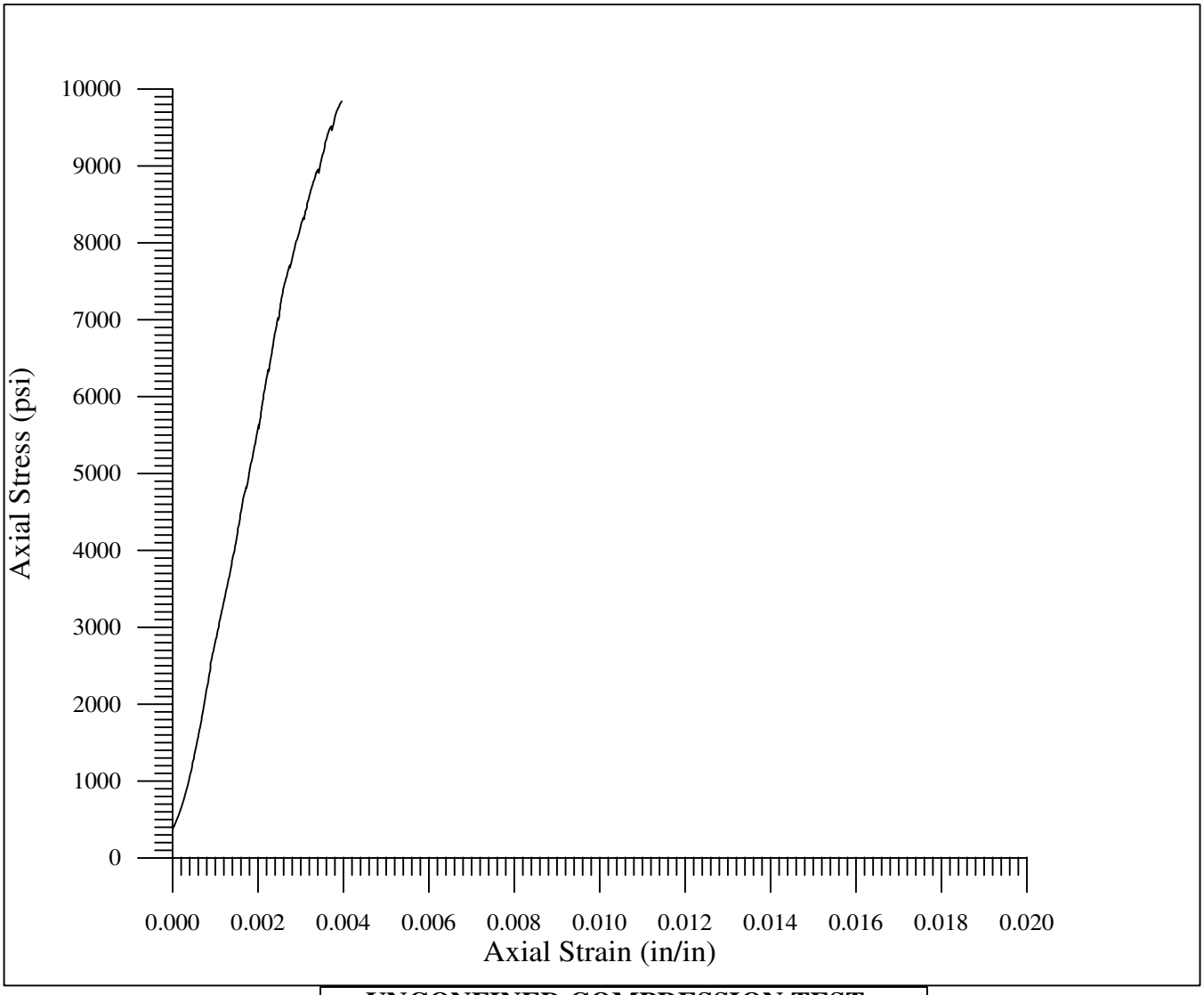
Geo Test G T U *Unlimited*
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: Earth Mechanics, Inc.
17660 Newhope St., Suite E
Fountain Valley, CA 92708

Project: SR-710 Tunnel

Project No: none

Test Date: April 11, 2009



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: Z1B3-177
Boring: Z1-B3
Depth: 177.3-178.0'

DESCRIPTION

Medium gray silty fine to medium grained sandstone with no apparent planes of weakness.

Density: 156.2 pcf
Strength: 9838 psi

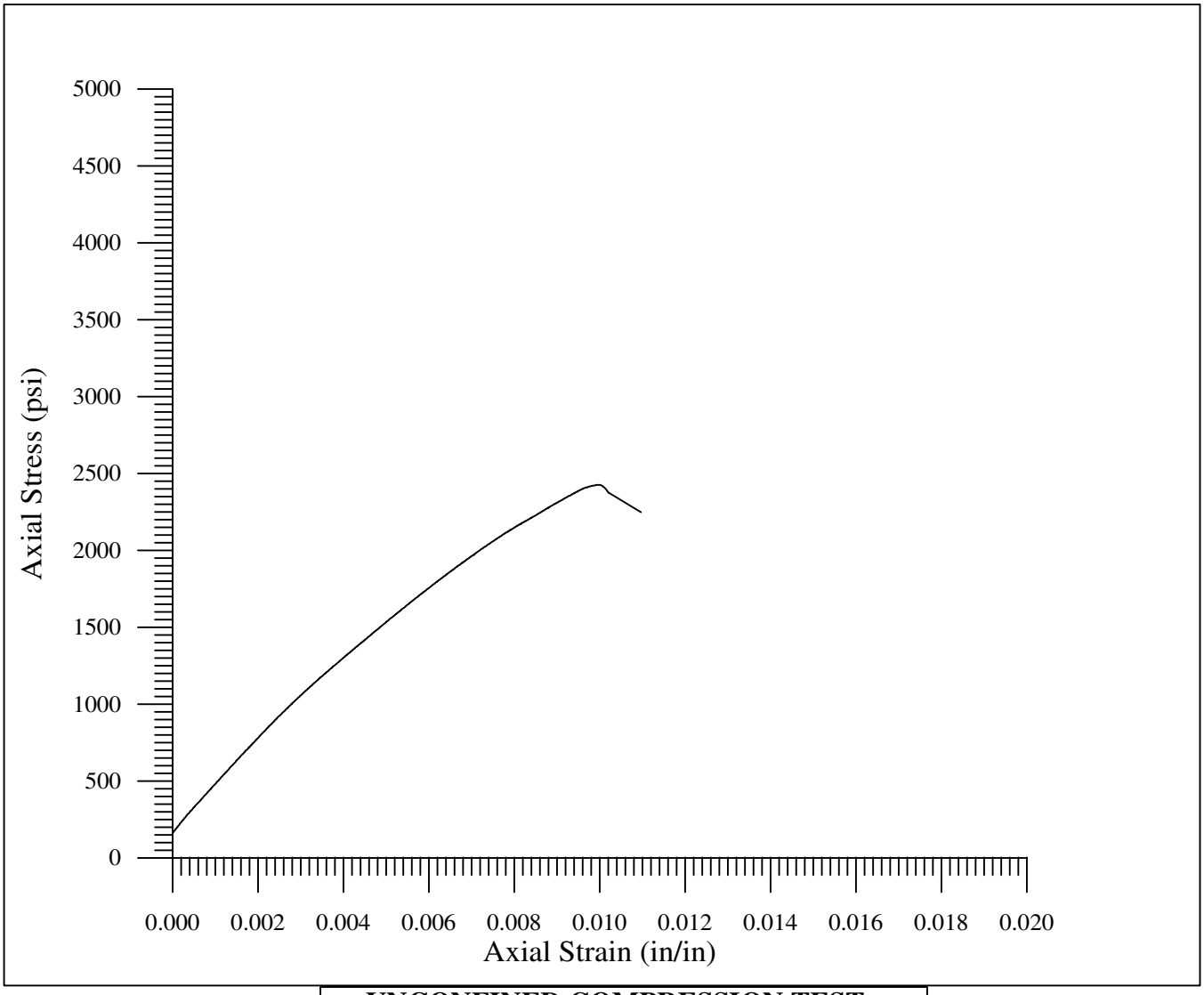
Geo Test G T U *Unlimited*
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: Earth Mechanics, Inc.
17660 Newhope St., Suite E
Fountain Valley, CA 92708

Project: SR-710 Tunnel

Project No: none

Test Date: April 8, 2009



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: Z1B3-193
Boring: Z1-B3
Depth: 193.8-195.3'

DESCRIPTION

Dark gray layered siltstone with a few light gray fine sandstone lenses.

Density: 136.5 pcf
Strength: 2427 psi

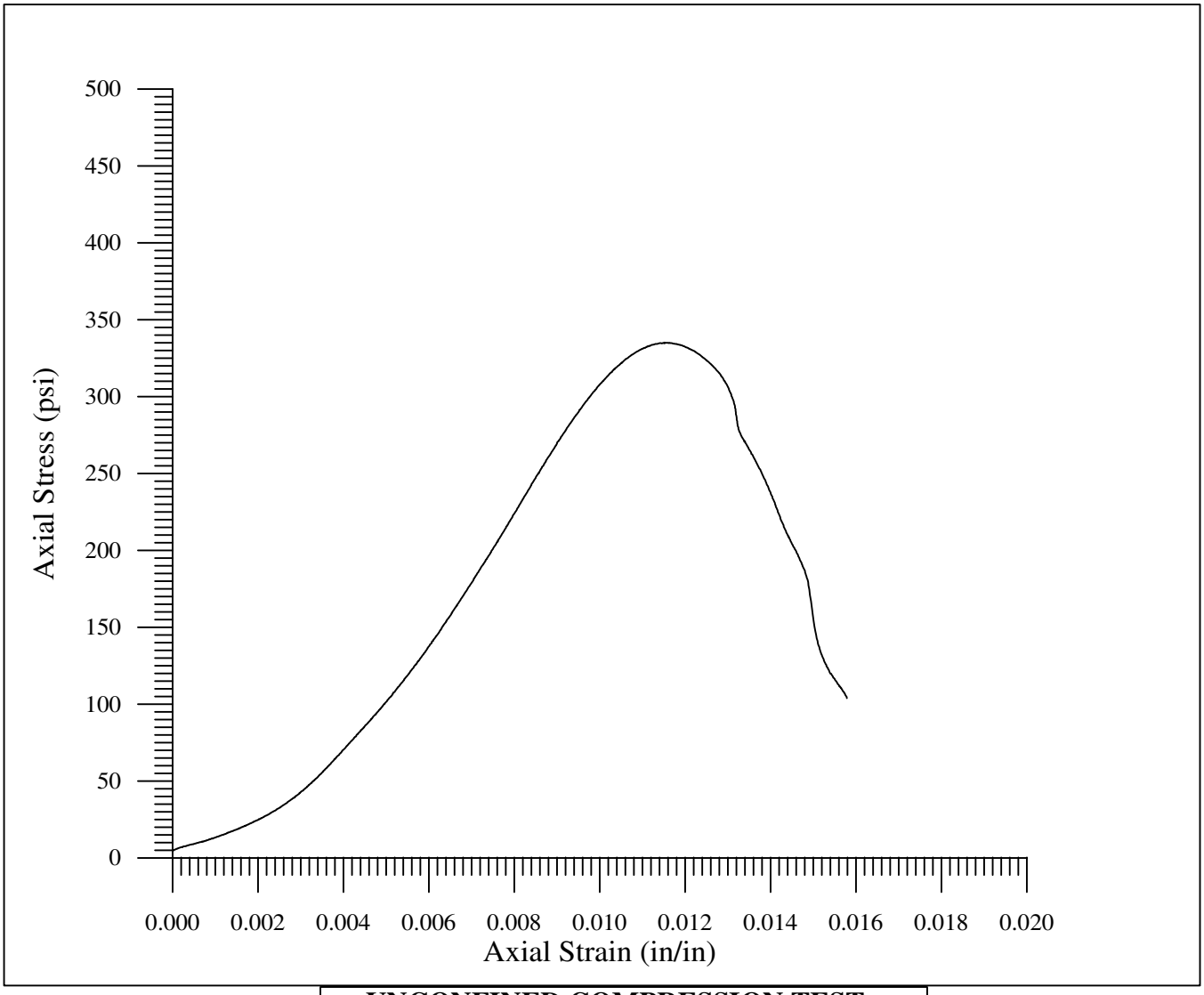
Geo Test G T U *Unlimited*
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: Earth Mechanics, Inc.
17660 Newhope St., Suite E
Fountain Valley, CA 92708

Project: SR-710 Tunnel

Project No: none

Test Date: April 8, 2009



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: Z1B3-225
Boring: Z1-B3
Depth: 225.0-226.7'

DESCRIPTION

Light gray silty medium grained friable sandstone with no apparent planes of weakness.

Density: 138.1 pcf
Strength: 335 psi

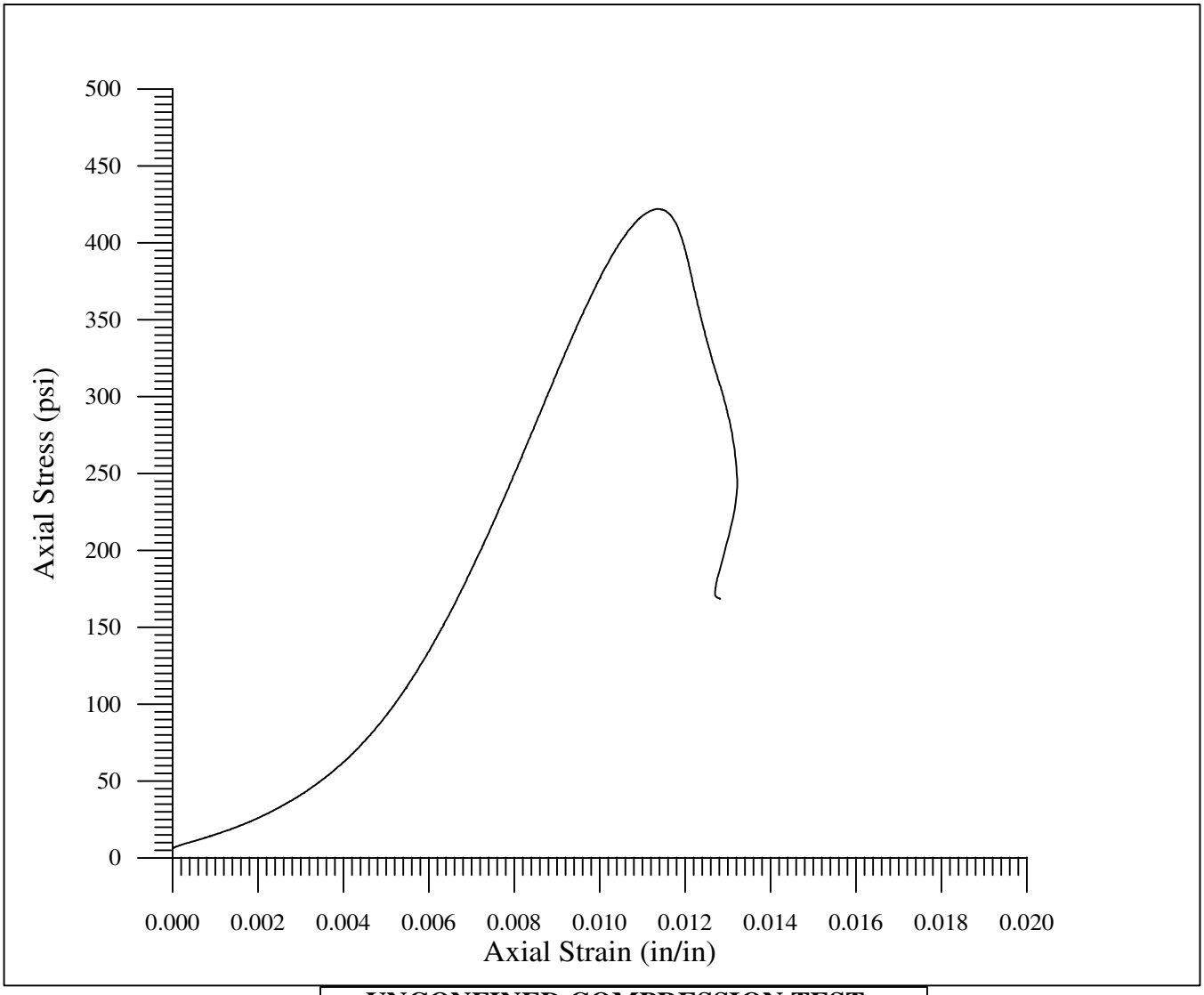
Geo Test G T U *Unlimited*
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: Earth Mechanics, Inc.
17660 Newhope St., Suite E
Fountain Valley, CA 92708

Project: SR-710 Tunnel

Project No: none

Test Date: April 11, 2009



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: Z1B3-231
Boring: Z1-B3
Depth: 231.6-233.1'

DESCRIPTION

Medium gray silty fine to medium grained friable sandstone with no apparent planes of weakness.

Density: 135.9 pcf
Strength: 422 psi

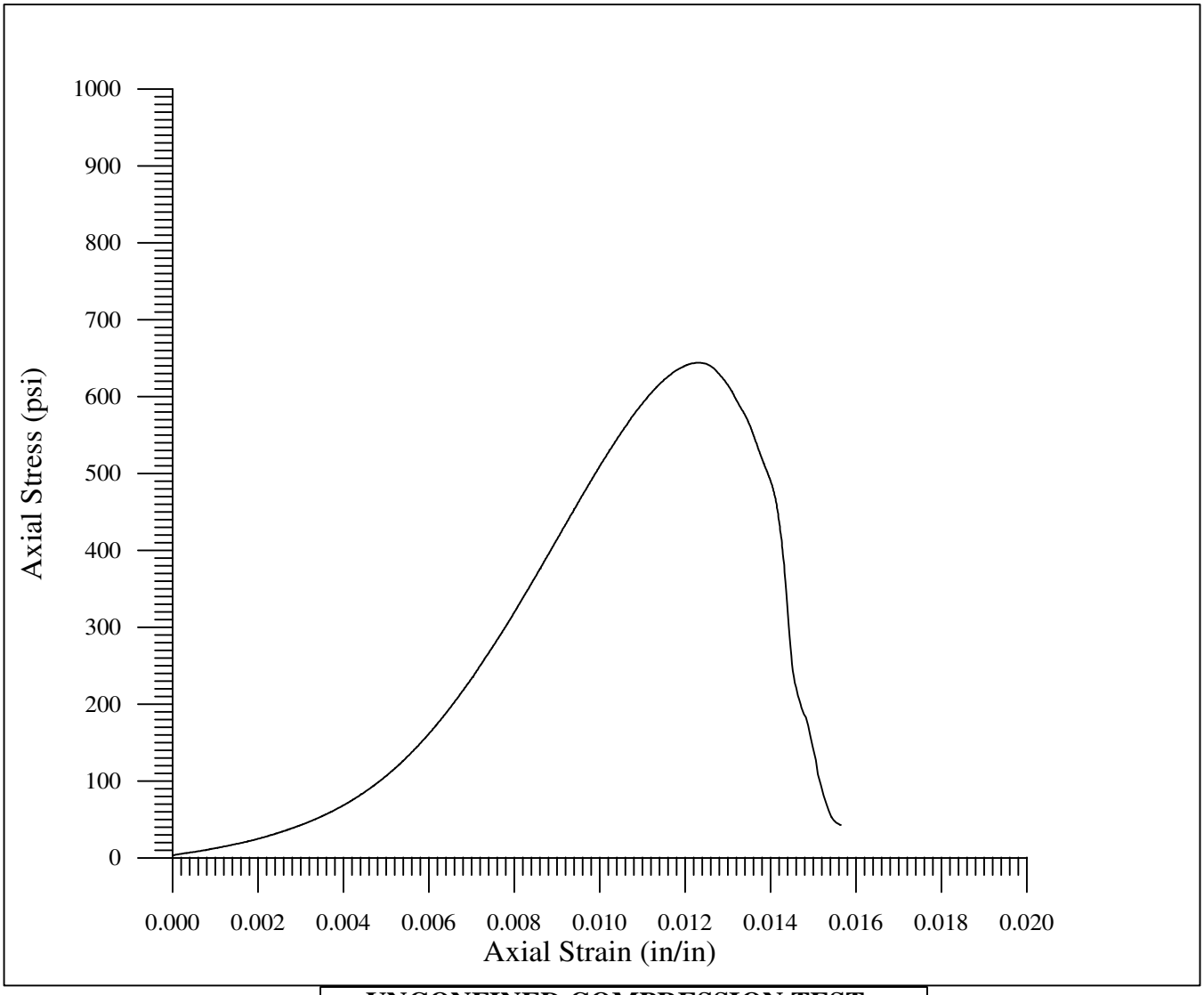
Geo Test G T U *Unlimited*
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: Earth Mechanics, Inc.
17660 Newhope St., Suite E
Fountain Valley, CA 92708

Project: SR-710 Tunnel

Project No: none

Test Date: April 7, 2009



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: Z1B3-234
Boring: Z1-B3
Depth: 234.8-236.0'

DESCRIPTION

Medium gray silty fine to medium grained friable sandstone with no apparent planes of weakness.

Density: 135.4 pcf
Strength: 644 psi

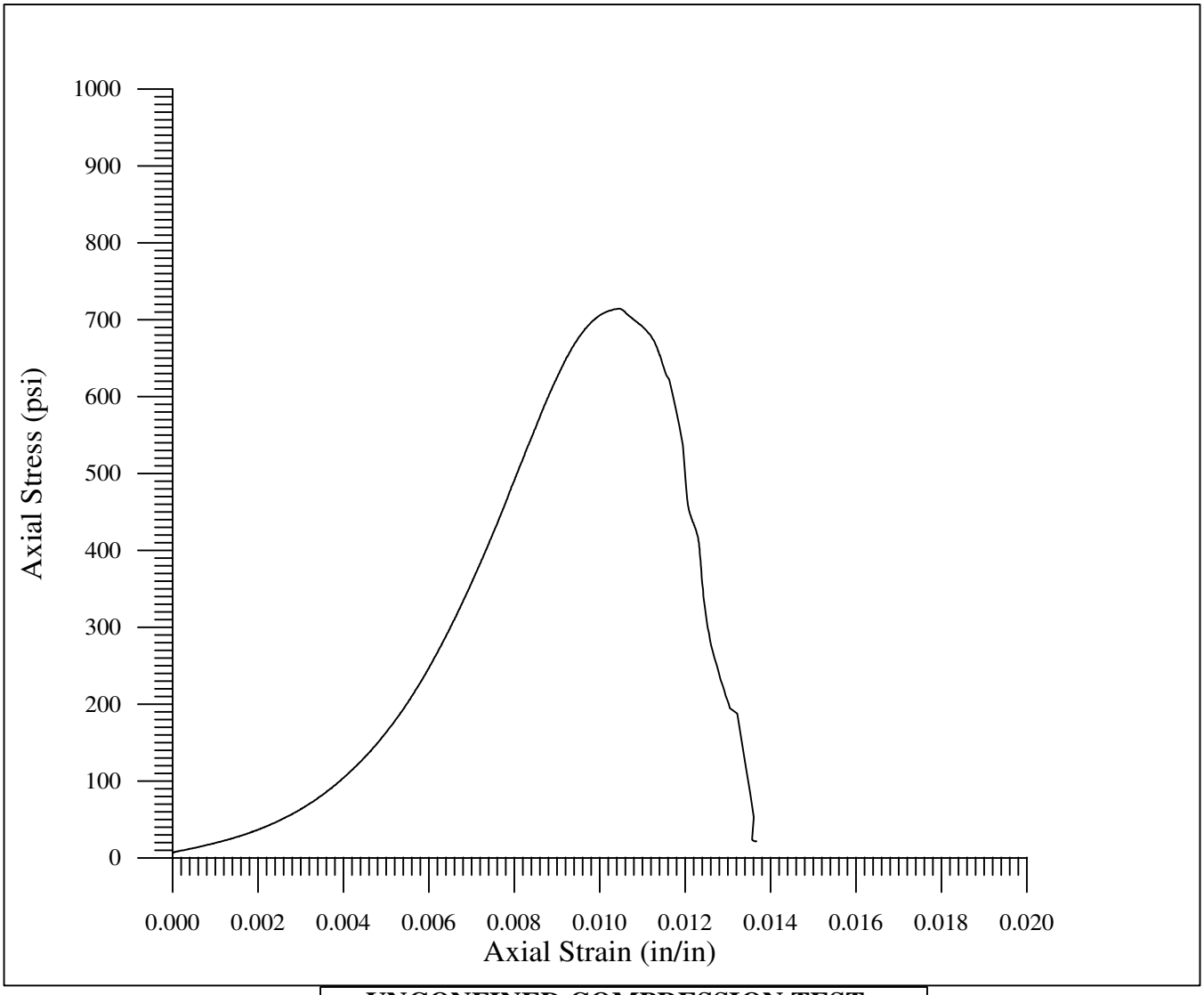
Geo Test G_TU *Unlimited*
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: Earth Mechanics, Inc.
17660 Newhope St., Suite E
Fountain Valley, CA 92708

Project: SR-710 Tunnel

Project No: none

Test Date: April 8, 2009



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: Z1B3-239
Boring: Z1-B3
Depth: 239.1-239.9'

DESCRIPTION

Medium gray silty fine to medium grained friable sandstone with no apparent planes of weakness.

Density: 137.5 pcf
Strength: 714 psi

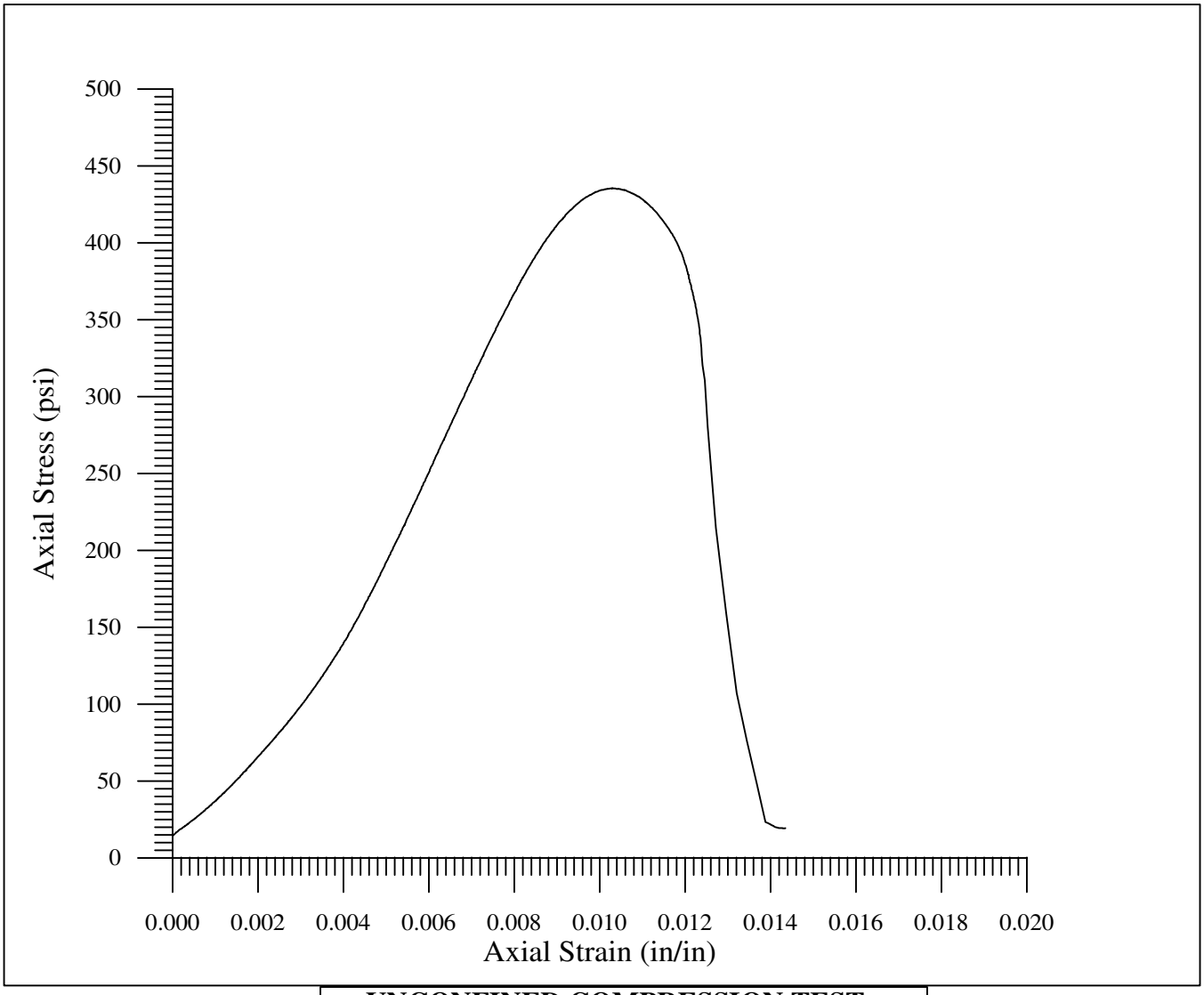
Geo Test G T U *Unlimited*
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: Earth Mechanics, Inc.
17660 Newhope St., Suite E
Fountain Valley, CA 92708

Project: SR-710 Tunnel

Project No: none

Test Date: April 8, 2009



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: Z1B3-251
Boring: Z1-B3
Depth: 251.0-252.0'

DESCRIPTION

Medium gray silty fine to medium grained friable sandstone with no apparent planes of weakness.

Density: 135.1 pcf
Strength: 435 psi

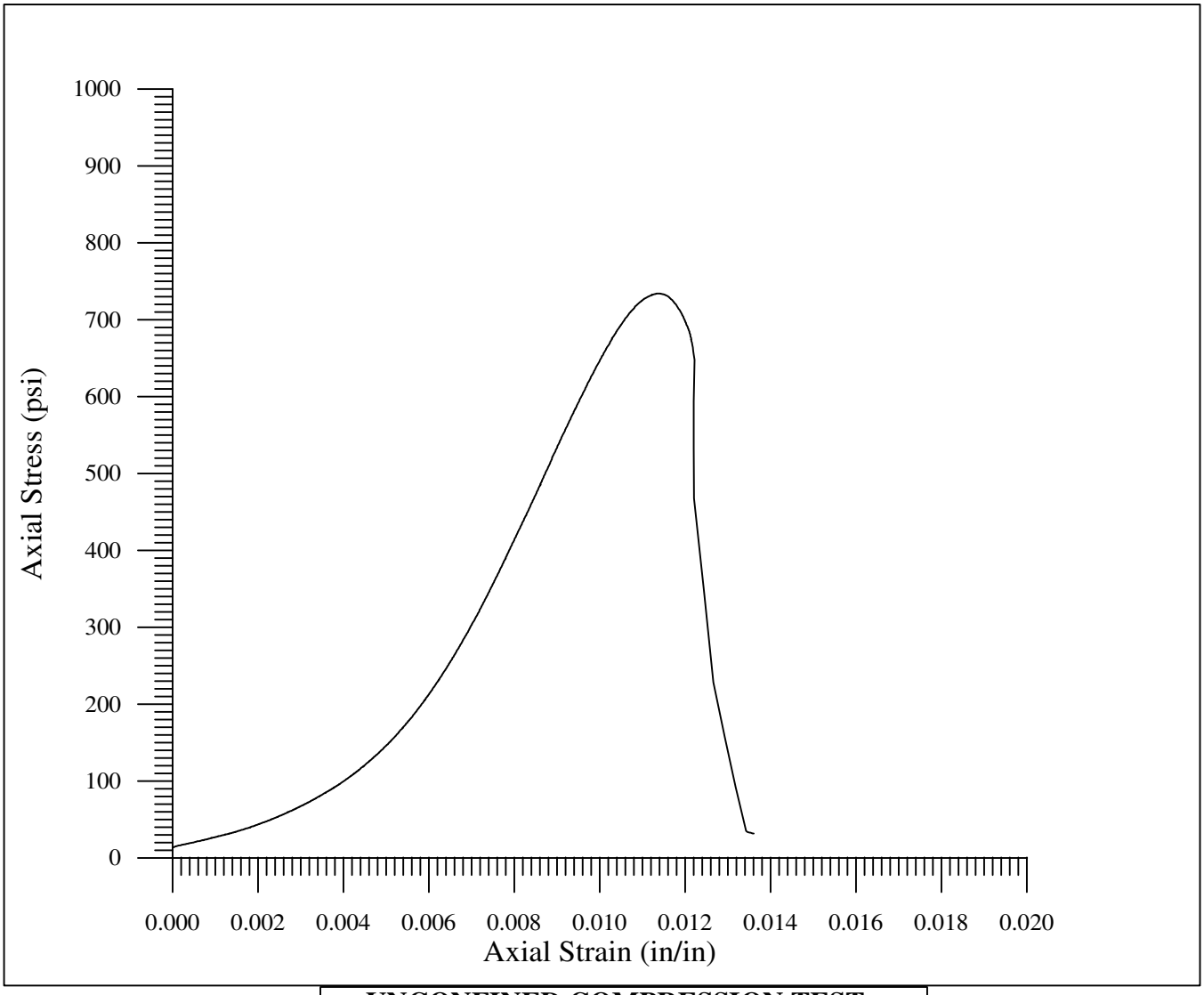
Geo Test G T U *Unlimited*
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: Earth Mechanics, Inc.
17660 Newhope St., Suite E
Fountain Valley, CA 92708

Project: SR-710 Tunnel

Project No: none

Test Date: April 8, 2009



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: Z1B3-262
Boring: Z1-B3
Depth: 262.0-263.1'

DESCRIPTION

Medium gray silty fine to medium grained friable sandstone with a diagonal tight joint.

Density: 135.2 pcf
Strength: 734 psi

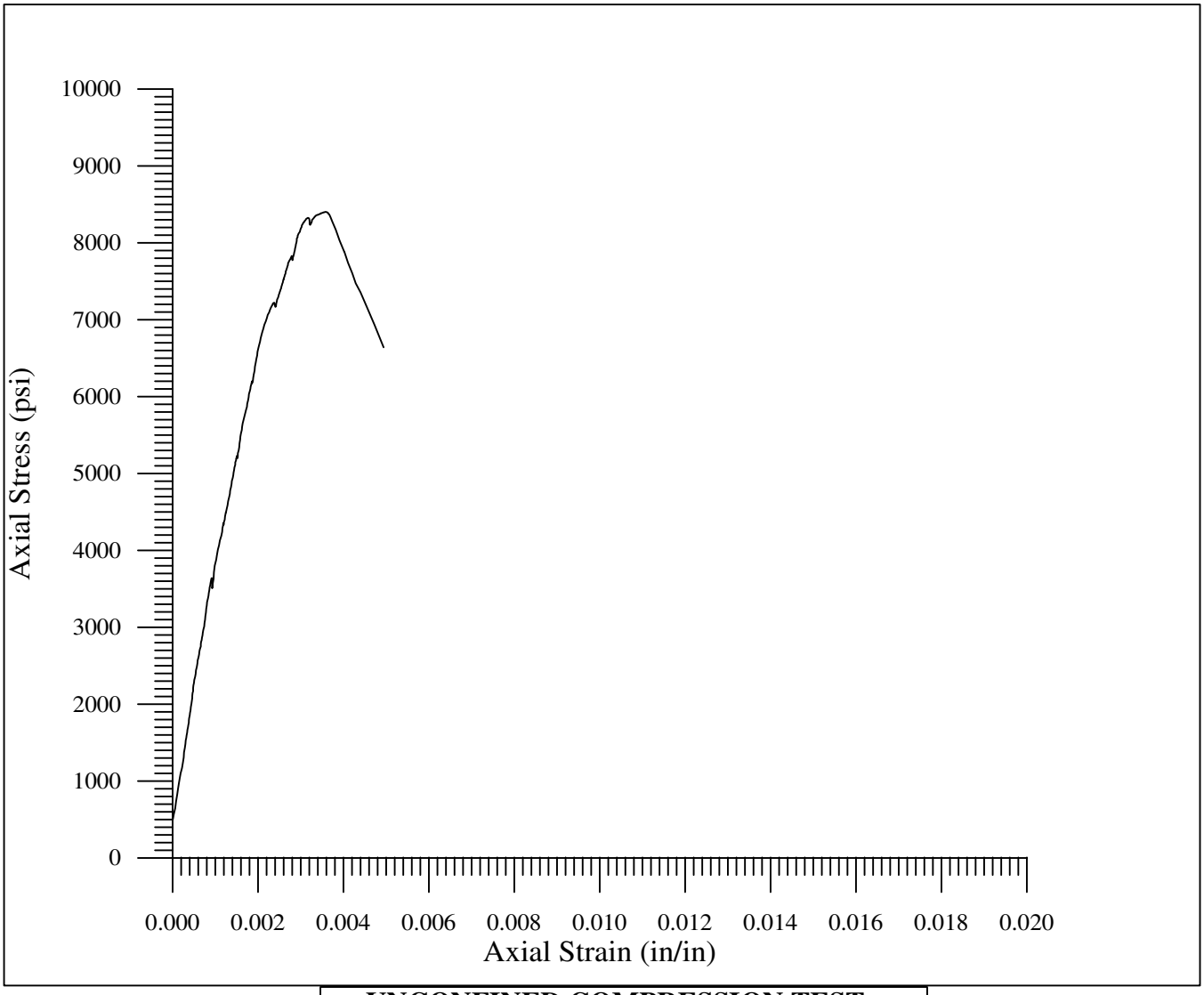
Geo Test G T U *Unlimited*
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: Earth Mechanics, Inc.
17660 Newhope St., Suite E
Fountain Valley, CA 92708

Project: SR-710 Tunnel

Project No: none

Test Date: April 8, 2009



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: Z1B3-289
Boring: Z1-B3
Depth: 289.0-289.6'

DESCRIPTION
Light gray fine to medium grained sandstone.

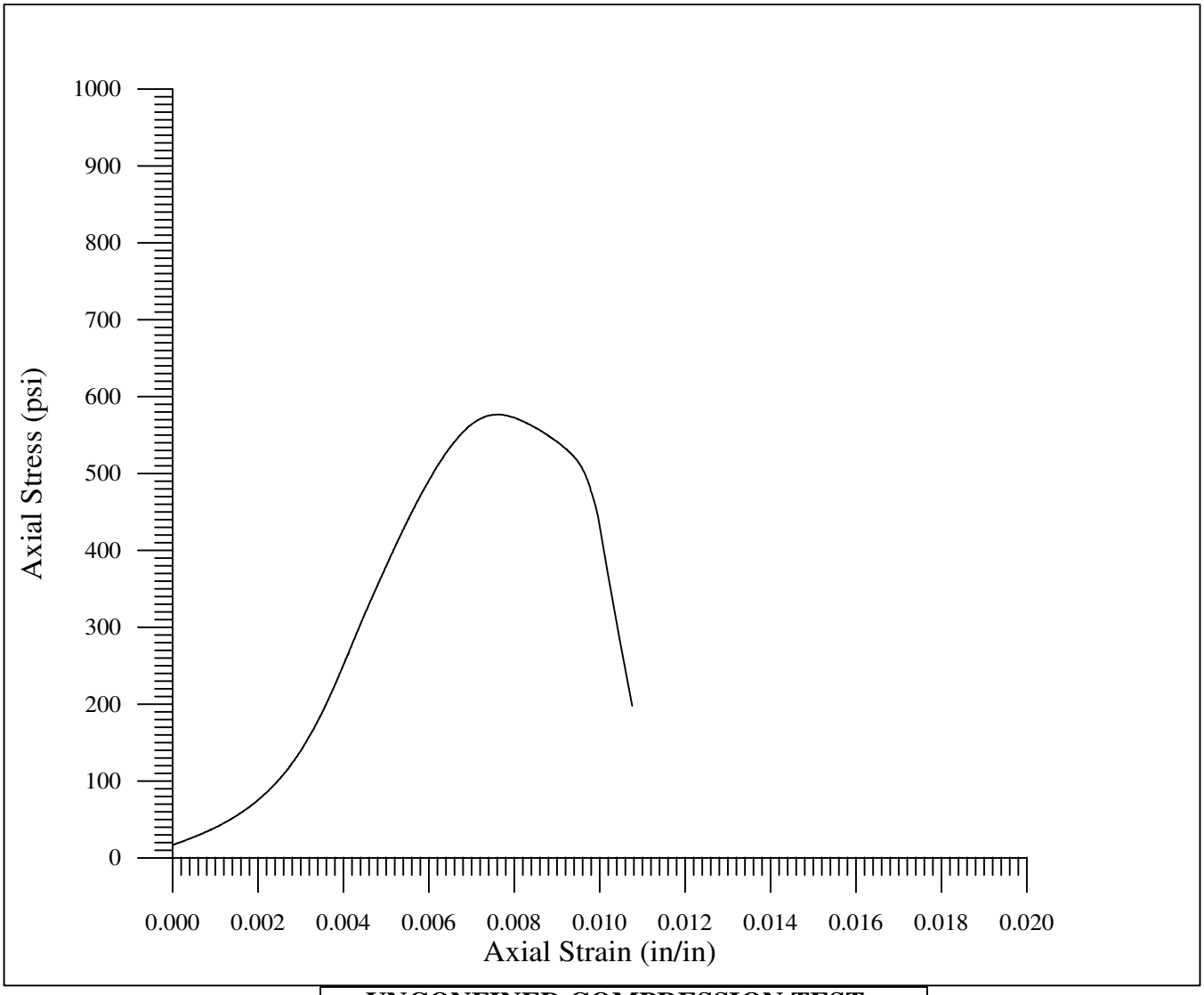
Density: 154.6 pcf
Strength: 8404 psi

Geo Test Unlimited G T U
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: Earth Mechanics, Inc.
17660 Newhope St., Suite E
Fountain Valley, CA 92708

Project: SR-710 Tunnel
Project No: none

Test Date: April 21, 2009



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: Z1B3-299
Boring: Z1-B3
Depth: 299.0-300.2'

DESCRIPTION

Medium gray silty fine to medium grained friable sandstone with no apparent planes of weakness.

Density: 136.7 pcf
Strength: 577 psi

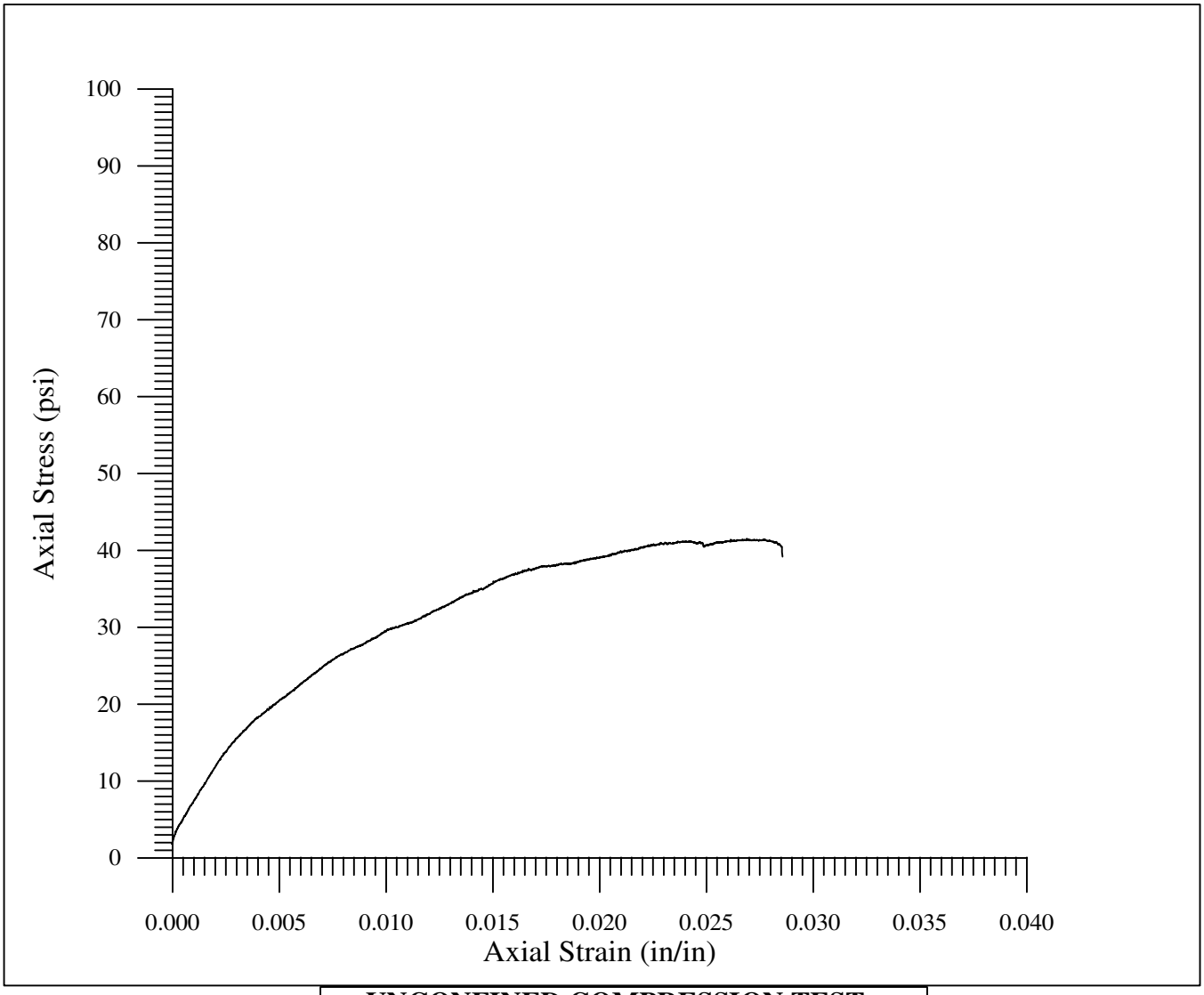
Geo Test G T U *Unlimited*
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: Earth Mechanics, Inc.
17660 Newhope St., Suite E
Fountain Valley, CA 92708

Project: SR-710 Tunnel

Project No: none

Test Date: April 8, 2009



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: Z2B1-120
Boring: Z2-B1
Depth: 120.0-122.0'

DESCRIPTION

Dark gray interbedded clayey siltstone and fine to medium grained brown sandstone with numerous fractures, two of which were glued.

Density: 125.2 pcf
Strength: 42 psi

Geo Test G_TU *Unlimited*
27069 N. Bloomfield Rd.
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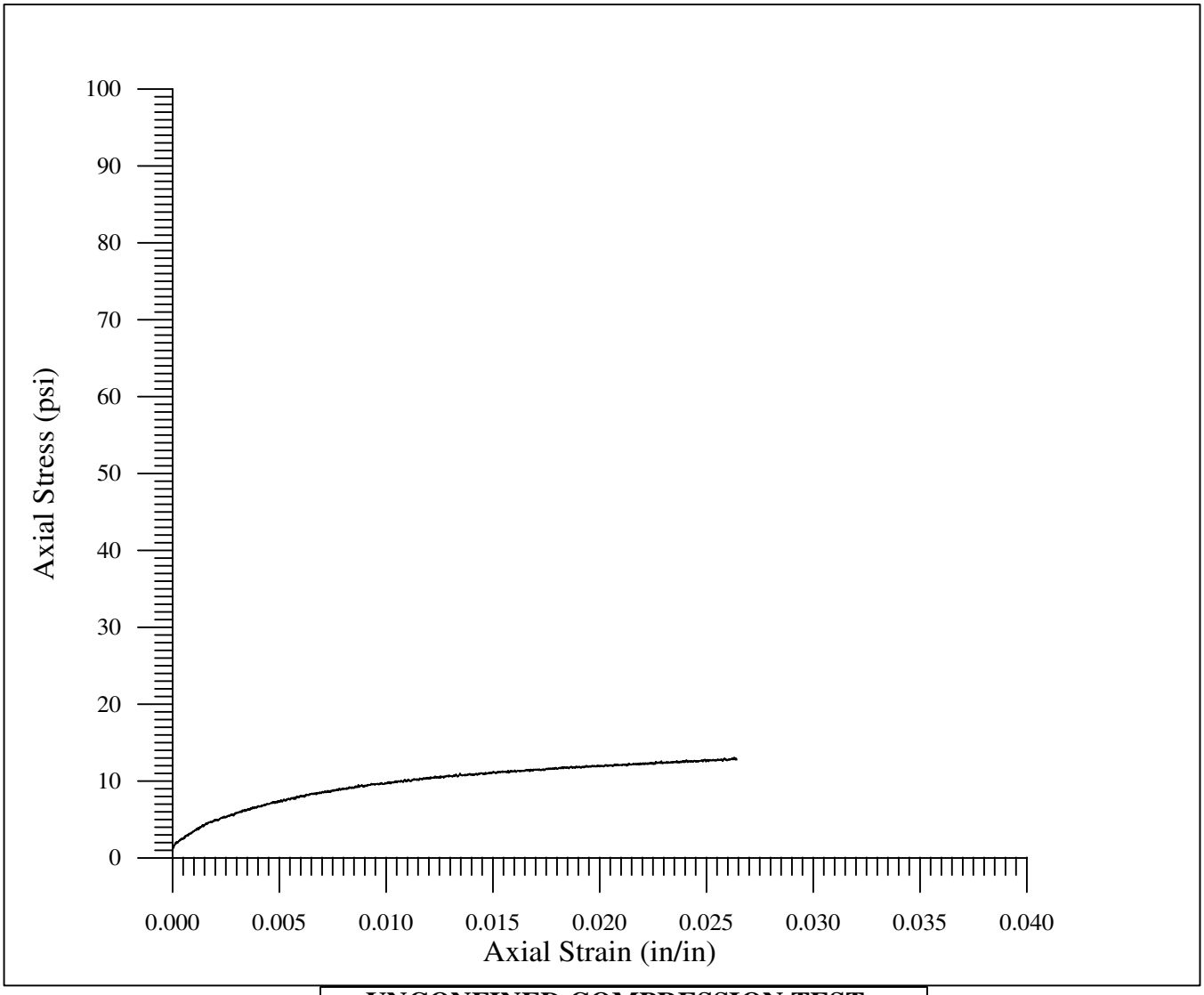
Client: Earth Mechanics, Inc.
17660 Newhope St., Suite E
Fountain Valley, CA 92708

Project: SR-710 Tunnel

Project No: none

Test Date: April 11, 2009



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: Z2B1-33
Boring: Z2-B1
Depth: 33.0-34.1'

DESCRIPTION

Mottled brown and gray sandy clayey siltstone with a diagonal joint.

Density: 127.1 pcf
Strength: 13 psi

Geo Test G T U *Unlimited*
27069 N. Bloomfield Rd.
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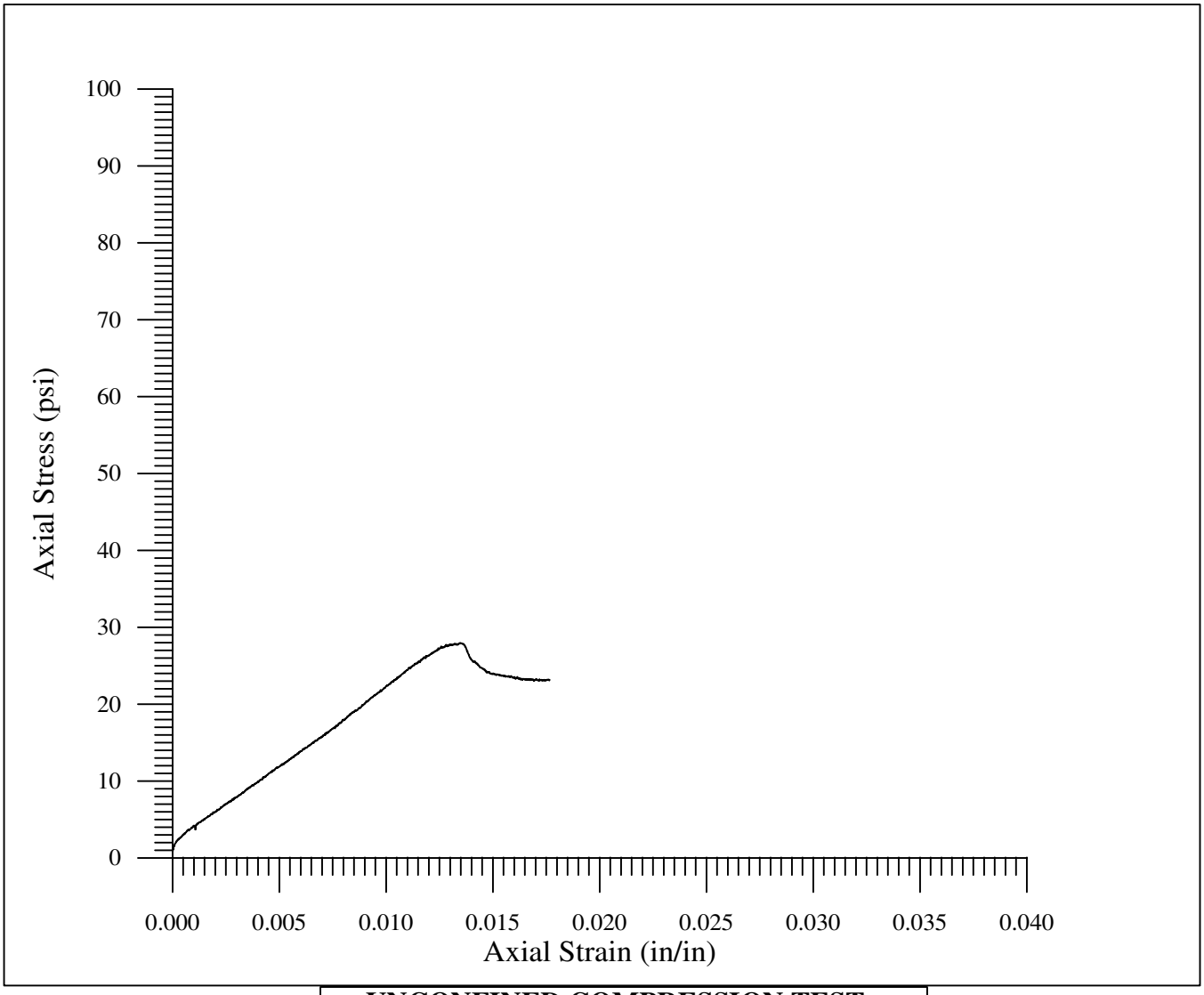
Client: Earth Mechanics, Inc.
17660 Newhope St., Suite E
Fountain Valley, CA 92708

Project: SR-710 Tunnel

Project No: none

Test Date: April 8, 2009



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: Z2B1-50
Boring: Z2-B1
Depth: 50.0-51.5'

DESCRIPTION

Medium brown silty claystone interbedded with light brown silty fine grained sandstone. Vertically bedded with a slab missing from the side of the sample.

Density: 129.5 pcf
Strength: 28 psi

Geo Test G T U *Unlimited*
27069 N. Bloomfield Rd.
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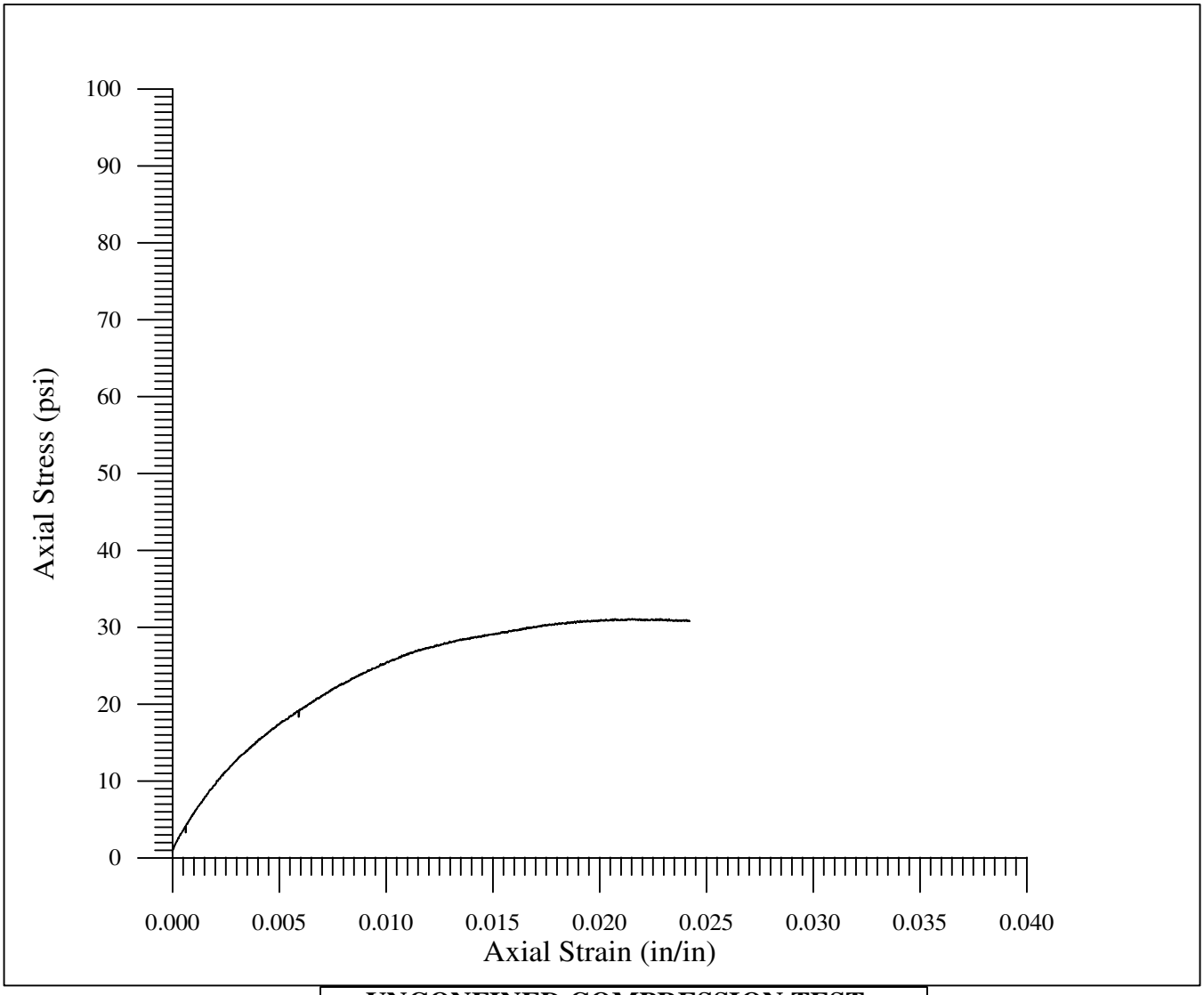
Client: Earth Mechanics, Inc.
17660 Newhope St., Suite E
Fountain Valley, CA 92708

Project: SR-710 Tunnel

Project No: none

Test Date: April 11, 2009



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: Z2B1-92
Boring: Z2-B1
Depth: 92.6-93.8'

DESCRIPTION

Dark gray silty clayey fine grained sandstone, soft with a diagonal shear.

Density: 132.3 pcf
Strength: 31 psi

Geo Test G T U *Unlimited*
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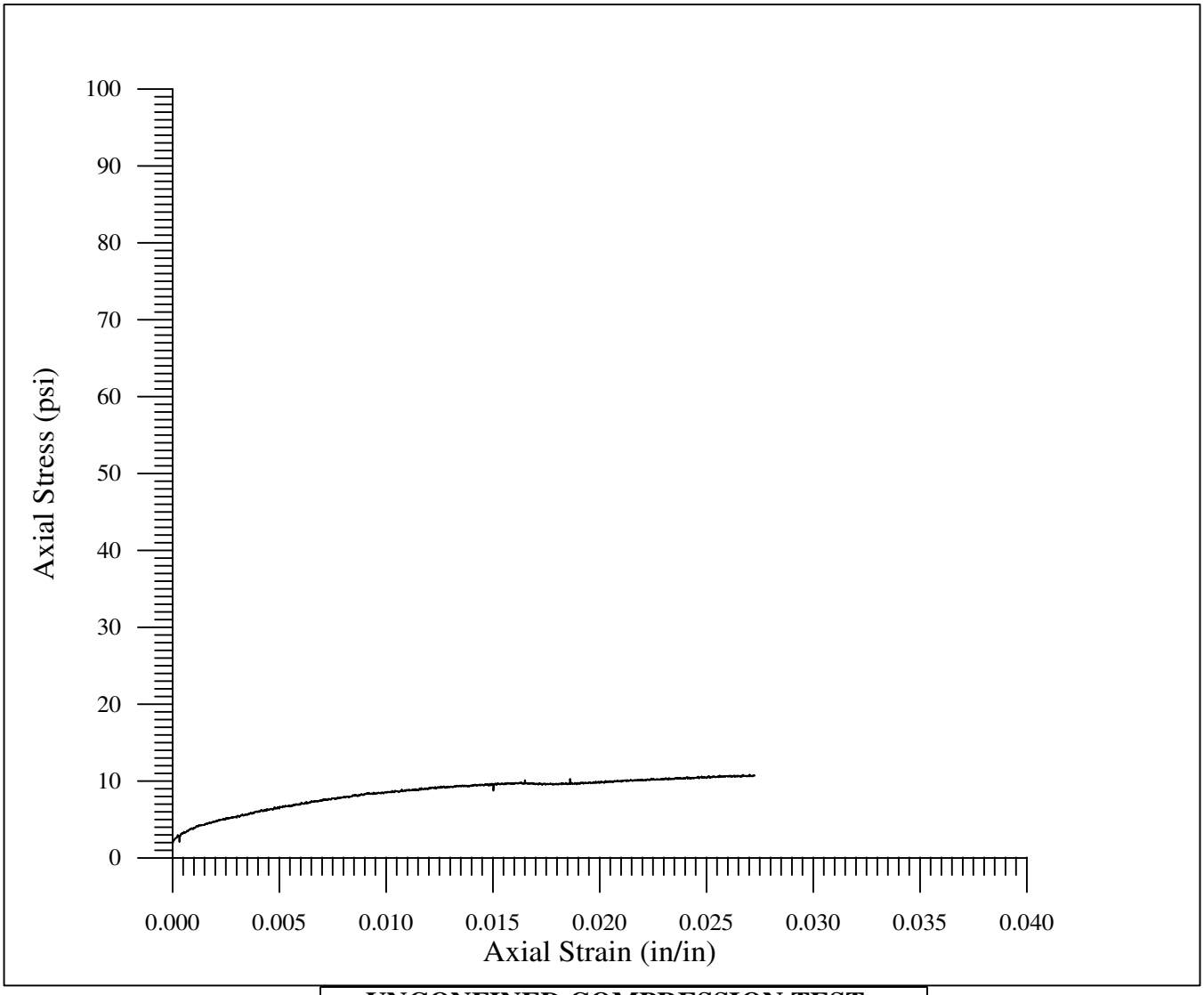
17660 Newhope St., Suite E
Fountain Valley, CA 92708

Project: SR-710 Tunnel

Project No: none

Test Date: April 8, 2009



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: Z2B1-114
Boring: Z2-B1
Depth: 114.0-116.3'

DESCRIPTION

Dark gray interbedded siltstone and silty fine grained sandstone. The siltstone appears to be highly fractured and brittle. With nearly vertical bedding and shears across the beds.

Density: 126.3 pcf
Strength: 11 psi

Geo Test G_TU *Unlimited*
27069 N. Bloomfield Rd.
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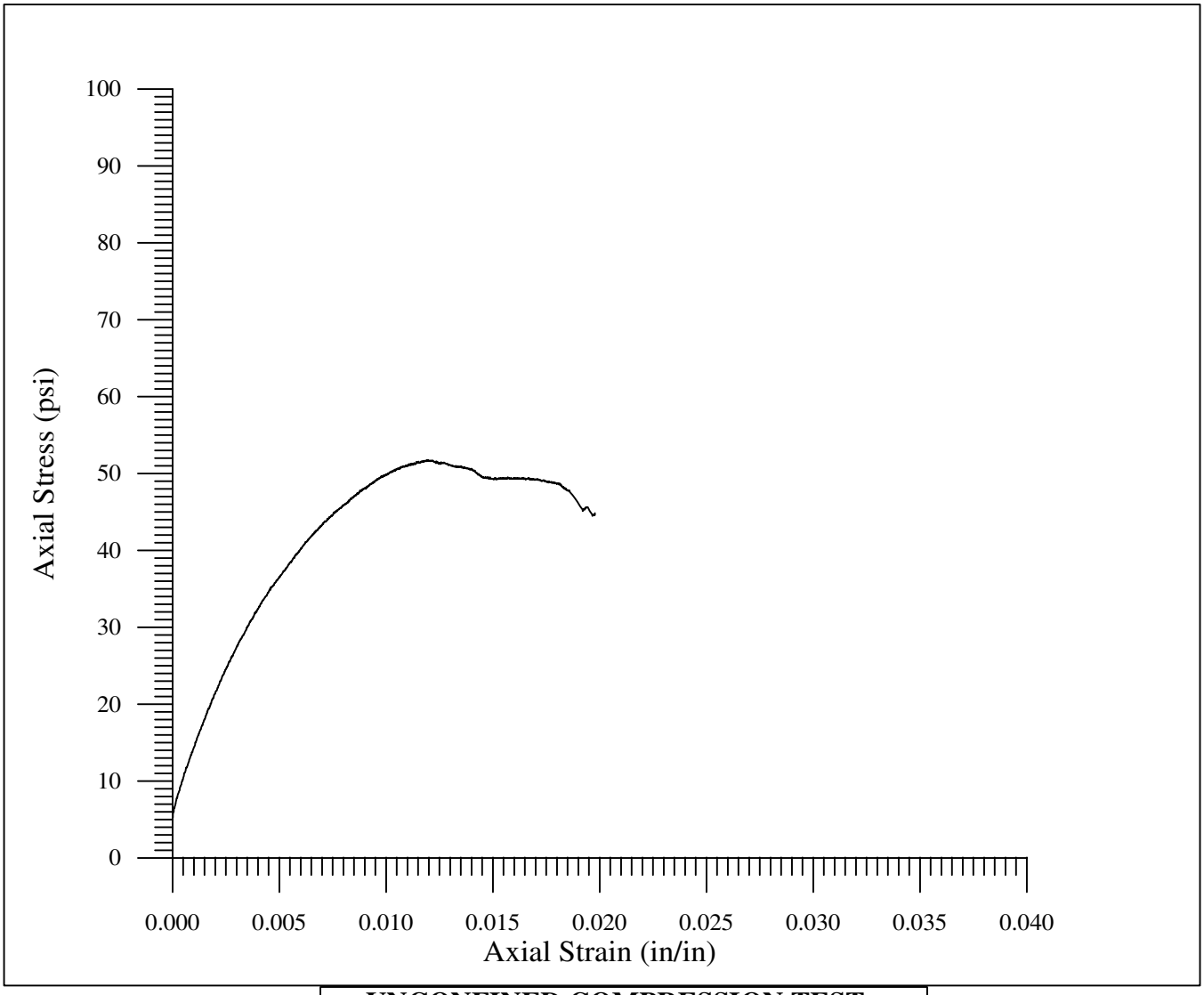
Client: Earth Mechanics, Inc.
17660 Newhope St., Suite E
Fountain Valley, CA 92708

Project: SR-710 Tunnel

Project No: none

Test Date: April 11, 2009



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: Z2B1-145
Boring: Z2-B1
Depth: 145.5-146.8'

DESCRIPTION

Interbedded medium gray siltstone and dark gray claystone, with vertically oriented bedding.

Density: 131.6 pcf
Strength: 52 psi

Geo Test G T U *Unlimited*
27069 N. Bloomfield Rd.
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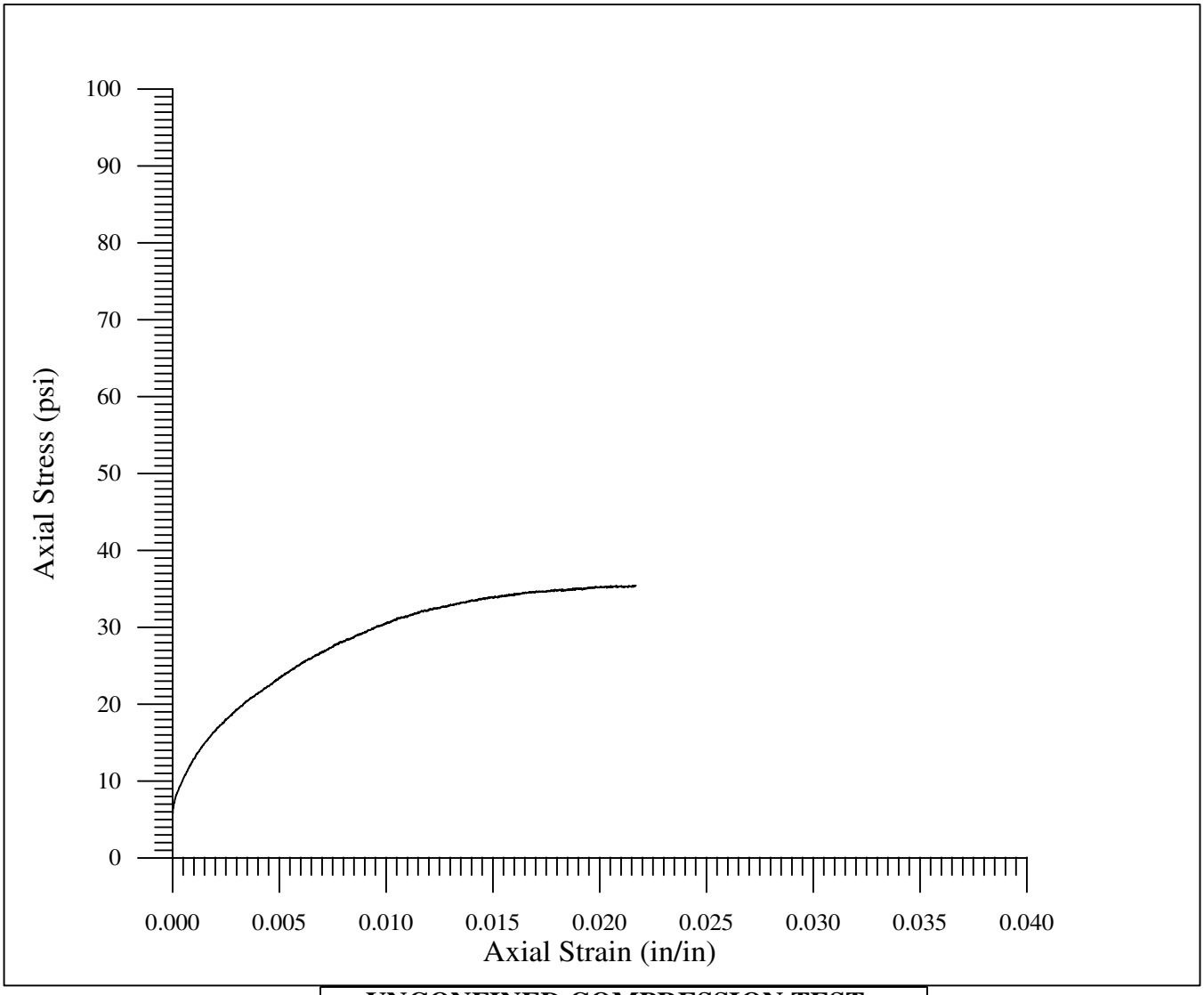
Client: Earth Mechanics, Inc.
17660 Newhope St., Suite E
Fountain Valley, CA 92708

Project: SR-710 Tunnel

Project No: none

Test Date: April 8, 2009



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: Z3B3-258
Boring: Z3-B3
Depth: 258.0-259.0'

DESCRIPTION

Light greenish gray clayey silty fine to medium grained sandy fault gouge.

Density: 151.2 pcf
Strength: 35 psi

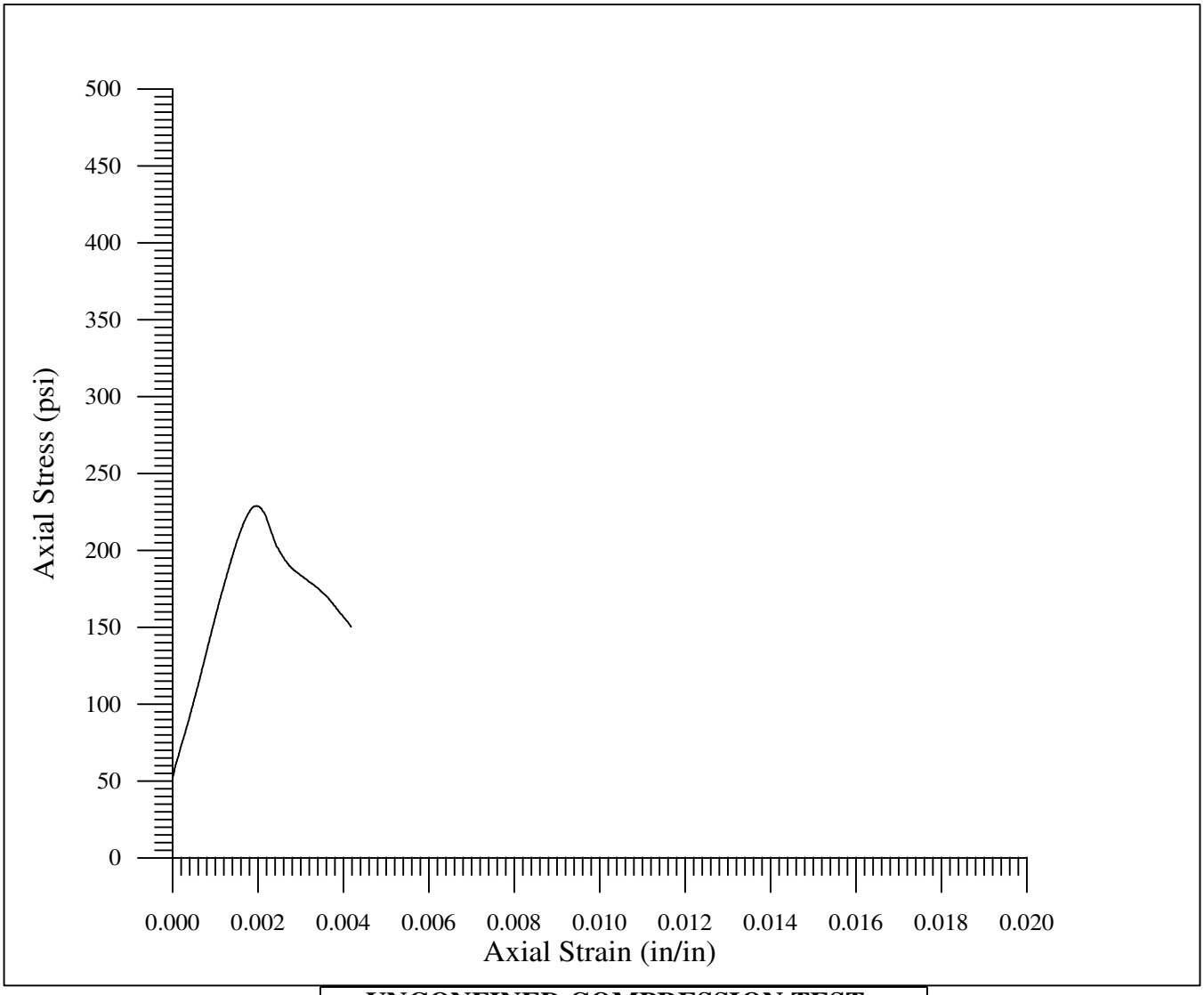
Geo Test G T U *Unlimited*
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: Earth Mechanics, Inc.
17660 Newhope St., Suite E
Fountain Valley, CA 92708

Project: SR-710 Tunnel

Project No: none

Test Date: April 8, 2009



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: Z3B3-254
Boring: Z3-B3
Depth: 254.0-256.0'

DESCRIPTION
Medium gray friable altered diorite.

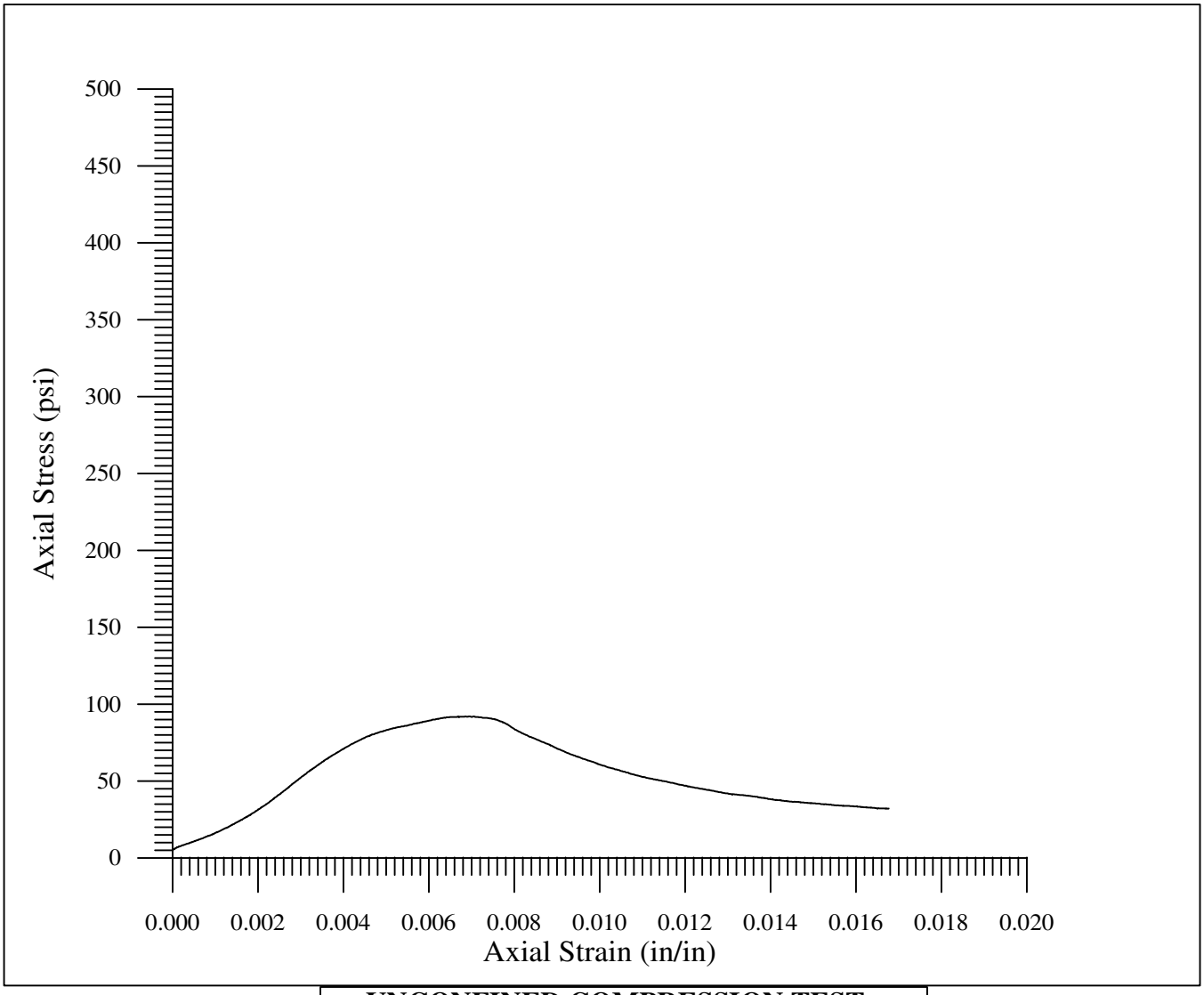
Density: 147.3 pcf
Strength: 229 psi

Geo Test Unlimited G T U
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: Earth Mechanics, Inc.
17660 Newhope St., Suite E
Fountain Valley, CA 92708

Project: SR-710 Tunnel
Project No: none

Test Date: April 11, 2009



UNCONFINED COMPRESSION TEST
Axial Stress vs. Strain

Sample: Z3B3-270
Boring: Z3-B3
Depth: 270.5-272.5'

DESCRIPTION
Medium gray friable altered diorite with the end repaired with plaster.

Density: 146.5 pcf
Strength: 92 psi

Geo Test G T U *Unlimited*
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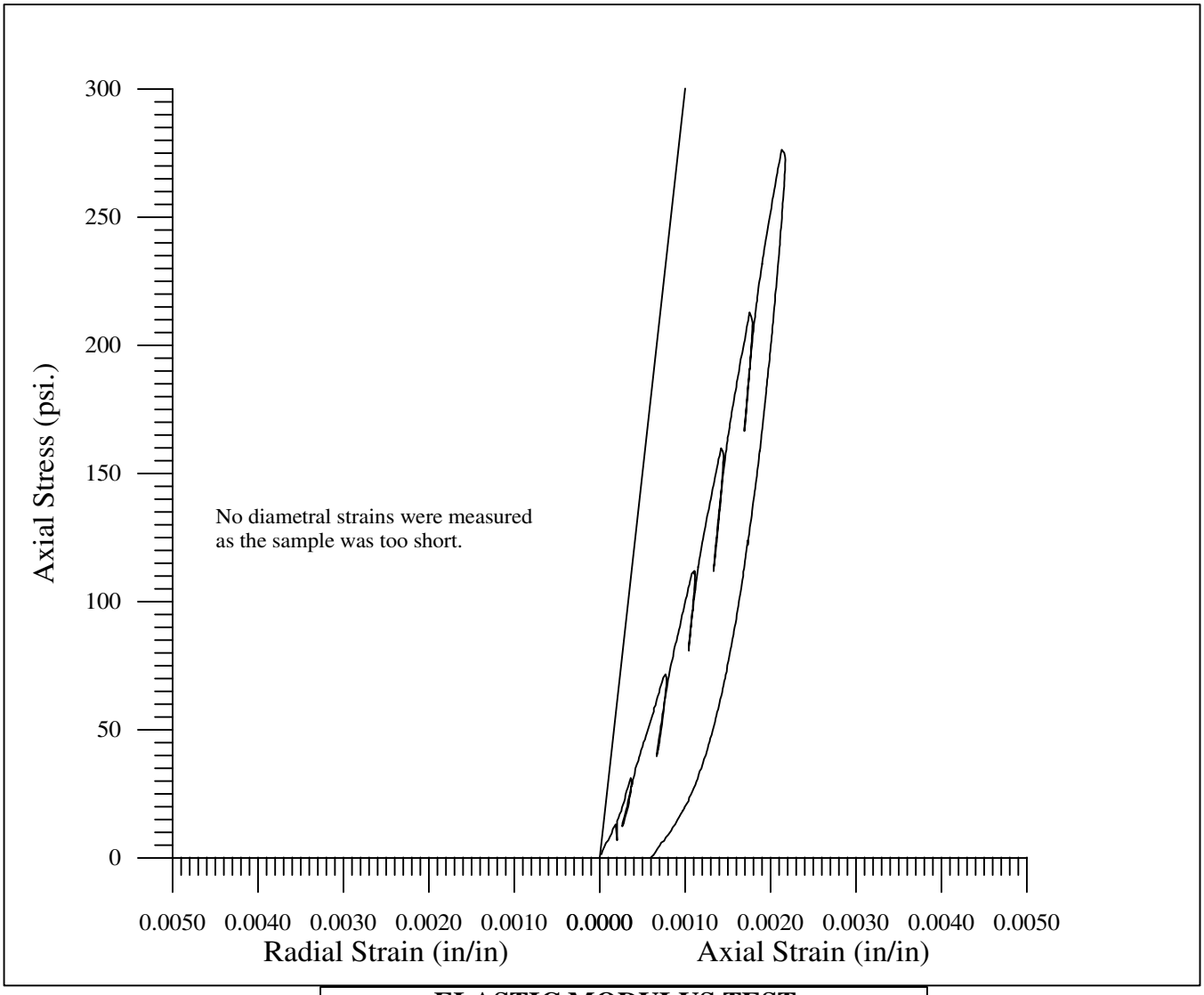
Nevada City, CA 95959

Client: Earth Mechanics, Inc.
17660 Newhope St., Suite E
Fountain Valley, CA 92708

Project: SR-710 Tunnel
Project No: none

Test Date: April 8, 2009



ELASTIC MODULUS TEST
Axial Stress vs. Axial & Radial Strain

Sample: Z1B2-270
Boring: Z1-B2
Depth: 270.1-270.9'

DESCRIPTION
Dark gray finely bedded claystone and siltstone.

Modulus: **300,000 psi**
Poisson's Ratio: **na (not measured)**
Density: **134.1 pcf**
UC Strength: **795 psi**

Geo Test G T U *Unlimited*
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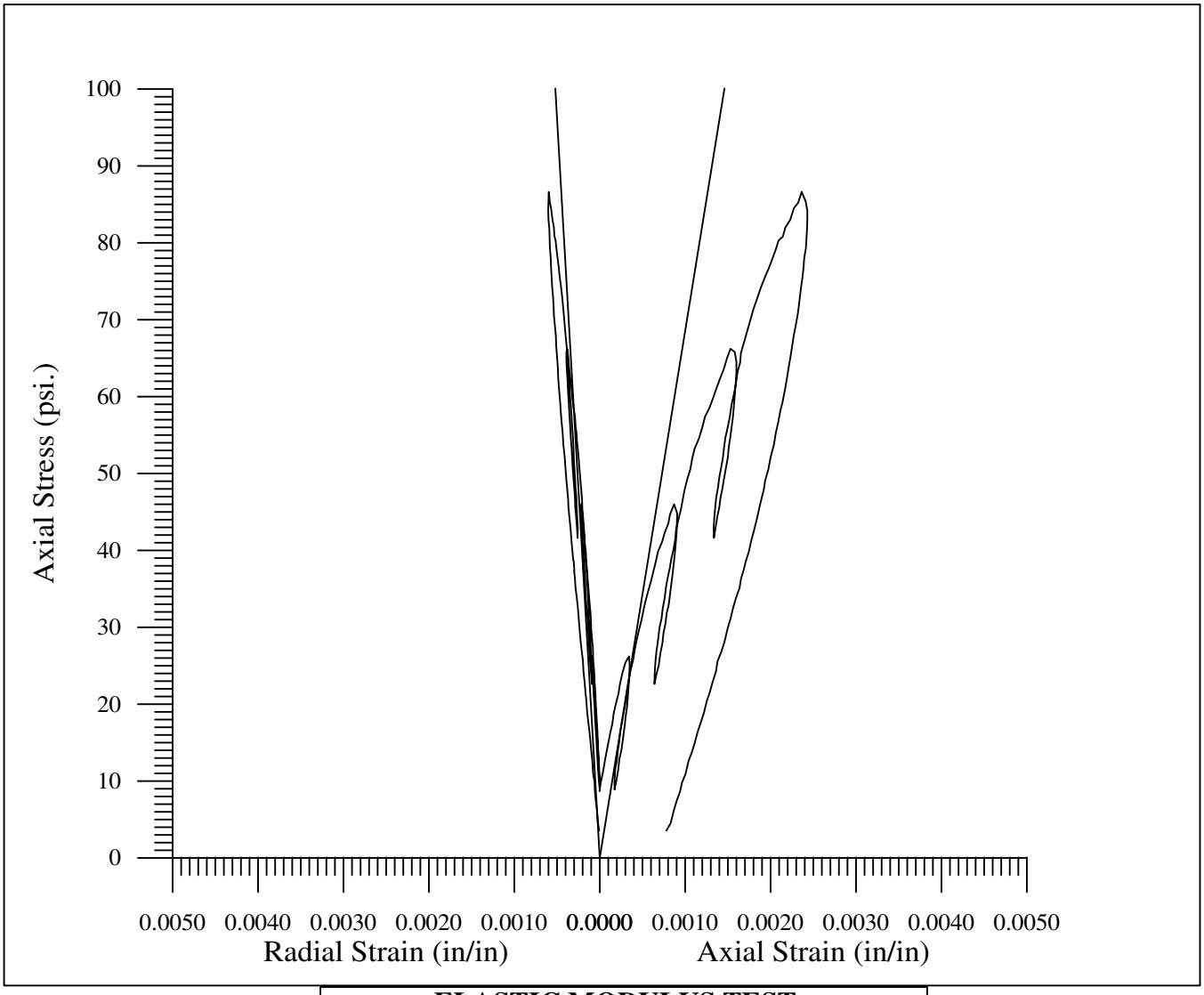
Client: Earth Mechanics, Inc.
17660 Newhope St., Suite E
Fountain Valley, CA 92708

Project: SR-710 Tunnel
Project No: none

Test Date: **April 21, 2009**



ELASTIC MODULUS TEST
Axial Stress vs. Axial & Radial Strain

Sample: Z1B2-122
Boring: Z1-B2
Depth: 122.8-123.5'

DESCRIPTION
Dark gray bedded siltstone and silty medium grained sandstone.

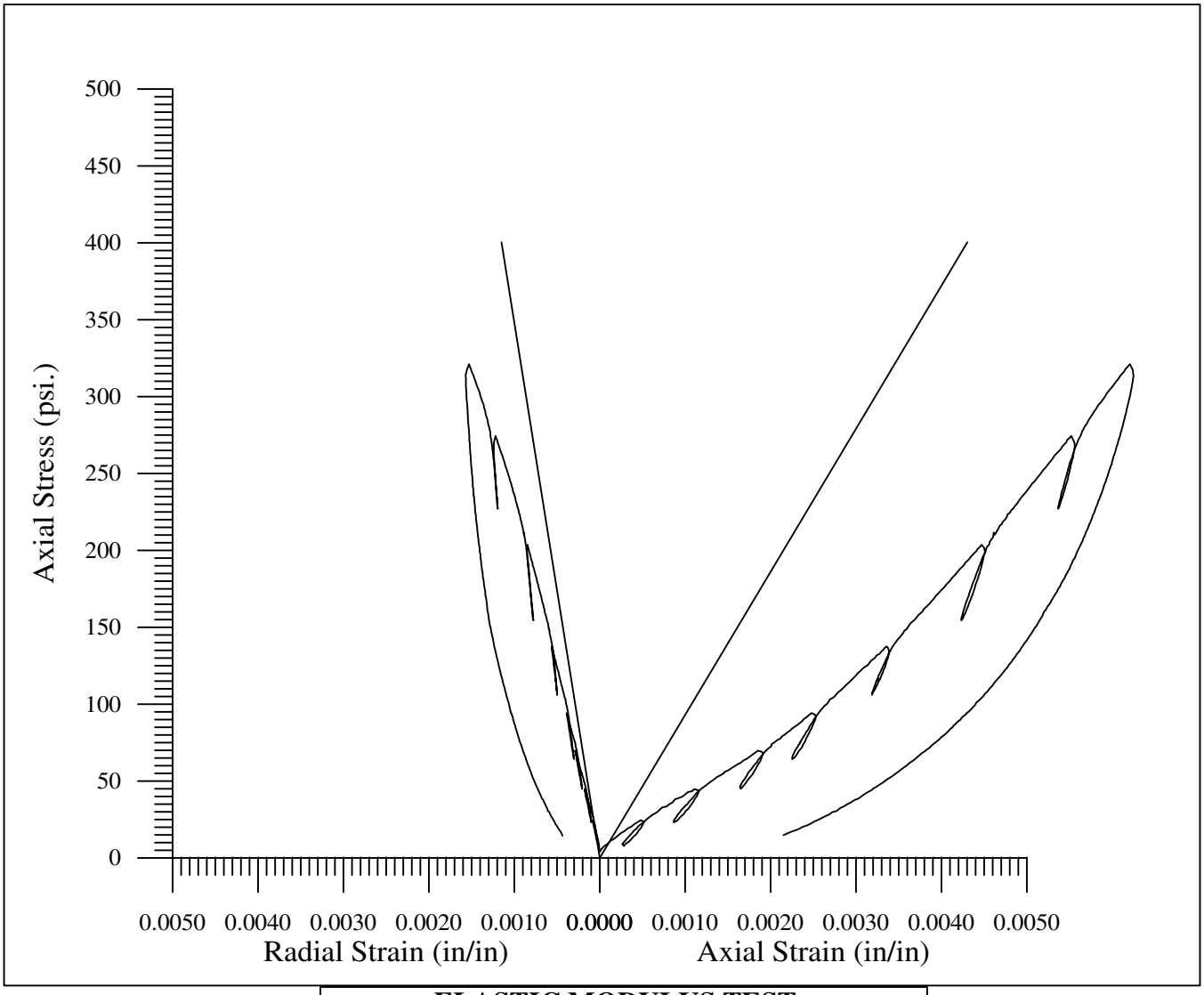
Modulus: 68,000 psi
Poisson's Ratio: .36
Density: 132.1 pcf
UC Strength: 231 psi

Geo Test G T U *Unlimited*
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: Earth Mechanics, Inc.
17660 Newhope St., Suite E
Fountain Valley, CA 92708

Project: SR-710 Tunnel
Project No: none

Test Date: April 20, 2009



ELASTIC MODULUS TEST
Axial Stress vs. Axial & Radial Strain

Sample: Z1B2-148
Boring: Z1-B2
Depth: 148.1-148.9'

DESCRIPTION
Dark gray fine to medium grained sandstone with soft dark gray claystone clasts (<2").

Modulus: **93,000 psi**
Poisson's Ratio: **.27**
Density: **139.4 pcf**
UC Strength: **471 psi**

Geo Test G T U *Unlimited*
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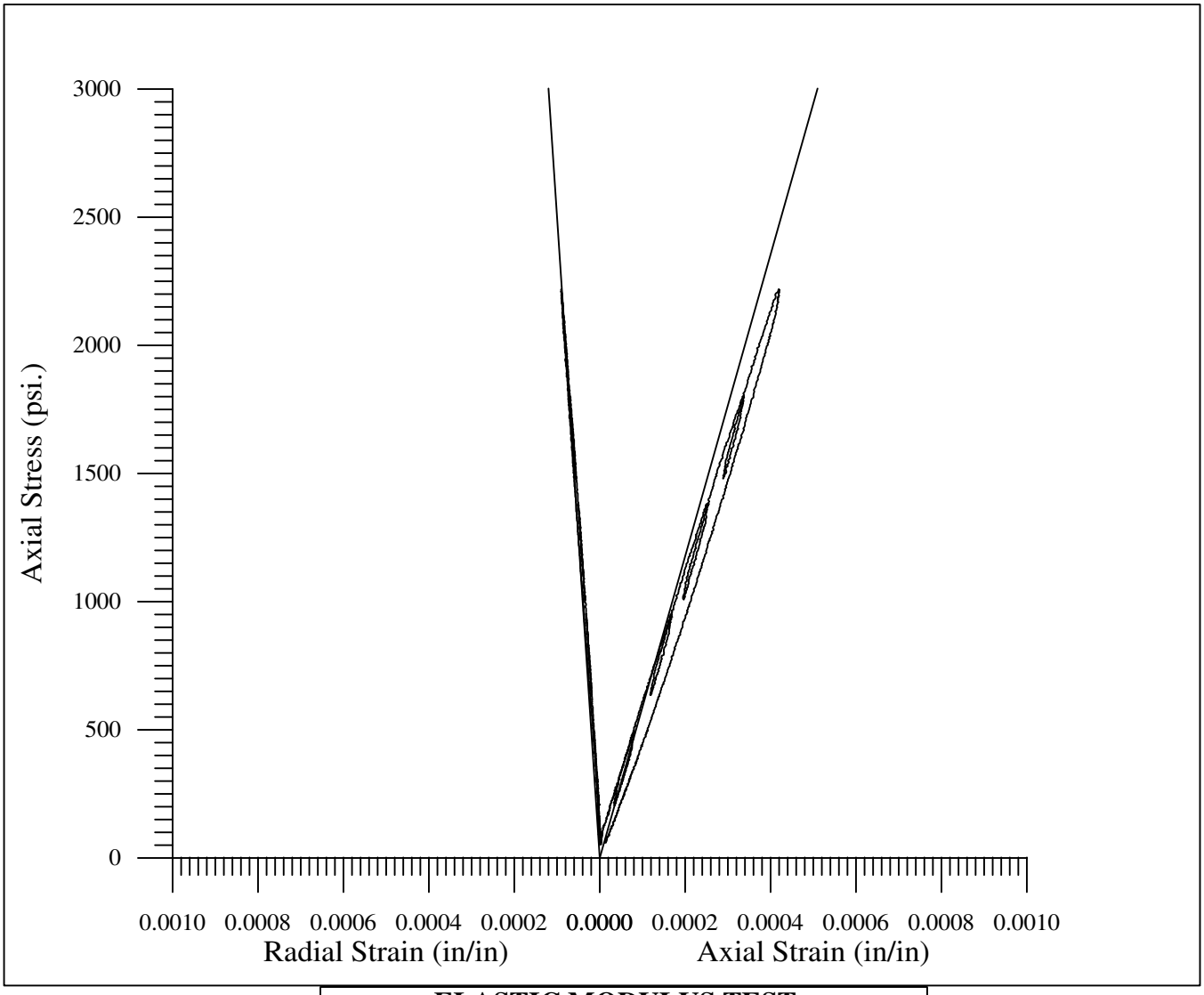
Nevada City, CA 95959

Client: Earth Mechanics, Inc.
17660 Newhope St., Suite E
Fountain Valley, CA 92708

Project: SR-710 Tunnel
Project No: none

Test Date: April 20, 2009



ELASTIC MODULUS TEST
Axial Stress vs. Axial & Radial Strain

Sample: Z1B2-158
Boring: Z1-B2
Depth: 158.4-159.1'

DESCRIPTION
Light gray medium grained sandstone with a diagonal oxide discolored zone.

Modulus: **5,880,000 psi**
Poisson's Ratio: **.24**
Density: **159.4 pcf**
UC Strength: **11,360 psi**

Geo Test G T U *Unlimited*
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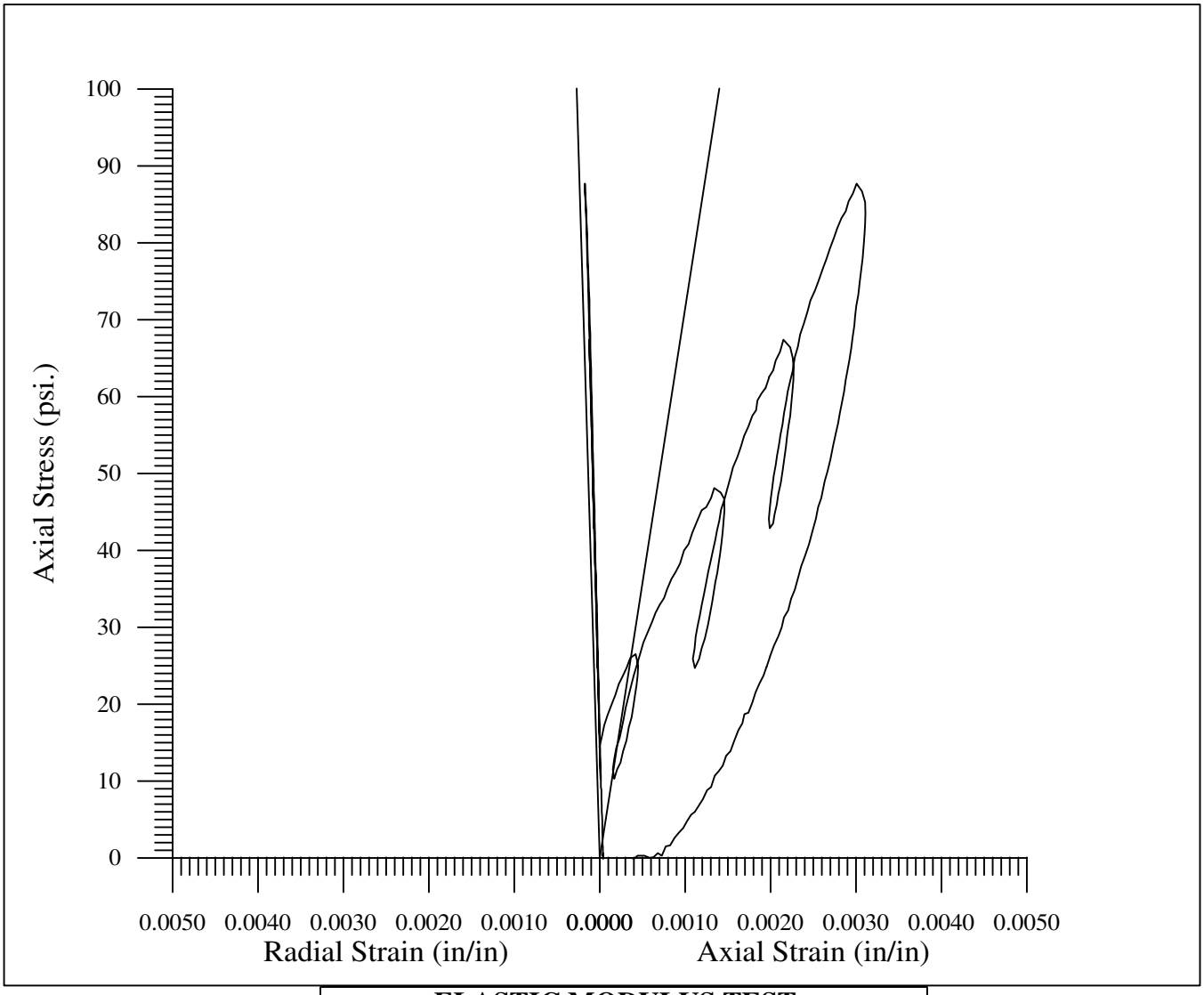
Nevada City, CA 95959

Client: Earth Mechanics, Inc.
17660 Newhope St., Suite E
Fountain Valley, CA 92708

Project: SR-710 Tunnel
Project No: none

Test Date: **April 20, 2009**



ELASTIC MODULUS TEST
Axial Stress vs. Axial & Radial Strain

Sample: Z1B2-167
Boring: Z1-B2
Depth: 167.0-167.8'

DESCRIPTION
Dark gray silty fine grained friable bedded sandstone with brown oxidation at one end.

Modulus: **71,000 psi**
Poisson's Ratio: **.19**
Density: **136.4 pcf**
UC Strength: **661 psi**

Geo Test G T U *Unlimited*
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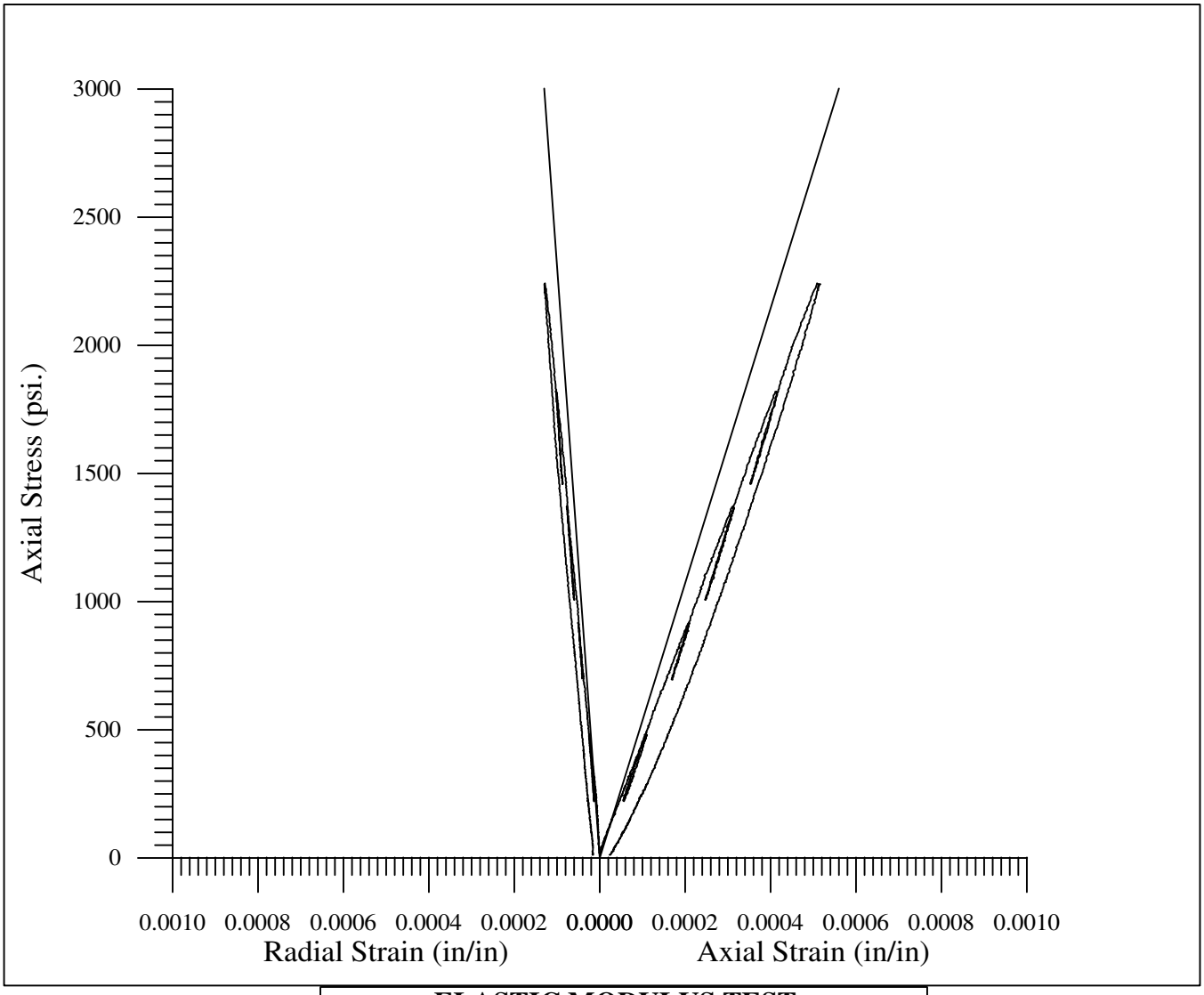
Client: Earth Mechanics, Inc.
17660 Newhope St., Suite E
Fountain Valley, CA 92708

Project: SR-710 Tunnel
Project No: none

Test Date: **April 20, 2009**



ELASTIC MODULUS TEST
Axial Stress vs. Axial & Radial Strain

Sample: Z1B2-172
Boring: Z1-B2
Depth: 172.6-173.4'

DESCRIPTION
Light gray fine to medium grained sandstone with tan discolored zones at each end.

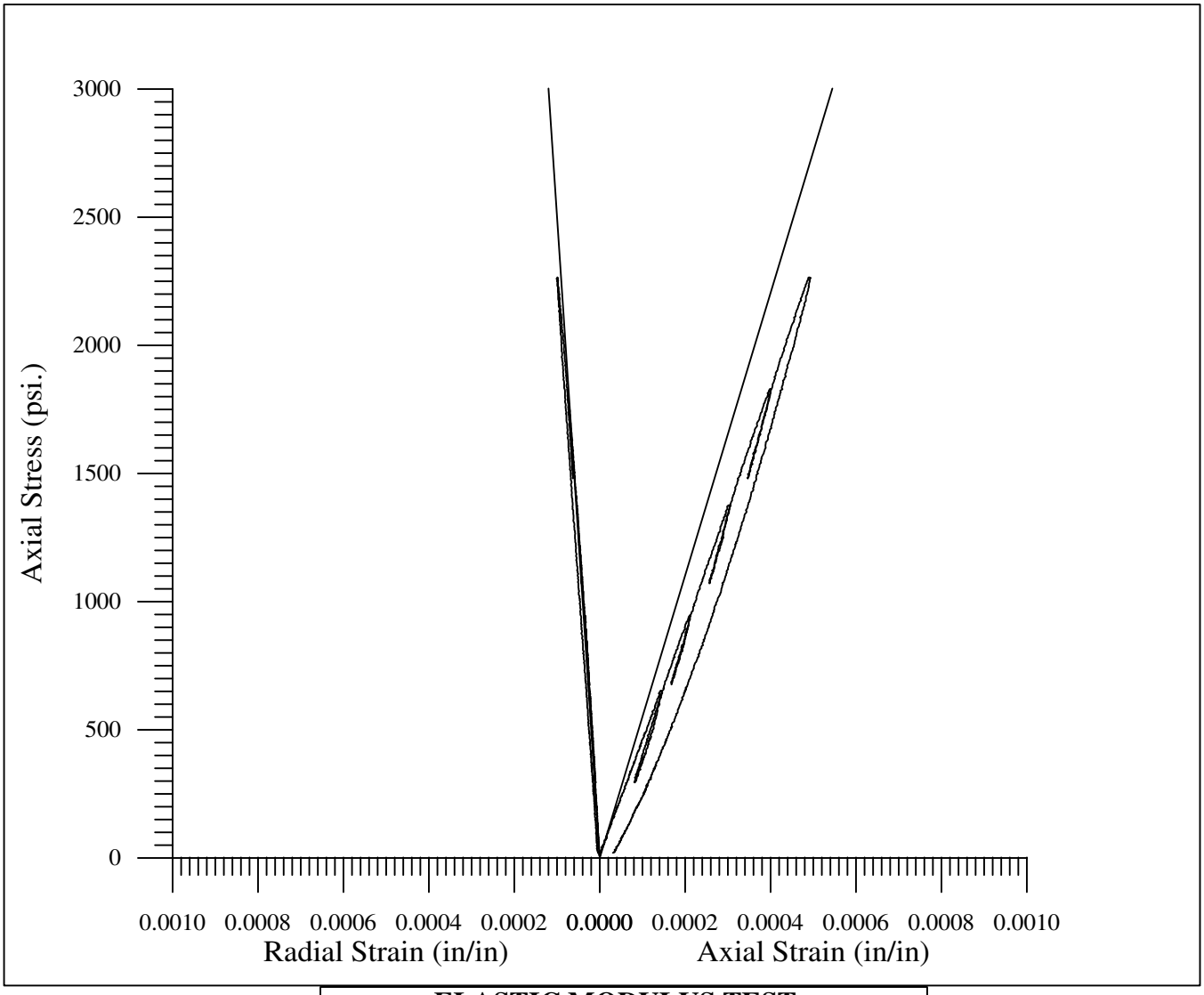
Modulus: **5,360,000 psi**
Poisson's Ratio: **.23**
Density: **158.5 pcf**
UC Strength: **10,835 psi**

Geo Test G T U *Unlimited*
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: Earth Mechanics, Inc.
17660 Newhope St., Suite E
Fountain Valley, CA 92708

Project: SR-710 Tunnel
Project No: none

Test Date: **April 20, 2009**



ELASTIC MODULUS TEST
Axial Stress vs. Axial & Radial Strain

Sample: Z1B2-176
Boring: Z1-B2
Depth: 176.9-177.8'

DESCRIPTION
Light gray fine to medium grained sandstone.

Modulus: **5,500,000 psi**
Poisson's Ratio: **.22**
Density: **159.1 pcf**
UC Strength: **11,238 psi**

Geo Test G T U *Unlimited*
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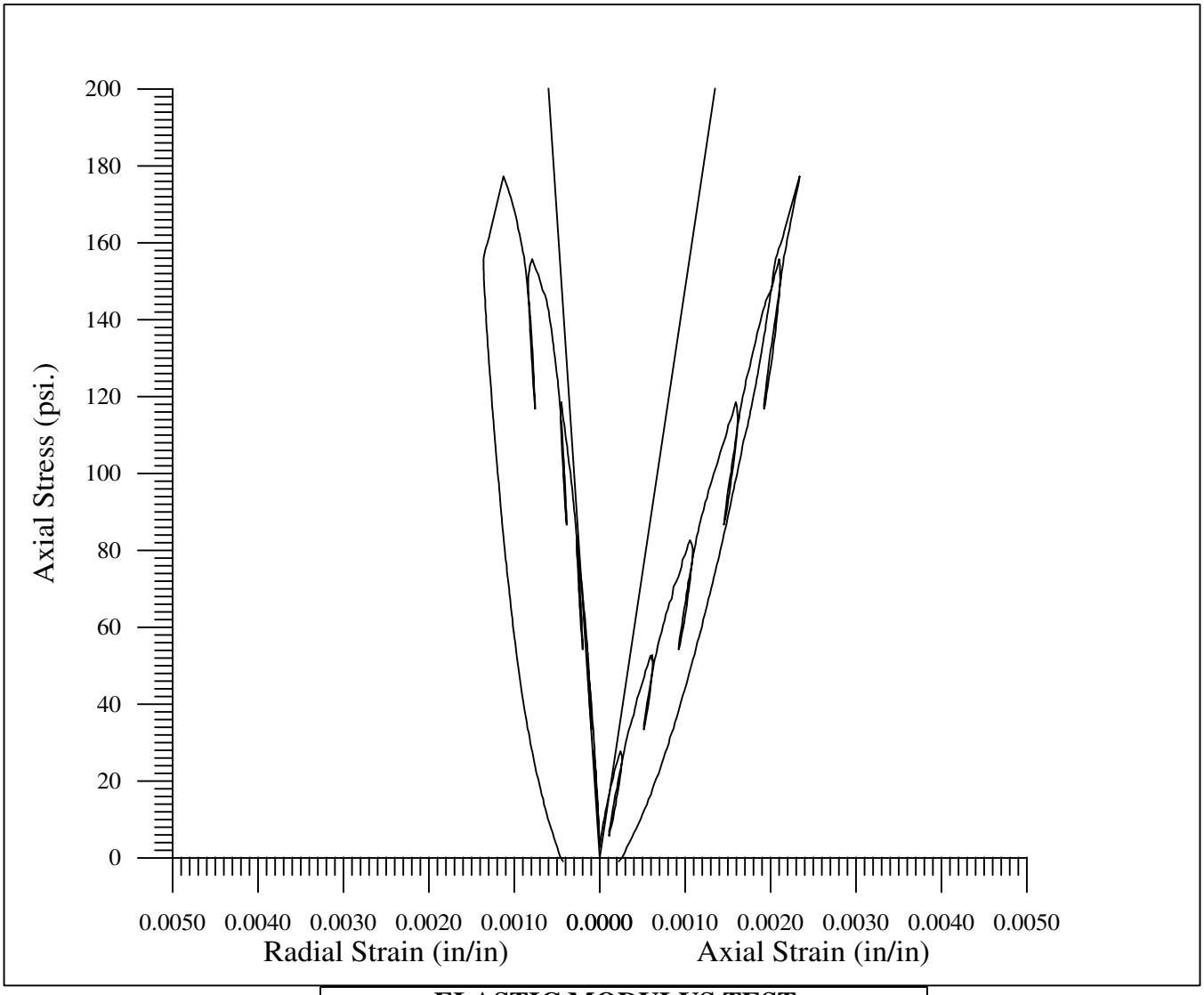
Client: Earth Mechanics, Inc.
17660 Newhope St., Suite E
Fountain Valley, CA 92708

Project: SR-710 Tunnel
Project No: none

Test Date: **April 21, 2009**



ELASTIC MODULUS TEST
Axial Stress vs. Axial & Radial Strain

Sample: Z1B2-205
Boring: Z1-B2
Depth: 205.0-205.6'

DESCRIPTION
Dark gray bedded siltstone and claystone capped with fine grained sandstone. Contains one non-through-going joint.

Modulus: **148,000 psi**
Poisson's Ratio: **.44**
Density: **139.3 pcf**
UC Strength: **243 psi**

Geo Test G T U *Unlimited*
27069 N. Bloomfield Rd.
Nevada City, CA 95959

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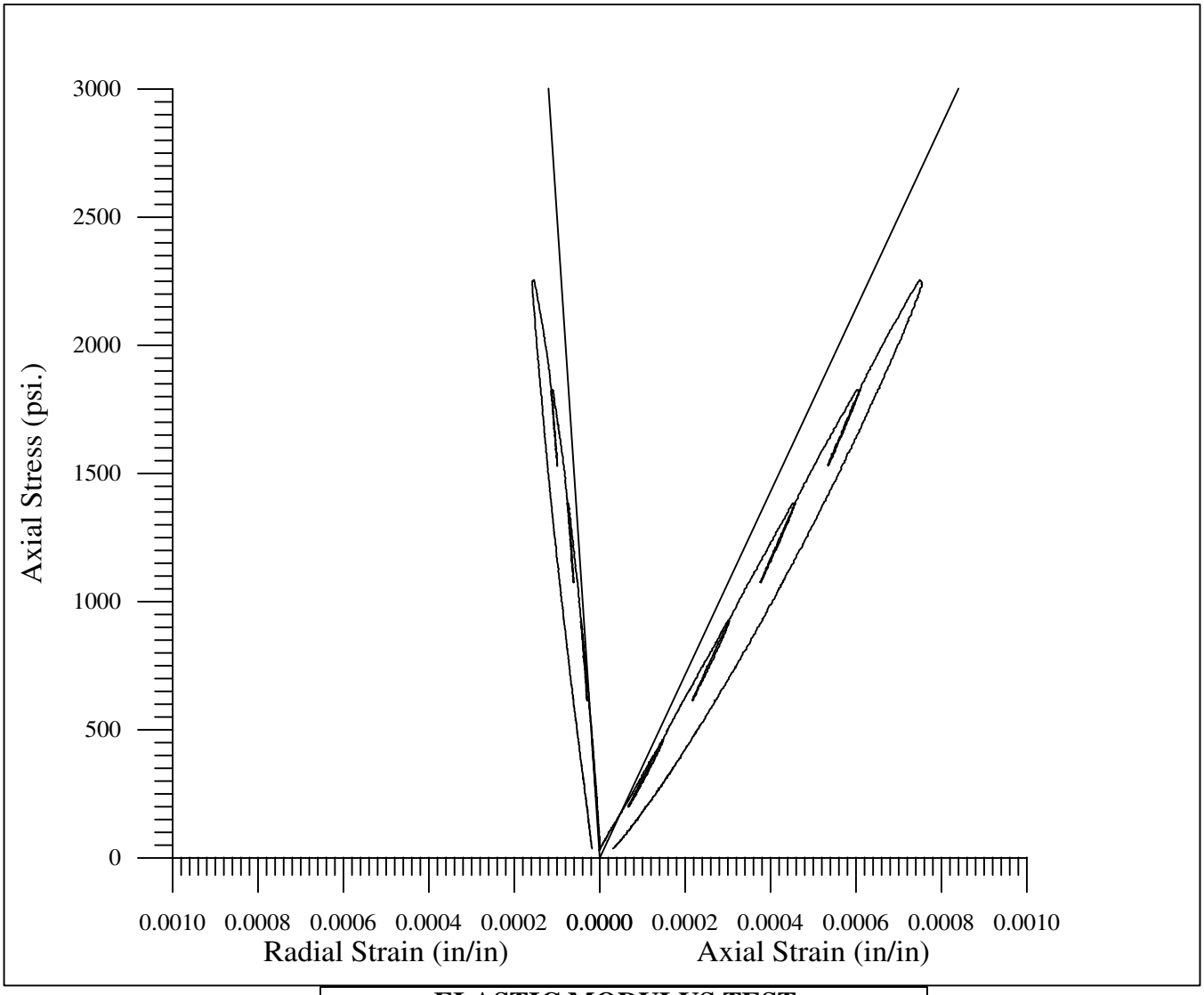
Fountain Valley, CA 92708

Project: SR-710 Tunnel
Project No: none

Test Date: **April 21, 2009**



ELASTIC MODULUS TEST
Axial Stress vs. Axial & Radial Strain

Sample: Z1B2-231
Boring: Z1-B2
Depth: 231.0-232.0'

DESCRIPTION

Light gray silty fine to medium grained sandstone with a claystone clast at one end and a calcite healed diagonal joint.

Modulus: **3,570,000 psi**
Poisson's Ratio: **.14**
Density: **156.8 pcf**
UC Strength: **4342 psi**

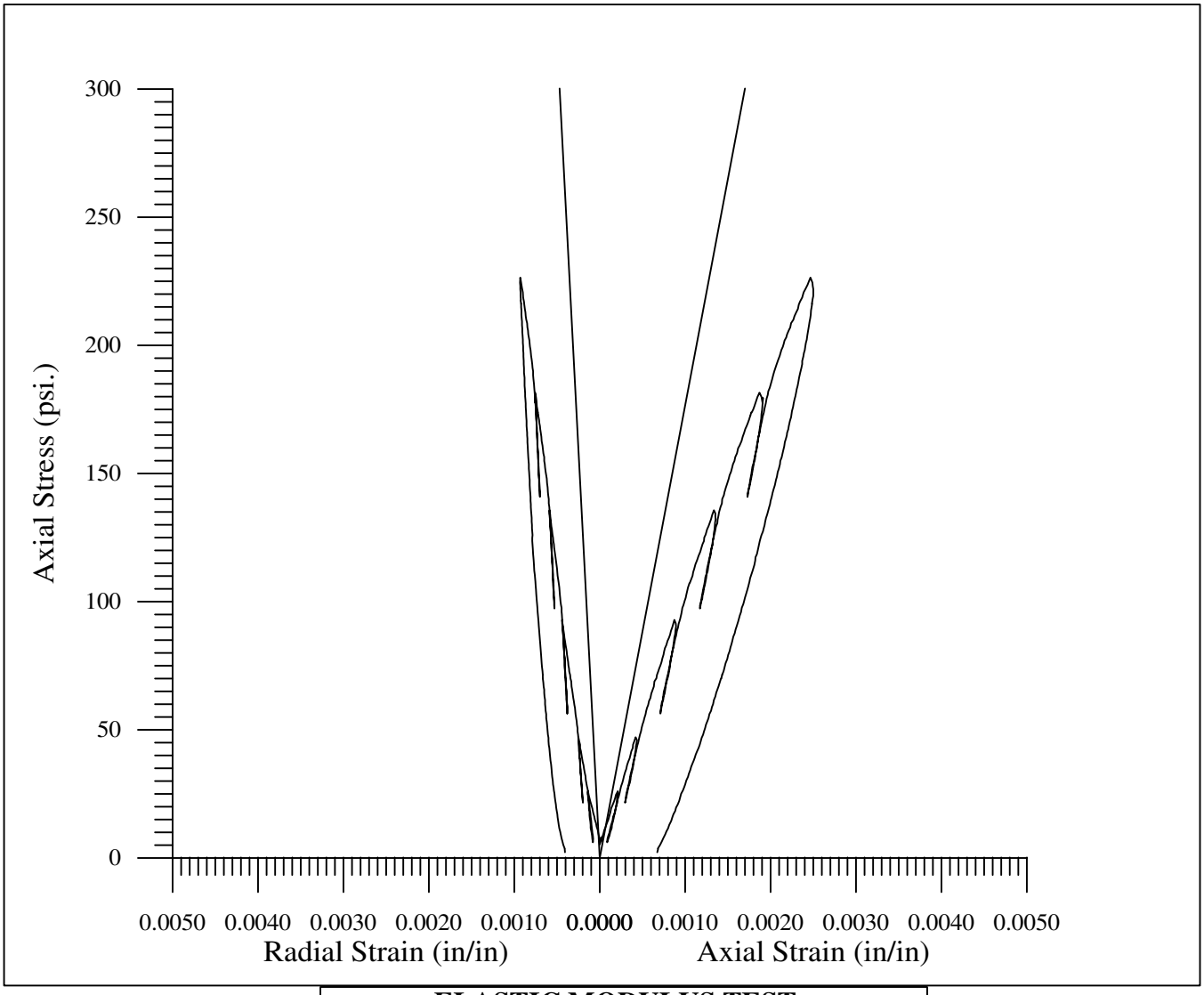
Geo Test GTU *Unlimited*
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: Earth Mechanics, Inc.
17660 Newhope St., Suite E
Fountain Valley, CA 92708

Project: SR-710 Tunnel

Project No: none

Test Date: **April 21, 2009**



ELASTIC MODULUS TEST
Axial Stress vs. Axial & Radial Strain

Sample: Z1B2-242
Boring: Z1-B2
Depth: 242.7-243.3'

DESCRIPTION
Dark gray finely bedded siltstone.

Modulus: 176,000 psi
Poisson's Ratio: .28
Density: 136.0 pcf
UC Strength: 514 psi

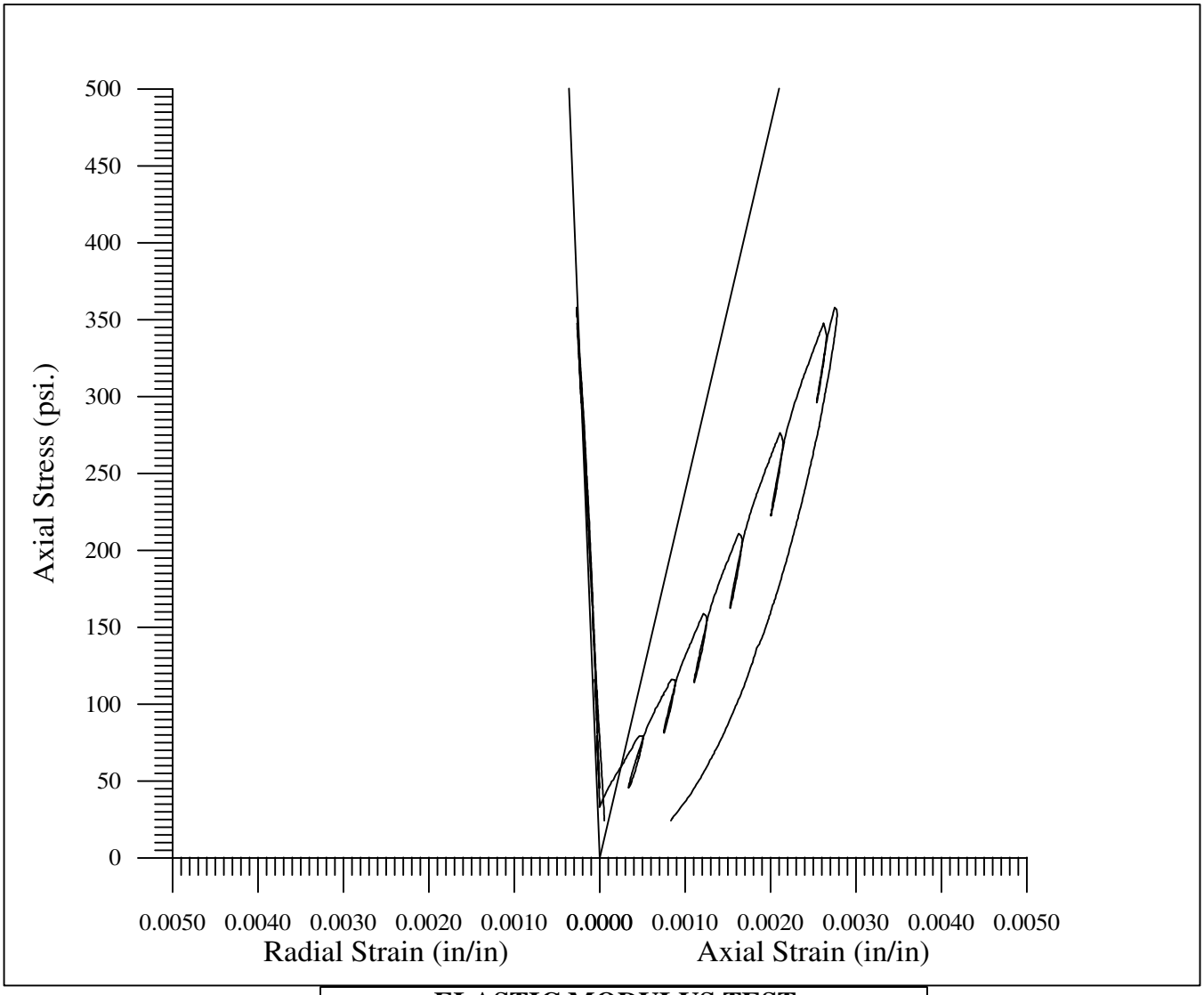
Geo Test G T U *Unlimited*
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: Earth Mechanics, Inc.
17660 Newhope St., Suite E
Fountain Valley, CA 92708

Project: SR-710 Tunnel

Project No: none

Test Date: April 21, 2009



ELASTIC MODULUS TEST
Axial Stress vs. Axial & Radial Strain

Sample: Z1B2-262
Boring: Z1-B2
Depth: 262.5-263.3'

DESCRIPTION
Dark gray bedded siltstone and fine grained sandstone.

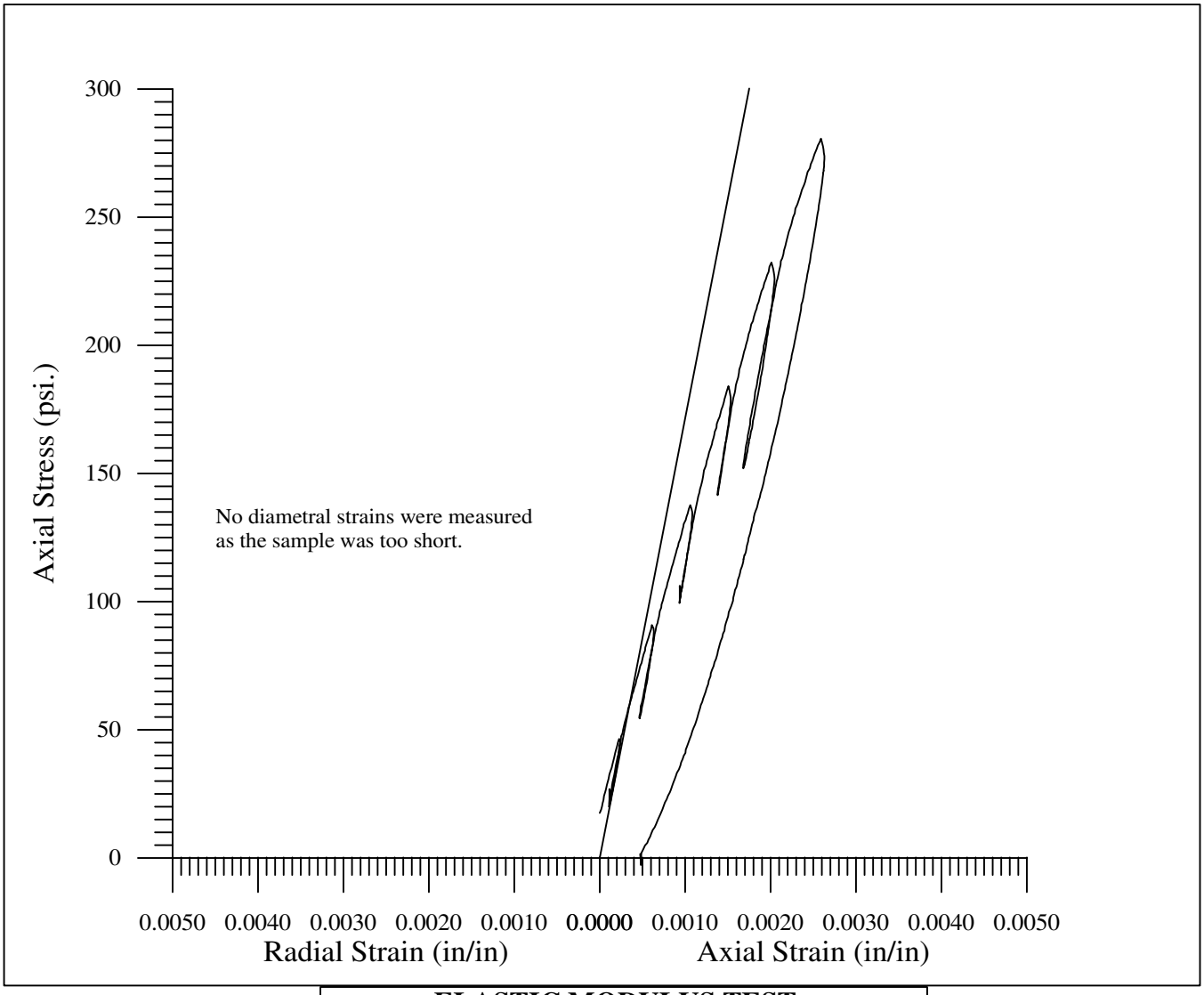
Modulus: 238,000 psi
Poisson's Ratio: .17
Density: 137.6 pcf
UC Strength: 700 psi

Geo Test Unlimited GTU
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: Earth Mechanics, Inc.
17660 Newhope St., Suite E
Fountain Valley, CA 92708

Project: SR-710 Tunnel
Project No: none

Test Date: April 21, 2009



ELASTIC MODULUS TEST
Axial Stress vs. Axial & Radial Strain

Sample: Z1B2-298
Boring: Z1-B2
Depth: 298.8-299.2'

DESCRIPTION
Dark gray finely bedded claystone and siltstone.

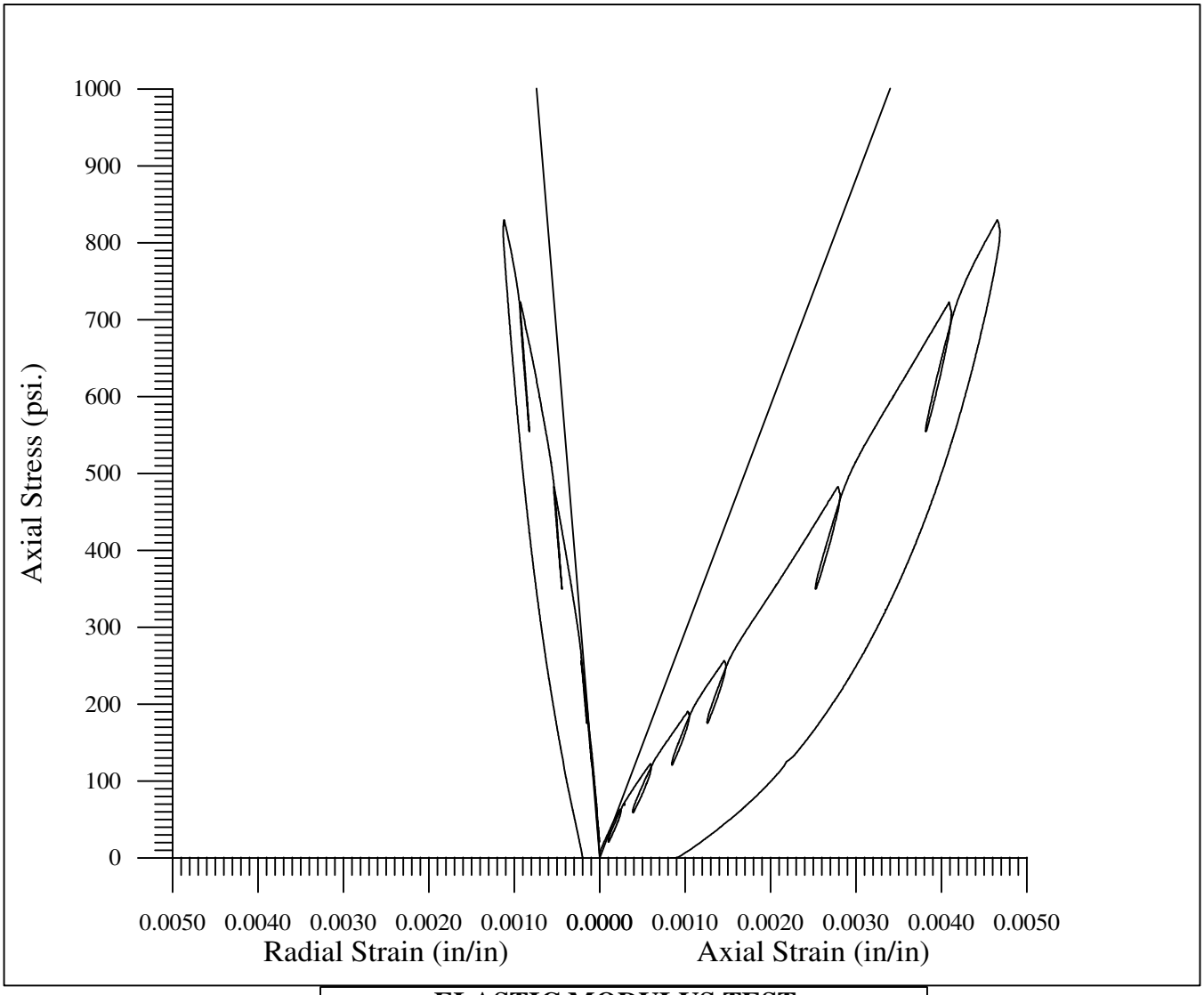
Modulus: **171,000 psi**
Poisson's Ratio: **na (not measured)**
Density: **133.2 pcf**
UC Strength: **438 psi**

Geo Test G T U *Unlimited*
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: Earth Mechanics, Inc.
17660 Newhope St., Suite E
Fountain Valley, CA 92708

Project: SR-710 Tunnel
Project No: none

Test Date: **April 21, 2009**



ELASTIC MODULUS TEST
Axial Stress vs. Axial & Radial Strain

Sample: Z1B3-291
Boring: Z1-B3
Depth: 291.8-293.1'

DESCRIPTION
Dark gray finely bedded siltstone with light gray fine grained sandstone lenses and fine to medium grained sandstone ends.

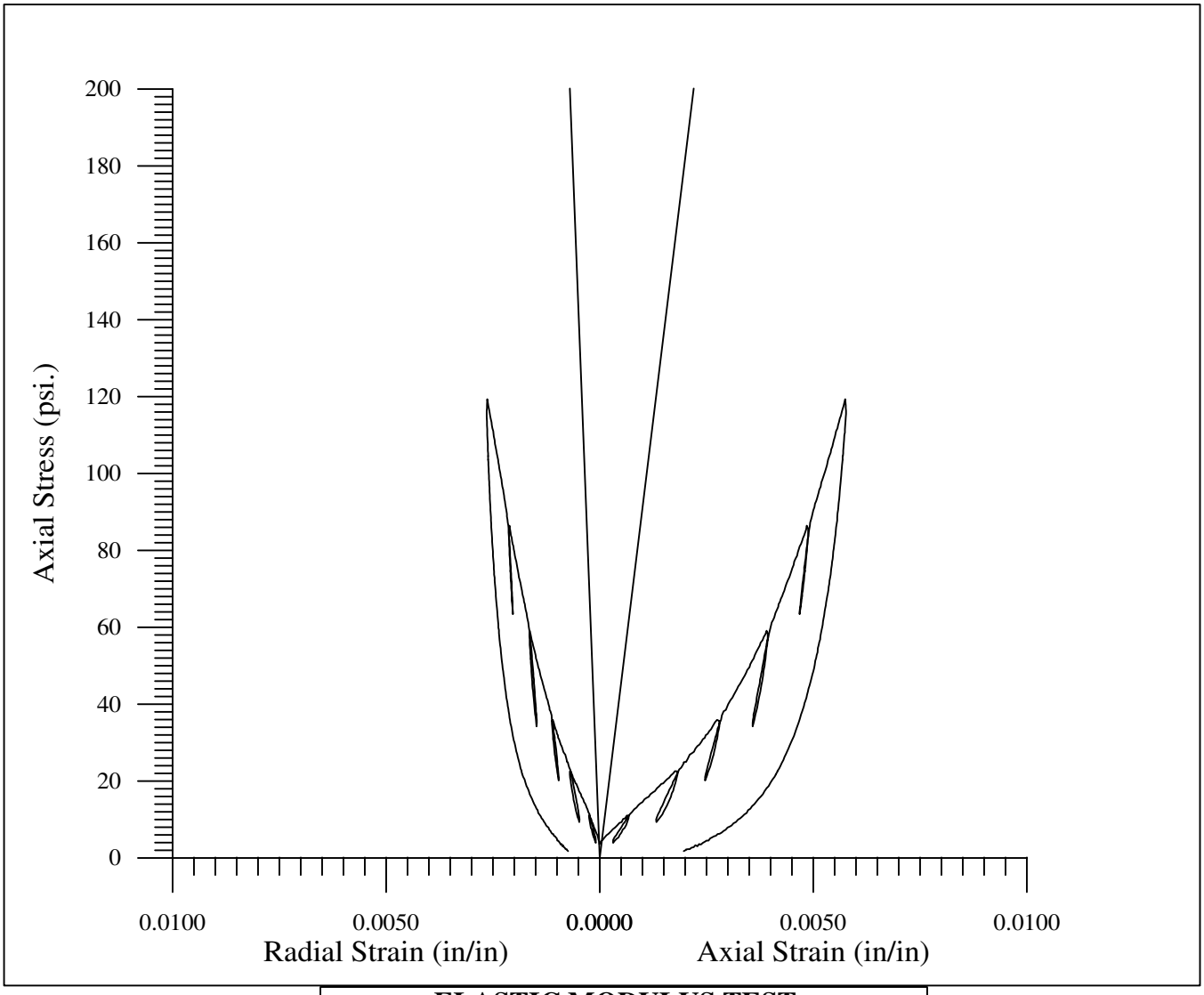
Modulus: **290,000 psi**
Poisson's Ratio: **.22**
Density: **140.0 pcf**
UC Strength: **1470 psi**

Geo Test G T U *Unlimited*
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: Earth Mechanics, Inc.
17660 Newhope St., Suite E
Fountain Valley, CA 92708

Project: SR-710 Tunnel
Project No: none

Test Date: **April 7, 2009**



ELASTIC MODULUS TEST
Axial Stress vs. Axial & Radial Strain

Sample: Z1B3-115
Boring: Z1-B3
Depth: 115.6-116.9'

DESCRIPTION
Medium gray silty fine to medium grained friable sandstone, with no apparent planes of weakness.

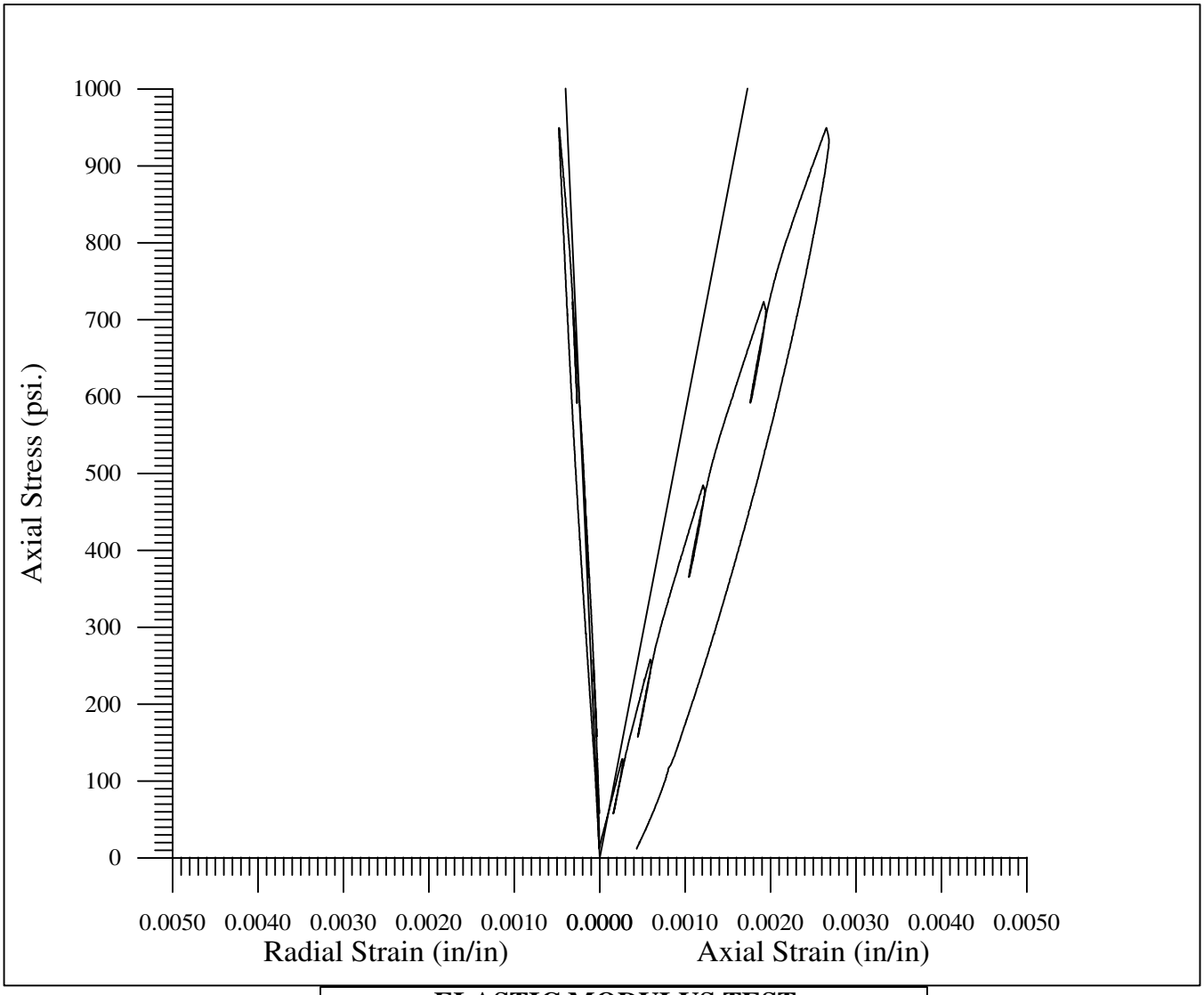
Modulus: **91,000 psi**
Poisson's Ratio: **.32**
Density: **137.4 pcf**
UC Strength: **258 psi**

Geo Test G T U *Unlimited*
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: Earth Mechanics, Inc.
17660 Newhope St., Suite E
Fountain Valley, CA 92708

Project: SR-710 Tunnel
Project No: none

Test Date: April 7, 2009



ELASTIC MODULUS TEST
Axial Stress vs. Axial & Radial Strain

Sample: Z1B3-193
Boring: Z1-B3
Depth: 193.8-195.3'

DESCRIPTION
Dark gray layered siltstone with a few light gray fine sandstone lenses.

Modulus: **580,000 psi**
Poisson's Ratio: **.23**
Density: **136.5 pcf**
UC Strength: **2427 psi**

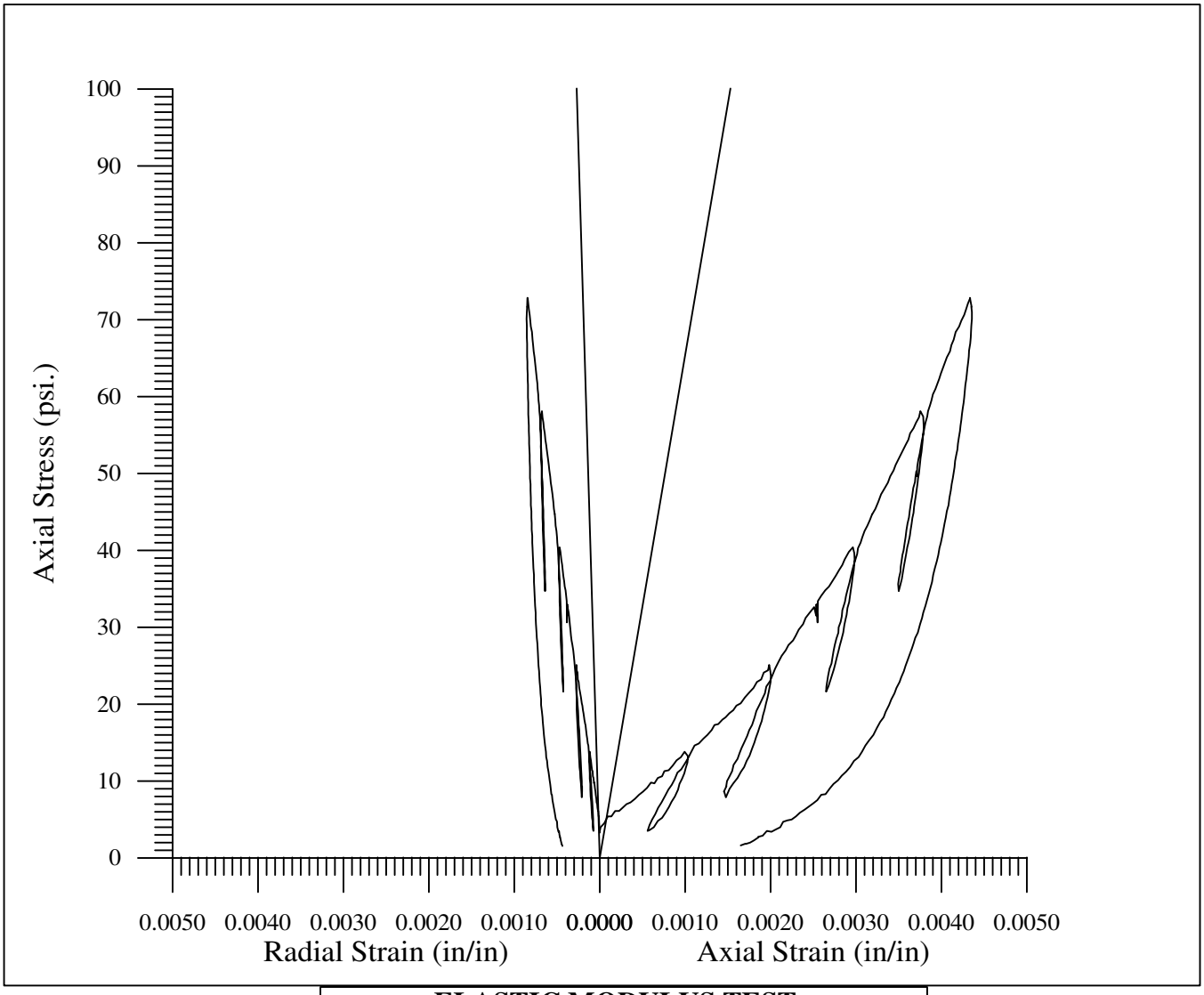
Geo Test G T U *Unlimited*
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: Earth Mechanics, Inc.
17660 Newhope St., Suite E
Fountain Valley, CA 92708

Project: SR-710 Tunnel

Project No: none

Test Date: **April 7, 2009**



ELASTIC MODULUS TEST
Axial Stress vs. Axial & Radial Strain

Sample: Z1B3-225
Boring: Z1-B3
Depth: 225.0-226.7'

DESCRIPTION
Light gray silty medium grained friable sandstone with no apparent planes of weakness.

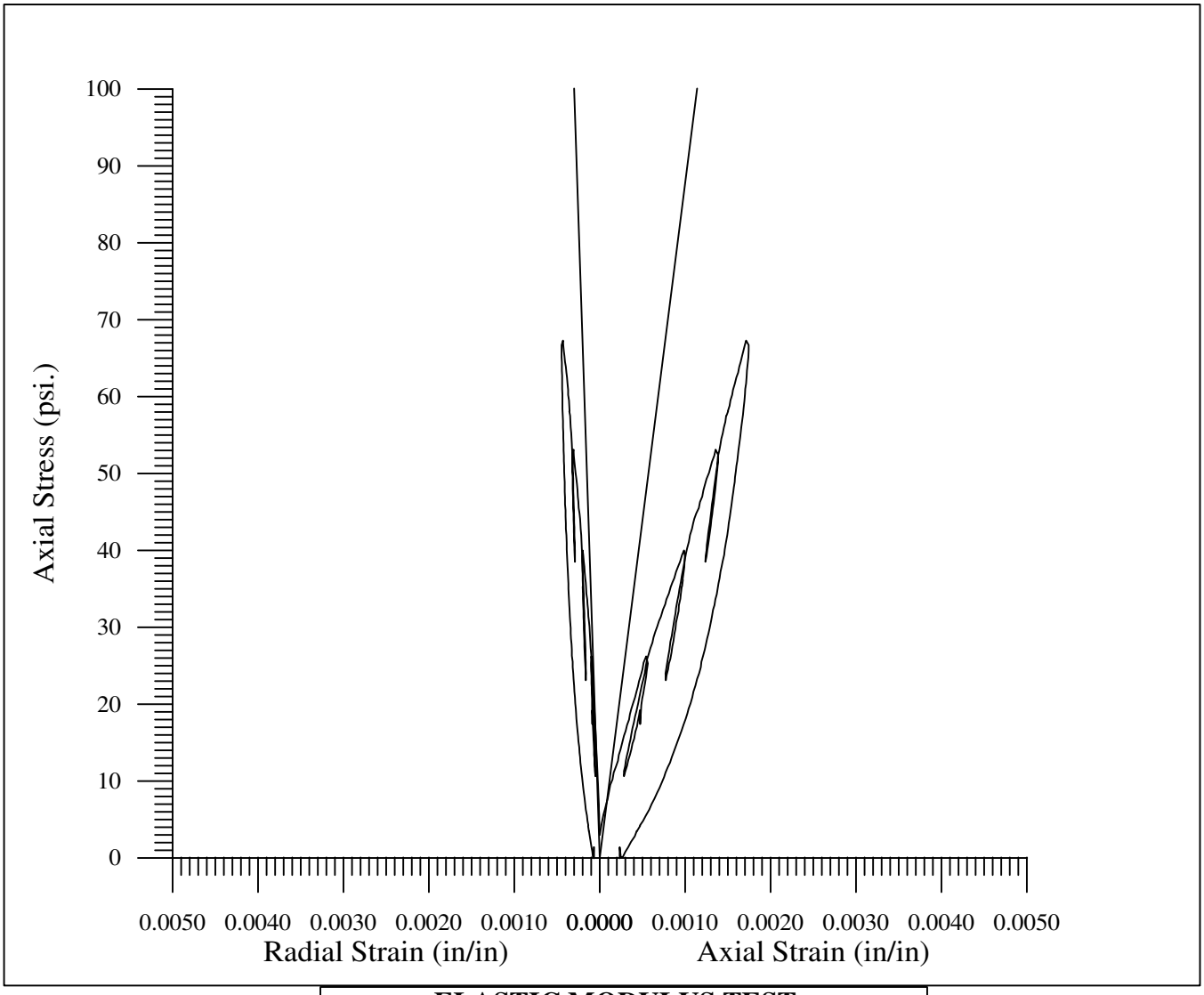
Modulus: 65,000 psi
Poisson's Ratio: .18
Density: 138.1 pcf
UC Strength: 335 psi

Geo Test G T U *Unlimited*
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: Earth Mechanics, Inc.
17660 Newhope St., Suite E
Fountain Valley, CA 92708

Project: SR-710 Tunnel
Project No: none

Test Date: April 11, 2009



ELASTIC MODULUS TEST
Axial Stress vs. Axial & Radial Strain

Sample: Z1B3-251
Boring: Z1-B3
Depth: 251.0-252.0'

DESCRIPTION
Medium gray silty fine to medium grained friable sandstone with no apparent planes of weakness.

Modulus: **88,000 psi**
Poisson's Ratio: **.26**
Density: **135.1 pcf**
UC Strength: **435 psi**

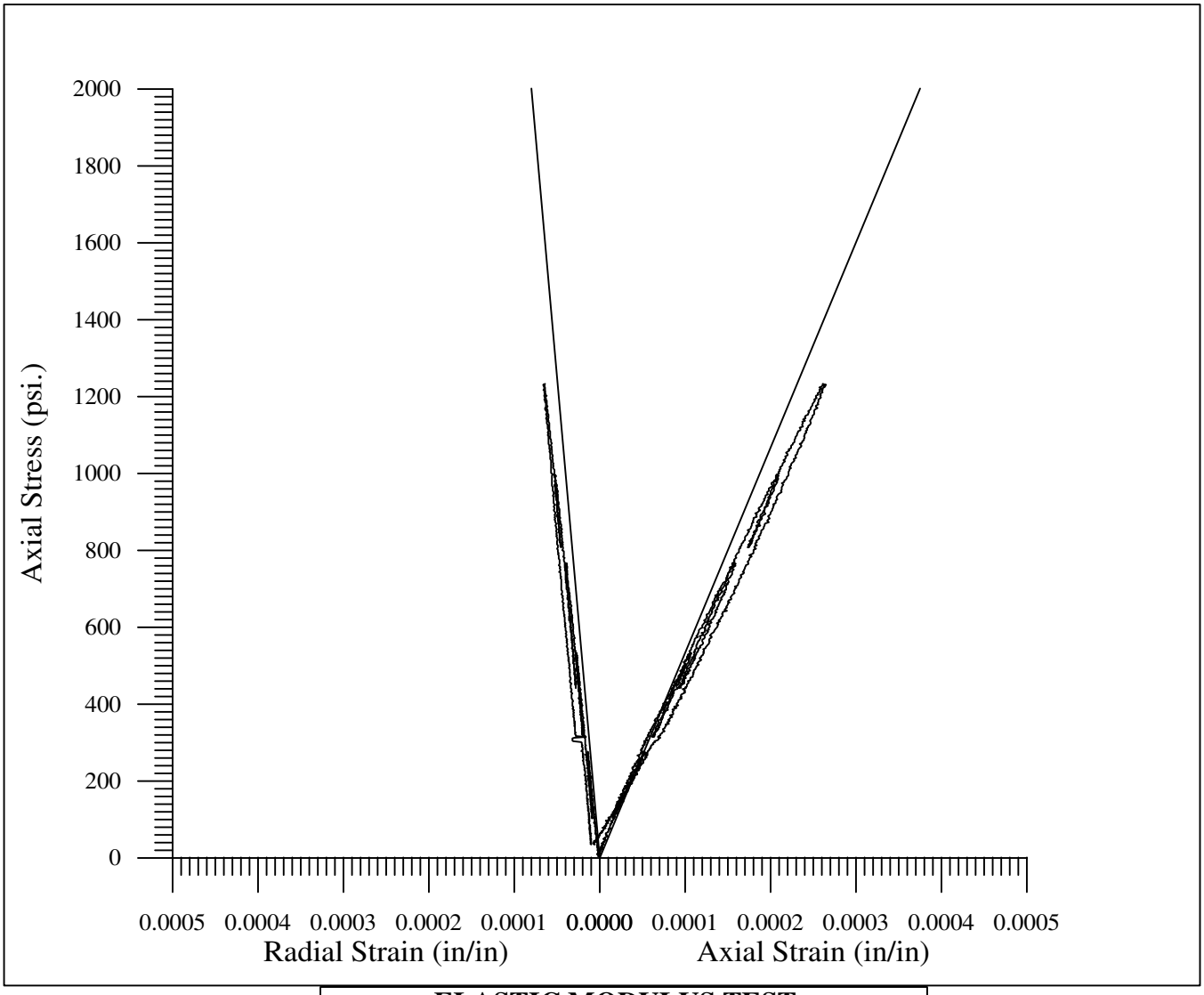
Geo Test G T U *Unlimited*
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: Earth Mechanics, Inc.
17660 Newhope St., Suite E
Fountain Valley, CA 92708

Project: SR-710 Tunnel

Project No: none

Test Date: April 7, 2009



ELASTIC MODULUS TEST
Axial Stress vs. Axial & Radial Strain

Sample: Z1B3-289
Boring: Z1-B3
Depth: 289.0-289.6'

DESCRIPTION
Light gray fine to medium grained sandstone.

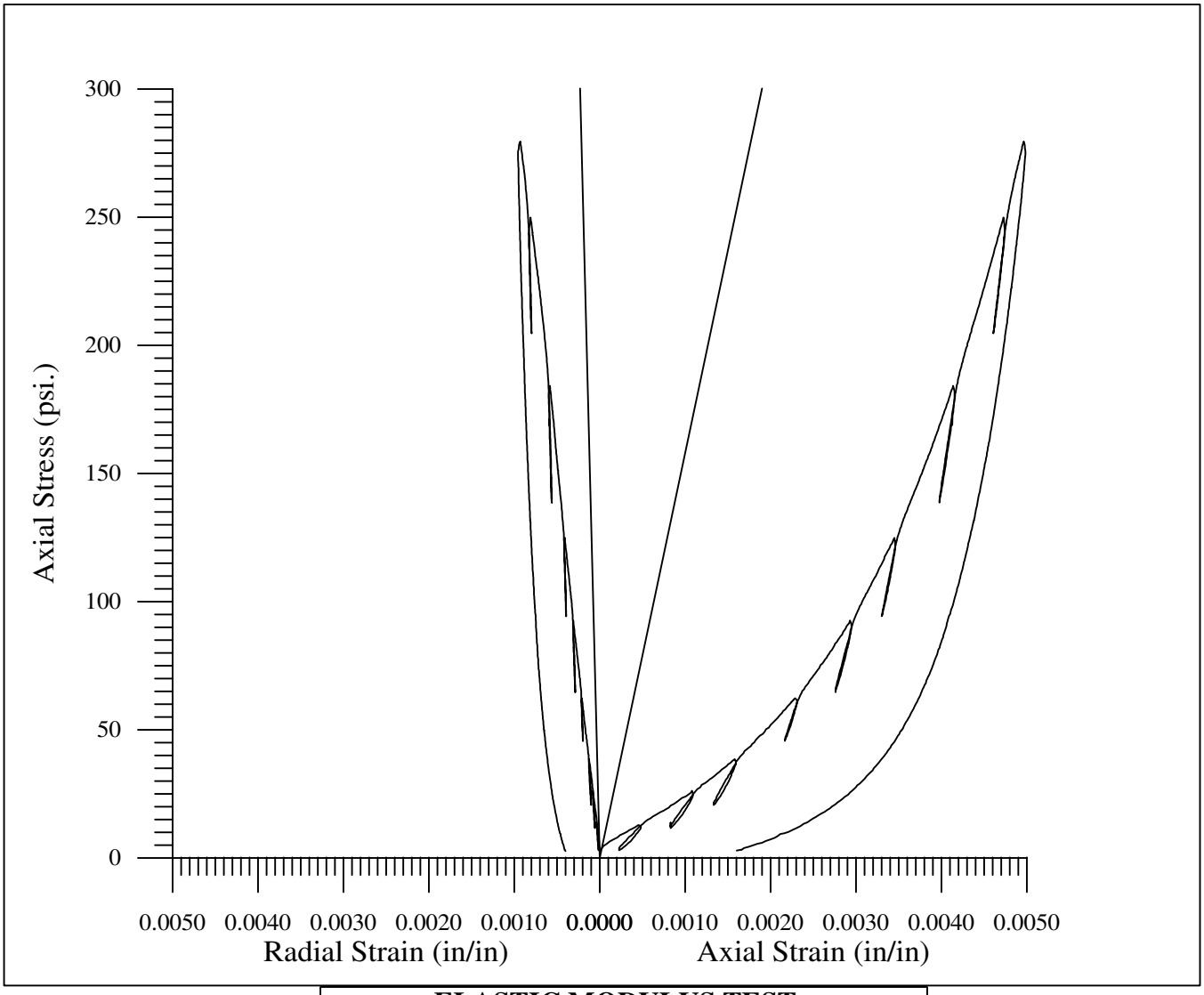
Modulus: **5,330,000 psi**
Poisson's Ratio: **.21**
Density: **154.6 pcf**
UC Strength: **8404 psi**

Geo Test G T U *Unlimited*
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: Earth Mechanics, Inc.
17660 Newhope St., Suite E
Fountain Valley, CA 92708

Project: SR-710 Tunnel
Project No: none

Test Date: **April 20, 2009**



ELASTIC MODULUS TEST
Axial Stress vs. Axial & Radial Strain

Sample: Z1B3-299
Boring: Z1-B3
Depth: 299.0-300.2'

DESCRIPTION
Medium gray silty fine to medium grained friable sandstone with no apparent planes of weakness.

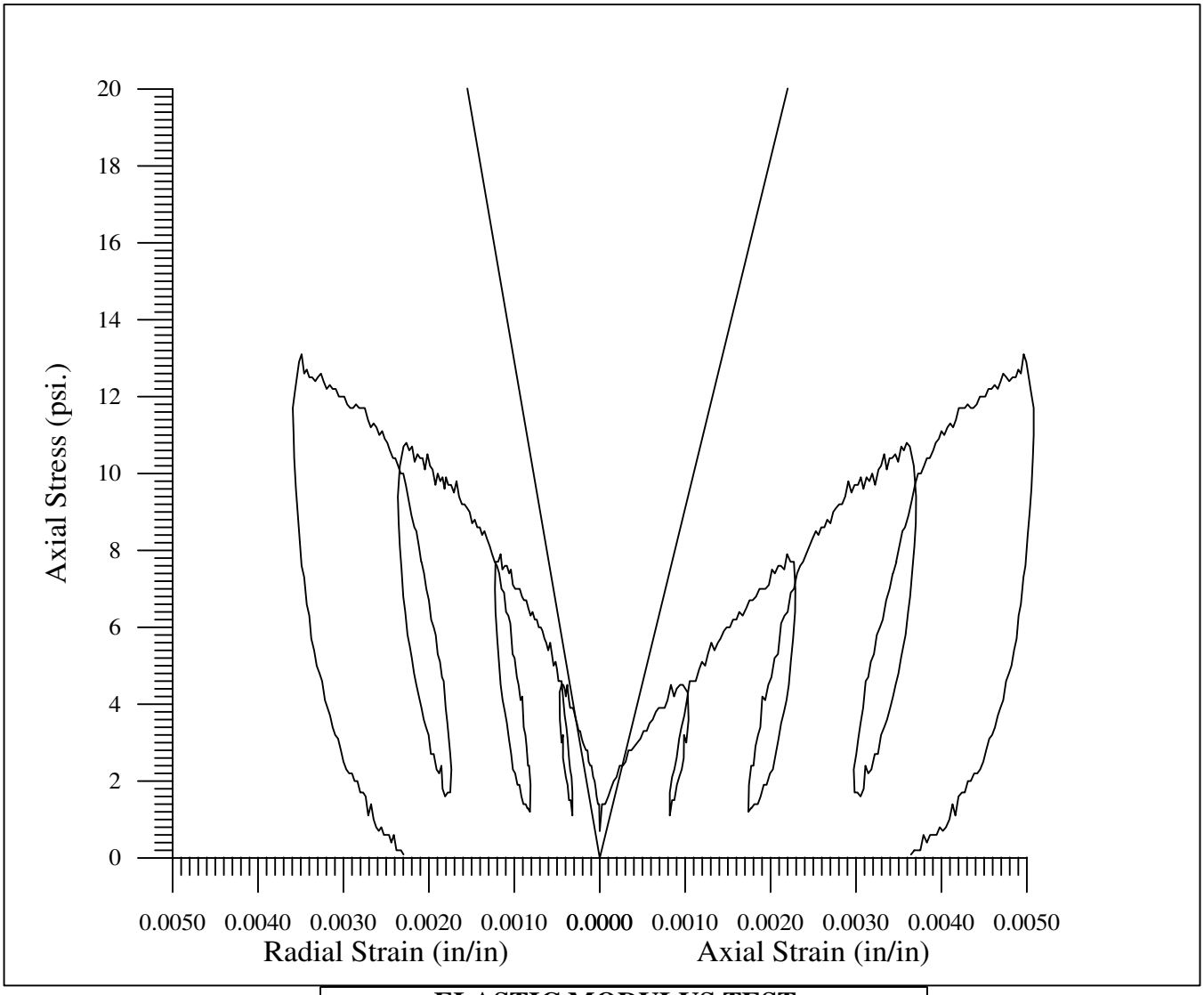
Modulus: **160,000 psi**
Poisson's Ratio: **.12**
Density: **136.7 pcf**
UC Strength: **577 psi**

Geo Test G T U *Unlimited*
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: Earth Mechanics, Inc.
17660 Newhope St., Suite E
Fountain Valley, CA 92708

Project: SR-710 Tunnel
Project No: none

Test Date: April 7, 2009



ELASTIC MODULUS TEST
Axial Stress vs. Axial & Radial Strain

Sample: Z2B1-120
Boring: Z2-B1
Depth: 120.0-122.0'

DESCRIPTION

Dark gray interbedded clayey siltstone
and fine to medium grained brown sandstone
with numerous fractures, two of which were glued.

Modulus: **9,000 psi**
Poisson's Ratio: **.70 (NA?)**
Density: **125.2 pcf**
UC Strength: **42 psi**

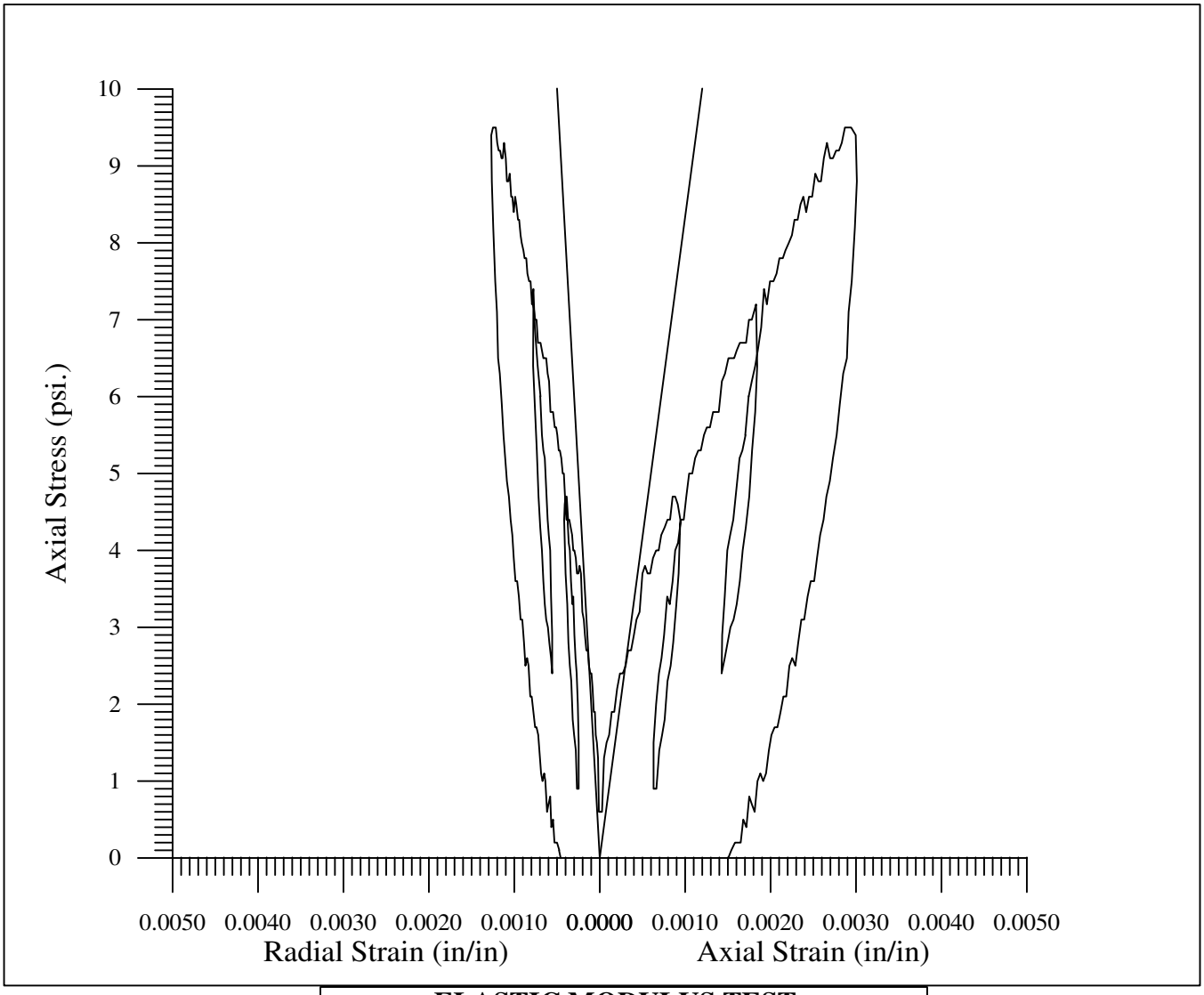
Geo Test G T U *Unlimited*
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: Earth Mechanics, Inc.
17660 Newhope St., Suite E
Fountain Valley, CA 92708

Project: SR-710 Tunnel

Project No: none

Test Date: **April 11, 2009**



ELASTIC MODULUS TEST
Axial Stress vs. Axial & Radial Strain

Sample: Z2B1-92
Boring: Z2-B1
Depth: 92.6-93.8'

DESCRIPTION
Dark gray silty clayey fine grained sandstone, soft with a diagonal shear.

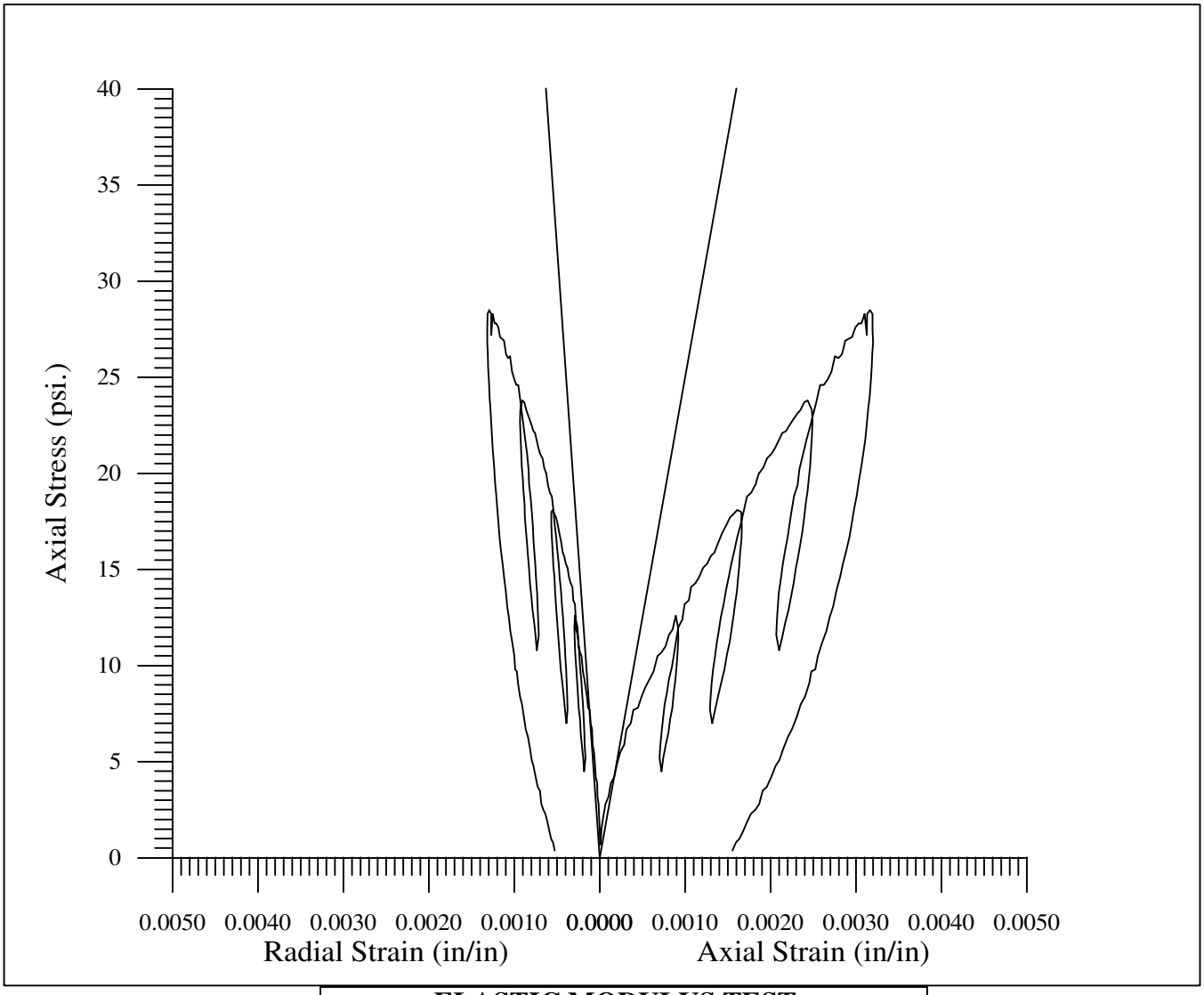
Modulus: **8,000 psi**
Poisson's Ratio: **.42 (?)**
Density: **132.3 pcf**
UC Strength: **31 psi**

Geo Test G T U *Unlimited*
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: Earth Mechanics, Inc.
17660 Newhope St., Suite E
Fountain Valley, CA 92708

Project: SR-710 Tunnel
Project No: none

Test Date: April 7, 2009



ELASTIC MODULUS TEST
Axial Stress vs. Axial & Radial Strain

Sample: Z2B1-145
Boring: Z2-B1
Depth: 145.5-146.8'

DESCRIPTION
Interbedded medium gray siltstone and dark gray claystone, with vertically oriented bedding.

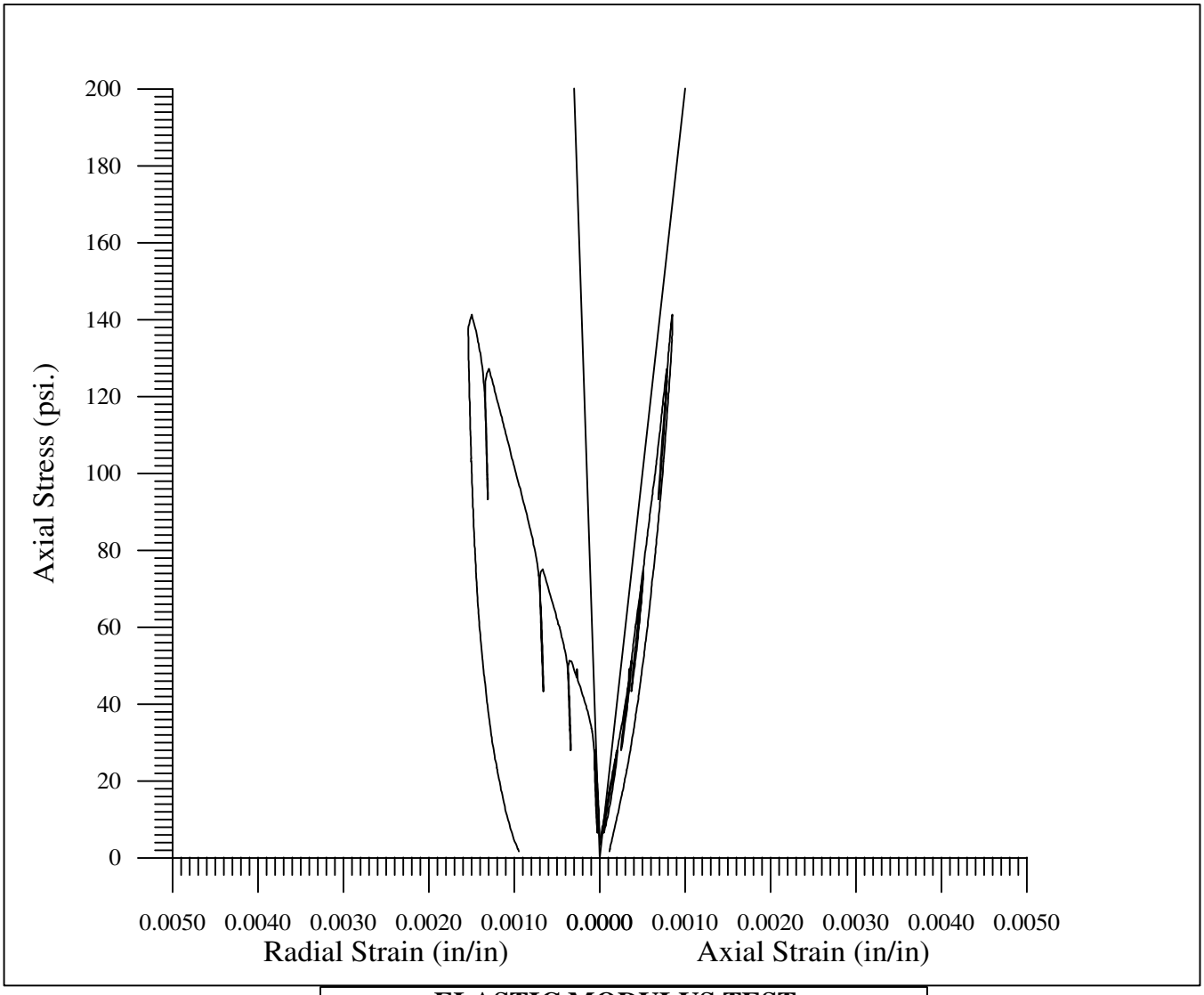
Modulus: **25,000 psi**
Poisson's Ratio: **.39**
Density: **131.6 pcf**
UC Strength: **52 psi**

Geo Test G T U *Unlimited*
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: Earth Mechanics, Inc.
17660 Newhope St., Suite E
Fountain Valley, CA 92708

Project: SR-710 Tunnel
Project No: none

Test Date: April 7, 2009



ELASTIC MODULUS TEST
Axial Stress vs. Axial & Radial Strain

Sample: Z3B3-254
Boring: Z3-B3
Depth: 254.0-256.0'

DESCRIPTION
Medium gray friable altered diorite.

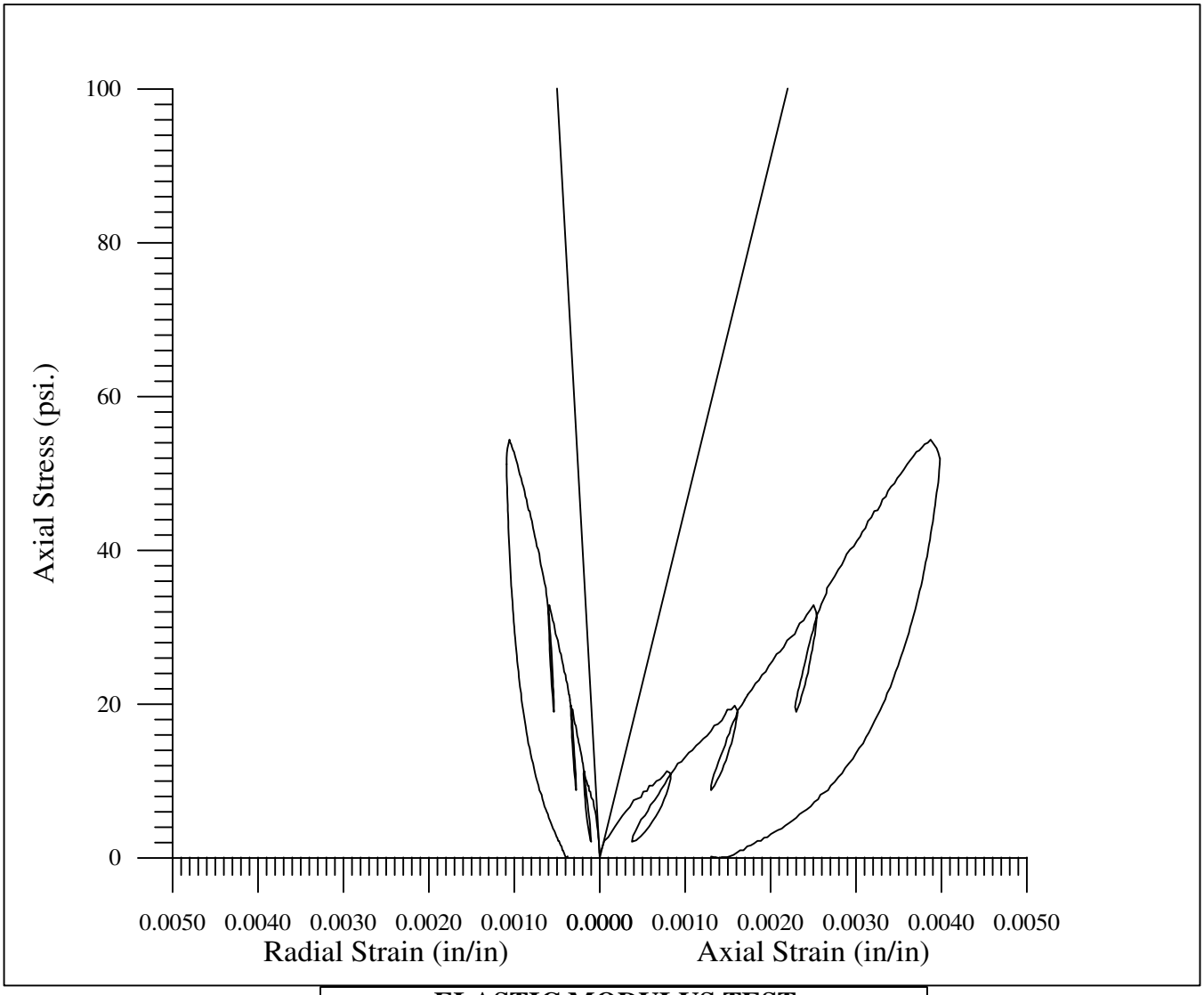
Modulus: **200,000 psi**
Poisson's Ratio: **.30**
Density: **147.3 pcf**
UC Strength: **229 psi**

Geo Test G T U *Unlimited*
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: Earth Mechanics, Inc.
17660 Newhope St., Suite E
Fountain Valley, CA 92708

Project: SR-710 Tunnel
Project No: none

Test Date: **April 11, 2009**



ELASTIC MODULUS TEST
Axial Stress vs. Axial & Radial Strain

Sample: Z3B3-270
Boring: Z3-B3
Depth: 270.5-272.5'

DESCRIPTION
Medium gray friable altered diorite with the end repaired with plaster.

Modulus: 45,000 psi
Poisson's Ratio: .23
Density: 146.5 pcf
UC Strength: 92 psi

Geo Test G T U *Unlimited*
27069 N. Bloomfield Rd.
Nevada City, CA 95959

Client: Earth Mechanics, Inc.
17660 Newhope St., Suite E
Fountain Valley, CA 92708

Project: SR-710 Tunnel
Project No: none

Test Date: April 7, 2009

UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: May 12, 2009

Client: CH2MHill

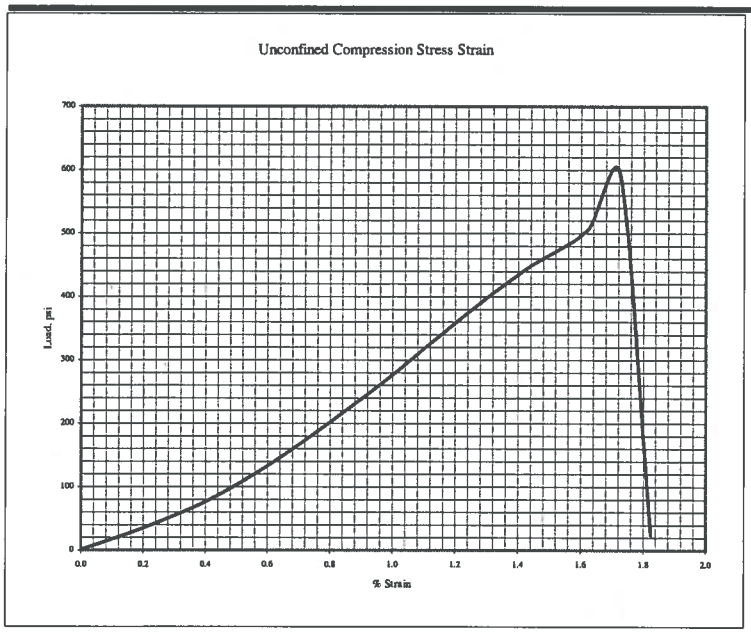
Material Type: Sandstone
Date Cast: n/a
Date Tested: 5/12/09
Age, Days: n/a

Depth: 203.1-204

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

Test Results

Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z1-B4, C48		2.44	4.9	134.3	117.5	14.3	593



Elastic Modulus (psi)*:	34,196

* using secant elastic modulus formula

Note: "As received" photo not available

UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: May 12, 2009

Client: CH2MHill

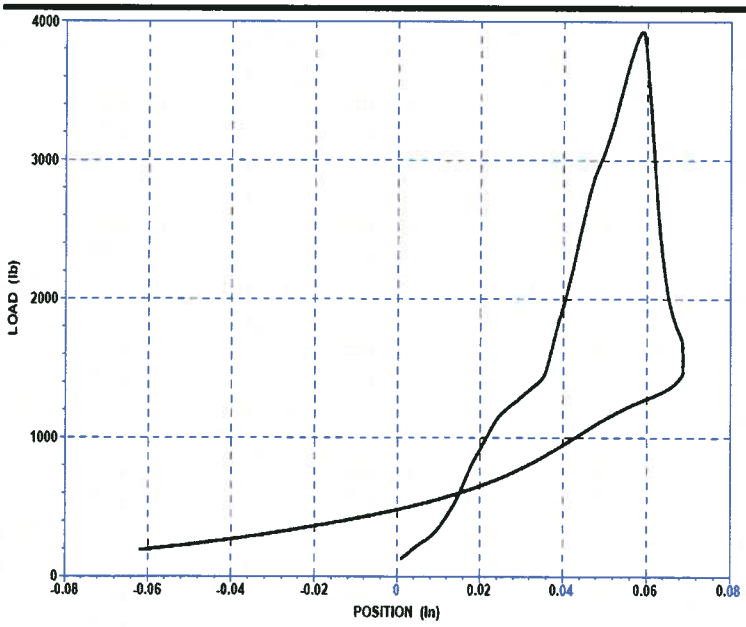
Material Type: Sandstone
Date Cast: n/a
Date Tested: 5/12/09
Age, Days: n/a

Depth: 226-226.8

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

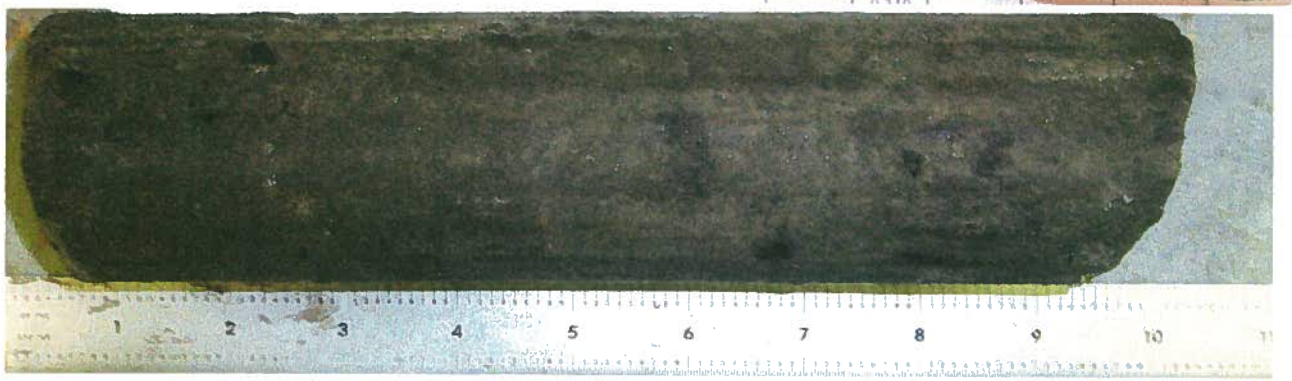
Test Results

Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z1-B4, C53		2.40	4.8	147.5	136.2	8.3	871



Elastic Modulus (psi)*:	70,654

* using secant elastic modulus formula



UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: May 12, 2009

Client: CH2MHill

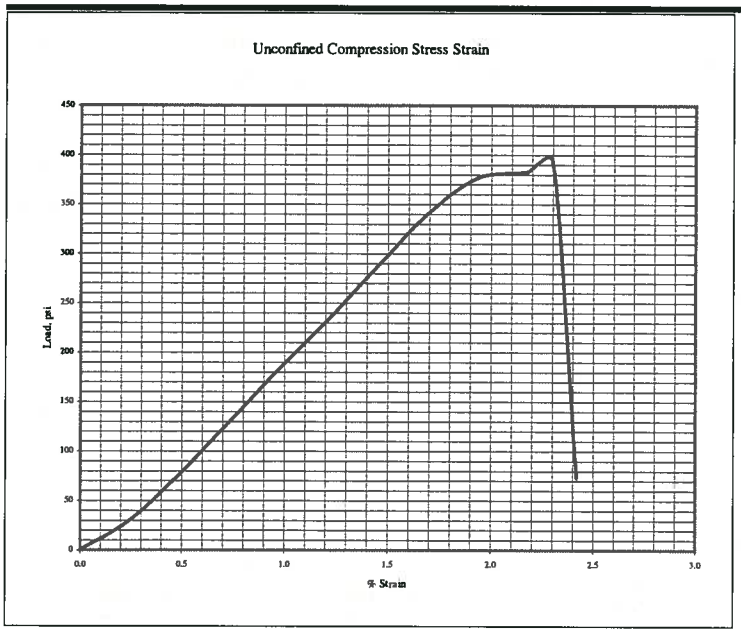
Material Type: Mudstone
Date Cast: n/a
Date Tested: 5/12/09
Age, Days: n/a

Depth: 307-307.8

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

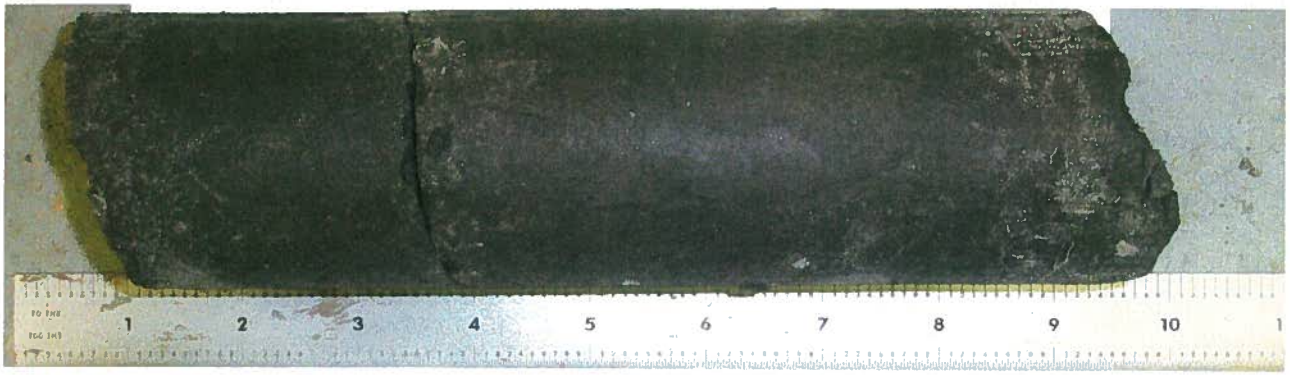
Test Results

Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z1-B4, C69		2.44	4.1	132.2	112.8	17.2	394



Elastic Modulus (psi)*:	16,991

* using secant elastic modulus formula



UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: May 12, 2009

Client: CH2MHill

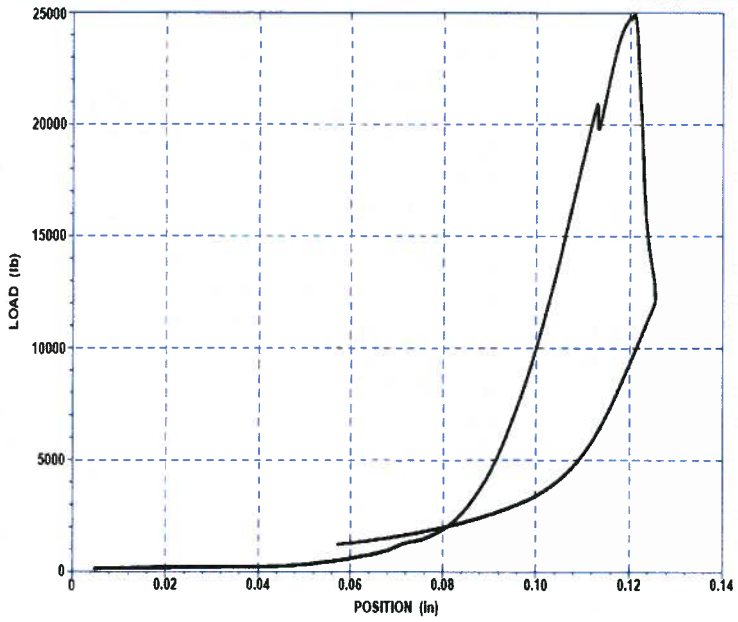
Material Type: Sandstone
Date Cast: n/a
Date Tested: 5/12/09
Age, Days: n/a

Depth: 318.9-319.8

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

Test Results

Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z1-B4, C71		2.41	4.8	159.9	157.1	1.8	5458



Elastic Modulus (psi)*:	216,321

* using secant elastic modulus formula

UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: April 17, 2009

Client: CH2MHill

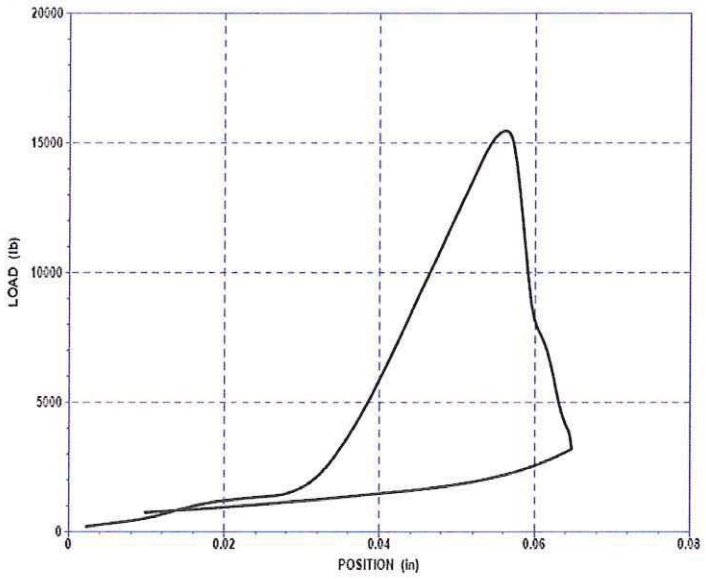
Material Type: Sandstone
Date Cast: n/a
Date Tested: 4/17/09
Age, Days: n/a

Depth: 407.4-408.4

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

Test Results

Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z1-B5, C57		3.26	6.5	151.0	143.8	5.0	1850



Elastic Modulus (psi)*:	214,533

* using secant elastic modulus formula

UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: April 10, 2009

Client: CH2MHill

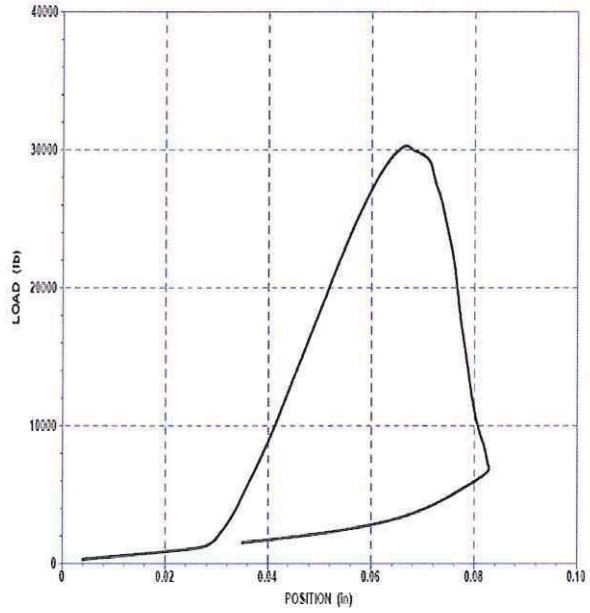
Material Type: Sandstone
Date Cast: n/a
Date Tested: 4/10/09
Age, Days: n/a

Depth: 211.5-212.4

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

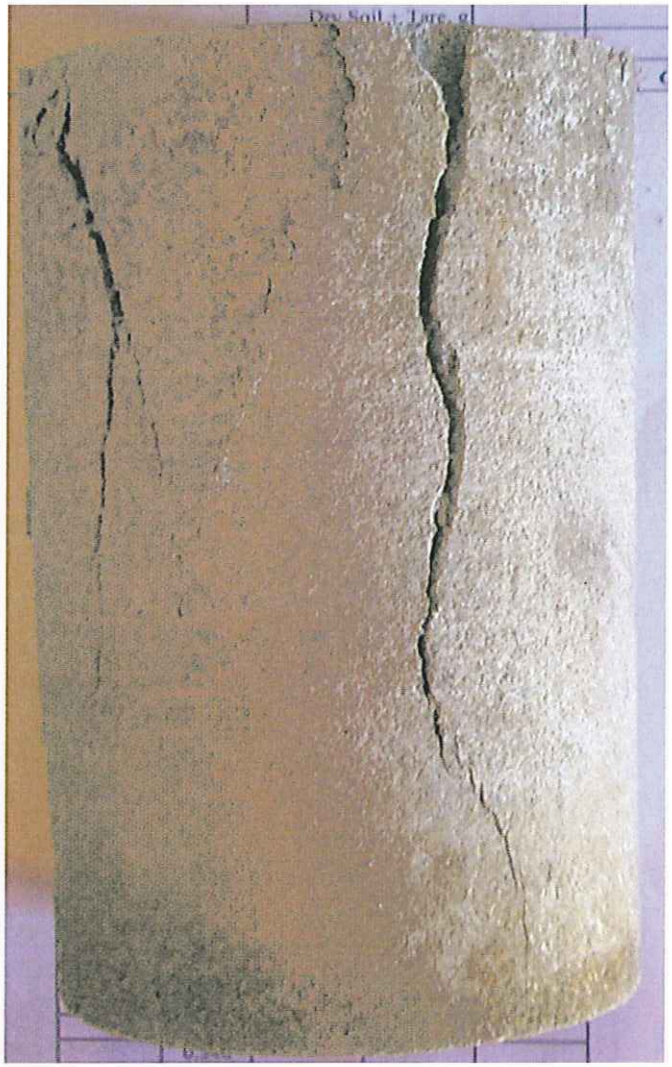
Test Results

Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z1-B5, C33		3.27	5.8	149.2	138.6	7.6	3581



Elastic Modulus (psi)*:	314382

*using secant elastic modulus formula



UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: April 10, 2009

Client: CH2MHill

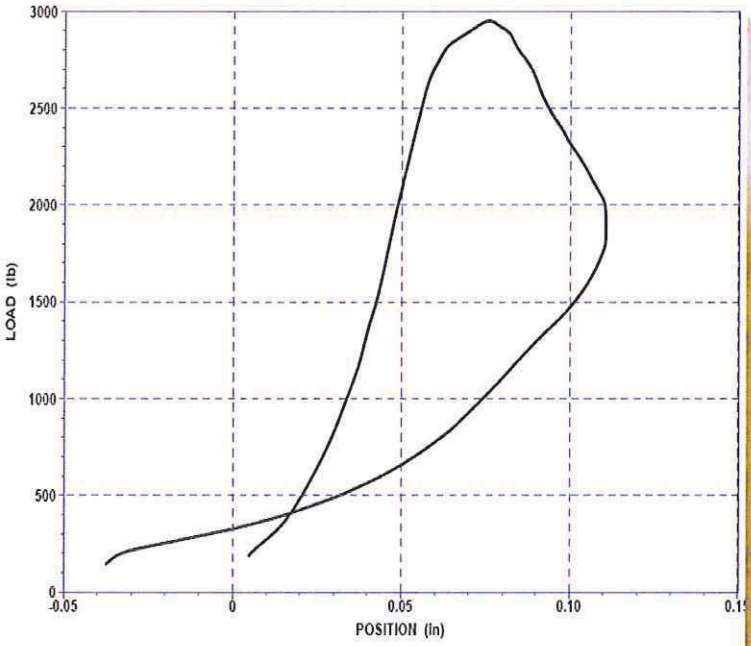
Material Type: Siltstone
Date Cast: n/a
Date Tested: 4/10/09
Age, Days: n/a

Depth: 230.6-231.5

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

Test Results

Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z1-B5, C35		3.22	3.6	122.4	106.3	15.1	325



Elastic Modulus (psi)*:	15212

*using secant elastic modulus formula

UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: April 10, 2009

Client: CH2MHill

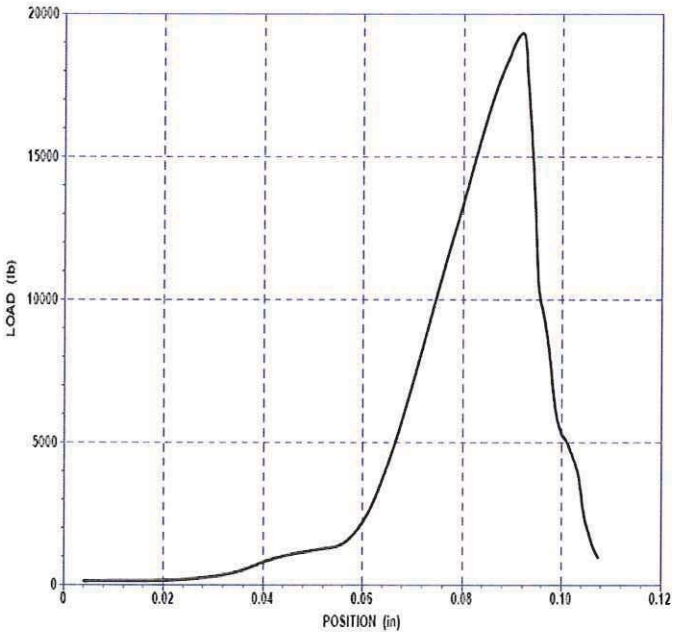
Material Type: Sandstone
Date Cast: n/a
Date Tested: 4/10/09
Age, Days: n/a

Depth: 322.2-323

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

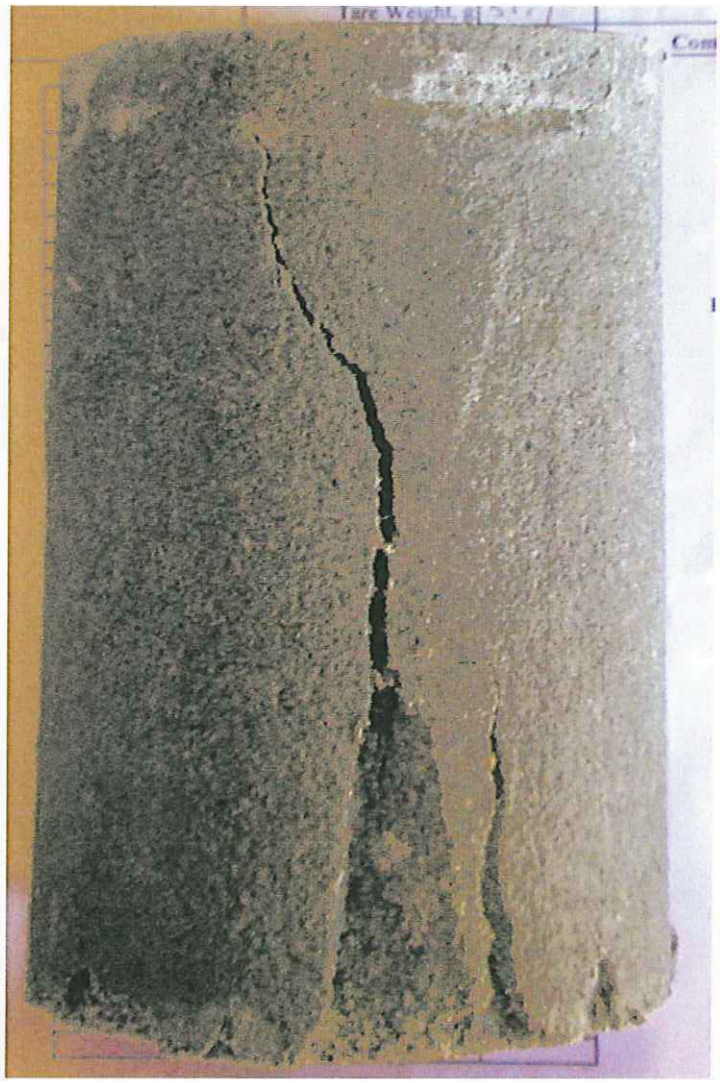
Test Results

Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z1-B5, C47		3.26	5.8	150.0	142.3	5.4	2299



Elastic Modulus (psi)*:	146284

*using secant elastic modulus formula



Leighton

UNCONFINED COMPRESSIVE STRENGTH of COHESIVE SOIL
ASTM D 2166

Project Name: SR-710 Tunnel Technical Study — Tested by: A. Santos — Date: 04/23/09

Project No.: 378312.04.09.01 — Checked by: J. Ward — Date: 04/28/09

Boring No.: R-09-Z1-B6 — Sample Type: Core

Sample No.: C36 — Depth (ft): 204-205.1

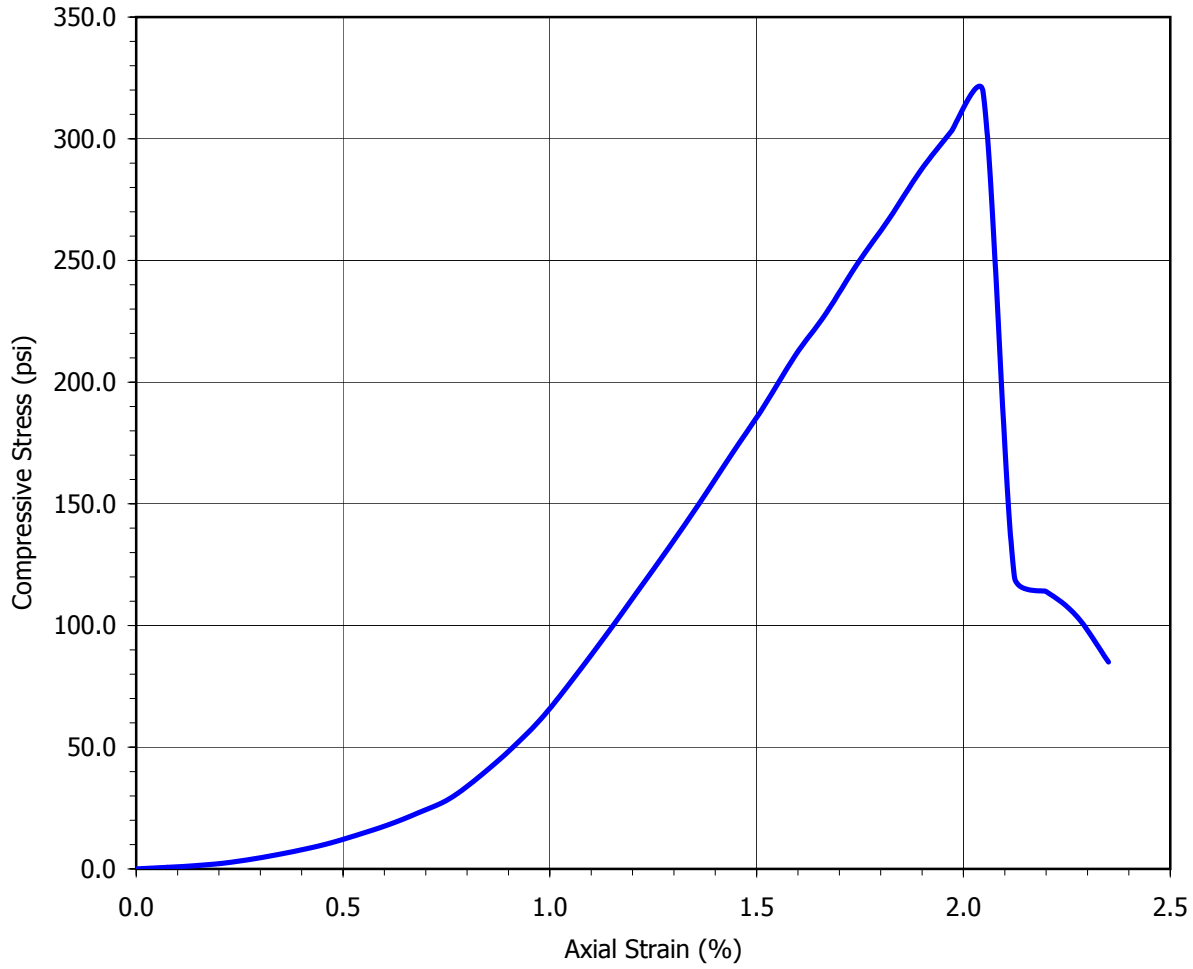
Sample Description: Olive gray silt'stone' (ML)

Weight of Sample + Tube / Rings (g)	1807.80
Weight of Tube / Rings (g)	0.00
Wet Weight of Soil + Container (g)	1910.30
Dry Weight of Soil + Container (g)	1725.70
Weight of Container (g)	106.91
Load Surcharge (lb)	2.20
Rate of Deformation (in/min)	0.012
Specific Gravity (Assumed)	2.70

Sample Measurements	
Diameter (in)	3.260
	3.275
	3.230
Area (sq.in.)	8.321
Height (in)	6.594
	6.597
	6.592

Axial Deformation (in.)	Load (lb.)	Compressive Stress (psi)	Axial Strain (%)
0.0000	0.0	0.00	0.000
0.0050	3.1	0.64	0.076
0.0100	10.0	1.46	0.152
0.0150	20.3	2.70	0.227
0.0200	37.0	4.70	0.303
0.0250	57.0	7.09	0.379
0.0300	81.2	9.98	0.455
0.0350	113.0	13.77	0.531
0.0400	148.0	17.94	0.607
0.0450	191.0	23.06	0.682
0.0500	240.5	28.94	0.758
0.0550	321.0	38.52	0.834
0.0600	416.0	49.80	0.910
0.0650	527.0	62.97	0.986
0.0700	664.0	79.21	1.062
0.0750	809.0	96.38	1.137
0.0800	960.0	114.23	1.213
0.0850	1113.0	132.29	1.289
0.0900	1272.0	151.03	1.365
0.0950	1438.0	170.58	1.441
0.1000	1601.0	189.74	1.516
0.1050	1779.0	210.64	1.592
0.1100	1930.0	228.32	1.668
0.1150	2104.0	248.69	1.744
0.1200	2261.0	267.03	1.820
0.1250	2430.0	286.74	1.896

Axial Deformation (in.)	Load (lb.)	Compressive Stress (psi)	Axial Strain (%)
0.1300	2572.0	303.25	1.97
0.1350	2709.0	319.14	2.05
0.1400	1018.0	120.00	2.12
0.1450	968.0	114.03	2.20
0.1500	880.0	103.61	2.27
0.1550	722.0	84.98	2.35



Boring No.:	R-09-Z1-B6
Sample No.:	C36
Depth (ft):	204-205.1
Soil Type:	Core
Sample Description:	Olive gray silt'stone' (ML)

Sample Diameter (in.)	3.255
Sample Height (in.)	6.594
Initial Moisture Content (%)	11.40
Dry Density (pcf)	112.7
Specific Gravity (assumed)	2.7
Saturation (%)	62.1
Rate of Deformation (in/min)	0.0120
Height / Diameter Ratio	2.03

At Failure

Compressive Strength (psi)	**319.14**
Axial Strain (%)	2.05

Leighton

Unconfined Compressive Strength of Cohesive Soil
ASTM D 2166

Project No.: **378312.04.09.01**

SR-710 Tunnel Technical Study

04/23/09

UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: April 2, 2009

Client: CH2MHill

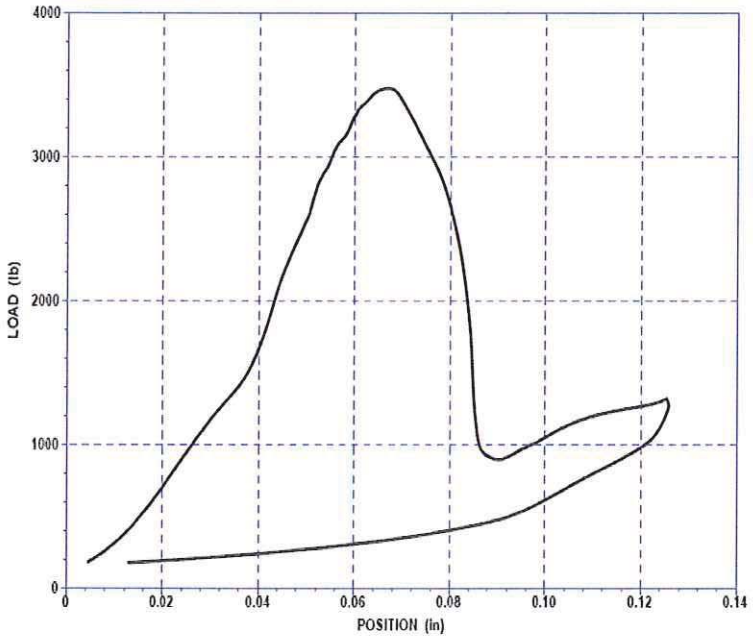
Material Type: Siltstone
Date Cast: n/a
Date Tested: 4/2/09
Age, Days: n/a

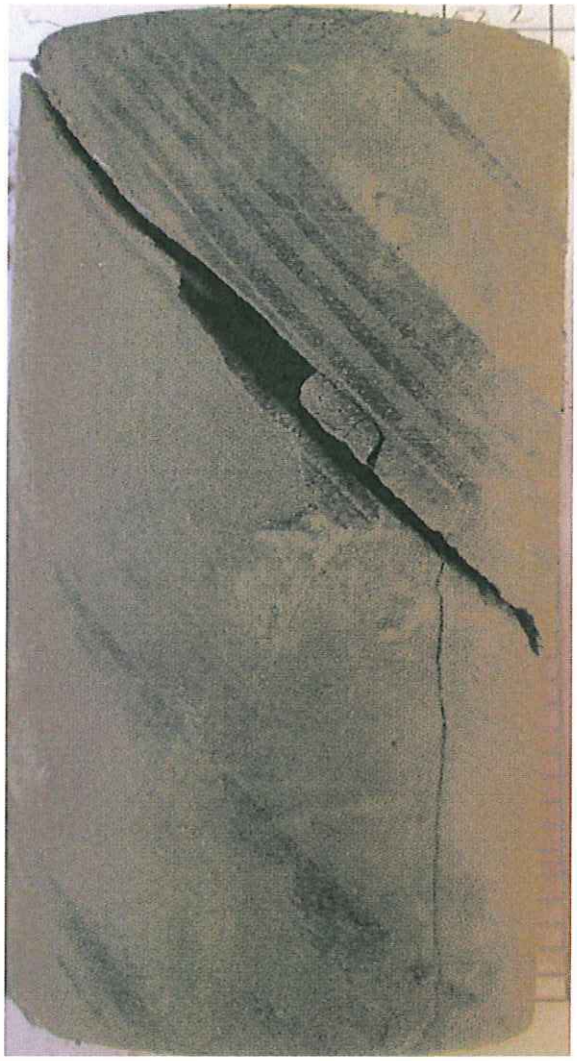
Depth: 238-239.0

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

Test Results

Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z1-B6, C39		3.20	6.3	130.1	110.5	17.7	432





Elastic Modulus (psi)*:	40617

*using secant elastic modulus formula

UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: April 2, 2009

Client: CH2MHill

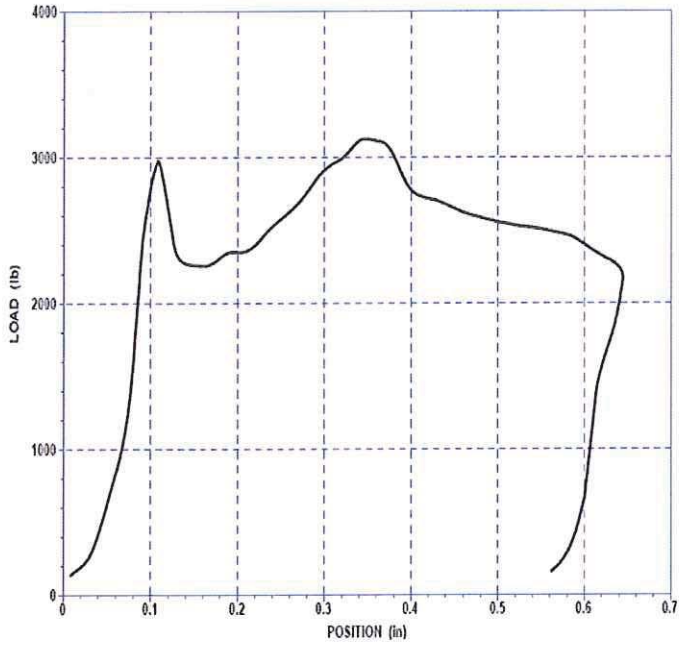
Material Type: Siltstone
Date Cast: n/a
Date Tested: 4/2/09
Age, Days: n/a

Depth: 267-268.0

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

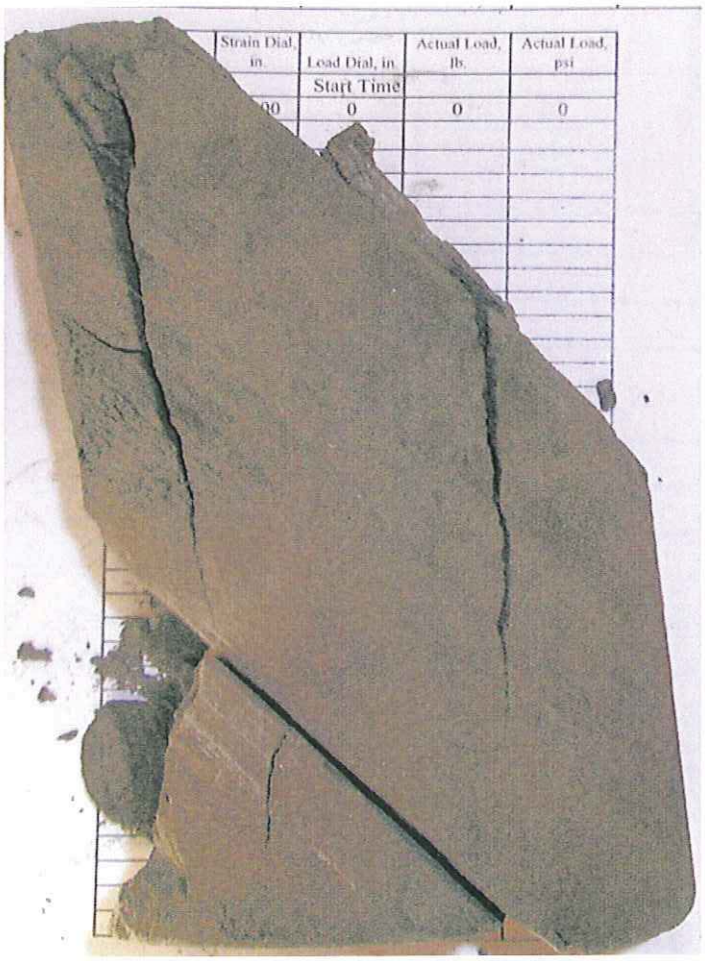
Test Results

Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z1-B6, C42		3.20	6.2	136.5	121.7	12.2	389



Elastic Modulus (psi)*:	7001

*using secant elastic modulus formula



UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: April 2, 2009

Client: CH2MHill

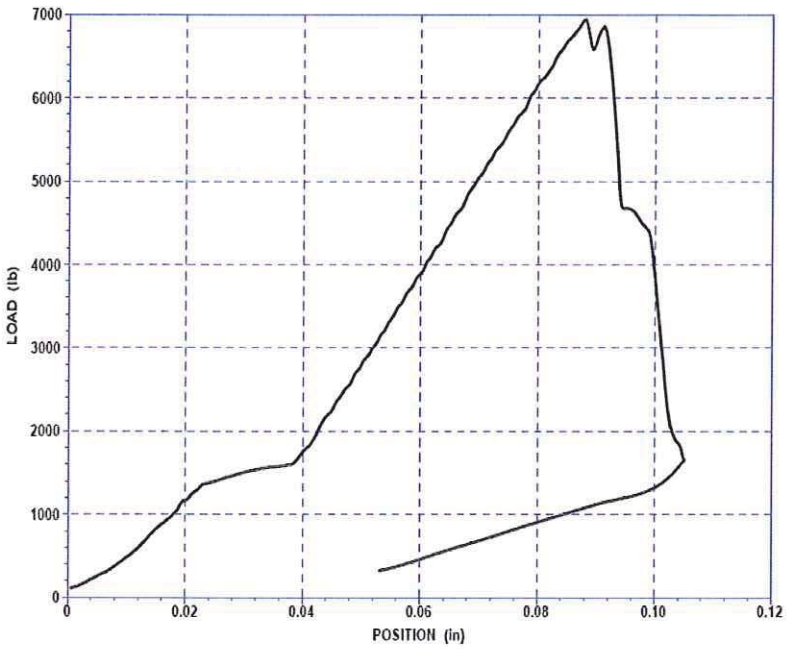
Material Type: Siltstone
Date Cast: n/a
Date Tested: 4/2/09
Age, Days: n/a

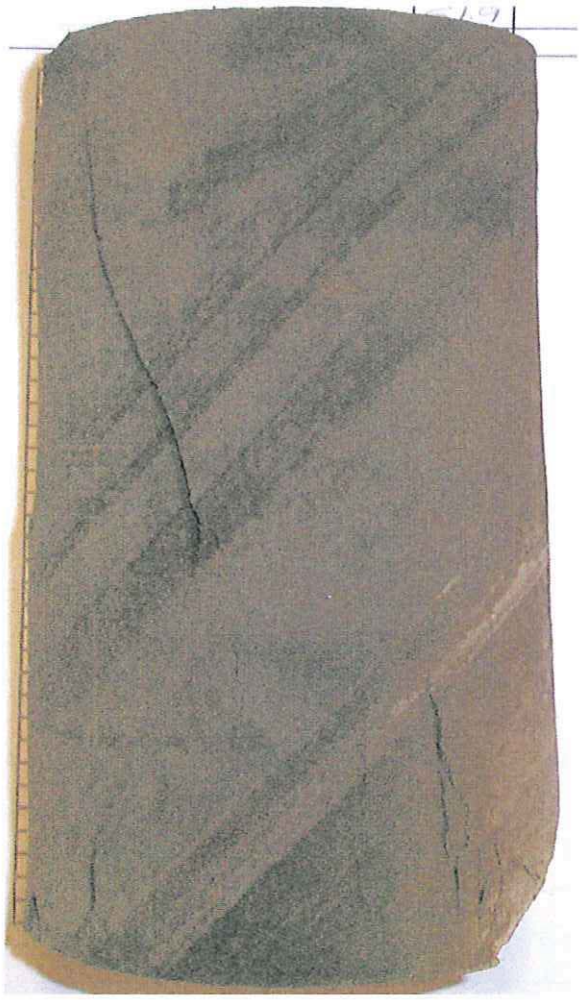
Depth: 299.9-300.8

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

Test Results

Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z1-B6, C46		3.20	6.2	129.6	111.1	16.6	863





Elastic Modulus (psi)*:	60175

*using secant elastic modulus formula

UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: April 2, 2009

Client: CH2MHill

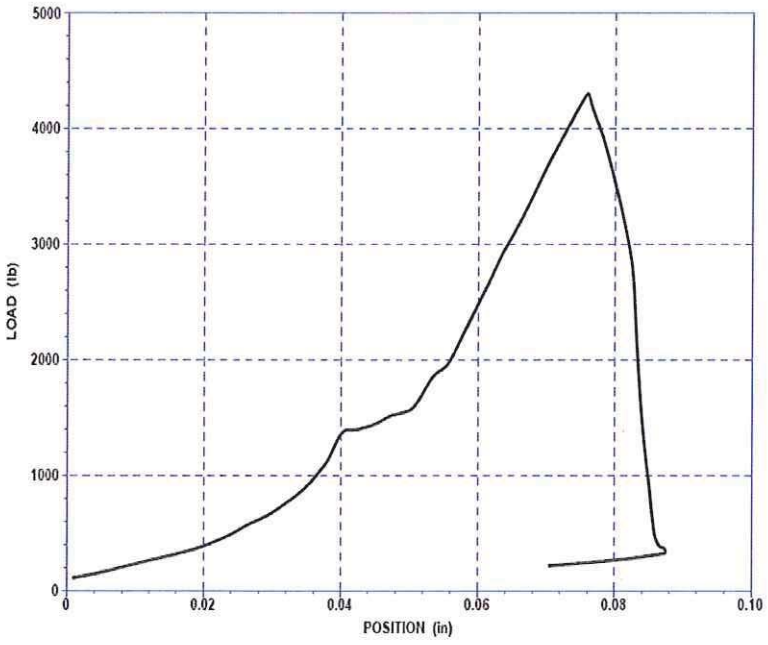
Material Type: Siltstone
Date Cast: n/a
Date Tested: 4/2/09
Age, Days: n/a

Depth: 333.5-334.2

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

Test Results

Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z1-B6, C50		3.20	5.8	134.2	115.1	16.6	537



Elastic Modulus (psi)*:	40575

*using secant elastic modulus formula

UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: April 2, 2009

Client: CH2MHill

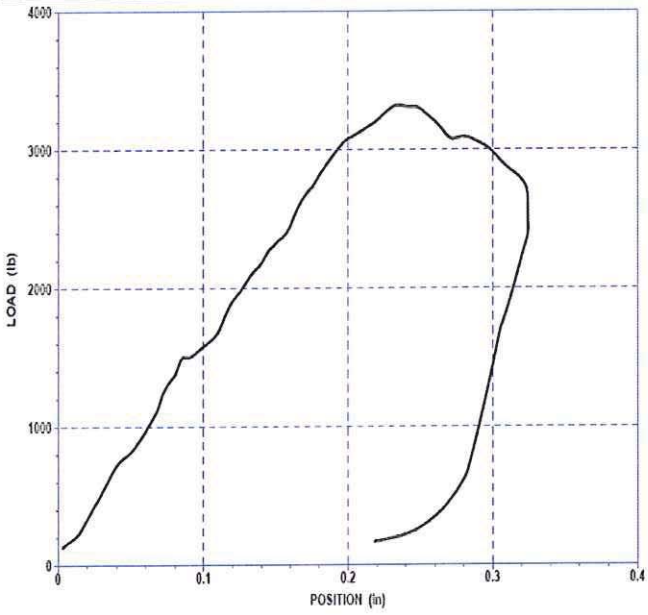
Material Type: Siltstone
Date Cast: n/a
Date Tested: 4/2/09
Age, Days: n/a

Depth: 376.3-377.1

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

Test Results

Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z1-B6, C57		3.20	5.2	127.7	111.4	14.6	400



Elastic Modulus (psi)*:	8921

*using secant elastic modulus formula

Leighton

UNCONFINED COMPRESSIVE STRENGTH of COHESIVE SOIL

ASTM D 2166

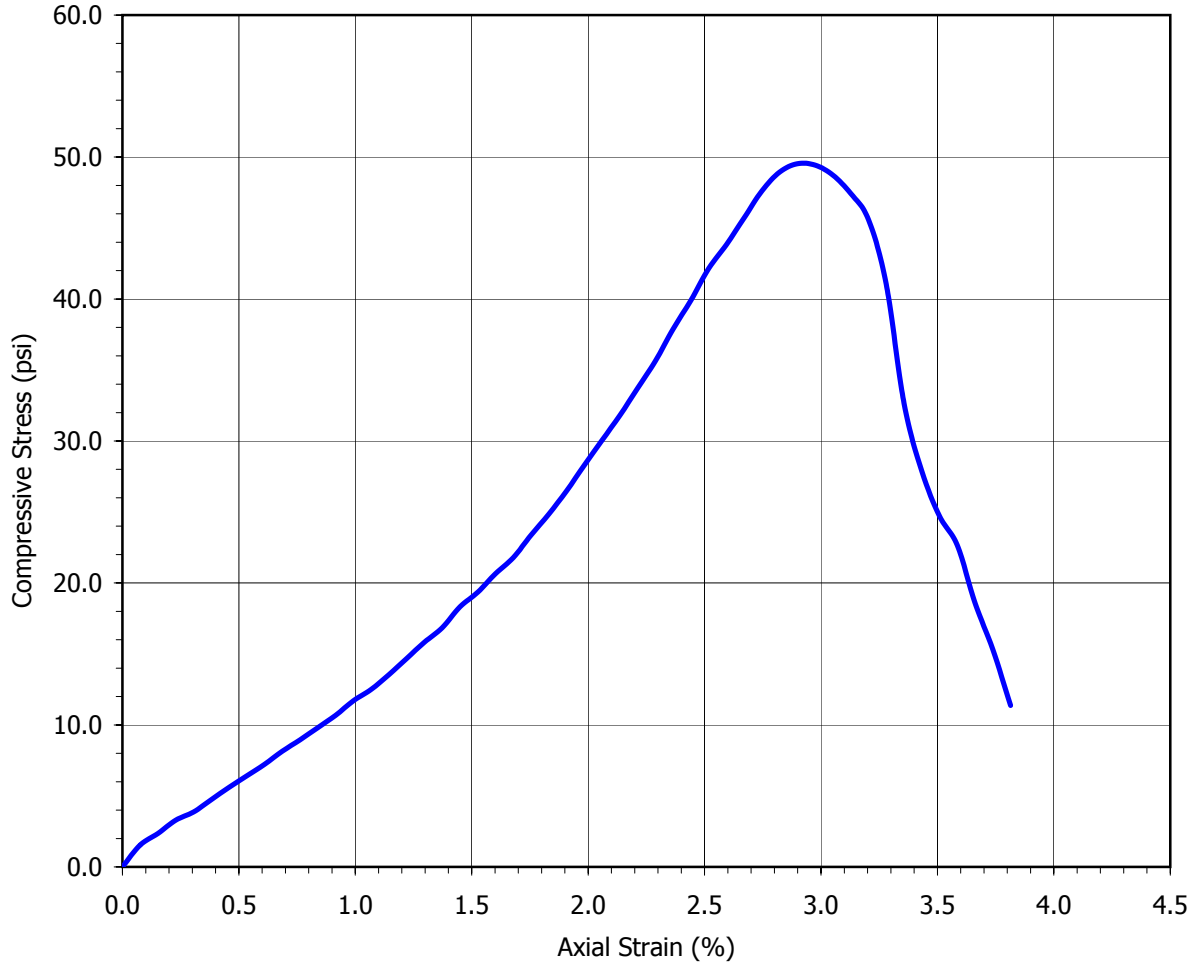
Project Name:	SR-710 Tunnel Technical Study		Tested by:	A. Santos	Date: 04/24/09
Project No.:	378312.04.09.01		Checked by:	J. Ward	Date: 04/28/09
Boring No.:	R-09-Z1-B7		Sample Type:	Core	
Sample No.:	C45		Depth (ft):	237.4-238.3	
Sample Description:	Dark gray silt'stone' (ML)				

Weight of Sample + Tube / Rings (g)	1729.80
Weight of Tube / Rings (g)	0.00
Wet Weight of Soil + Container (g)	1806.10
Dry Weight of Soil + Container (g)	1730.40
Weight of Container (g)	106.90
Load Surcharge (lb)	2.20
Rate of Deformation (in/min)	0.012
Specific Gravity (Assumed)	2.70

Sample Measurements	
Diameter (in)	3.330
	3.310
	3.265
Area (sq.in.)	8.562
Height (in)	6.557
	6.551
	6.554

Axial Deformation (in.)	Load (lb.)	Compressive Stress (psi)	Axial Strain (%)
0.0000	0.0	0.00	0.000
0.0050	11.0	1.54	0.076
0.0100	18.0	2.36	0.153
0.0150	26.0	3.29	0.229
0.0200	31.0	3.87	0.305
0.0250	38.5	4.74	0.381
0.0300	46.0	5.60	0.458
0.0350	53.0	6.41	0.534
0.0400	60.0	7.22	0.610
0.0450	68.0	8.14	0.687
0.0500	75.0	8.95	0.763
0.0550	82.5	9.81	0.839
0.0600	90.0	10.67	0.915
0.0650	99.0	11.70	0.992
0.0700	106.0	12.50	1.068
0.0750	115.0	13.53	1.144
0.0800	125.0	14.68	1.221
0.0850	135.0	15.82	1.297
0.0900	144.0	16.84	1.373
0.0950	157.0	18.33	1.449
0.1000	166.0	19.35	1.526
0.1050	177.5	20.65	1.602
0.1100	187.5	21.79	1.678
0.1150	201.5	23.37	1.755
0.1200	214.5	24.85	1.831
0.1250	229.0	26.49	1.907

Axial Deformation (in.)	Load (lb.)	Compressive Stress (psi)	Axial Strain (%)
0.1300	245.0	28.30	1.98
0.1350	260.5	30.05	2.06
0.1400	276.0	31.80	2.14
0.1450	293.0	33.72	2.21
0.1500	310.0	35.63	2.29
0.1550	330.0	37.88	2.36
0.1600	348.0	39.90	2.44
0.1650	368.0	42.15	2.52
0.1700	383.0	43.82	2.59
0.1750	400.0	45.72	2.67
0.1800	417.0	47.62	2.75
0.1850	429.0	48.94	2.82
0.1900	434.5	49.53	2.90
0.1950	434.0	49.43	2.98
0.2000	428.0	48.71	3.05
0.2050	417.0	47.43	3.13
0.2100	401.0	45.58	3.20
0.2150	361.0	41.03	3.28
0.2200	287.0	32.64	3.36
0.2250	245.0	27.88	3.43
0.2300	217.0	24.70	3.51
0.2350	199.0	22.66	3.59
0.2400	163.0	18.59	3.66
0.2450	134.0	15.31	3.74
0.2500	99.0	11.37	3.81



Boring No.:	R-09-Z1-B7
Sample No.:	C45
Depth (ft):	237.4-238.3
Soil Type:	Core
Sample Description:	Dark gray silt'stone' (ML)

Sample Diameter (in.)	3.302
Sample Height (in.)	6.554
Initial Moisture Content (%)	4.66
Dry Density (pcf)	112.2
Specific Gravity (assumed)	2.7
Saturation (%)	25.1
Rate of Deformation (in/min)	0.0120
Height / Diameter Ratio	1.99

At Failure

Compressive Strength (psi)	**49.53**
Axial Strain (%)	2.90

Leighton

Unconfined Compressive Strength of Cohesive Soil
ASTM D 2166

Project No.: **378312.04.09.01**

SR-710 Tunnel Technical Study

04/24/09

UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: April 2, 2009

Client: CH2MHill

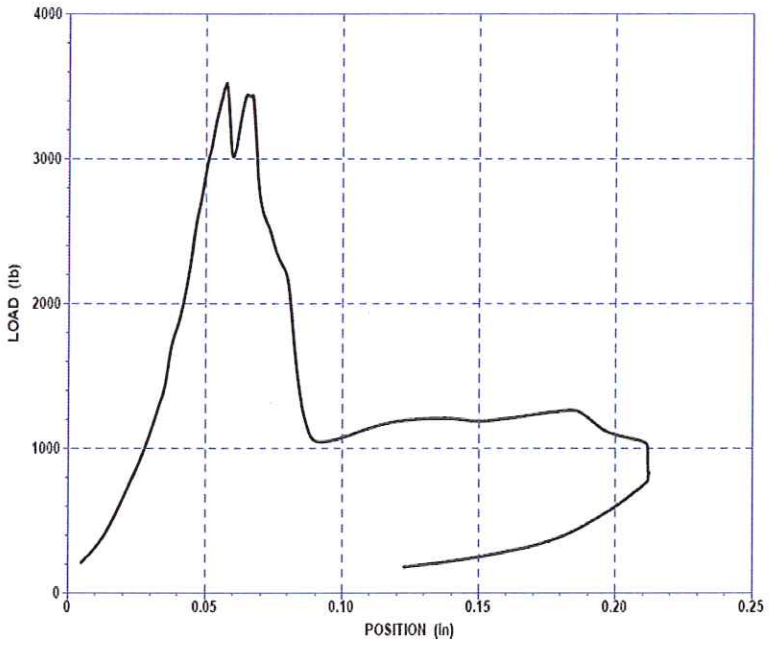
Material Type: Sandstone
Date Cast: n/a
Date Tested: 4/2/09
Age, Days: n/a

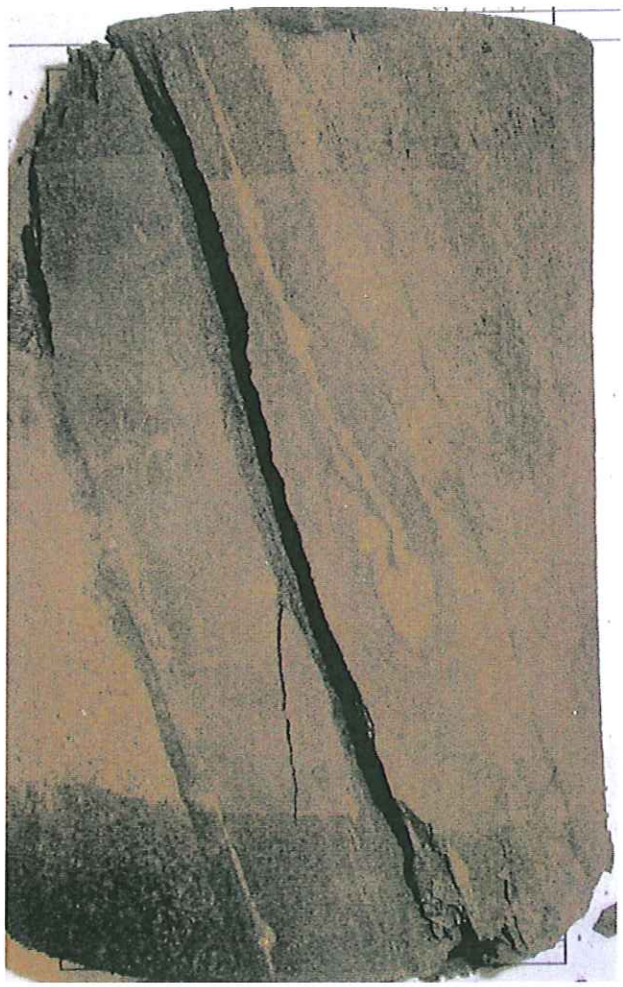
Depth: 247.3-248.7

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

Test Results

Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z1-B7, C47		3.26	5.9	128.0	113.4	12.9	440





Elastic Modulus (psi)*:	44759

*using secant elastic modulus formula

UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: April 2, 2009

Client: CH2MHill

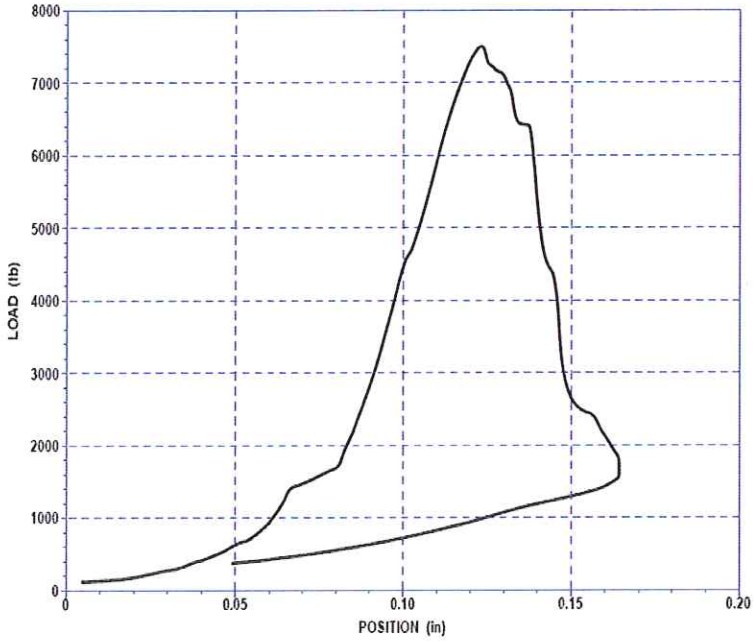
Material Type: Siltstone
Date Cast: n/a
Date Tested: 4/2/09
Age, Days: n/a

Depth: 284.1-285.6

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

Test Results

Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z1-B7, C56		3.24	6.1	121.5	107.6	13.0	932



Elastic Modulus (psi)*:	46259

*using secant elastic modulus formula

UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: April 10, 2009

Client: CH2MHill

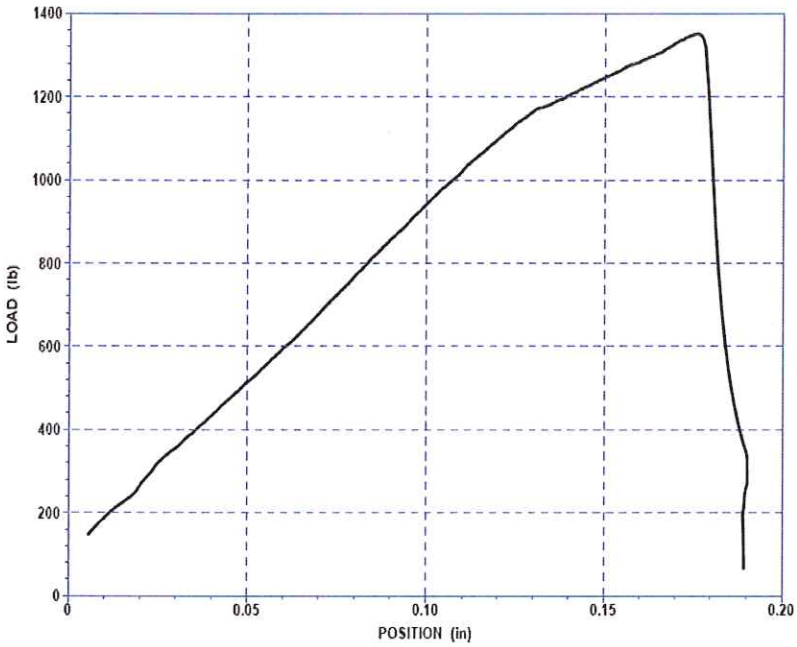
Material Type: Mudstone
Date Cast: n/a
Date Tested: 4/10/09
Age, Days: n/a

Depth: 133.1-134

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

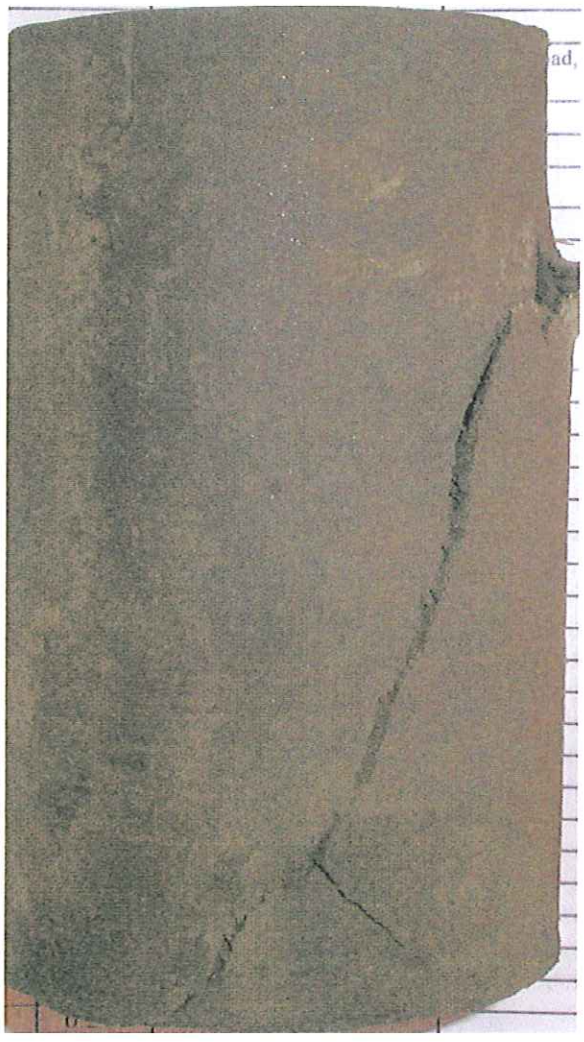
Test Results

Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z1-B8, C28		2.41	4.7	123.3	100.2	23.0	299



Elastic Modulus (psi)*:	7940

*using secant elastic modulus formula



UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: April 10, 2009

Client: CH2MHill

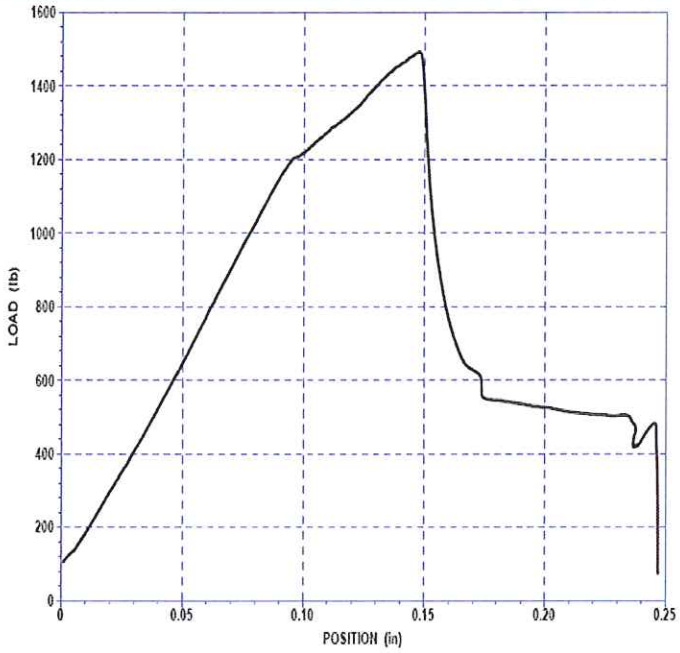
Material Type: Mudstone
Date Cast: n/a
Date Tested: 4/10/09
Age, Days: n/a

Depth: 147.9-148.5

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

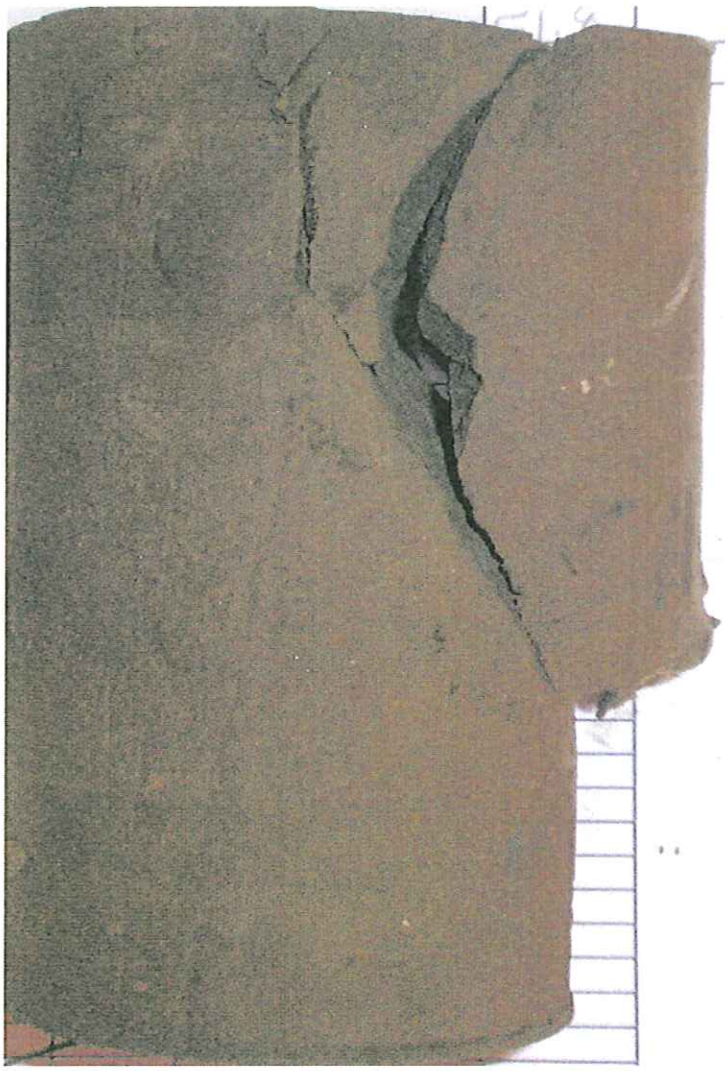
Test Results

Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z1-B8, C31		2.42	4.6	127.8	104.9	21.8	324



Elastic Modulus (psi)*:	10,009

*using secant elastic modulus formula



UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: April 10, 2009

Client: CH2MHill

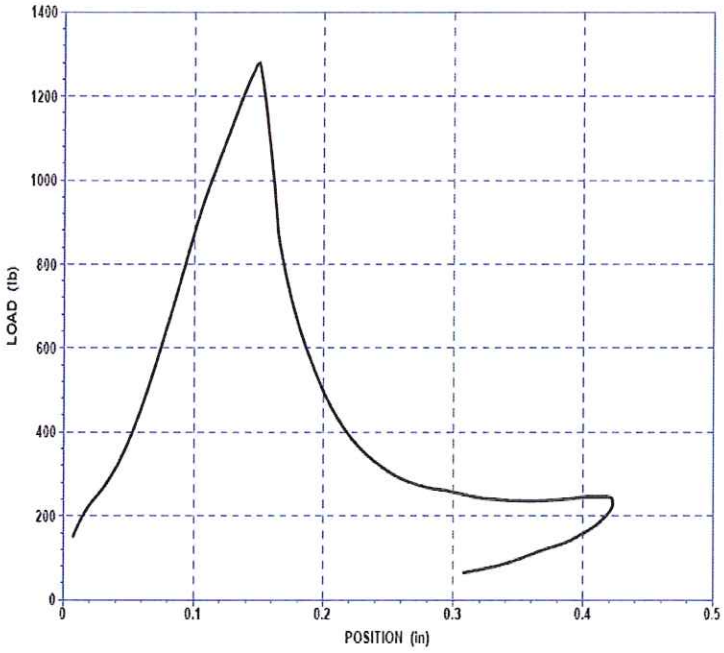
Material Type: Mudstone
Date Cast: n/a
Date Tested: 4/10/09
Age, Days: n/a

Depth: 175-175.75

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

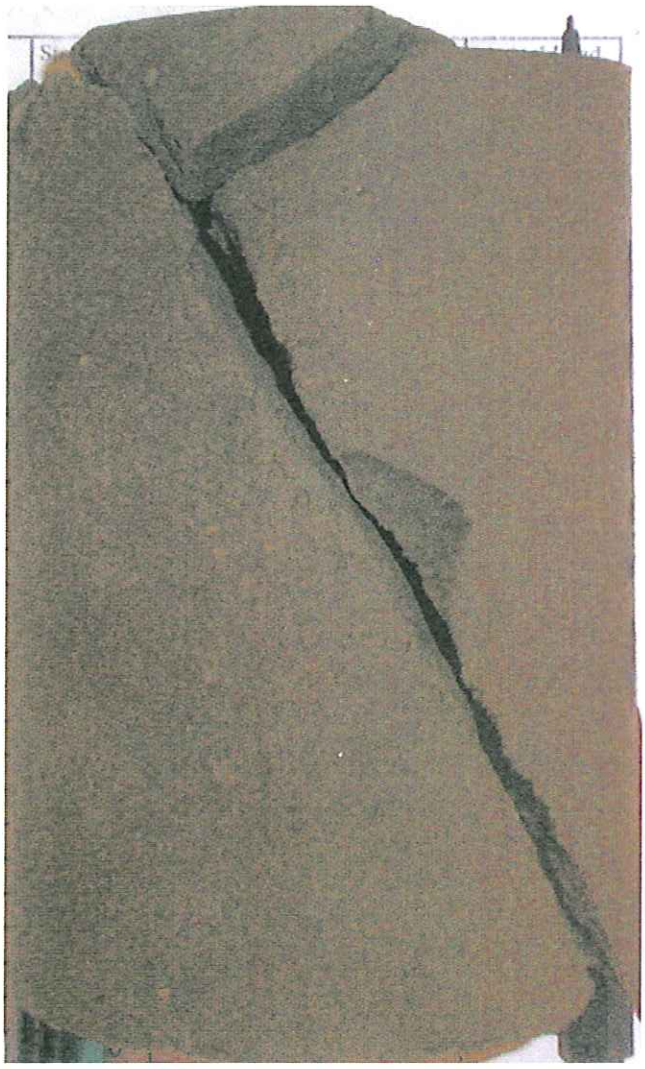
Test Results

Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z1-B8, C37		2.42	4.7	124.3	102.2	21.7	289



Elastic Modulus (psi)*:	8,792

*using secant elastic modulus formula



UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: April 10, 2009

Client: CH2MHill

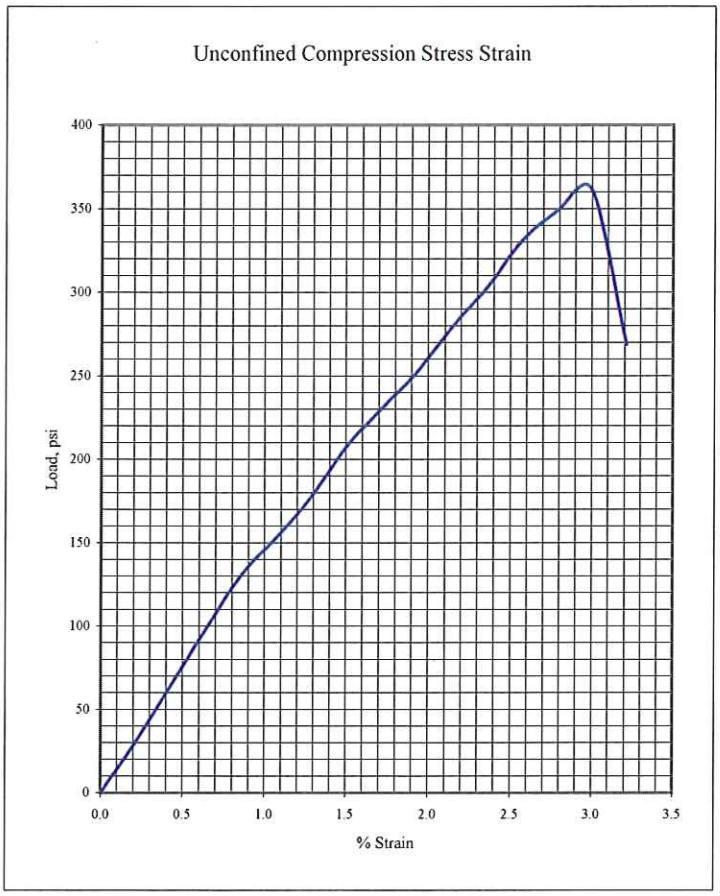
Material Type: Mudstone
Date Cast: n/a
Date Tested: 4/10/09
Age, Days: n/a

Depth: 195-196.25

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

Test Results

Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z1-B8, C41		2.32	4.7	123.7	101.6	21.7	361



Elastic Modulus (psi)*:	12052

*using secant elastic modulus formula

UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: May 1, 2009

Client: CH2MHill

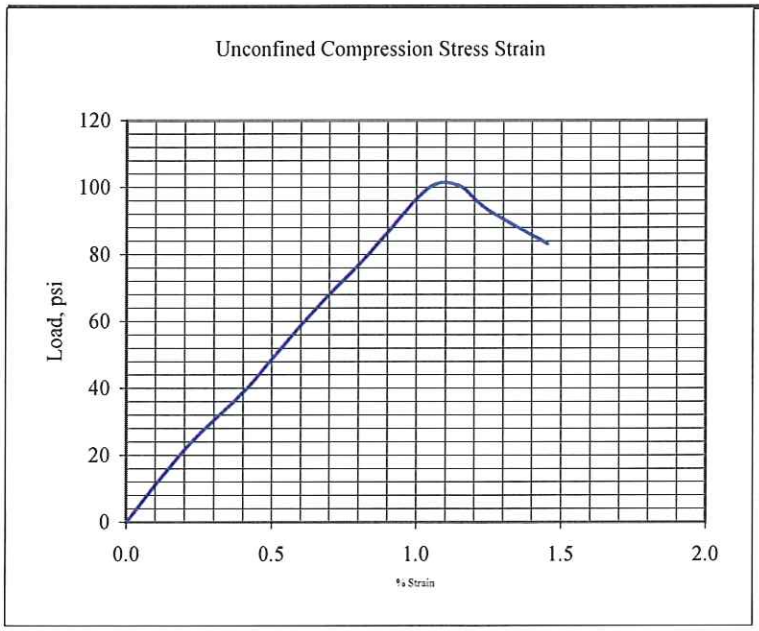
Material Type: Claystone
Date Cast: n/a
Date Tested: 5/1/09
Age, Days: n/a

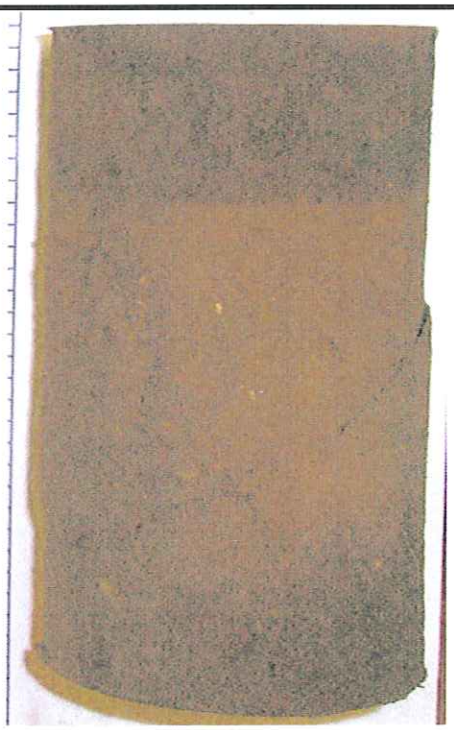
Depth: 192.4-193.1

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

Test Results

Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z2-B2, C34		2.44	4.8	141.1	127.3	10.8	101





Elastic Modulus (psi)*:	8,788

* using secant elastic modulus formula

UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: May 1, 2009

Client: CH2MHill

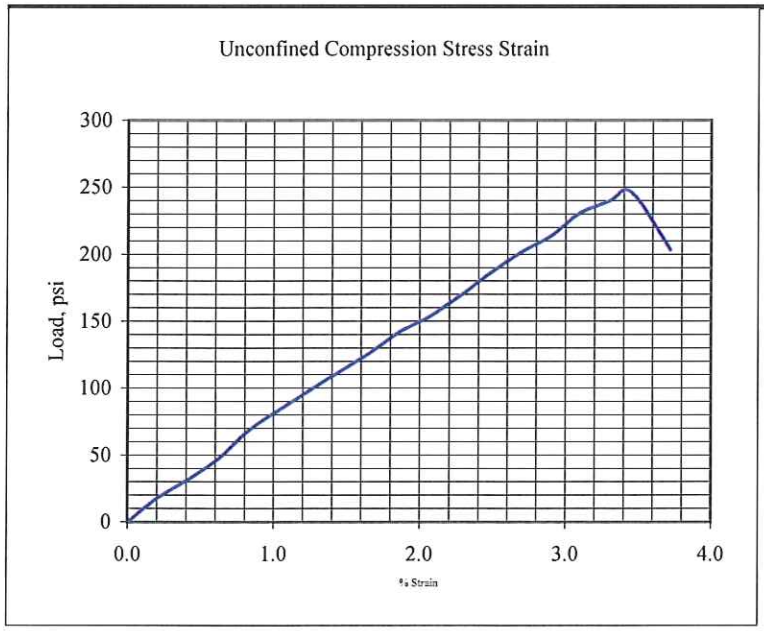
Material Type: Siltstone
Date Cast: n/a
Date Tested: 5/1/09
Age, Days: n/a

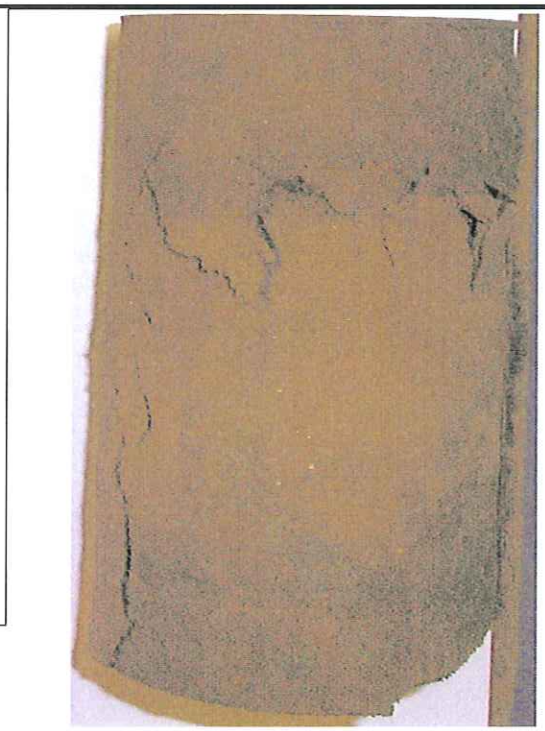
Depth: 206-206.6

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

Test Results

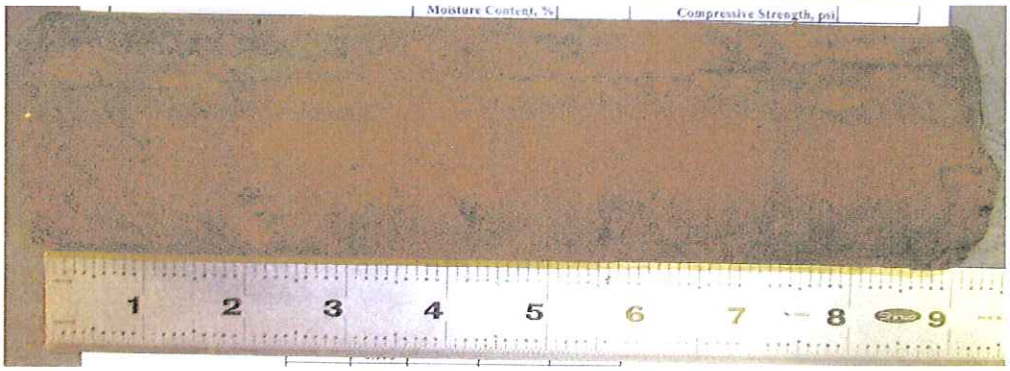
Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z2-B2, C37		2.44	4.8	142.2	129.1	10.2	248





Elastic Modulus (psi)*:	7,223

* using secant elastic modulus formula



Leighton

UNCONFINED COMPRESSIVE STRENGTH of COHESIVE SOIL

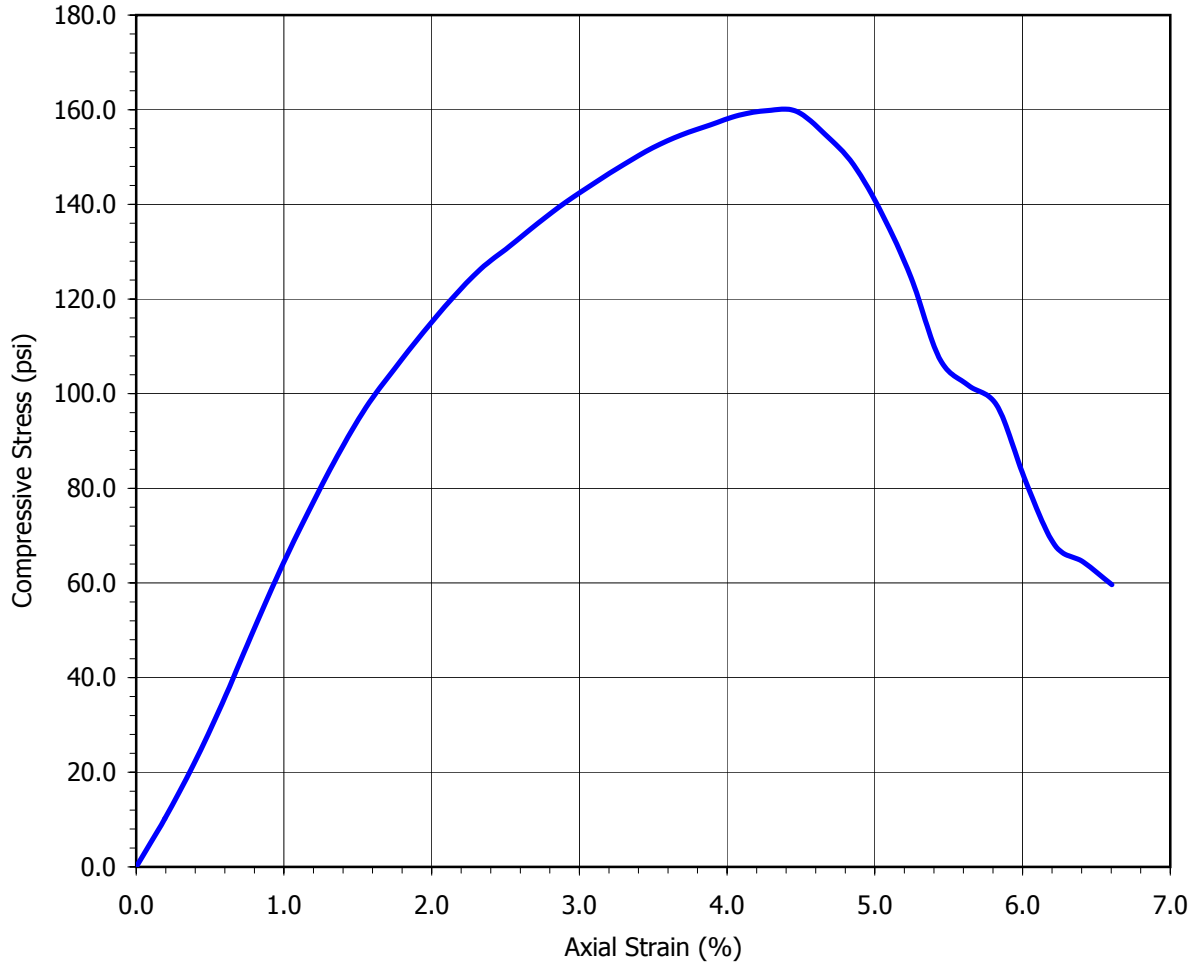
ASTM D 2166

Project Name:	SR-710 Tunnel Technical Study	Tested by:	A. Santos	Date:	05/21/09
Project No.:	378312.04.09.01	Checked by:	J. Ward	Date:	05/27/09
Boring No.:	R-09-Z2-B2	Sample Type:	Core		
Sample No.:	C42	Depth (ft):	232.8-233.4		
Sample Description:	Dark olive brown lean clay'stone' (CL)				

Weight of Sample + Tube / Rings (g)	919.30
Weight of Tube / Rings (g)	0.00
Wet Weight of Soil + Container (g)	1470.10
Dry Weight of Soil + Container (g)	1339.30
Weight of Container (g)	108.50
Load Surcharge (lb)	2.20
Rate of Deformation (in/min)	0.012
Specific Gravity (Assumed)	2.70

Sample Measurements	
Diameter (in)	2.490
	2.450
	2.485
Area (sq.in.)	4.811
Height (in)	5.152
	5.144
	5.147

Axial Deformation (in.)	Load (lb.)	Compressive Stress (psi)	Axial Strain (%)
0.0000	0.0	0.00	0.000
0.0100	47.0	10.21	0.194
0.0200	102.5	21.68	0.389
0.0300	165.0	34.55	0.583
0.0400	234.0	48.71	0.777
0.0500	301.5	62.51	0.971
0.0600	363.0	75.02	1.166
0.0700	421.0	86.77	1.360
0.0800	472.0	97.03	1.554
0.0900	513.0	105.21	1.748
0.1000	552.0	112.95	1.943
0.1100	588.0	120.05	2.137
0.1200	620.0	126.31	2.331
0.1300	645.0	131.13	2.525
0.1400	670.5	136.02	2.720
0.1500	694.5	140.59	2.914
0.1600	716.0	144.64	3.108
0.1700	736.5	148.47	3.303
0.1800	755.5	151.98	3.497
0.1900	770.5	154.68	3.691
0.2000	782.5	156.77	3.885
0.2100	794.5	158.84	4.080
0.2200	801.0	159.81	4.274
0.2300	802.0	159.69	4.468
0.2400	779.0	154.80	4.662
0.2500	748.0	148.36	4.857
0.2600	696.0	137.79	5.05
0.2700	630.0	124.51	5.25
0.2800	544.0	107.35	5.44
0.2900	516.5	101.74	5.63
0.3000	495.5	97.42	5.83
0.3100	414.5	81.40	6.02
0.3200	347.0	68.07	6.22
0.3300	329.0	64.43	6.41
0.3400	305.0	59.64	6.61



Boring No.:	R-09-Z2-B2
Sample No.:	C42
Depth (ft):	232.8-233.4
Soil Type:	Core
Sample Description:	Dark olive brown lean clay'stone' (CL)

Sample Diameter (in.)	2.475
Sample Height (in.)	5.148
Initial Moisture Content (%)	10.63
Dry Density (pcf)	127.8
Specific Gravity (assumed)	2.7
Saturation (%)	90.2
Rate of Deformation (in/min)	0.0120
Height / Diameter Ratio	2.08

At Failure

Compressive Strength (psi)	**159.81**
Axial Strain (%)	4.27

Leighton

Unconfined Compressive Strength of Cohesive Soil
ASTM D 2166

Project No.: **378312.04.09.01**

SR-710 Tunnel Technical Study

05/21/09

UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: June 1, 2009

Client: CH2MHill

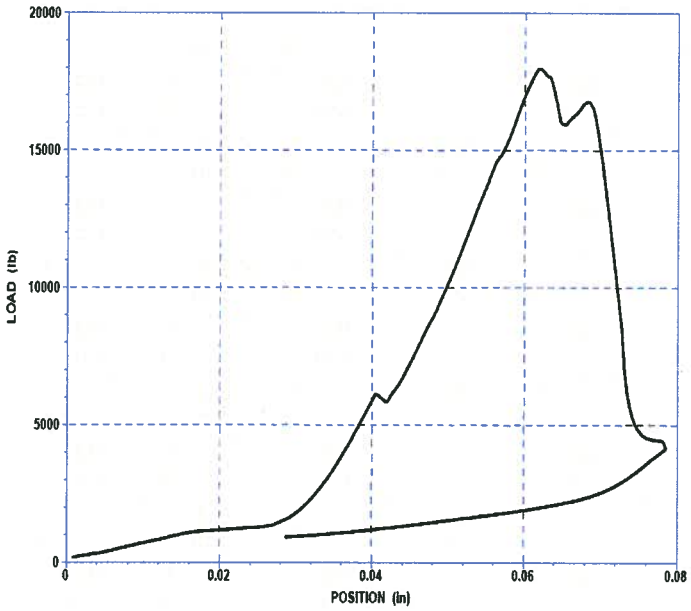
Material Type: siltstone
Date Cast: n/a
Date Tested: 6/1/09
Age, Days: n/a

Depth: 250.9-251.5

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

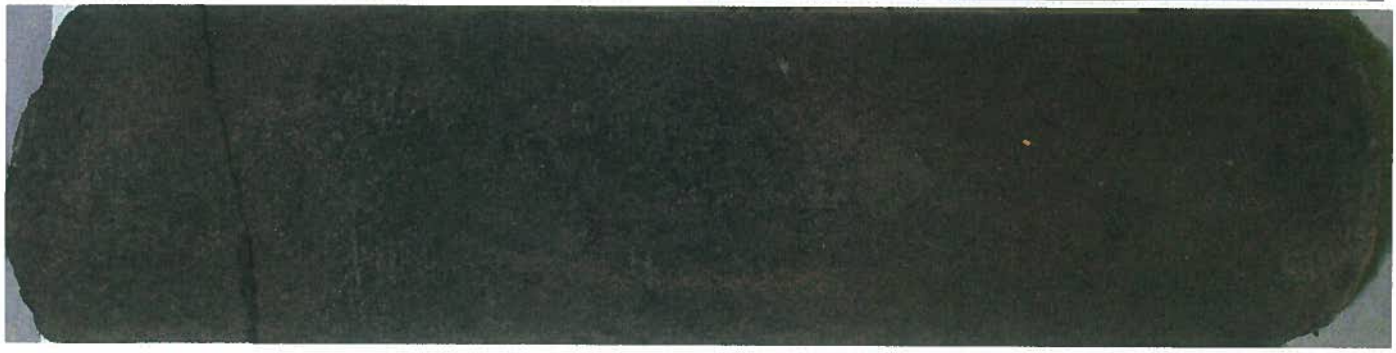
Test Results

Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z2-B3, C62		2.39	4.8	159.8	155.0	3.1	4026



Elastic Modulus (psi)*:	311,659

* using secant elastic modulus formula



UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: June 1, 2009

Client: CH2MHill

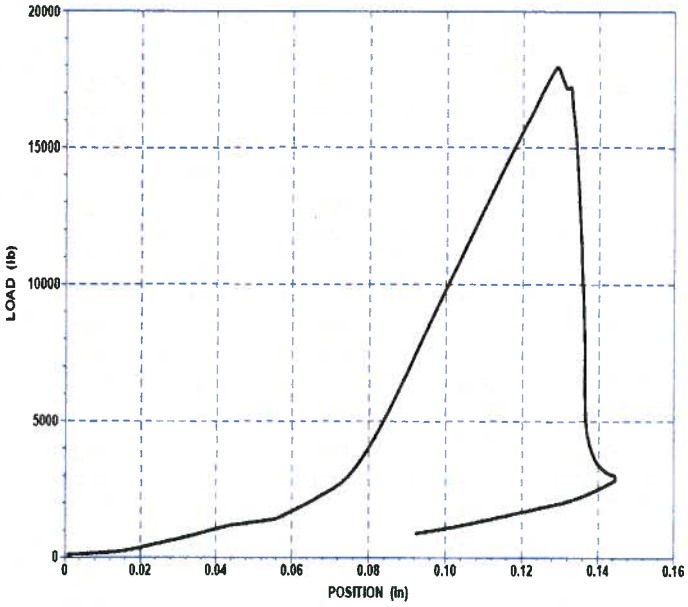
Material Type: siltstone
Date Cast: n/a
Date Tested: 6/1/09
Age, Days: n/a

Depth: 342.5-343.3

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

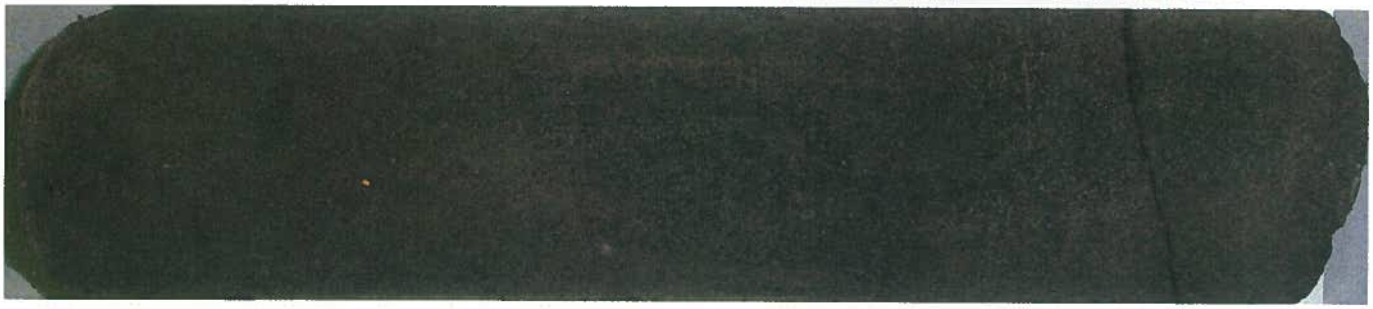
Test Results

Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z2-B3, C79		2.38	4.8	145.8	136.6	6.7	4043



Elastic Modulus (psi)*:	150,077

* using secant elastic modulus formula



UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: June 1, 2009

Client: CH2MHill

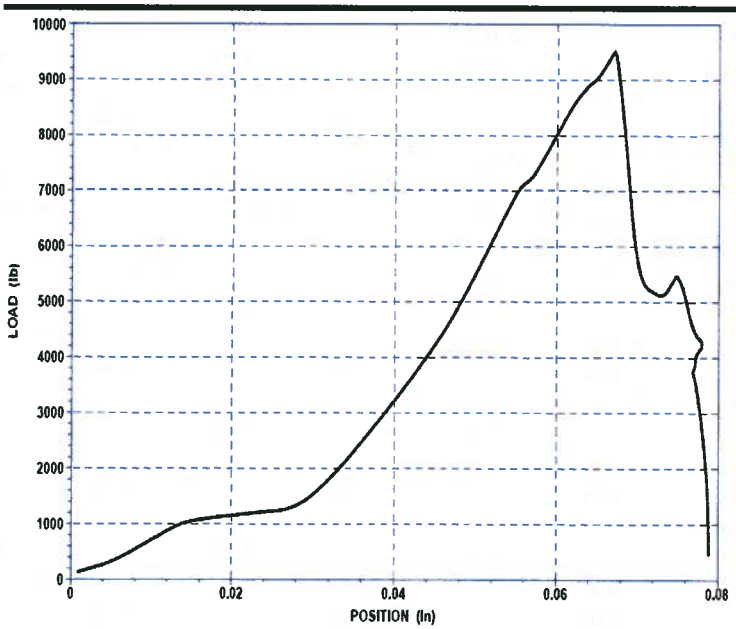
Material Type: siltstone
Date Cast: n/a
Date Tested: 6/1/09
Age, Days: n/a

Depth: 280.5-281.4

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

Test Results

Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z2-B3, C68		2.40	4.8	133.5	119.3	11.9	2128



Elastic Modulus (psi)*:	151,072

* using secant elastic modulus formula

UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: June 2, 2009

Client: CH2MHill

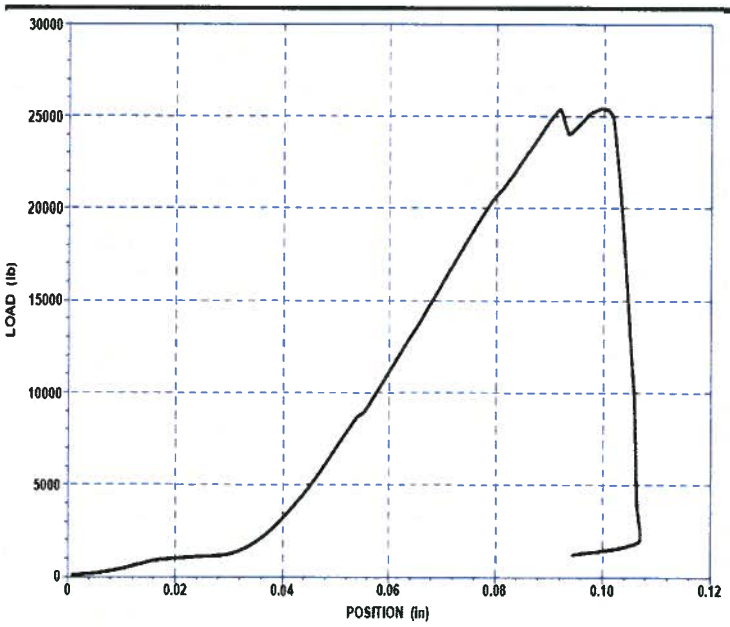
Material Type: siltstone
Date Cast: n/a
Date Tested: 6/1/09
Age, Days: n/a

Depth: 197.2-198

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

Test Results

Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z2-B3, C50		2.40	4.8	137.0	124.1	10.3	5636



Elastic Modulus (psi)*:	271,356

* using secant elastic modulus formula

UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: June 1, 2009

Client: CH2MHill

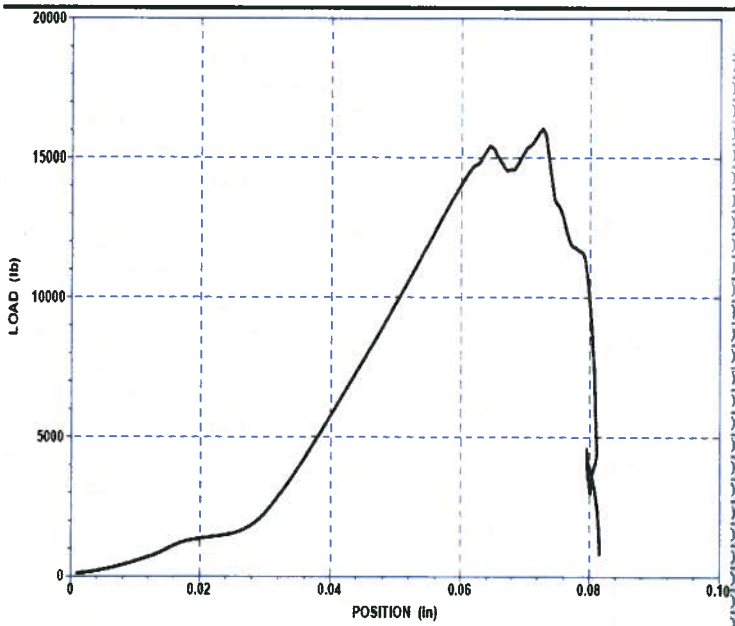
Material Type: siltstone
Date Cast: n/a
Date Tested: 6/1/09
Age, Days: n/a

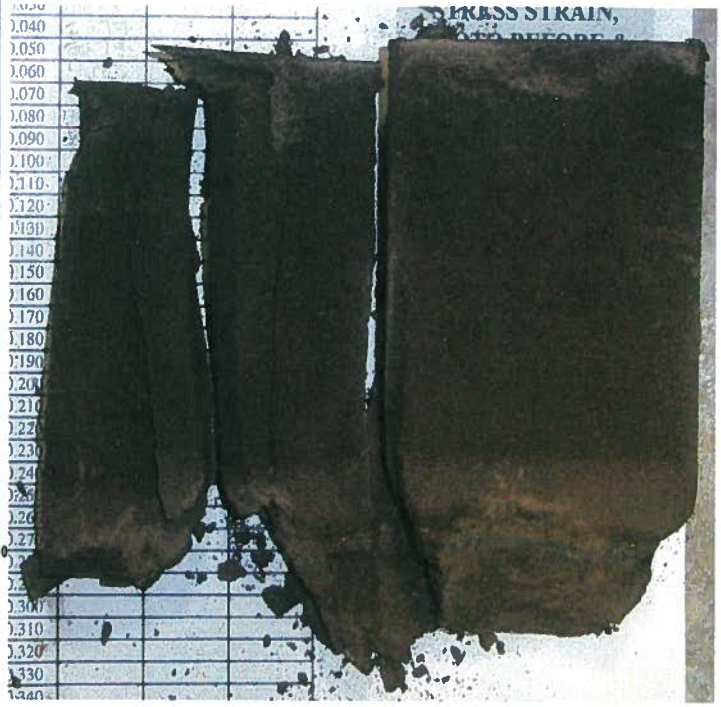
Depth: 306-306.8

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

Test Results

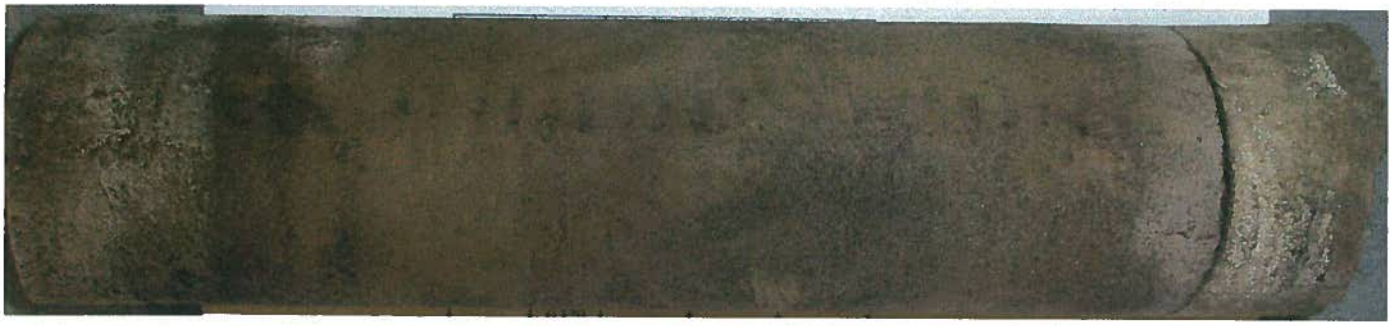
Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z2-B3, C73		2.40	4.8	147.7	137.0	7.8	3558





Elastic Modulus (psi)*:	234,298

* using secant elastic modulus formula



UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: June 1, 2009

Client: CH2MHill

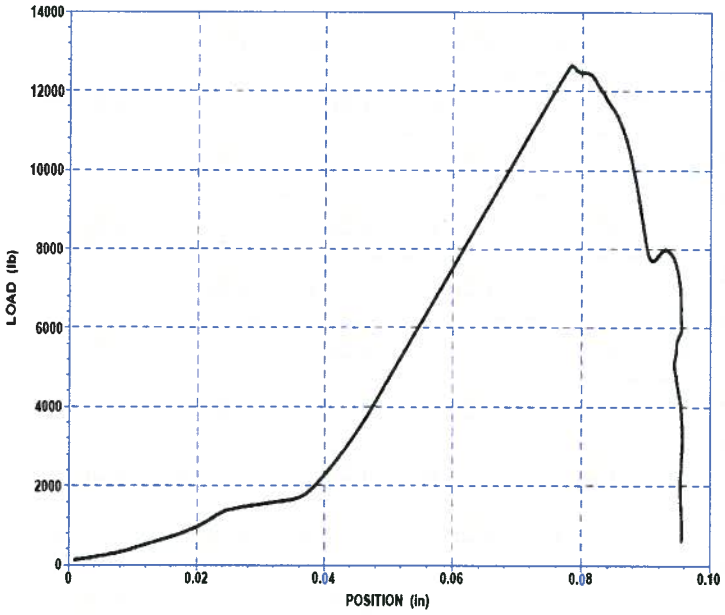
Material Type: siltstone
Date Cast: n/a
Date Tested: 6/1/09
Age, Days: n/a

Depth: 215-215.9

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

Test Results

Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z2-B3, C55		2.40	4.3	140.2	126.7	10.6	2812



Elastic Modulus (psi)*:	175,507

* using secant elastic modulus formula

UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: May 1, 2009

Client: CH2MHill

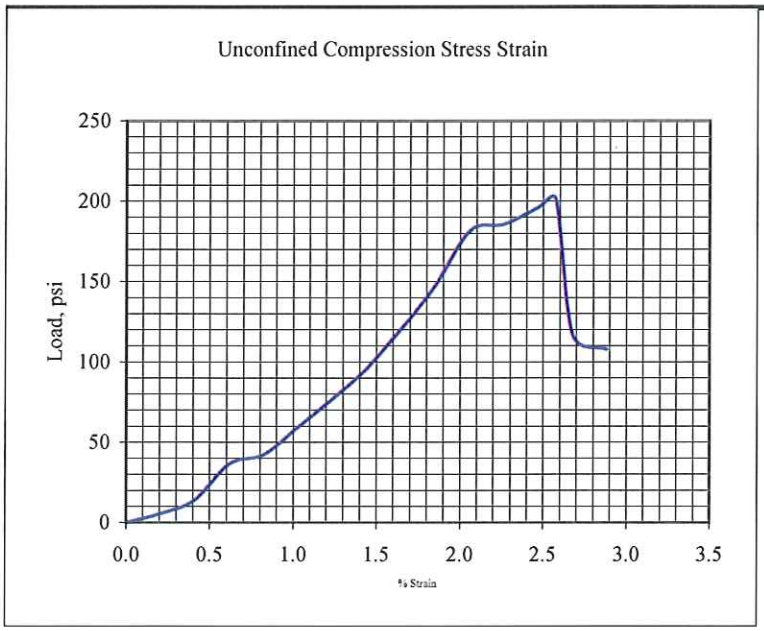
Material Type: Siltstone
Date Cast: n/a
Date Tested: 5/1/09
Age, Days: n/a

Depth: 138-138.7

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

Test Results

Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z2-B4, C34		2.44	4.9	129.8	113.3	14.6	201



Elastic Modulus (psi)*:	7,899

* using secant elastic modulus formula

UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: May 1, 2009

Client: CH2MHill

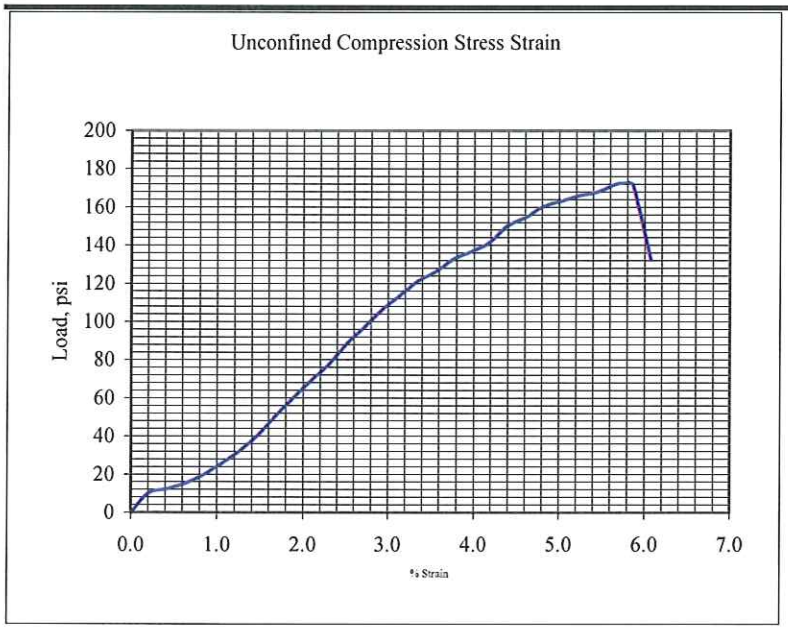
Material Type: Sandstone
Date Cast: n/a
Date Tested: 5/1/09
Age, Days: n/a

Depth: 208.3-209

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

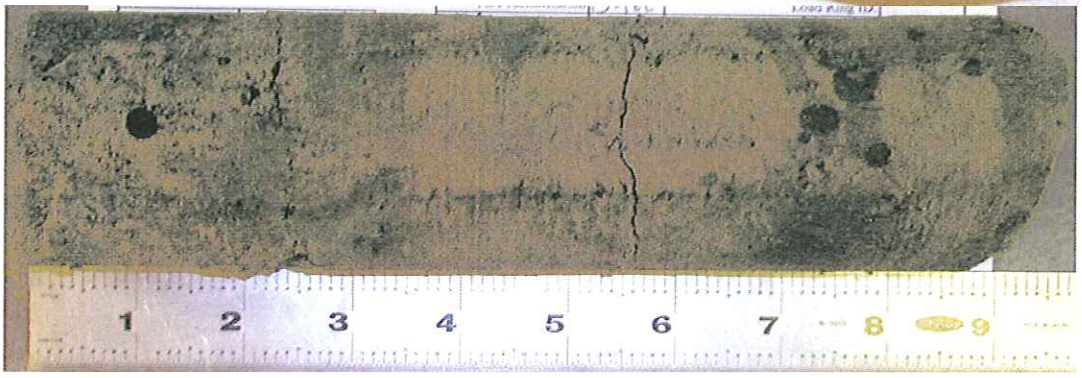
Test Results

Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z2-B4, C55		2.42	4.8	137.6	127.0	8.3	173



Elastic Modulus (psi)*:	3,013

* using secant elastic modulus formula



UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: May 1, 2009

Client: CH2MHill

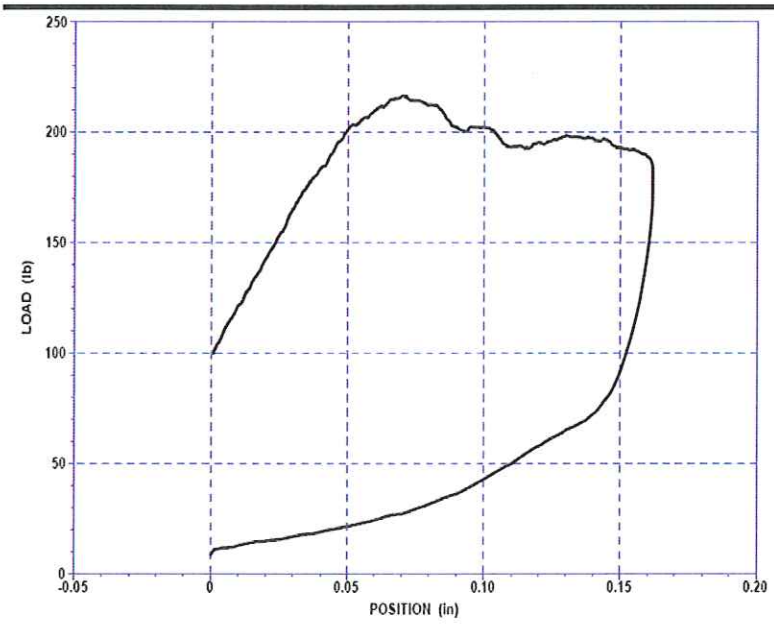
Material Type: Sandstone
Date Cast: n/a
Date Tested: 5/1/09
Age, Days: n/a

Depth: 276-276.7

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

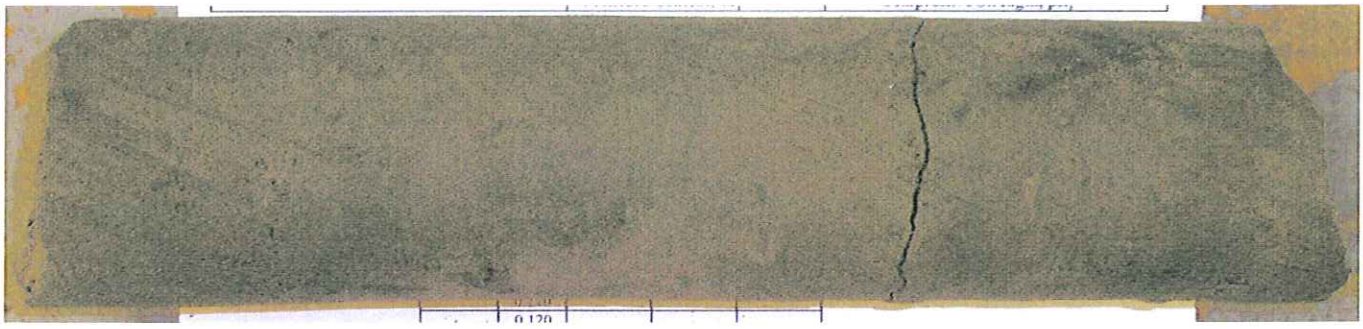
Test Results

Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z2-B4, C74		2.44	4.9	127.7	114.6	11.4	47



Elastic Modulus (psi)*:	2,740

* using secant elastic modulus formula



UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: May 1, 2009

Client: CH2MHill

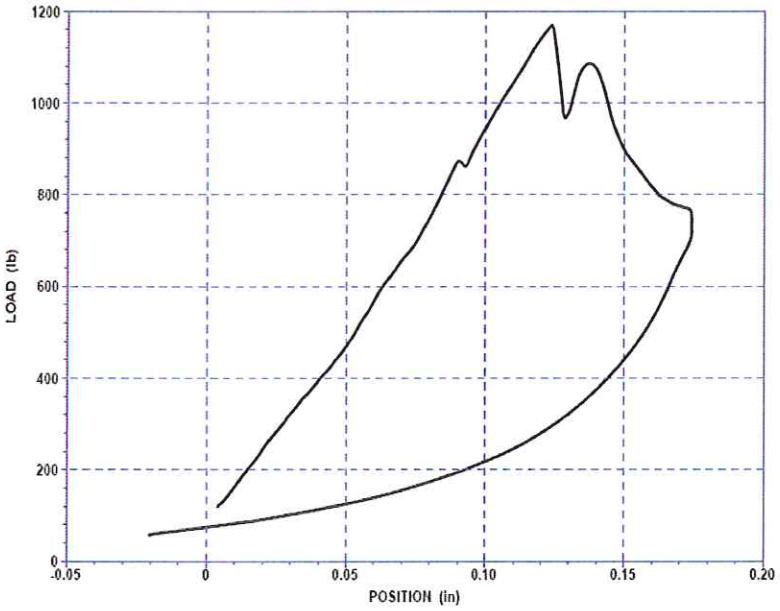
Material Type: Mudstone
Date Cast: n/a
Date Tested: 5/1/09
Age, Days: n/a

Depth: 288.5-289.3

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

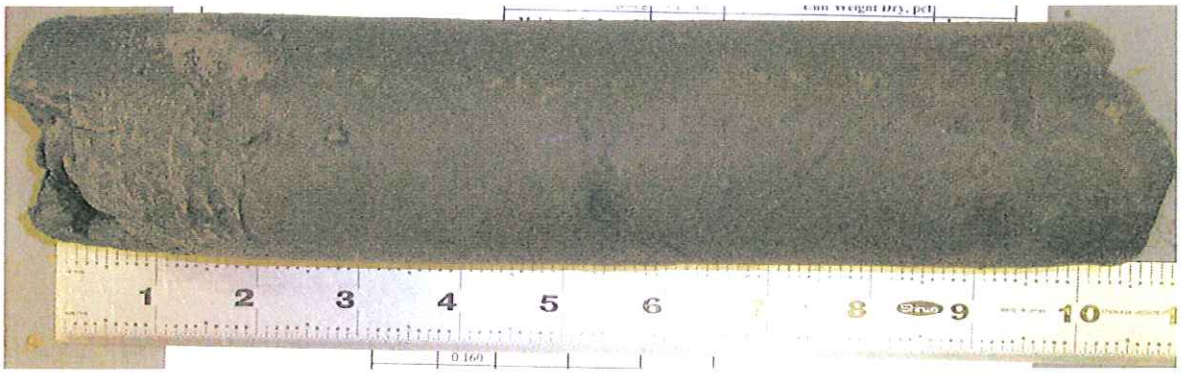
Test Results

Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z2-B4, C78		2.44	4.9	127.7	110.3	15.8	252



Elastic Modulus (psi)*:	9,835

* using secant elastic modulus formula



UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: May 1, 2009

Client: CH2MHill

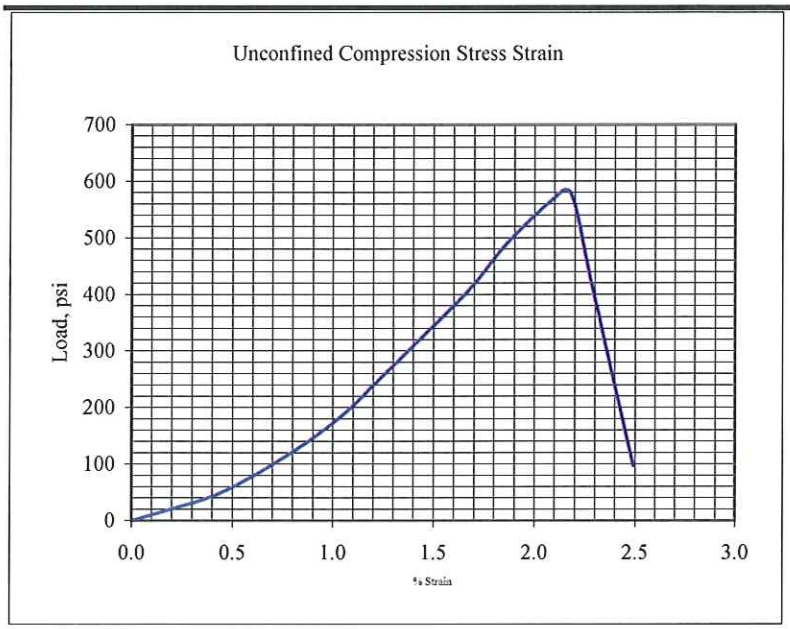
Material Type: Mudstone
Date Cast: n/a
Date Tested: 5/1/09
Age, Days: n/a

Depth: 328.8-329.4

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

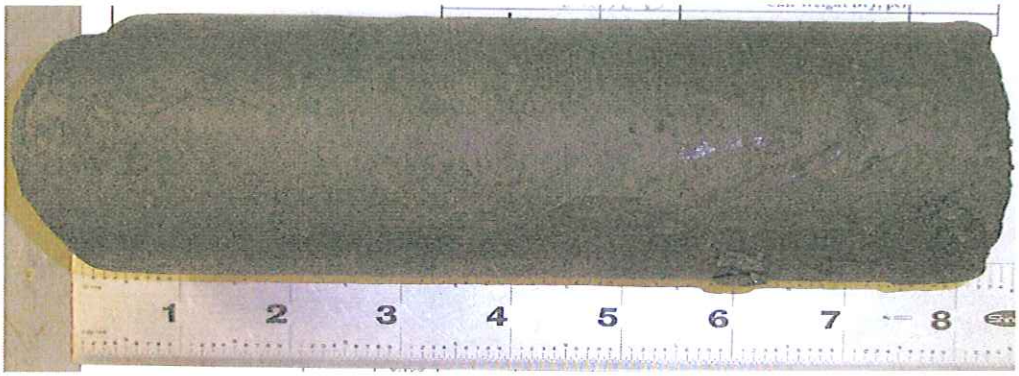
Test Results

Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z2-B4, C90		2.41	4.8	135.4	119.5	13.3	579



Elastic Modulus (psi)*:	26,446

* using secant elastic modulus formula



UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: May 1, 2009

Client: CH2MHill

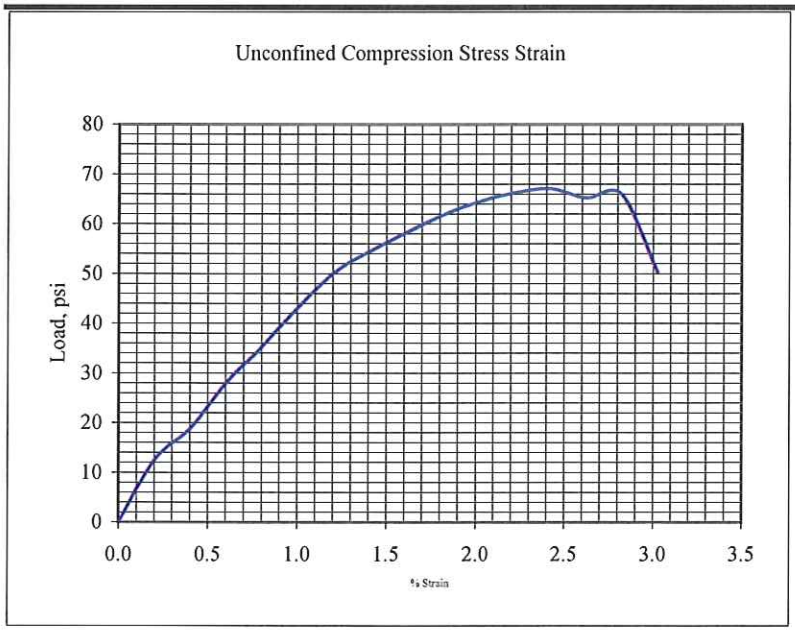
Material Type: Mudstone
Date Cast: n/a
Date Tested: 5/1/09
Age, Days: n/a

Depth: 392-392.6

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

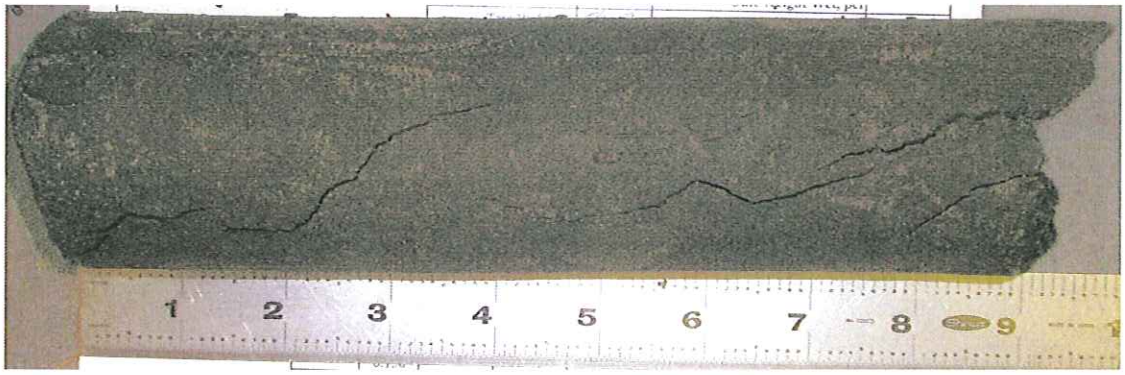
Test Results

Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z2-B4, C109		2.49	5.0	133.0	115.4	15.3	67



Elastic Modulus (psi)*:	2,800

* using secant elastic modulus formula



Leighton

UNCONFINED COMPRESSIVE STRENGTH of COHESIVE SOIL

ASTM D 2166

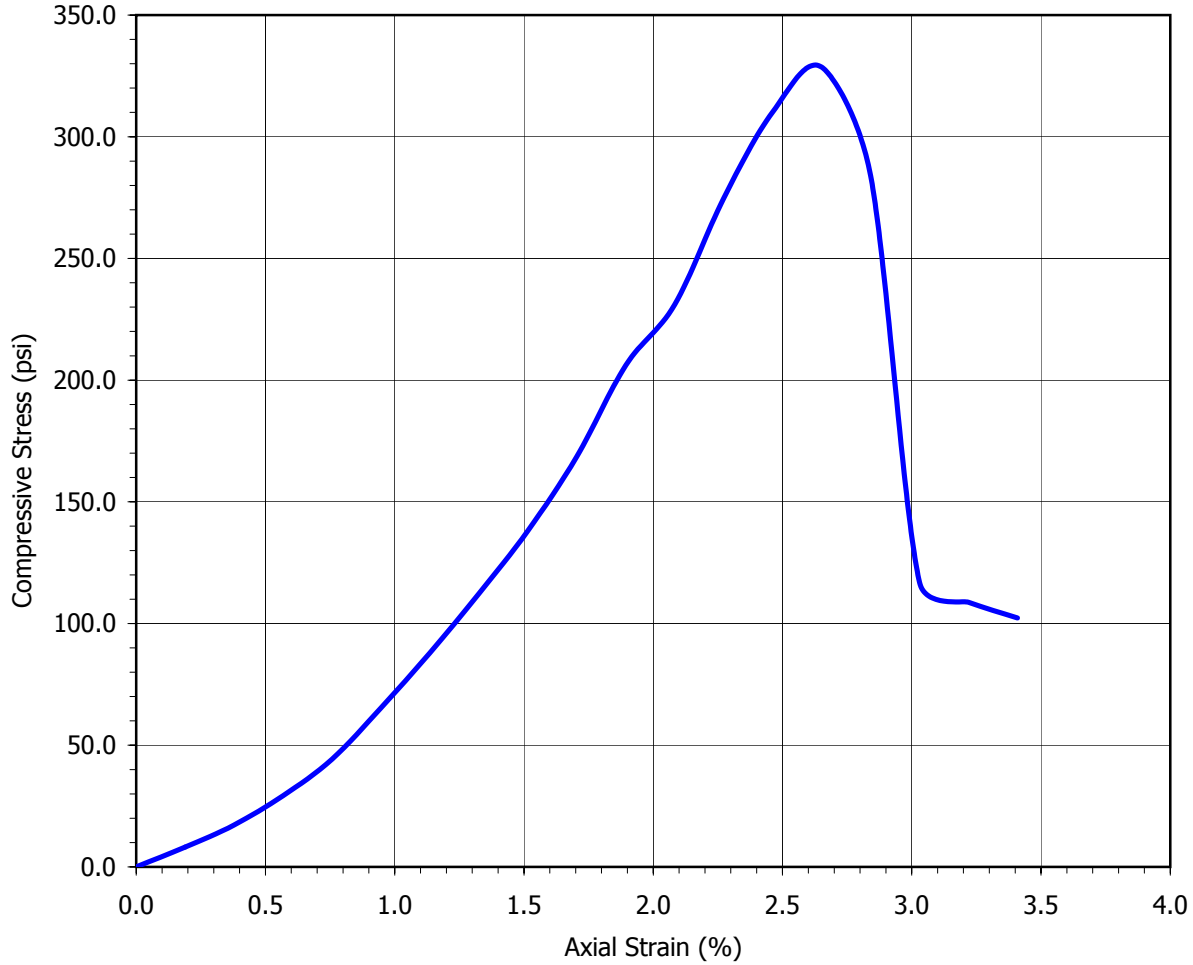
Project Name:	SR-710 Tunnel Technical Study	Tested by:	A. Santos	Date:	05/18/09
Project No.:	378312.04.09.01	Checked by:	J. Ward	Date:	05/28/09
Boring No.:	R-09-Z2-B4	Sample Type:	Core		
Sample No.:	C59	Depth (ft):	219.4-220		
Sample Description:	Dark olive fat clay'stone' (CH)				

Weight of Sample + Tube / Rings (g)	841.90
Weight of Tube / Rings (g)	0.00
Wet Weight of Soil + Container (g)	948.60
Dry Weight of Soil + Container (g)	840.90
Weight of Container (g)	108.00
Load Surcharge (lb)	2.20
Rate of Deformation (in/min)	0.012
Specific Gravity (Assumed)	2.70

Sample Measurements	
Diameter (in)	2.470
	2.455
	2.450
Area (sq.in.)	4.746
Height (in)	5.307
	5.255
	5.280

Axial Deformation (in.)	Load (lb.)	Compressive Stress (psi)	Axial Strain (%)
0.0000	0.0	0.00	0.000
0.0100	36.5	8.14	0.189
0.0200	80.0	17.25	0.379
0.0300	137.5	29.27	0.568
0.0400	209.5	44.26	0.758
0.0500	311.0	65.36	0.947
0.0600	420.0	87.94	1.136
0.0700	538.0	112.30	1.326
0.0800	663.5	138.13	1.515
0.0900	812.0	168.61	1.704
0.1000	995.0	206.11	1.894
0.1100	1118.0	231.09	2.083
0.1200	1332.0	274.70	2.273
0.1300	1507.0	310.13	2.462
0.1400	1600.0	328.60	2.651
0.1500	1385.5	284.06	2.841
0.1600	570.0	116.90	3.030
0.1700	531.0	108.72	3.220
0.1800	500.5	102.30	3.409

Axial Deformation (in.)	Load (lb.)	Compressive Stress (psi)	Axial Strain (%)



Boring No.:	R-09-Z2-B4
Sample No.:	C59
Depth (ft):	219.4-220
Soil Type:	Core
Sample Description:	Dark olive fat clay'stone' (CH)

Sample Diameter (in.)	2.458
Sample Height (in.)	5.280
Initial Moisture Content (%)	14.70
Dry Density (pcf)	111.6
Specific Gravity (assumed)	2.7
Saturation (%)	77.8
Rate of Deformation (in/min)	0.0120
Height / Diameter Ratio	2.15

At Failure

Compressive Strength (psi)	**328.60**
Axial Strain (%)	2.65

Leighton

Unconfined Compressive Strength of Cohesive Soil
ASTM D 2166

Project No.: **378312.04.09.01**

SR-710 Tunnel Technical Study

05/18/09

UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: May 12, 2009

Client: CH2MHill

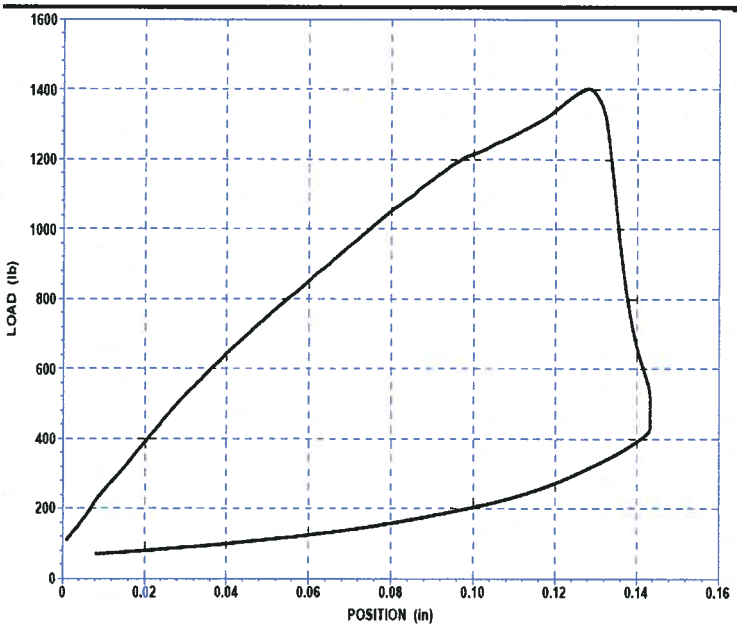
Material Type: Siltstone
Date Cast: n/a
Date Tested: 5/12/09
Age, Days: n/a

Depth: 188-188.8

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

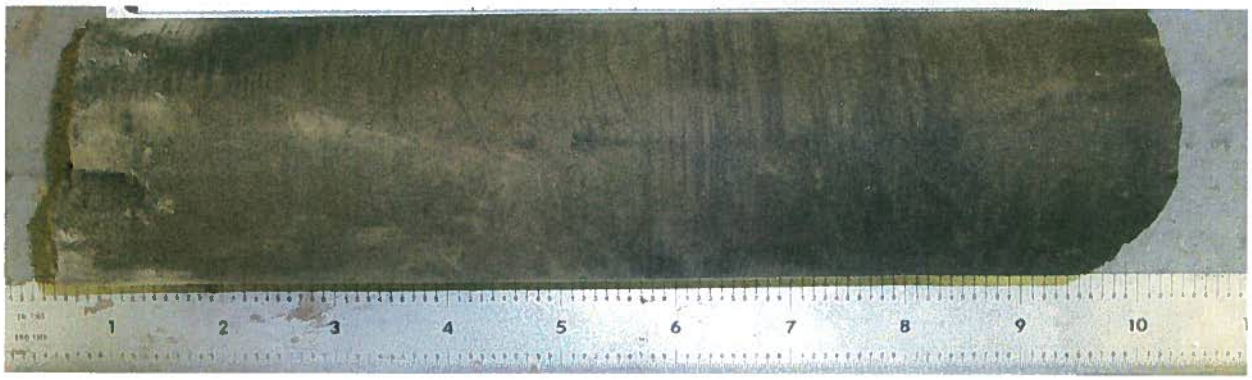
Test Results

Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z2-B5, C39		2.40	4.8	128.4	106.5	20.6	311



Elastic Modulus (psi)*:	11,556

* using secant elastic modulus formula



UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: May 12, 2009

Client: CH2MHill

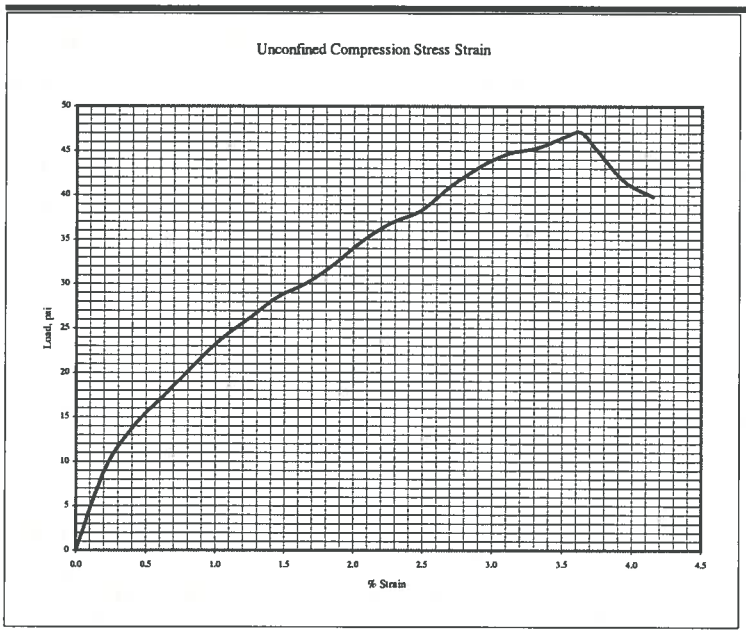
Material Type: Mudstone
Date Cast: n/a
Date Tested: 5/12/09
Age, Days: n/a

Depth: 203.4-204.2

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

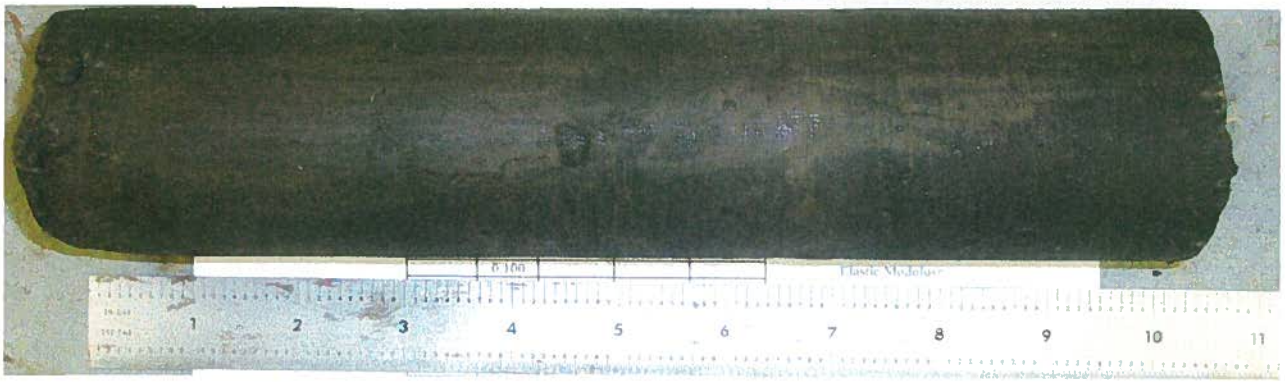
Test Results

Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z2-B5, C43		2.40	4.8	127.6	104.6	22.0	47



Elastic Modulus (psi)*:	1,292

* using secant elastic modulus formula



UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: May 12, 2009

Client: CH2MHill

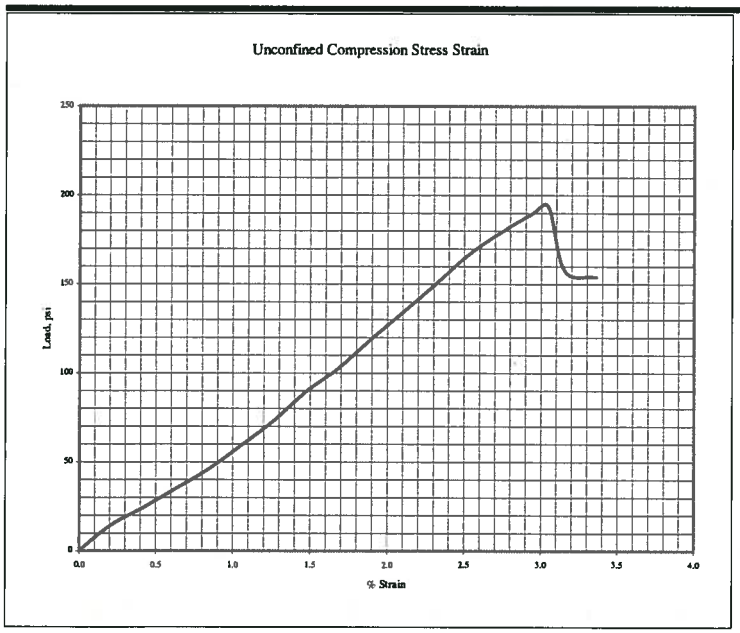
Material Type: Mudstone
Date Cast: n/a
Date Tested: 5/12/09
Age, Days: n/a

Depth: 240.5-241.2

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

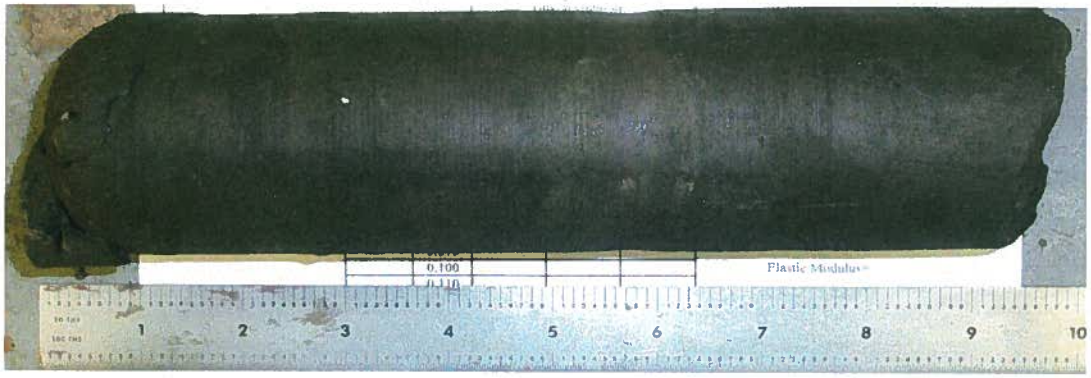
Test Results

Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z2-B5, C53	0	2.36	4.8	131.7	108.8	21.1	194



Elastic Modulus (psi)*:	6,409

* using secant elastic modulus formula



UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: May 12, 2009

Client: CH2MHill

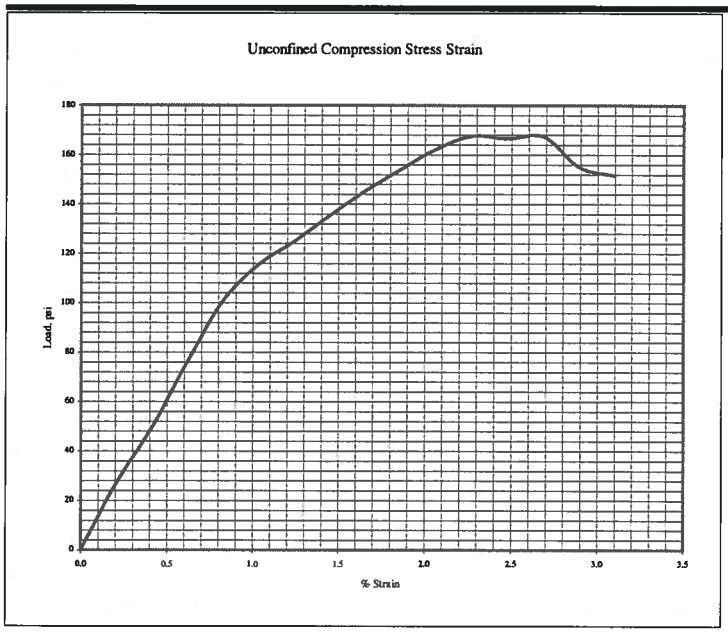
Material Type: Mudstone
Date Cast: n/a
Date Tested: 5/12/09
Age, Days: n/a

Depth: 291.8-292.4

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

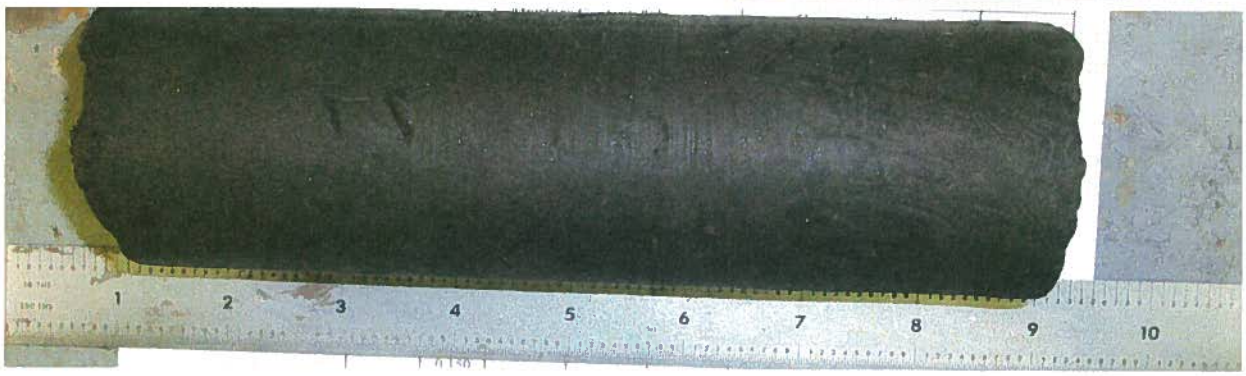
Test Results

Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z2-B5, C65		2.40	4.8	115.0	87.8	30.9	168



Elastic Modulus (psi)*:	6,188

* using secant elastic modulus formula



Leighton

UNCONFINED COMPRESSIVE STRENGTH of COHESIVE SOIL

ASTM D 2166

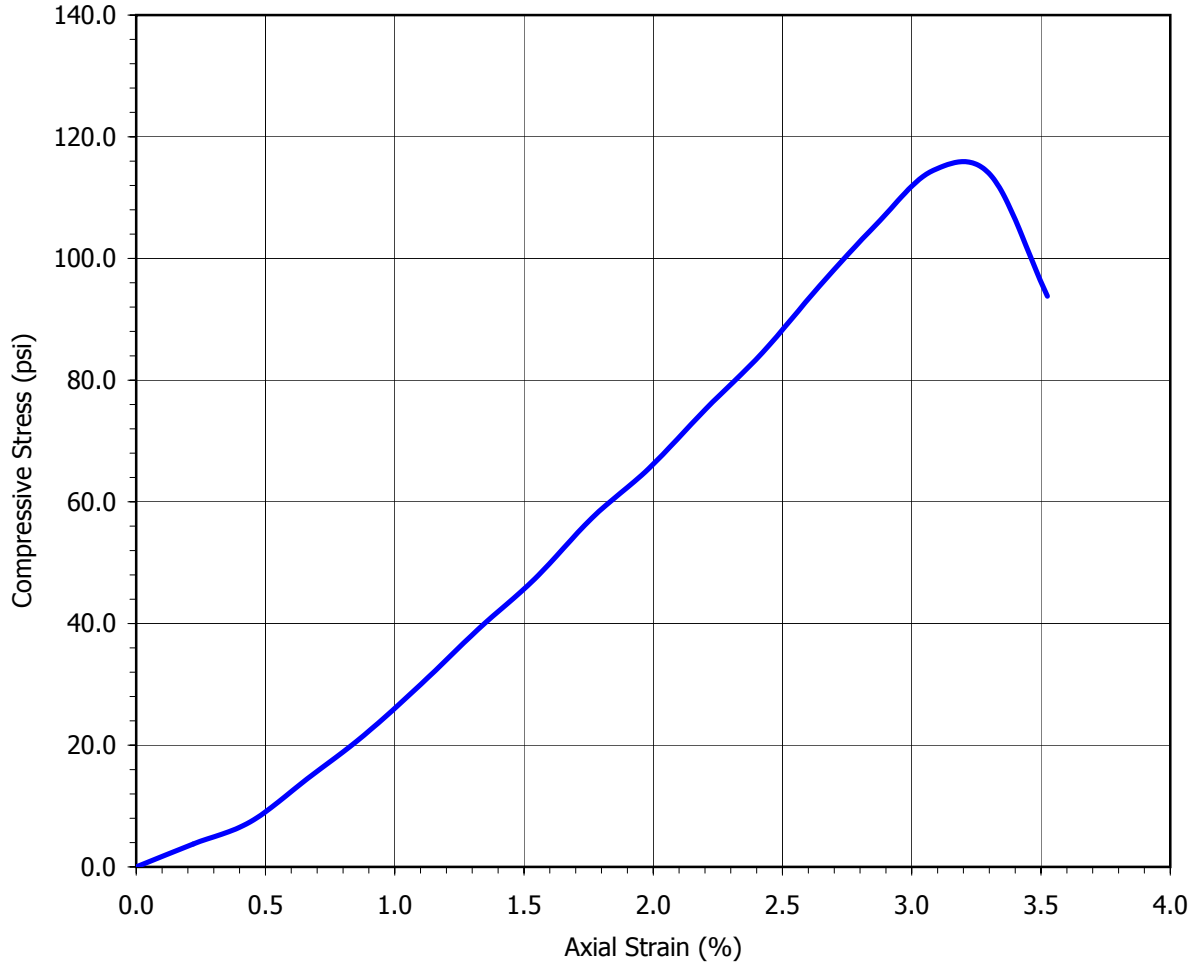
Project Name:	SR-710 Tunnel Technical Study	Tested by:	A. Santos	Date:	05/27/09
Project No.:	378312.04.09.01	Checked by:	J. Ward	Date:	06/01/09
Boring No.:	R-09-Z2-B5	Sample Type:	Core		
Sample No.:	C36	Depth (ft):	176.6-177.2		
Sample Description:	Very dark olive silt'stone' (ML)				

Weight of Sample + Tube / Rings (g)	693.60
Weight of Tube / Rings (g)	0.00
Wet Weight of Soil + Container (g)	1221.40
Dry Weight of Soil + Container (g)	1011.50
Weight of Container (g)	110.60
Load Surcharge (lb)	2.20
Rate of Deformation (in/min)	0.012
Specific Gravity (Assumed)	2.70

Sample Measurements	
Diameter (in)	2.450
	2.445
	2.430
Area (sq.in.)	4.682
Height (in)	4.540
	4.540
	4.539

Axial Deformation (in.)	Load (lb.)	Compressive Stress (psi)	Axial Strain (%)
0.0000	0.0	0.00	0.000
0.0100	15.5	3.77	0.220
0.0200	32.5	7.38	0.441
0.0300	66.0	14.47	0.661
0.0400	100.0	21.63	0.881
0.0500	140.0	30.03	1.101
0.0600	183.0	39.03	1.322
0.0700	223.0	47.35	1.542
0.0800	271.0	57.32	1.762
0.0900	310.5	65.46	1.983
0.1000	358.0	75.23	2.203
0.1100	403.5	84.54	2.423
0.1200	457.0	95.48	2.644
0.1300	507.0	105.63	2.864
0.1400	551.0	114.50	3.084
0.1500	548.5	113.73	3.304
0.1600	453.0	93.79	3.525

Axial Deformation (in.)	Load (lb.)	Compressive Stress (psi)	Axial Strain (%)



Boring No.:	R-09-Z2-B5
Sample No.:	C36
Depth (ft):	176.6-177.2
Soil Type:	Core
Sample Description:	Very dark olive silt'stone' (ML)

Sample Diameter (in.)	2.442
Sample Height (in.)	4.539
Initial Moisture Content (%)	23.30
Dry Density (pcf)	100.8
Specific Gravity (assumed)	2.7
Saturation (%)	93.7
Rate of Deformation (in/min)	0.0120
Height / Diameter Ratio	1.86

At Failure

Compressive Strength (psi)	**114.50**
Axial Strain (%)	3.08

Leighton

Unconfined Compressive Strength of Cohesive Soil
ASTM D 2166

Project No.: **378312.04.09.01**

SR-710 Tunnel Technical Study

05/27/09

UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: April 22, 2009

Client: CH2MHill

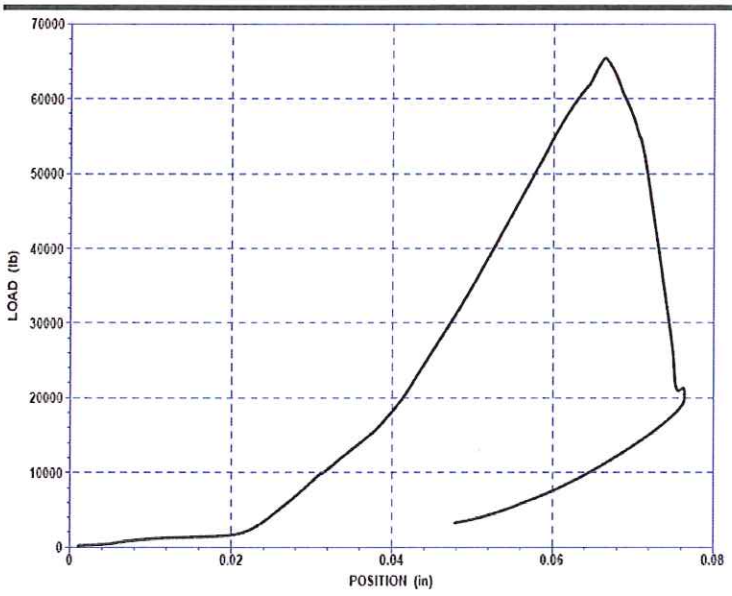
Material Type: Core
Date Cast: n/a
Date Tested: 4/22/09
Age, Days: n/a

Depth: 266.3-267

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

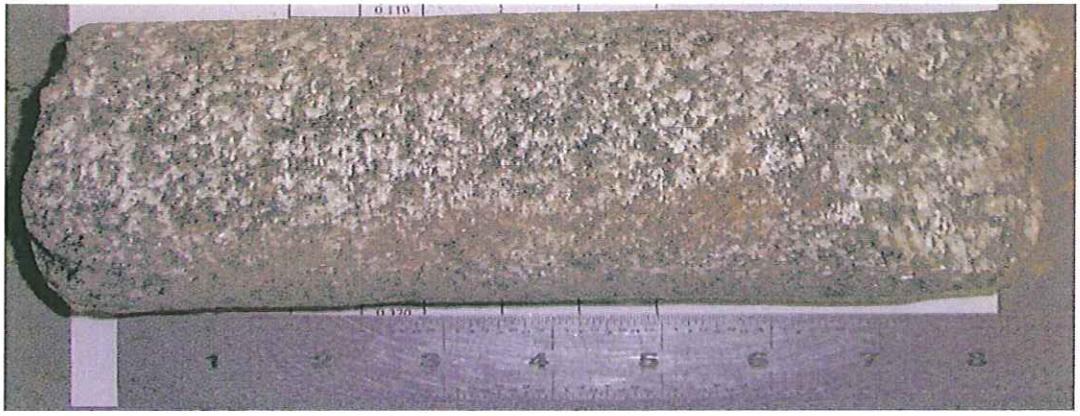
Test Results

Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z3-B1, C58		3.22	6.3	168.0	167.5	0.3	8045



Elastic Modulus (psi)*:	765,806

* using secant elastic modulus formula



UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: April 22, 2009

Client: CH2MHill

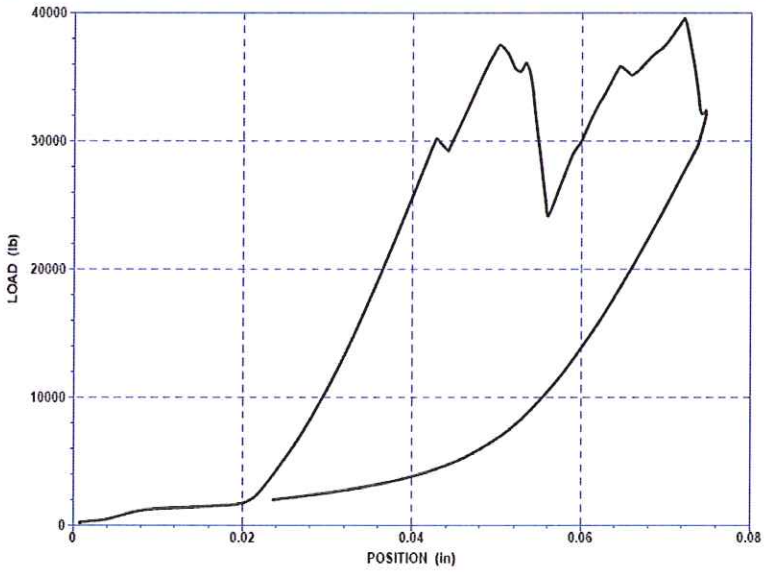
Material Type: Core
Date Cast: n/a
Date Tested: 4/22/09
Age, Days: n/a

Depth: 192.1-192.8

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

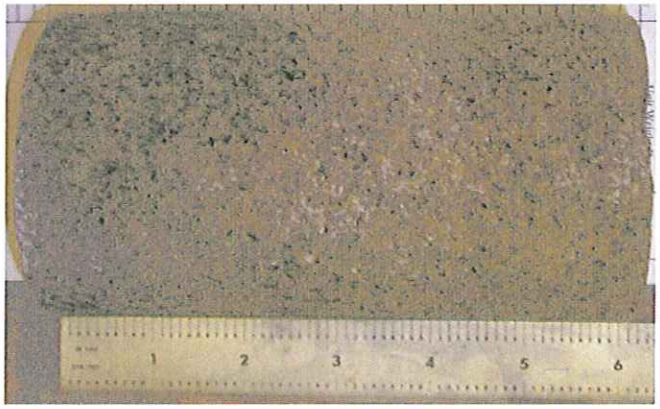
Test Results

Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z3-B1, C42		3.25	5.5	164.9	164.4	0.3	4690



Elastic Modulus (psi)*:	357,087

* using secant elastic modulus formula



UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: April 22, 2009

Client: CH2MHill

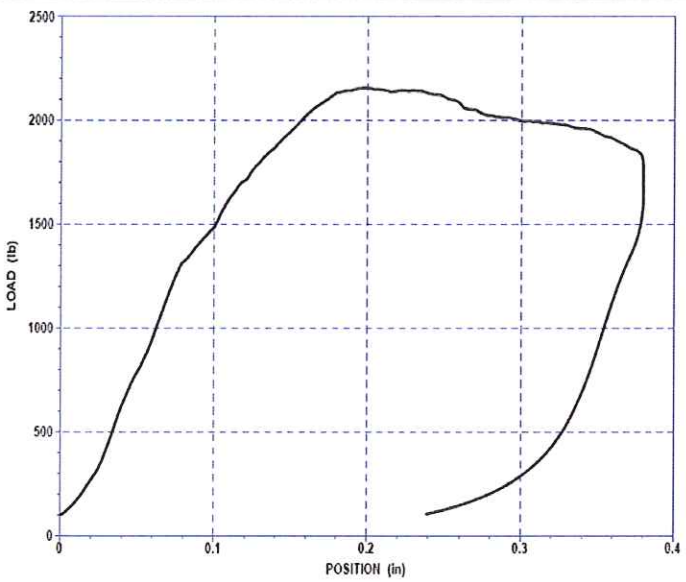
Material Type: Core
Date Cast: n/a
Date Tested: 4/22/09
Age, Days: n/a

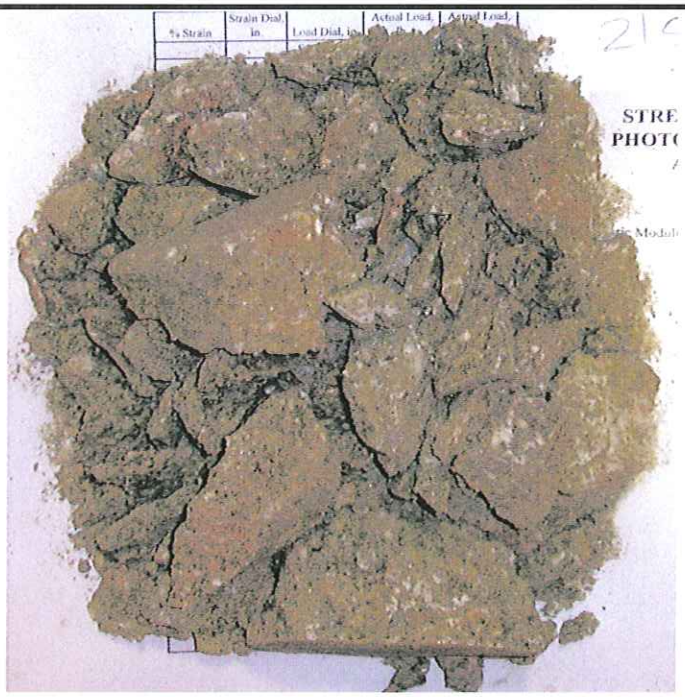
Depth: 220.5-221.8

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

Test Results

Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z3-B4, C45		3.14	3.7	260.7	254.1	2.6	254





Elastic Modulus (psi)*:	4,576

* using secant elastic modulus formula

UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: April 22, 2009

Client: CH2MHill

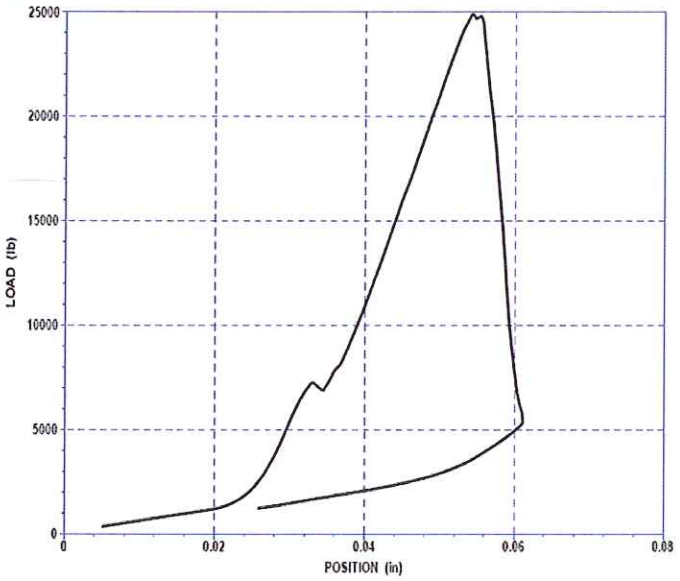
Material Type: Core
Date Cast: n/a
Date Tested: 4/22/09
Age, Days: n/a

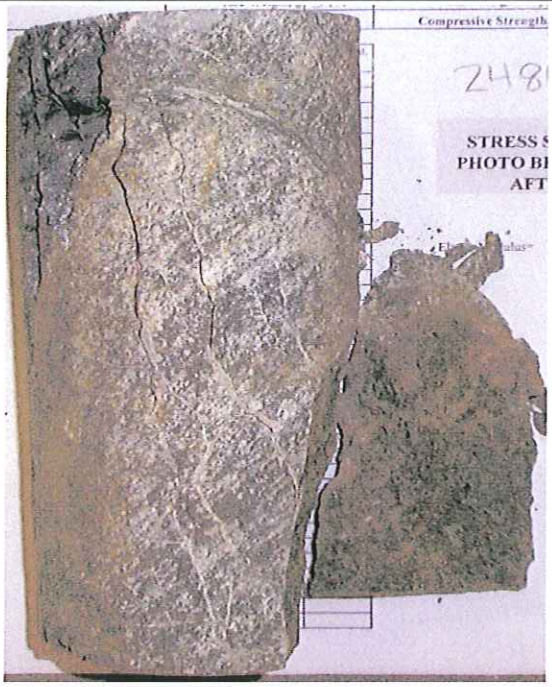
Depth: 272-273.2

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

Test Results

Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z3-B4, C57		3.25	6.5	91.5	90.4	1.2	2998





Elastic Modulus (psi)*:	358,181

* using secant elastic modulus formula

UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: April 22, 2009

Client: CH2MHill

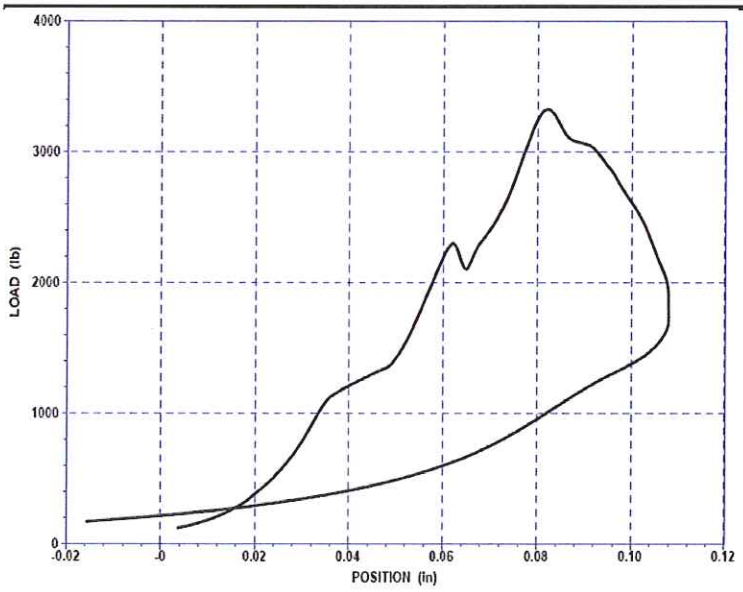
Material Type: Core
Date Cast: n/a
Date Tested: 4/22/09
Age, Days: n/a

Depth: 217.8-218.6

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

Test Results

Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z3-B4, C43		3.23	5.9	164.3	162.2	1.2	406



Elastic Modulus (psi)*:	28, 965

* using secant elastic modulus formula

UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: June 1, 2009

Client: CH2MHill

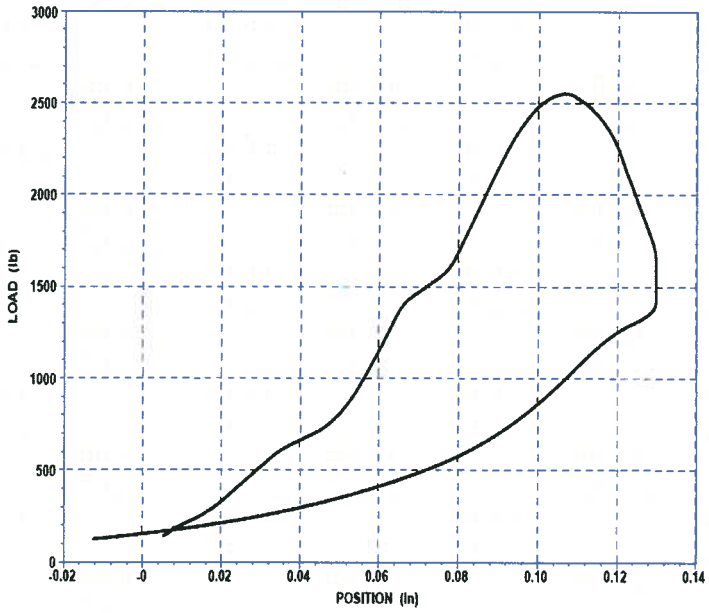
Material Type: sandstone
Date Cast: n/a
Date Tested: 6/1/09
Age, Days: n/a

Depth: 370.1-370.9

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

Test Results

Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z3-B5, C79		2.39	4.8	126.2	118.8	6.2	569



Elastic Modulus (psi)*:	13,644

* using secant elastic modulus formula

UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: June 1, 2009

Client: CH2MHill

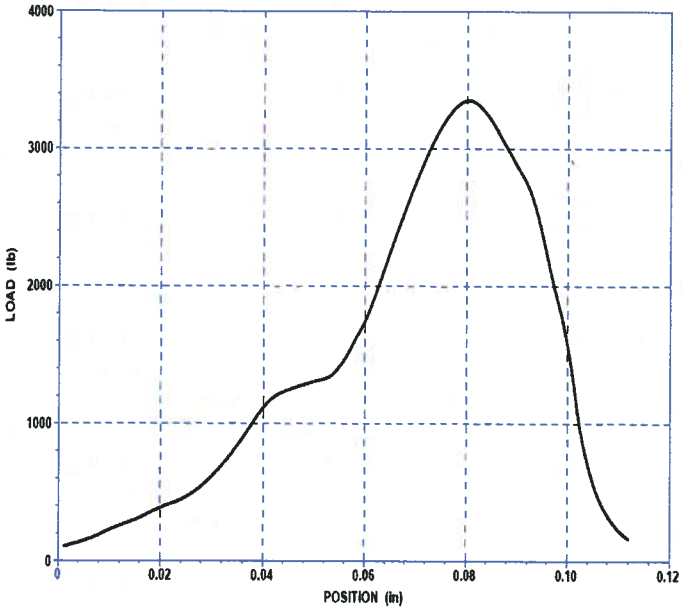
Material Type: sandstone
Date Cast: n/a
Date Tested: 6/1/09
Age, Days: n/a

Depth: 200-200.8

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

Test Results

Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z3-B5, C41		2.35	4.7	149.7	141.5	5.8	773



Elastic Modulus (psi)*:	45,149

* using secant elastic modulus formula

UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: June 2, 2009

Client: CH2MHill

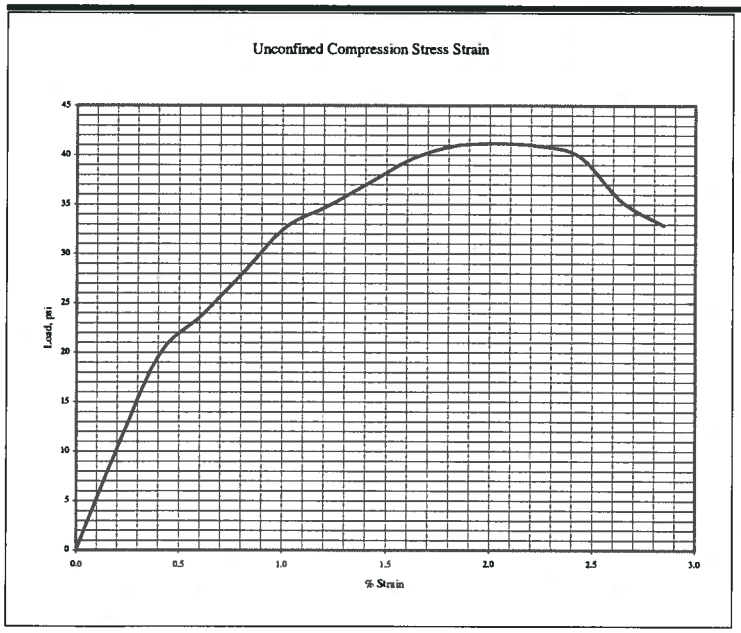
Material Type: mudstone
Date Cast: n/a
Date Tested: 6/1/2009 Revised
Age, Days: n/a

Depth: 306.5-307.3

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

Test Results

Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z3-B5, C64		2.42	4.9	144.6	133.2	8.5	41



Elastic Modulus (psi)*:	2,014

* using secant elastic modulus formula

UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: June 1, 2009 Revised

Client: CH2MHill

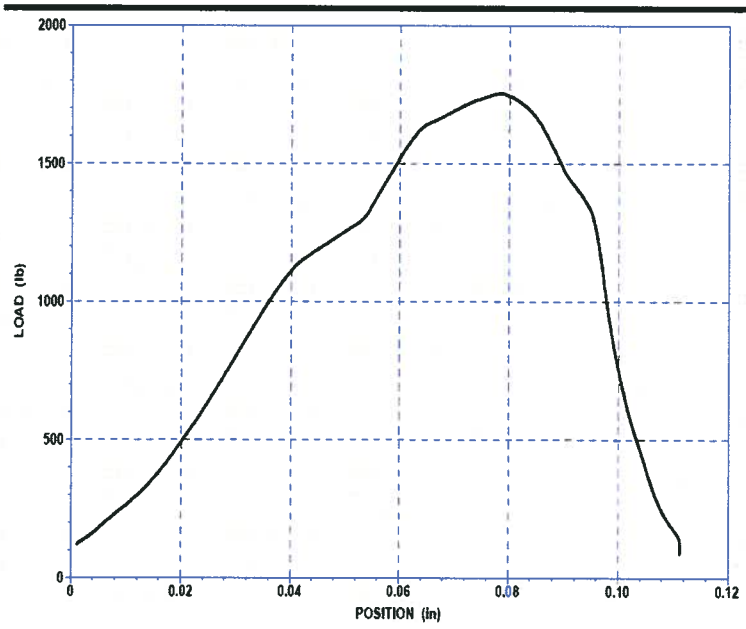
Material Type: mudstone
Date Cast: n/a
Date Tested: 6/1/2009 Revised
Age, Days: n/a

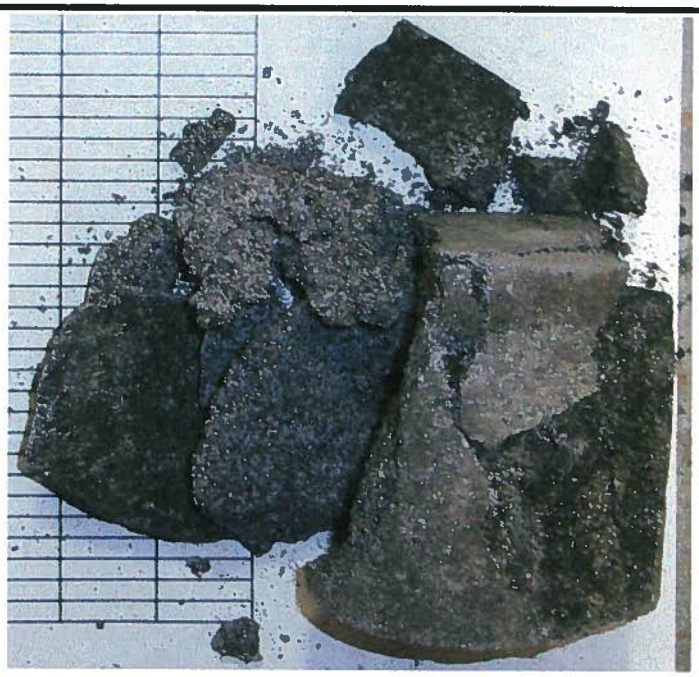
Depth: 345.2-346

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

Test Results

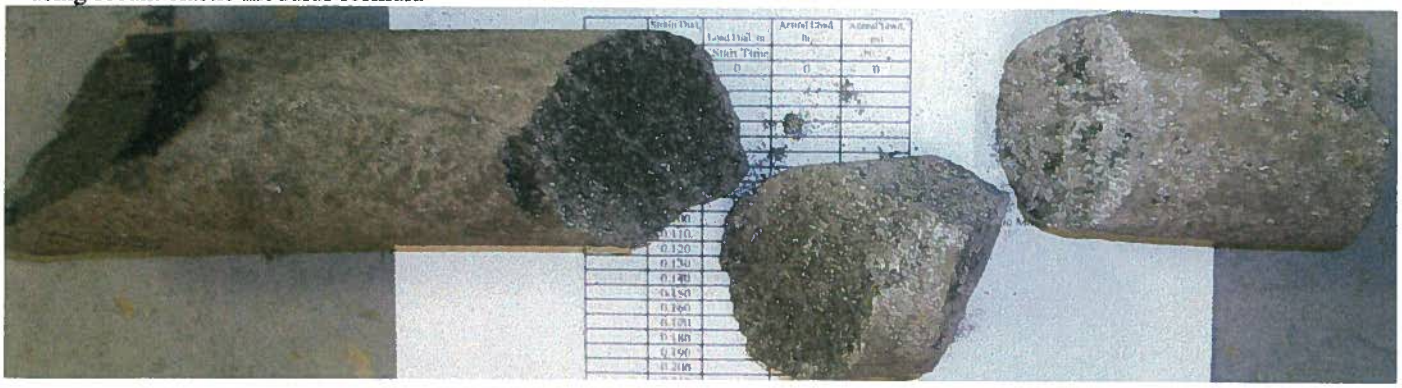
Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z3-B5, C75		2.39	2.9	146.5	142.5	2.8	361





Elastic Modulus (psi)*:	13,414

* using secant elastic modulus formula



UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: June 1, 2009 Revised

Client: CH2MHill

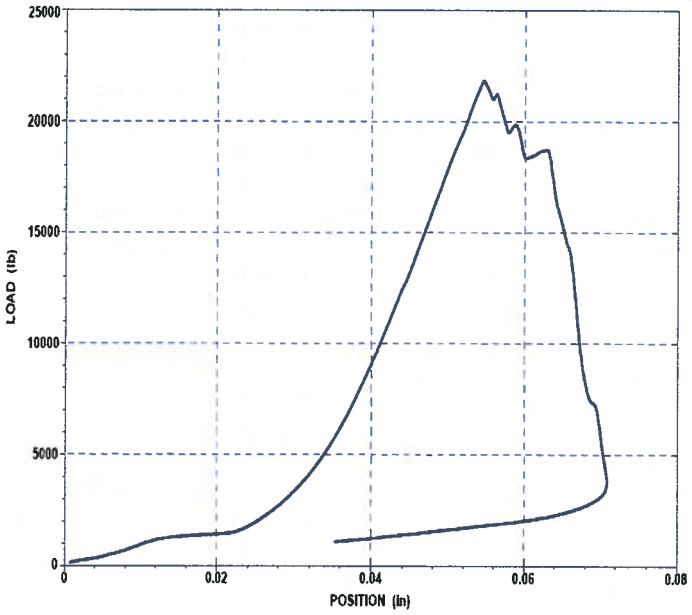
Material Type: sandstone
Date Cast: n/a
Date Tested: 6/1/2009 Revised
Age, Days: n/a

Depth: 295.3-296

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

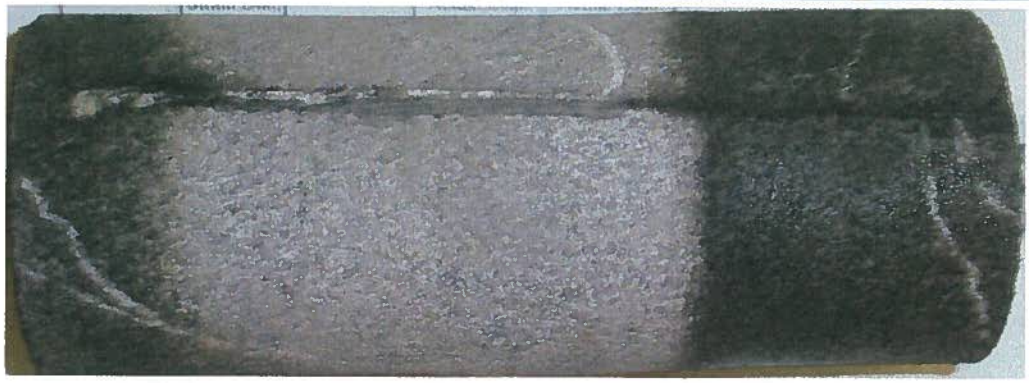
Test Results

Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z3-B5, C61		2.32	4.7	163.7	162.2	0.9	5196



Elastic Modulus (psi)*:	445,599

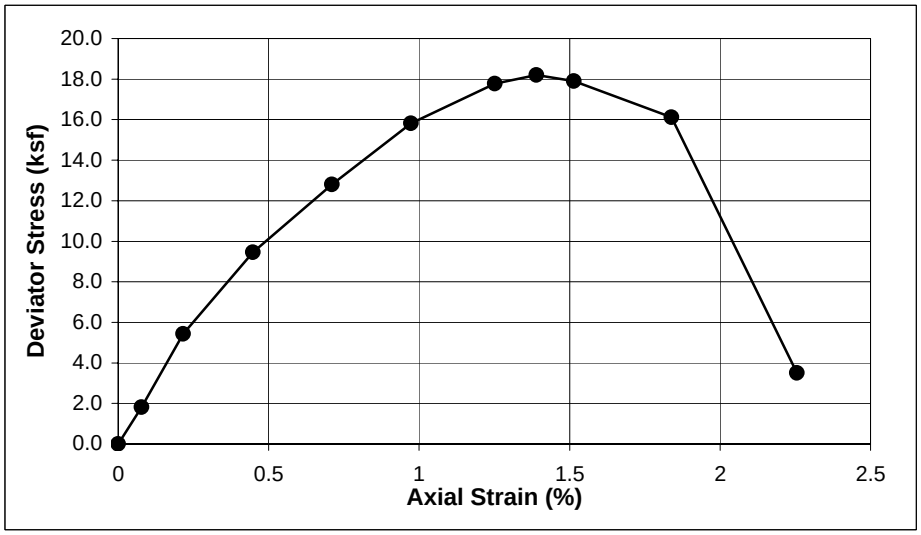
* using secant elastic modulus formula



AP Engineering & Testing, Inc.

UNCONFINED COMPRESSION TEST RESULTS

Project Name:	SR-710 Tunnel Technical Study	Sample Type:	Core
Project No.:	378312.04.09.01	Soil Description	Gray Sandstone
Boring No.:	R-09-Z3-B5	Dry Density (pcf):	135.5
Sample No.:	C-84	Moisture Content (%)	5.2
Depth (feet):	394-394.8	Test Date:	6/4/2009
Sample Diameter (inch):	2.414	Wt. Wet Soil+Container(gms)	1302.28
Sample Hieght (inch):	6	Wt. Dry Soil+Container(gms)	1247.59
Sample Weight (gms):	1108.78	Wt. Container (gms)	196.25



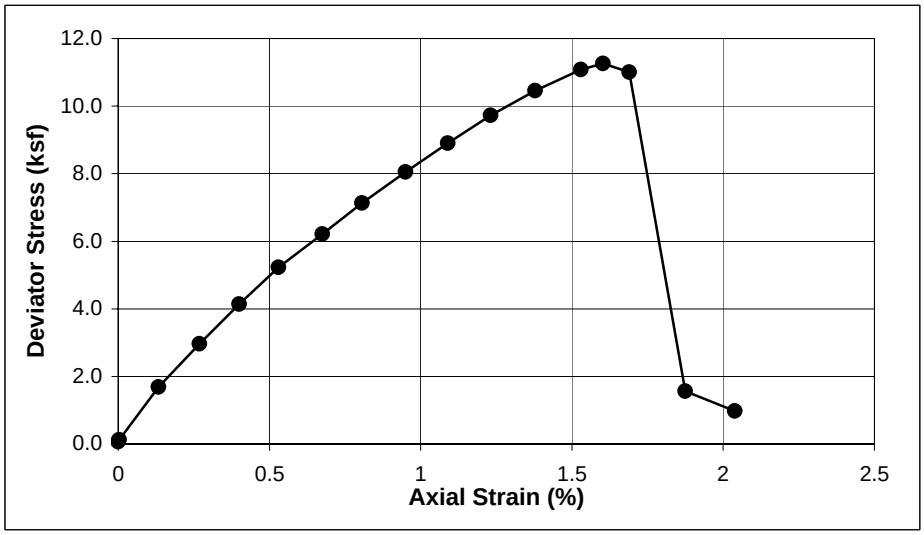
Load (lbs)	Deformation (inch)	Area (sq.in)	Deviator Stress (ksf)	Axial Strain (%)
0	0.000	4.58	0.00	0.00
58	0.005	4.58	1.82	0.08
173	0.014	4.59	5.43	0.22
302	0.029	4.60	9.46	0.45
410	0.046	4.61	12.80	0.71
508	0.063	4.62	15.82	0.97
572	0.081	4.64	17.77	1.25
587	0.090	4.64	18.21	1.39
578	0.098	4.65	17.91	1.51
522	0.119	4.66	16.12	1.84
114	0.146	4.68	3.50	2.26

AP Engineering & Testing, Inc.

UNCONFINED COMPRESSION TEST RESULTS

Project Name:	SR-710 Tunnel Technical Study	Sample Type:	Core
Project No.:	378312.04.09.01	Soil Description	Gray Sandstone
Boring No.:	R-09-Z3-B5	Dry Density (pcf):	135.5
Sample No.:	C-52	Moisture Content (%)	5.4
Depth (feet):	258.8-259.5	Test Date:	6/3/2009

Sample Diameter (inch):	2.422	Wt. Wet Soil+Container(gms)	1294.85
Sample Hieght (inch):	6	Wt. Dry Soil+Container(gms)	1238.05
Sample Weight (gms):	1101.76	Wt. Container (gms)	194.37

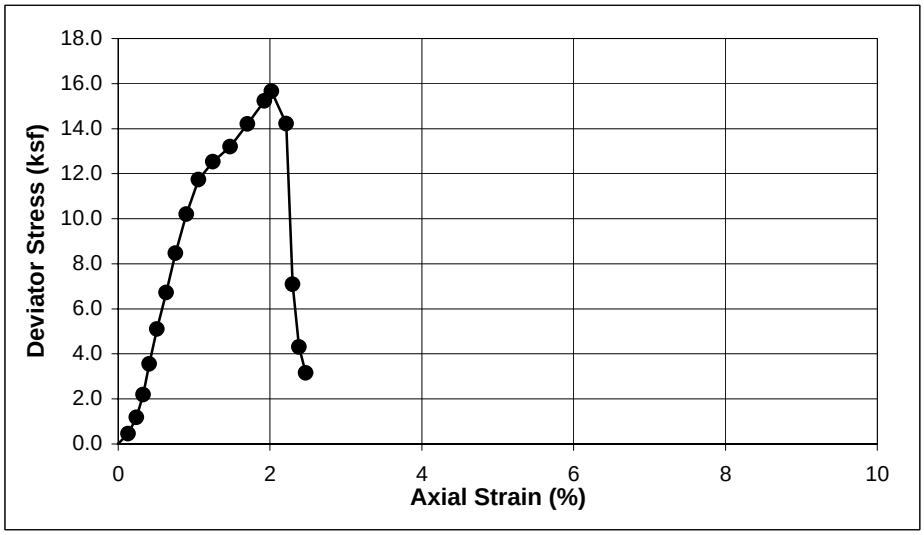


Load (lbs)	Deformation (inch)	Area (sq.in)	Deviator Stress (ksf)	Axial Strain (%)
2	0.00	4.61	0.06	0.00
4	0.00	4.61	0.13	0.00
54	0.01	4.61	1.69	0.13
95	0.02	4.62	2.96	0.27
133	0.03	4.62	4.14	0.40
168	0.03	4.63	5.22	0.53
200	0.04	4.64	6.21	0.67
230	0.05	4.64	7.13	0.81
260	0.06	4.65	8.05	0.95
288	0.07	4.66	8.91	1.09
315	0.08	4.66	9.73	1.23
339	0.09	4.67	10.45	1.38
360	0.10	4.68	11.08	1.53
366	0.10	4.68	11.26	1.60
358	0.11	4.69	11.00	1.69
51	0.12	4.69	1.56	1.87
32	0.13	4.70	0.98	2.04

AP Engineering & Testing, Inc.

UNCONFINED COMPRESSION TEST RESULTS

Project Name:	SR-710 Tunnel Technical Study	Sample Type:	Core
Project No.:	378312.04.09.01	Soil Description	Gray Sandstone
Boring No.:	R-09-Z3-B5	Dry Density (pcf):	141.7
Sample No.:	C-48	Moisture Content (%)	4.8
Depth (feet):	242-242.8	Test Date:	6/2/2009
Sample Diameter (inch):	2.368	Wt. Wet Soil+Container(gms)	1201.8
Sample Hieght (inch):	6	Wt. Dry Soil+Container(gms)	1156.09
Sample Weight (gms):	1008.56	Wt. Container (gms)	194.3

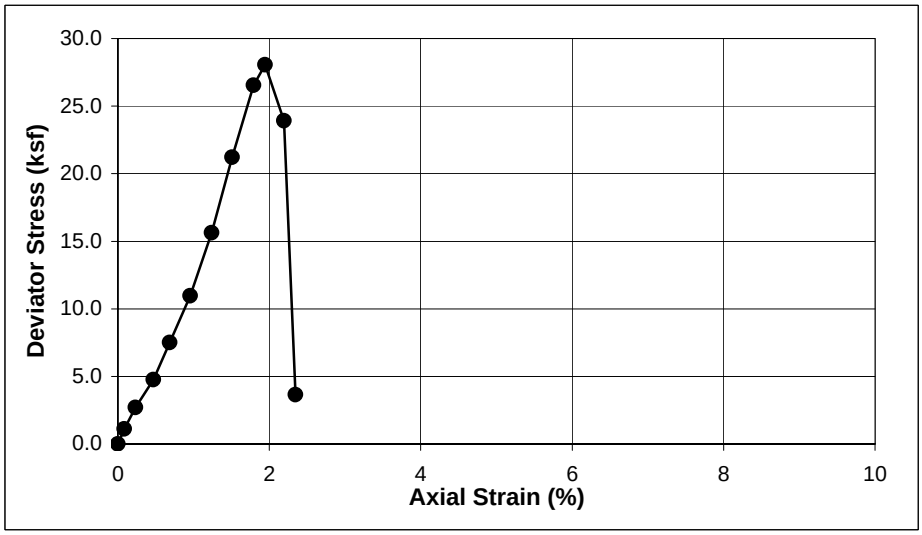


Load (lbs)	Deformation (inch)	Area (sq.in)	Deviator Stress (ksf)	Axial Strain (%)
0	0.000	4.41	0.00	0.00
14	0.008	4.41	0.46	0.13
36	0.014	4.42	1.17	0.24
67	0.019	4.42	2.18	0.33
109	0.024	4.42	3.55	0.41
157	0.030	4.43	5.11	0.51
207	0.037	4.43	6.72	0.63
261	0.044	4.44	8.47	0.75
315	0.053	4.45	10.20	0.90
363	0.062	4.45	11.74	1.06
388	0.073	4.46	12.52	1.25
410	0.087	4.47	13.20	1.47
442	0.100	4.48	14.20	1.70
475	0.113	4.49	15.23	1.93
489	0.119	4.50	15.66	2.02
445	0.130	4.51	14.22	2.21
222	0.135	4.51	7.09	2.30
135	0.140	4.51	4.31	2.38
99	0.145	4.52	3.16	2.47

AP Engineering & Testing, Inc.

UNCONFINED COMPRESSION TEST RESULTS

Project Name:	SR-710 Tunnel Technical Study	Sample Type:	Core
Project No.:	378312.04.09.01	Soil Description	Gray Sandstone
Boring No.:	R-09-Z3-B5	Dry Density (pcf):	142.3
Sample No.:	C-32	Moisture Content (%)	6.2
Depth (feet):	155-155.8	Test Date:	6/2/2009
Sample Diameter (inch):	2.327	Wt. Wet Soil+Container(gms)	1198.49
Sample Hieght (inch):	6	Wt. Dry Soil+Container(gms)	1139.55
Sample Weight (gms):	1007.43	Wt. Container (gms)	193.1



Load (lbs)	Deformation (inch)	Area (sq.in)	Deviator Stress (ksf)	Axial Strain (%)
0	0.000	4.25	0.00	0.00
33	0.005	4.26	1.12	0.08
80	0.014	4.26	2.70	0.23
141	0.028	4.27	4.75	0.47
223	0.041	4.28	7.50	0.69
327	0.057	4.29	10.97	0.95
467	0.074	4.31	15.62	1.24
636	0.090	4.32	21.22	1.51
798	0.107	4.33	26.54	1.79
845	0.116	4.34	28.06	1.94
722	0.131	4.35	23.92	2.19
110	0.140	4.35	3.64	2.34

UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: June 1, 2009 Revised

Client: CH2MHill

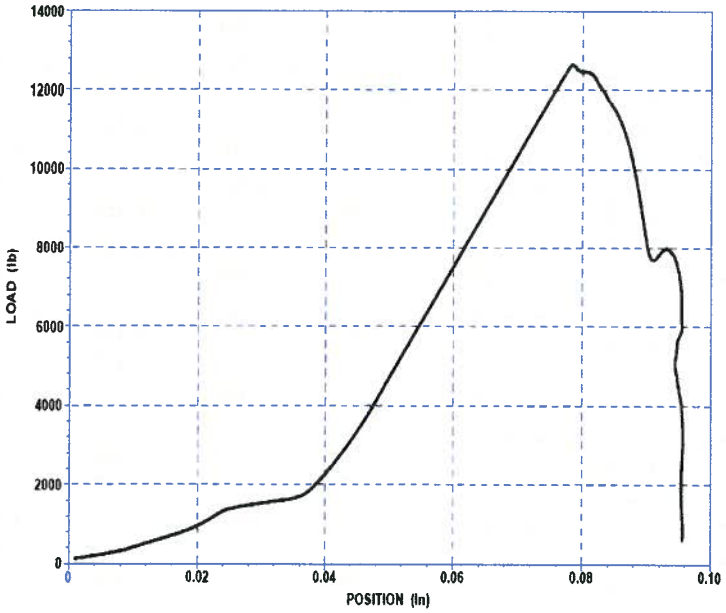
Material Type: siltstone
Date Cast: n/a
Date Tested: 6/1/09
Age, Days: n/a

Depth: 215-215.9

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

Test Results

Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z2-B3, C55		2.40	4.3	140.2	126.7	10.6	2812



Elastic Modulus (psi)*:	154,017

* using secant elastic modulus formula

UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: April 22, 2009

Client: CH2MHill

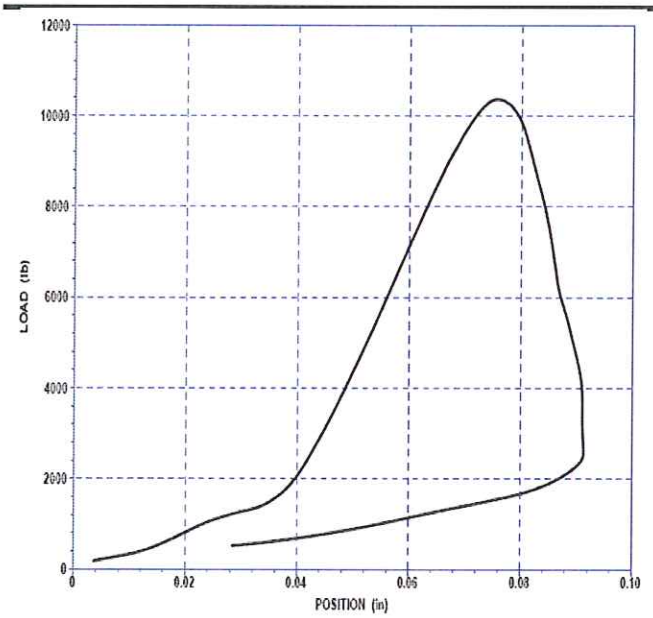
Material Type: Core
Date Cast: n/a
Date Tested: 4/22/09
Age, Days: n/a

Depth: 209-209.5

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

Test Results

Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z3-B6, C34		3.26	6.4	152.0	145.8	4.2	1243



Elastic Modulus (psi)*:	105,745

* using secant elastic modulus formula

UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: April 22, 2009

Client: CH2MHill

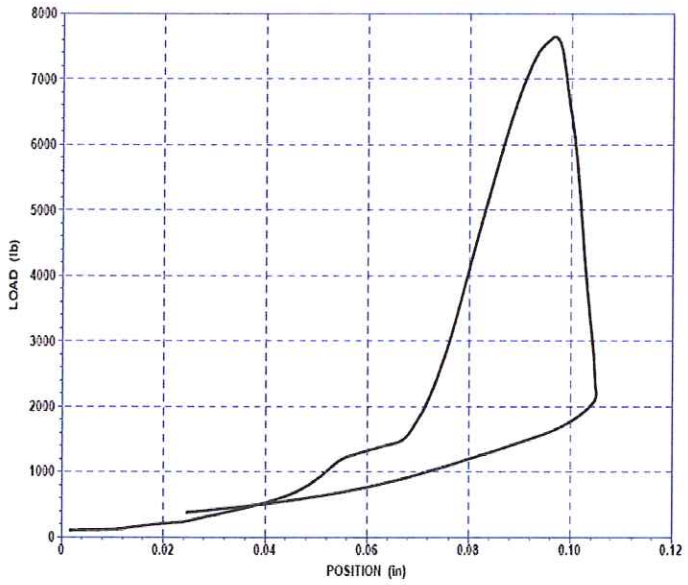
Material Type: Core
Date Cast: n/a
Date Tested: 4/22/09
Age, Days: n/a

Depth: 218-218.6

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

Test Results

Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z3-B6, C35		3.29	6.5	151.7	148.8	1.9	899



Elastic Modulus (psi)*:	60,487

* using secant elastic modulus formula

UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: April 22, 2009

Client: CH2MHill

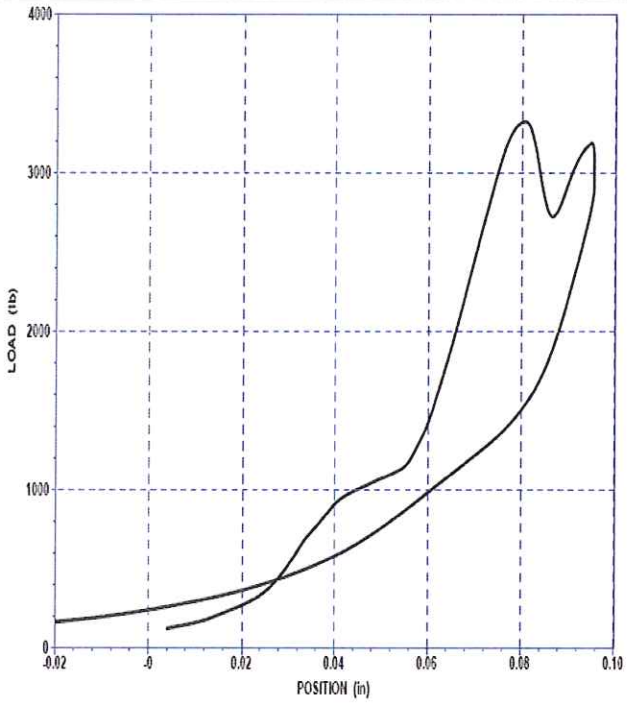
Material Type: Core
Date Cast: n/a
Date Tested: 4/22/09
Age, Days: n/a

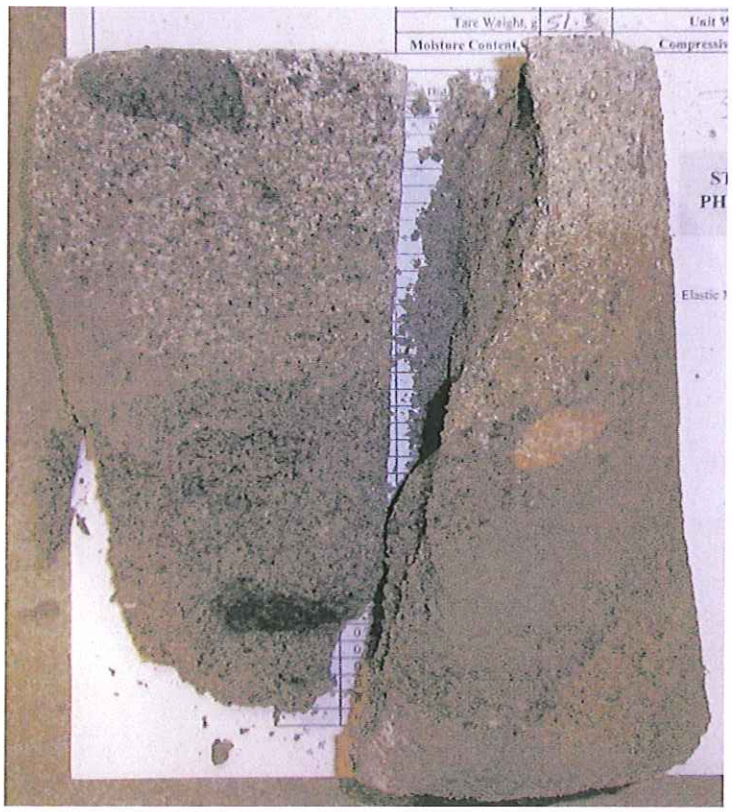
Depth: 221-222

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

Test Results

Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z3-B6, C 35		3.28	6.5	146.3	141.8	3.1	393





Elastic Modulus (psi)*:	31,599

* using secant elastic modulus formula

UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: April 22, 2009

Client: CH2MHill

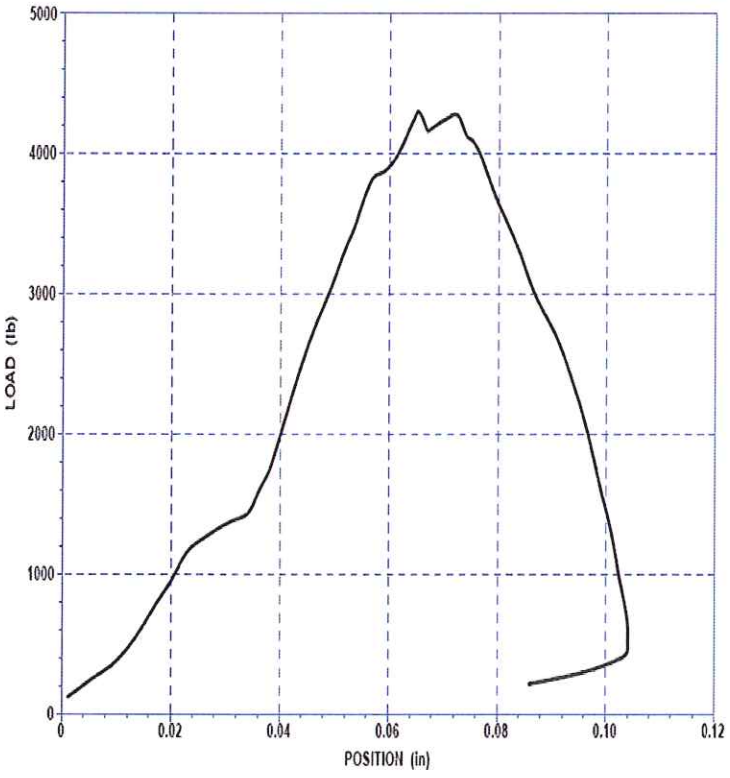
Material Type: Core
Date Cast: n/a
Date Tested: 4/22/09
Age, Days: n/a

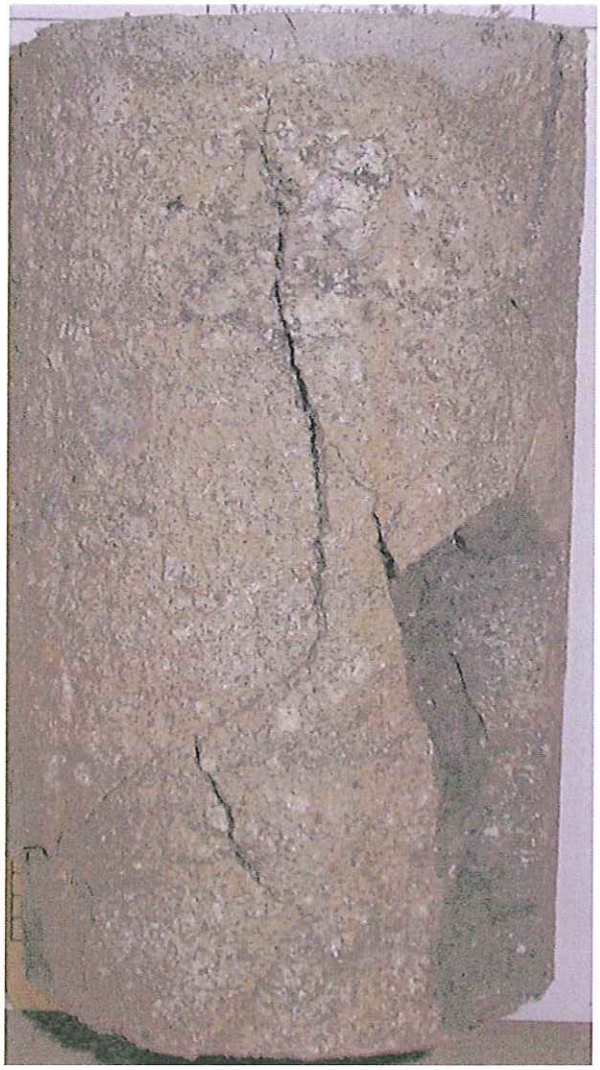
Depth: 227-228

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

Test Results

Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z3-B6, C 37		3.25	6.5	155.7	152.0	2.4	523





Elastic Modulus (psi)*:	51,713

* using secant elastic modulus formula

UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: April 22, 2009

Client: CH2MHill

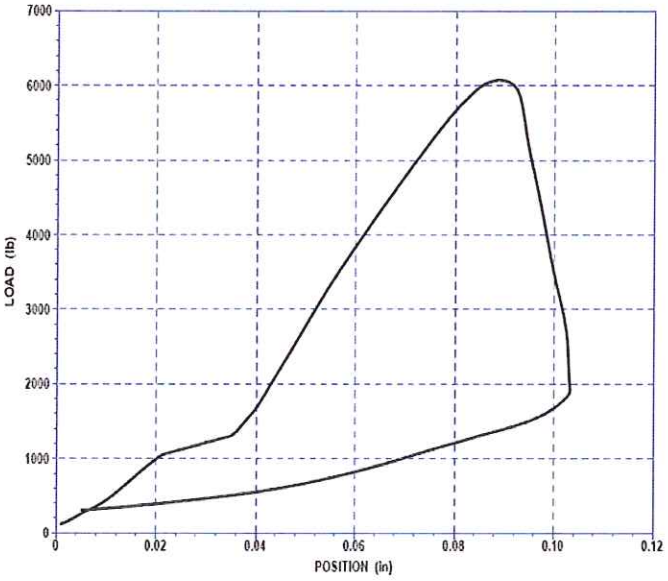
Material Type: Core
Date Cast: n/a
Date Tested: 4/22/09
Age, Days: n/a

Depth: 258.2-258.8

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

Test Results

Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z3-B6, C	44	3.17	6.3	156.9	153.7	2.0	770



Elastic Modulus (psi)*:	54,499

* using secant elastic modulus formula

UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: April 10, 2009

Client: CH2MHill

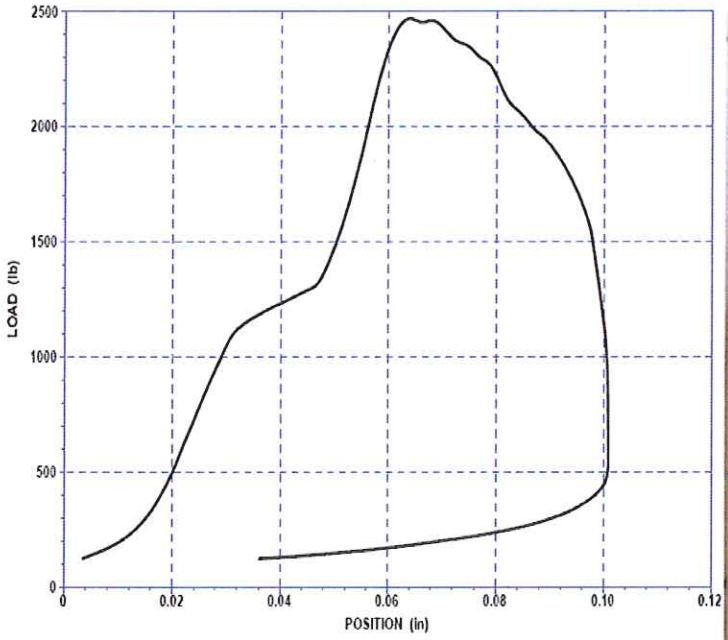
Material Type: Sandstone
Date Cast: n/a
Date Tested: 4/10/09
Age, Days: n/a

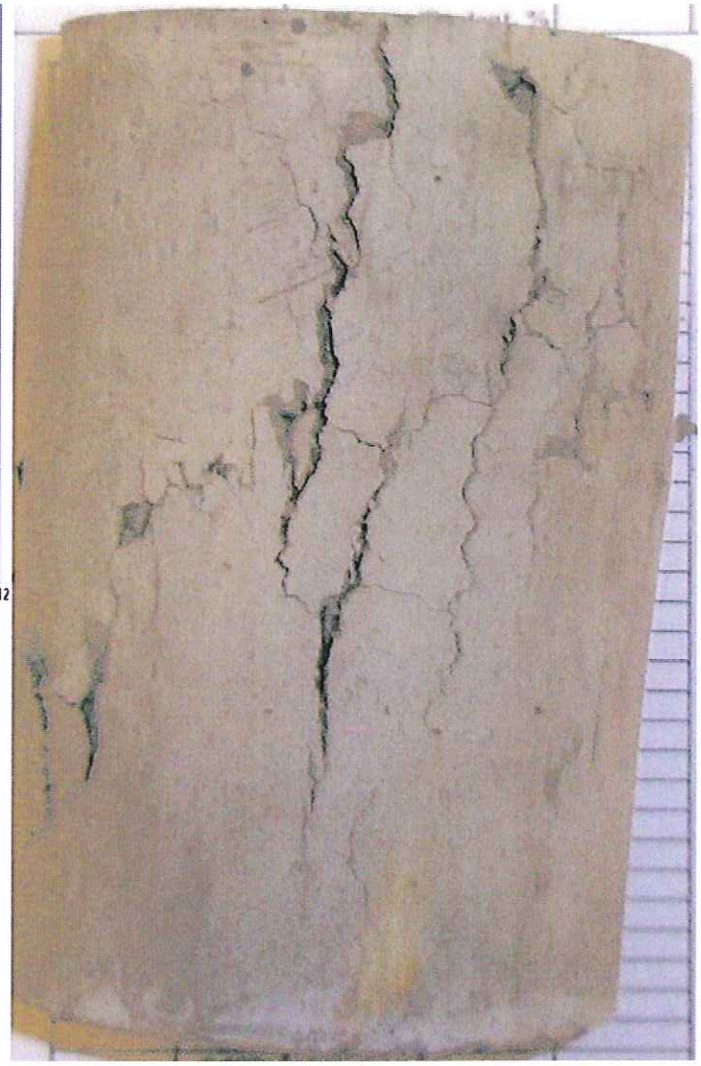
Depth: 154.2-155.1

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

Test Results

Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z3-B7, C30		2.42	3.9	148.4	141.6	4.8	521





Elastic Modulus (psi)*:	32562

*using secant elastic modulus formula

UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: April 10, 2009

Client: CH2MHill

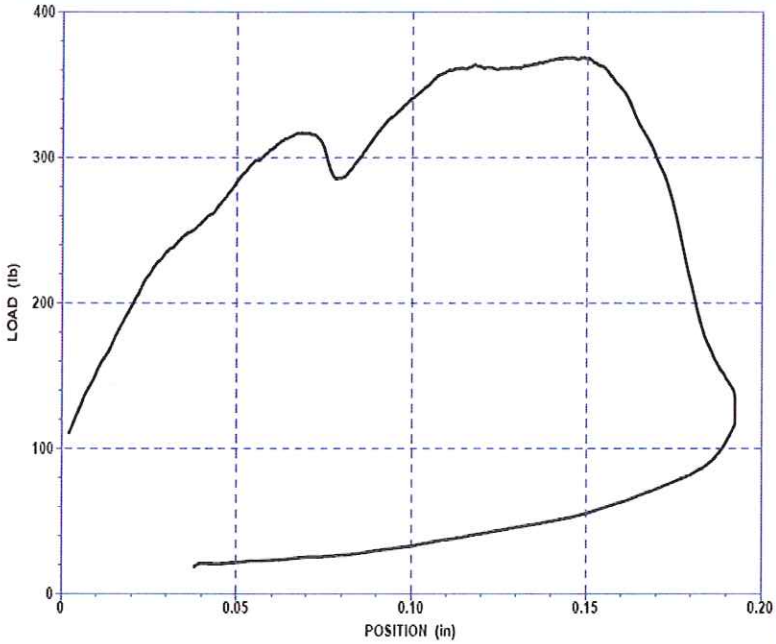
Material Type: Sandstone
Date Cast: n/a
Date Tested: 4/10/09
Age, Days: n/a

Depth: 173.9-174.4

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

Test Results

Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z3-B7, C-34		2.42	4.6	146.8	138.1	6.3	82



Elastic Modulus (psi)*:	5621

*using secant elastic modulus formula

UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: April 10, 2009

Client: CH2MHill

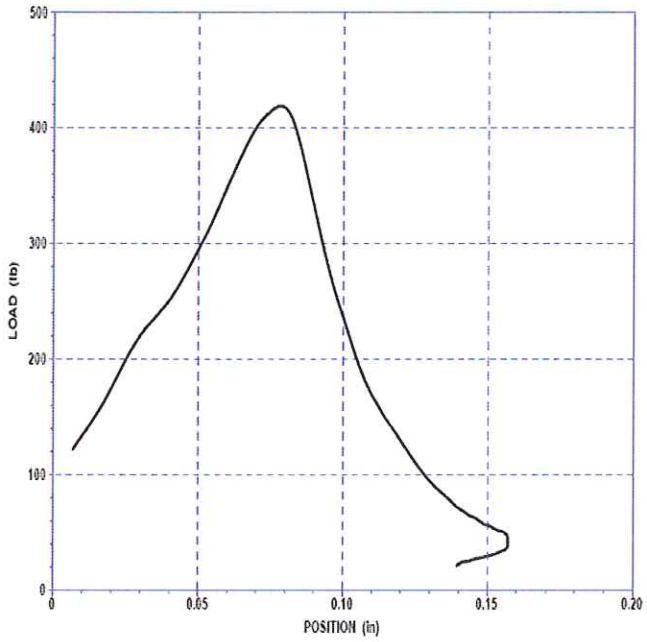
Material Type: Sandstone
Date Cast: n/a
Date Tested: 4/10/09
Age, Days: n/a

Depth: 206.2-206.7

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

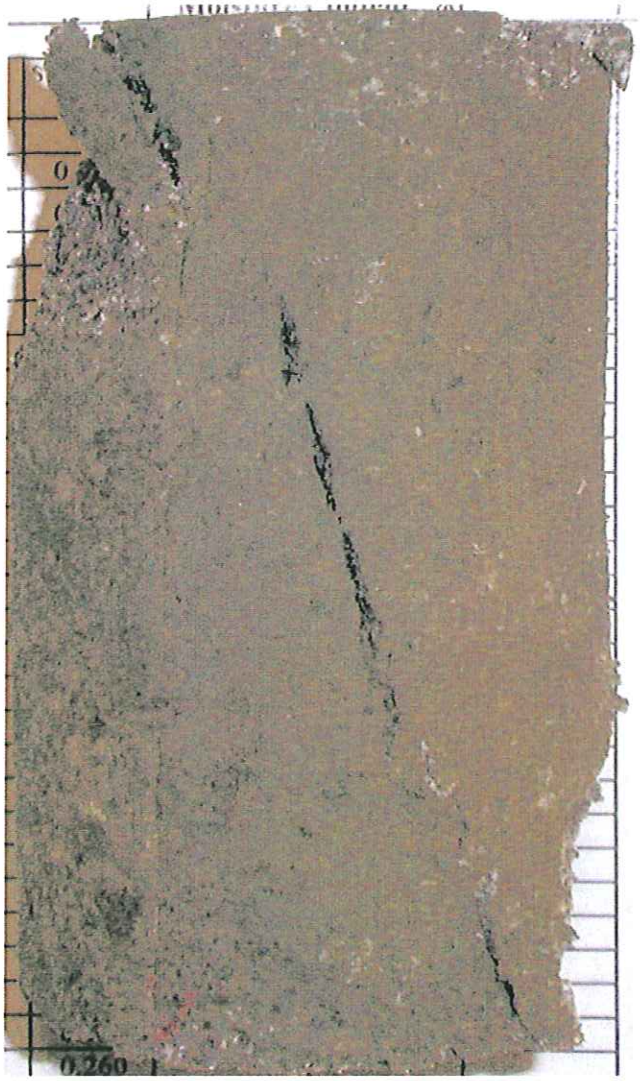
Test Results

Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z3-B7, C-43		2.40	4.7	146.4	138.0	6.1	93



Elastic Modulus (psi)*:	5423

*using secant elastic modulus formula



UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: April 10, 2009

Client: CH2MHill

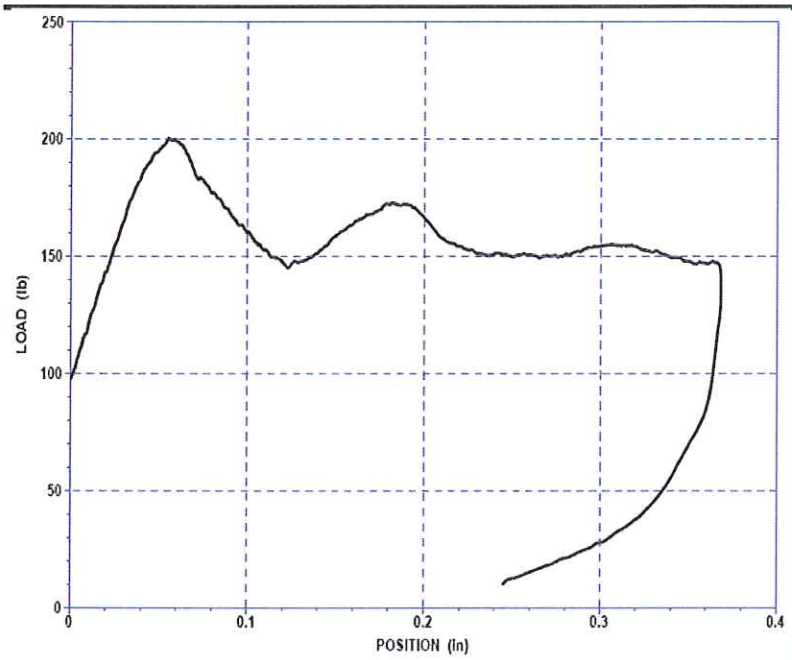
Material Type: Sandstone
Date Cast: n/a
Date Tested: 4/10/09
Age, Days: n/a

Depth: 231-231.7

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

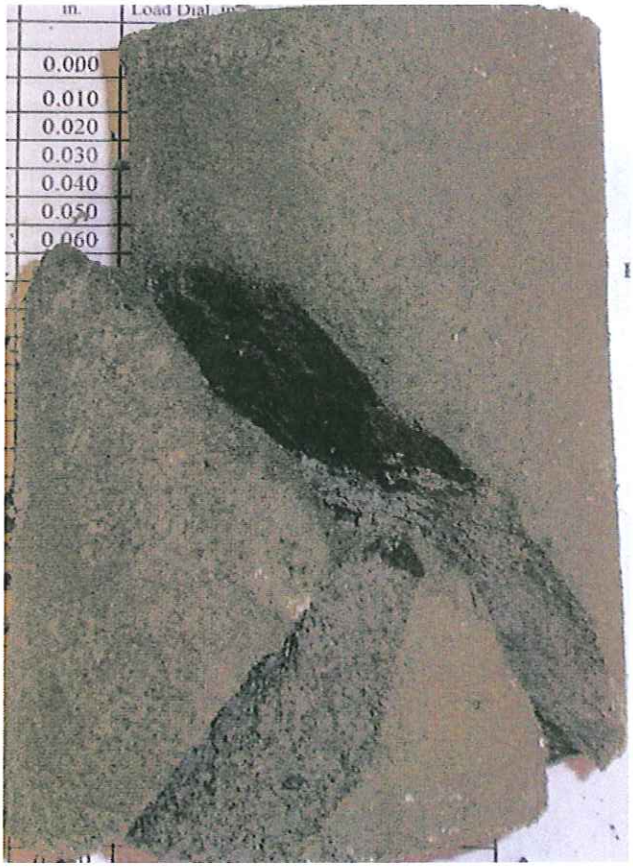
Test Results

Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z3-B7, C51		2.42	4.7	151.4	143.0	5.9	45



Elastic Modulus (psi)*:	3525

*using secant elastic modulus formula



UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: April 10, 2009

Client: CH2MHill

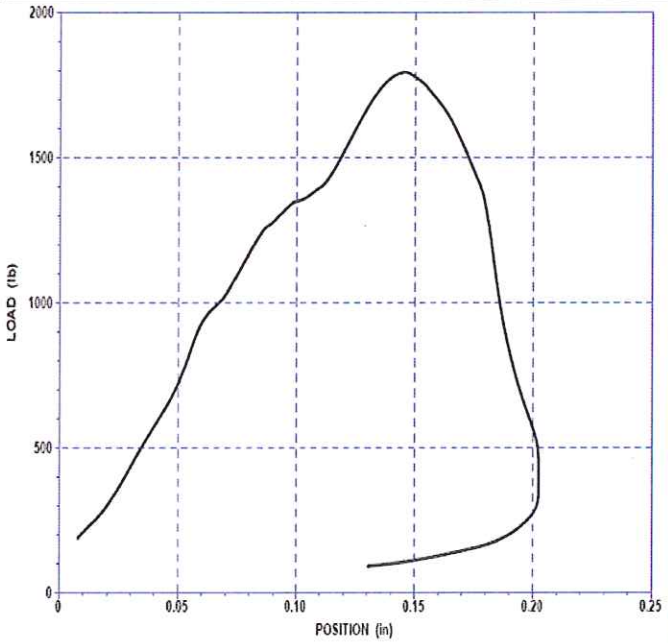
Material Type: Sandstone
Date Cast: n/a
Date Tested: 4/10/09
Age, Days: n/a

Depth: 241.2-242

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

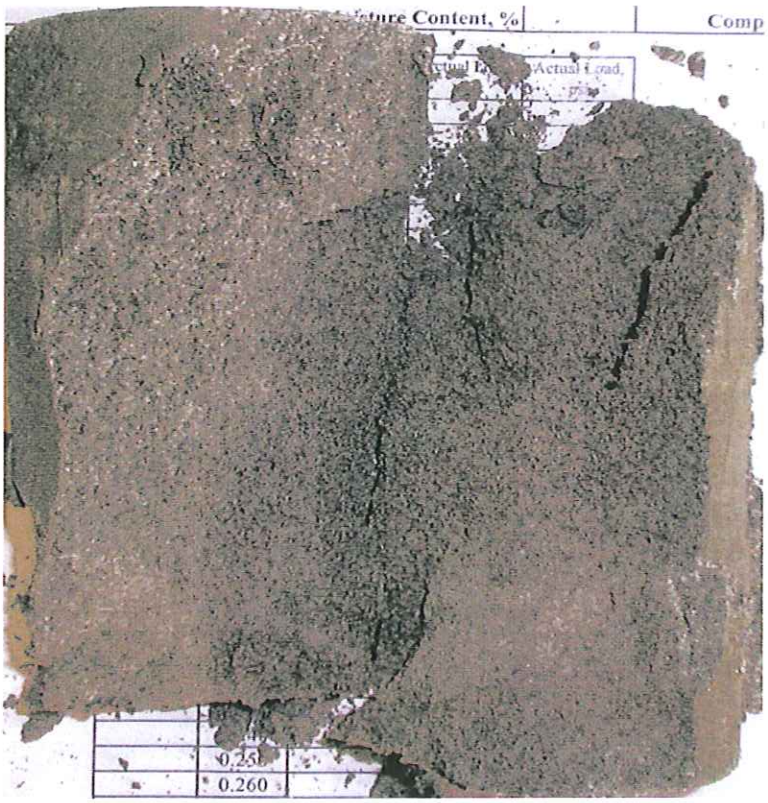
Test Results

Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z3-B7, C53		2.42	4.6	153.2	146.7	4.4	397



Elastic Modulus (psi)*:	12339

*using secant elastic modulus formula



UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: April 10, 2009

Client: CH2MHill

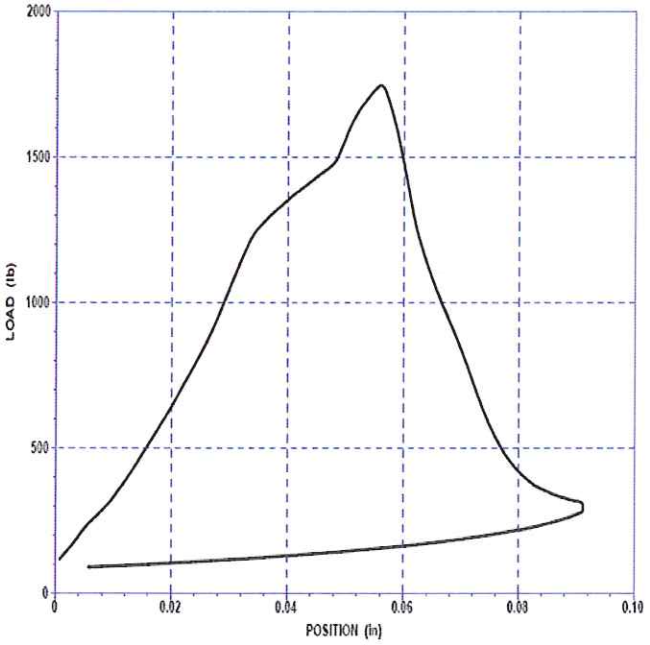
Material Type: Sandstone
Date Cast: n/a
Date Tested: 4/10/09
Age, Days: n/a

Depth: 260.6-261

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

Test Results

Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z3-B7, C59		2.42	4.6	149.6	143.8	4.0	385



Elastic Modulus (psi)*:	31165

*using secant elastic modulus formula

UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: April 10, 2009

Client: CH2MHill

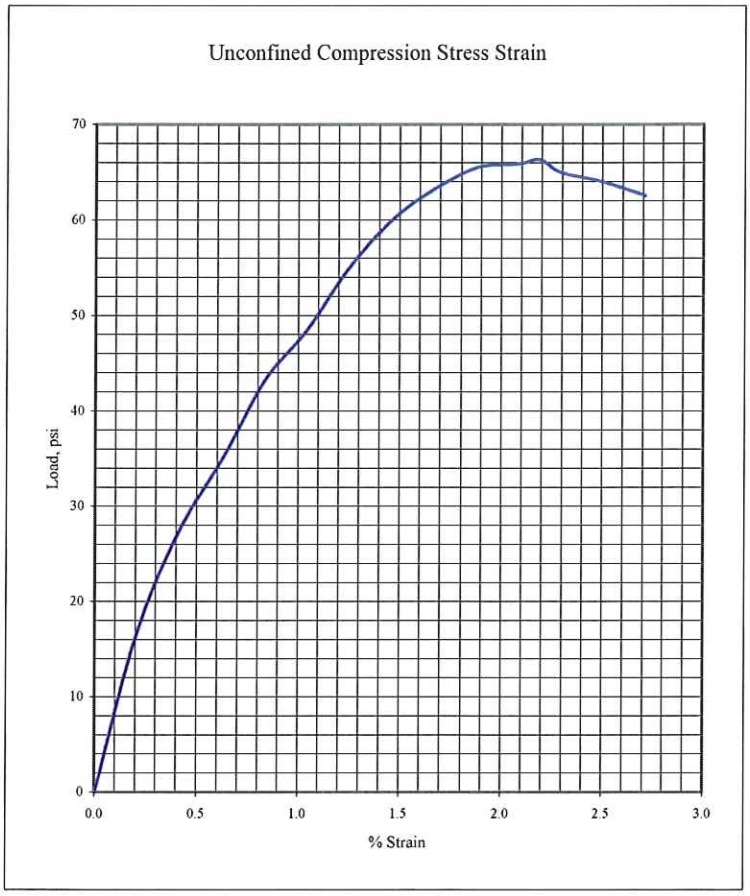
Material Type: Sandstone
Date Cast: n/a
Date Tested: 4/10/09
Age, Days: n/a

Depth: 281-281.9

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

Test Results

Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z3-B7, C65		2.41	4.8	156.5	146.6	6.8	66



Elastic Modulus (psi)*	3031

*

UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: April 10, 2009

Client: CH2MHill

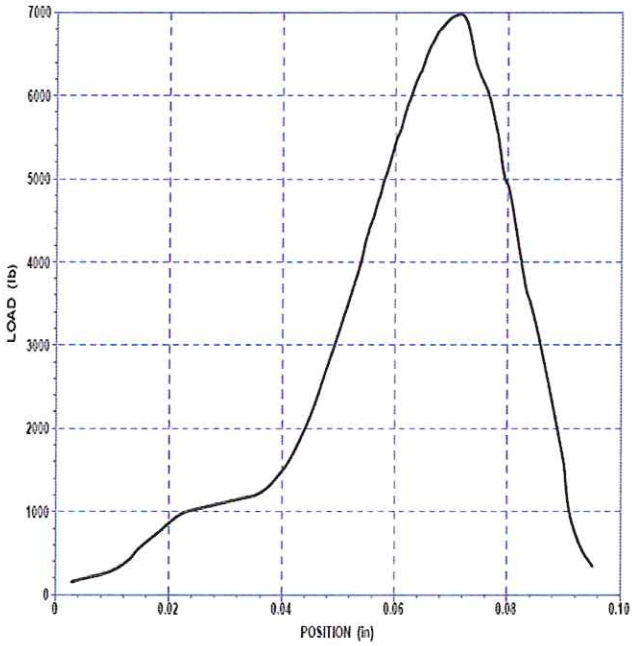
Material Type: Sandstone
Date Cast: n/a
Date Tested: 4/10/09
Age, Days: n/a

Depth: 321.4-322.1

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

Test Results

Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z3-B7, C73		2.40	4.7	154.6	149.9	3.2	1542



Elastic Modulus (psi)*:	100735

*using secant elastic modulus formula

UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: May 12, 2009

Client: CH2MHill

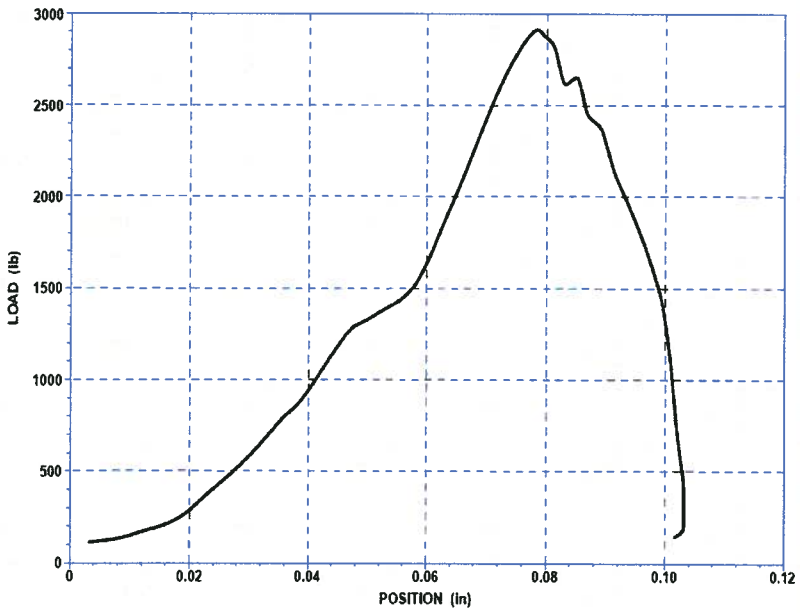
Material Type: siltstone
Date Cast: n/a
Date Tested: 5/12/09
Age, Days: n/a

Depth: 174.1-174.7

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

Test Results

Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z3-B8, C42		2.37	4.8	146.7	137.4	6.8	663



Elastic Modulus (psi)*:	40,489

* using secant elastic modulus formula

UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: May 12, 2009

Client: CH2MHill

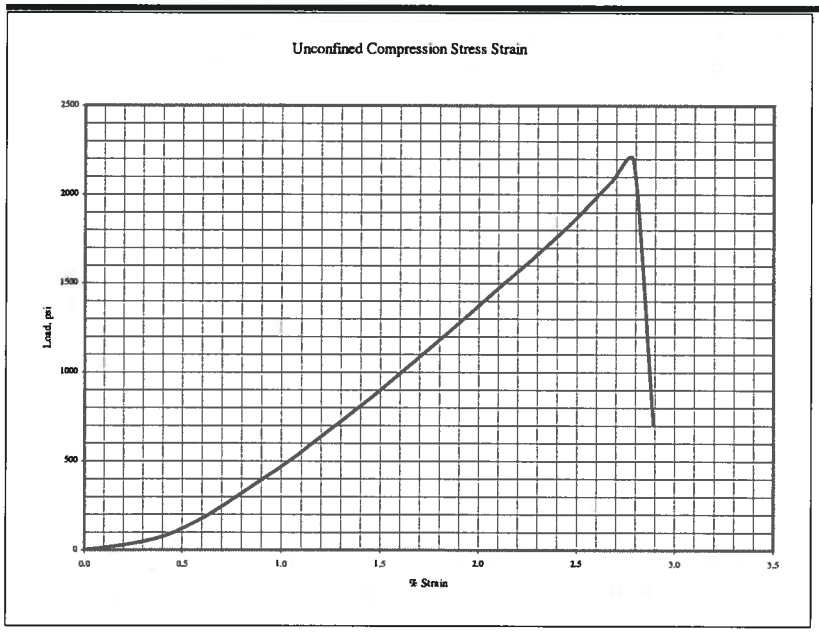
Material Type: siltstone
Date Cast: n/a
Date Tested: 5/12/09
Age, Days: n/a

Depth: 196.7-197.3

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

Test Results

Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z3-B8, C48		2.39	4.8	141.6	131.0	8.1	2193



Elastic Modulus (psi)*:	77,963

* using secant elastic modulus formula

UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: May 12, 2009

Client: CH2MHill

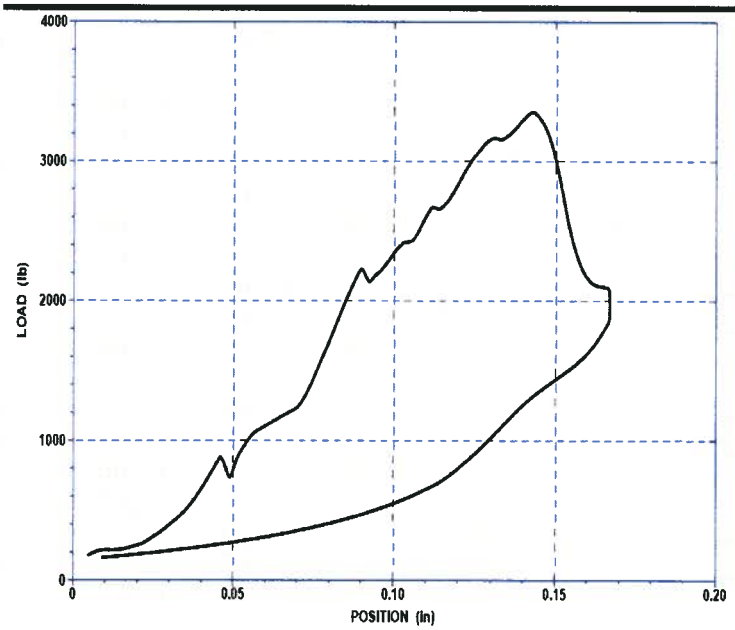
Material Type: siltstone
Date Cast: n/a
Date Tested: 5/12/09
Age, Days: n/a

Depth: 205.1-205.7

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

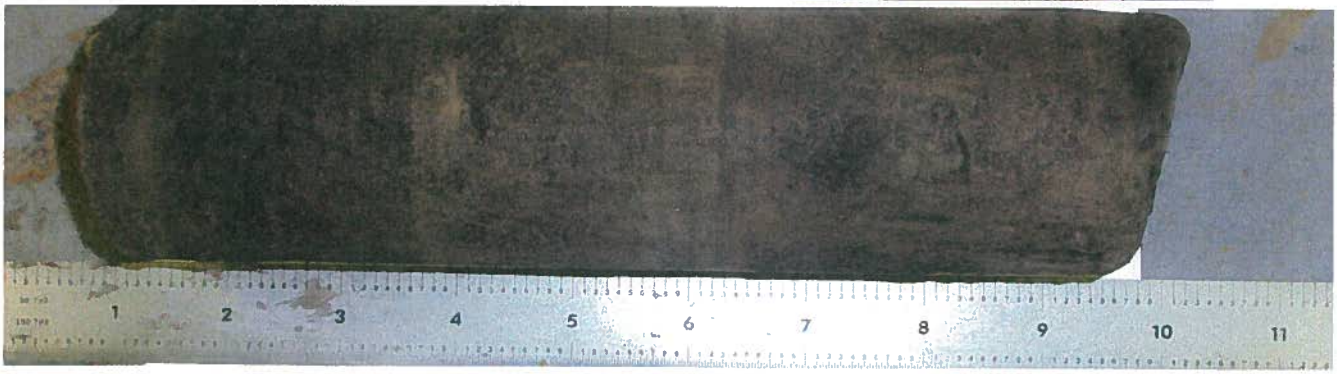
Test Results

Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z3-B8, C51		2.35	4.8	143.4	132.7	8.1	774



Elastic Modulus (psi)*:	25,933

* using secant elastic modulus formula



UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: May 12, 2009

Client: CH2MHill

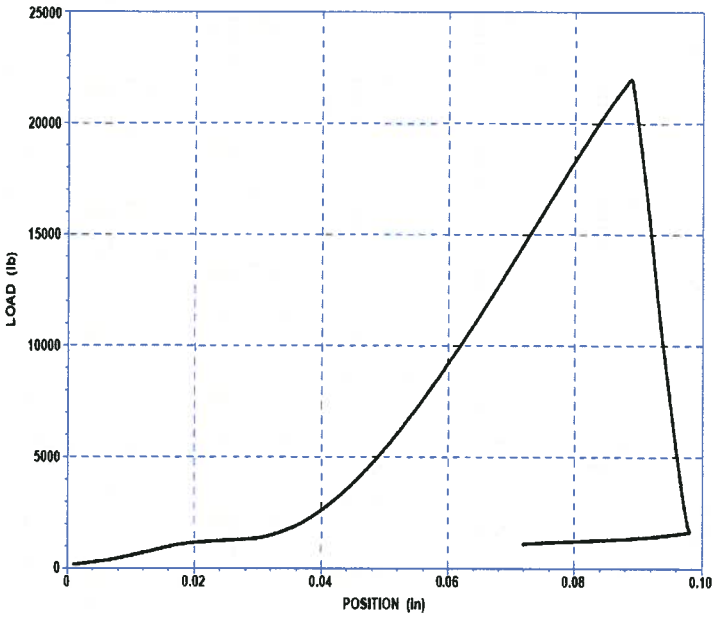
Material Type: siltstone
Date Cast: n/a
Date Tested: 5/12/09
Age, Days: n/a

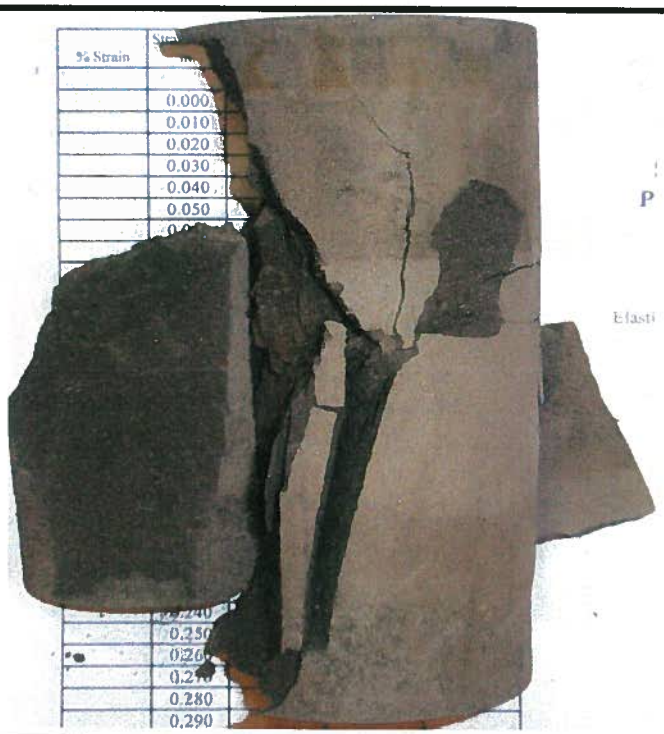
Depth: 235.3-236

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

Test Results

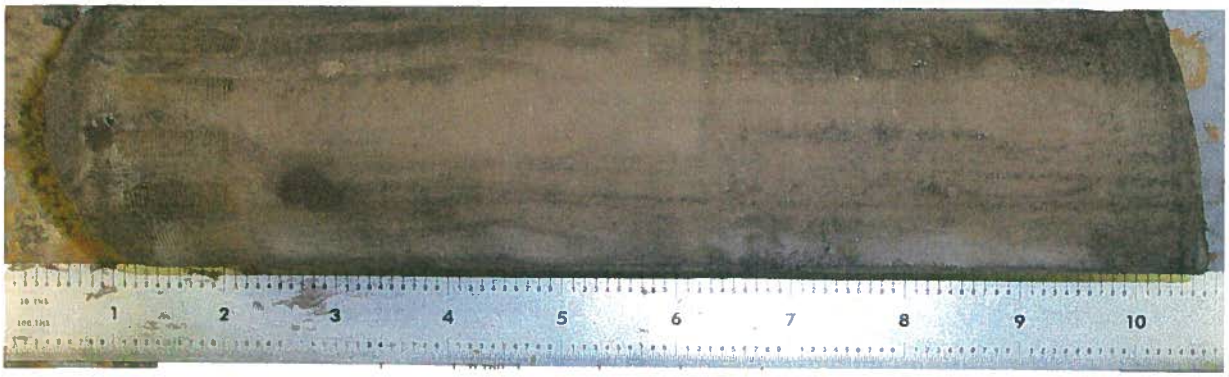
Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z3-B8, C58		2.40	4.9	143.1	135.1	5.9	4898





Elastic Modulus (psi)*:	268,481

* using secant elastic modulus formula



UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: May 12, 2009

Client: CH2MHill

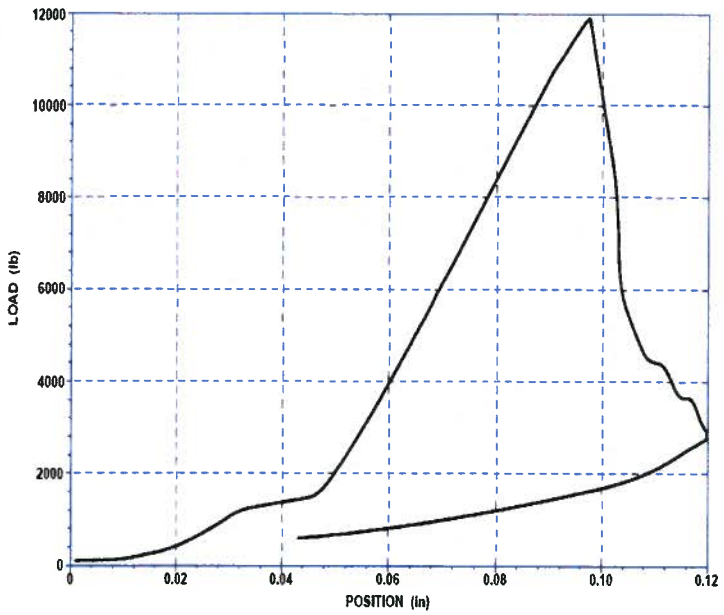
Material Type: siltstone
Date Cast: n/a
Date Tested: 5/12/09
Age, Days: n/a

Depth: 256-256.7

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

Test Results

Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z3-B8, C63		2.40	4.8	140.5	131.6	6.7	2641



Elastic Modulus (psi)*:	130,559

* using secant elastic modulus formula

UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: May 1, 2009

Client: CH2MHill

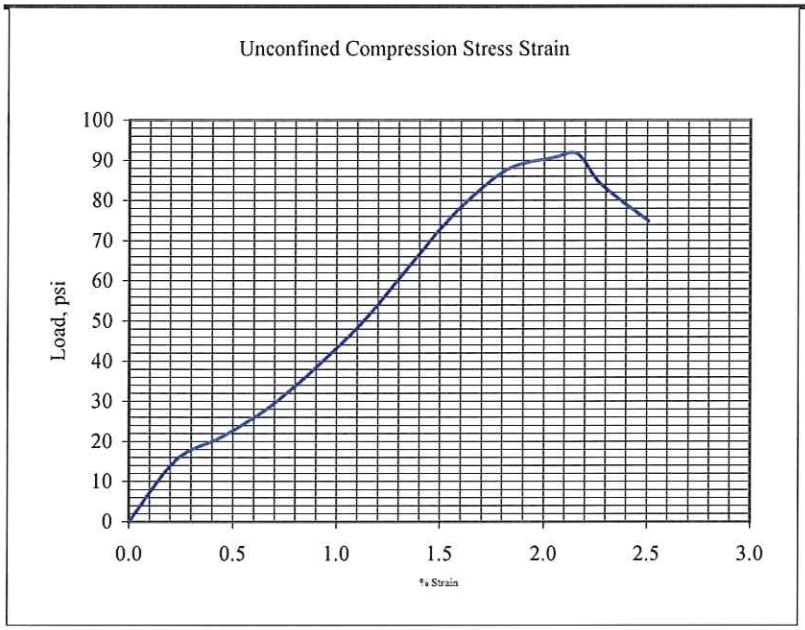
Material Type: Sandstone
Date Cast: n/a
Date Tested: 5/1/09
Age, Days: n/a

Depth: 225-225.7

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

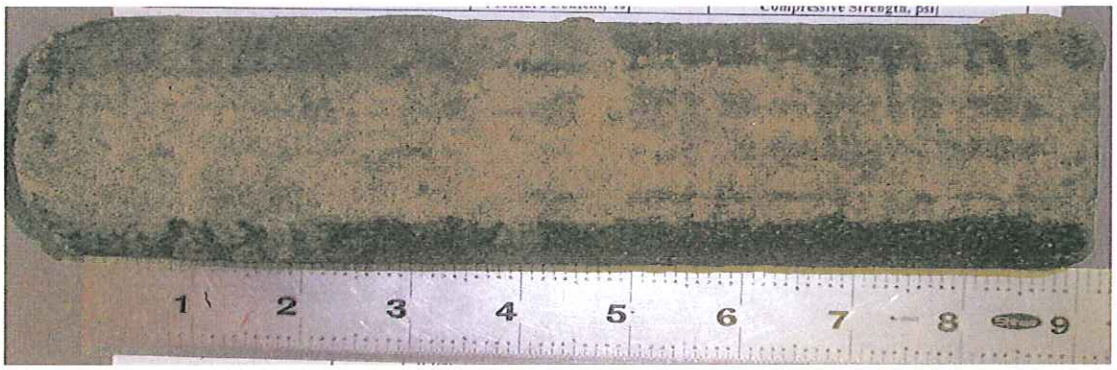
Test Results

Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z3-B10, C59		2.25	4.4	138.1	122.8	12.5	92



Elastic Modulus (psi)*:	4,238

* using secant elastic modulus formula



UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: May 1, 2009

Client: CH2MHill

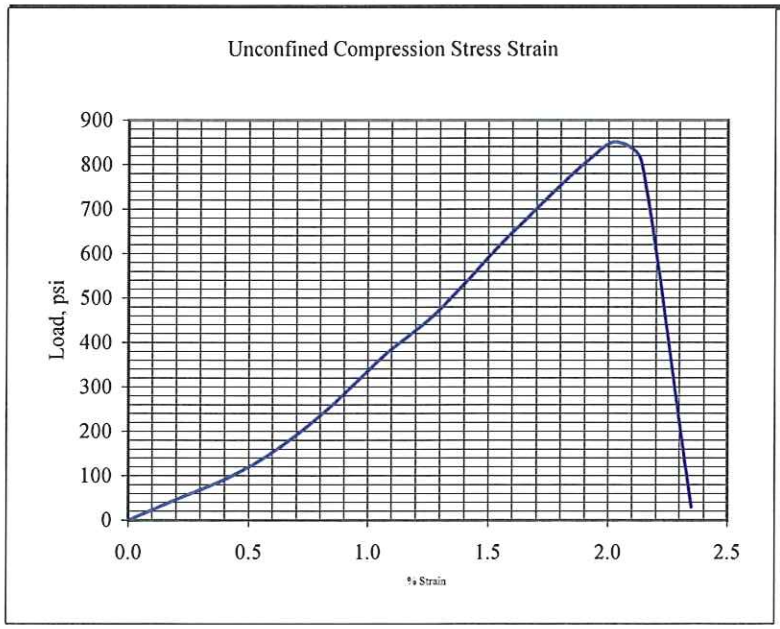
Material Type: Siltstone
Date Cast: n/a
Date Tested: 5/1/09
Age, Days: n/a

Depth: 289-289.9

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

Test Results

Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z3-B10, C73		2.34	4.7	138.6	126.5	9.5	851



Elastic Modulus (psi)*:	42,107

* using secant elastic modulus formula

UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: May 1, 2009

Client: CH2MHill

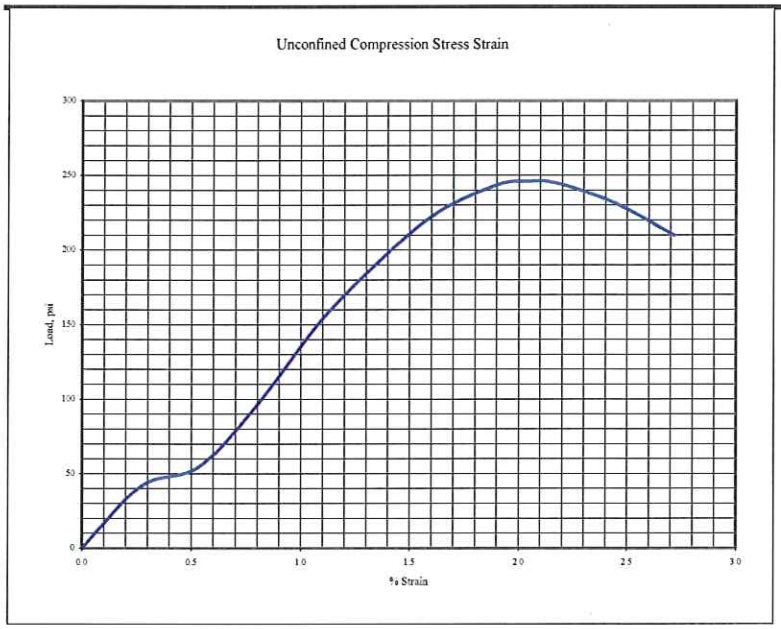
Material Type: Sandstone
Date Cast: n/a
Date Tested: 5/1/09
Age, Days: n/a

Depth: 316-316.8

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

Test Results

Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z3-B10, C79		2.17	3.7	144.8	132.6	9.2	246



Elastic Modulus (psi)*:	12,151

* using secant elastic modulus formula

UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: May 1, 2009

Client: CH2MHill

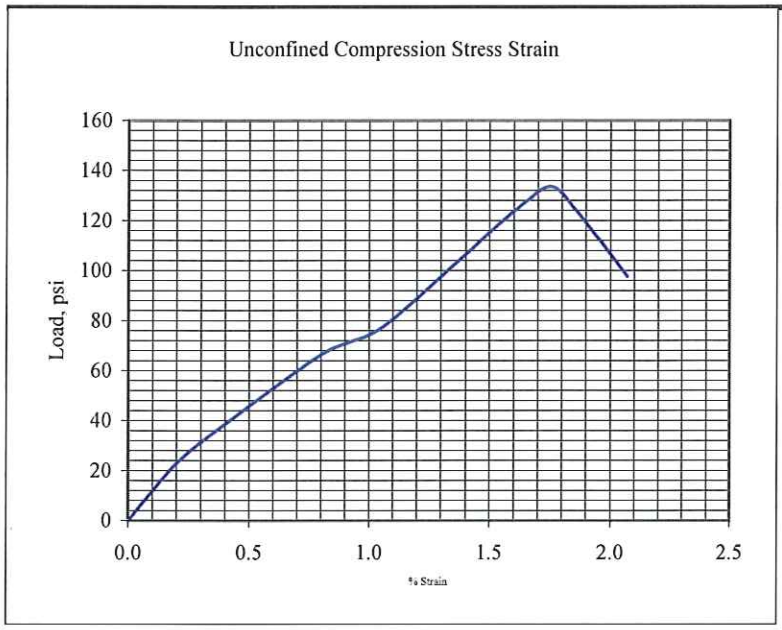
Material Type: Siltstone
Date Cast: n/a
Date Tested: 5/1/09
Age, Days: n/a

Depth: 331.9-332.6

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

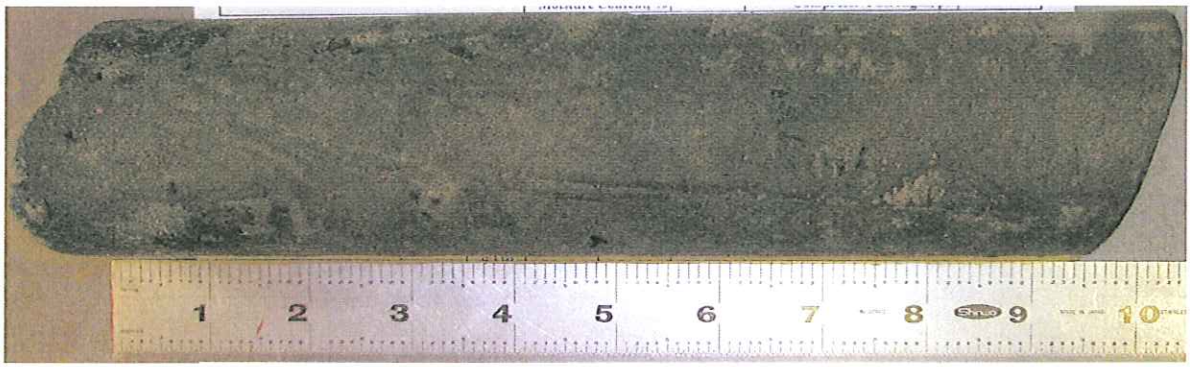
Test Results

Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z3-B10, C83		2.43	4.8	135.5	120.9	12.0	133



Elastic Modulus (psi)*:	7,539

* using secant elastic modulus formula



UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: May 1, 2009

Client: CH2MHill

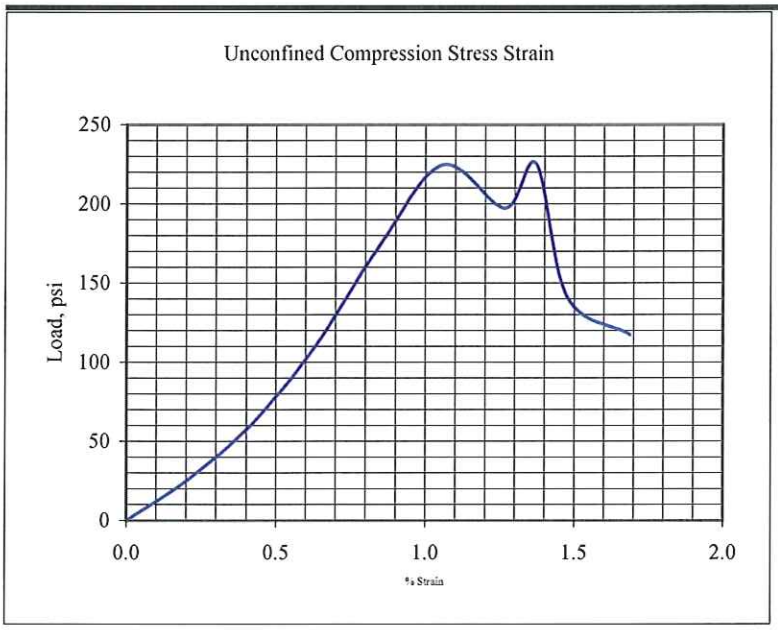
Material Type: Sandstone
Date Cast: n/a
Date Tested: 5/1/09
Age, Days: n/a

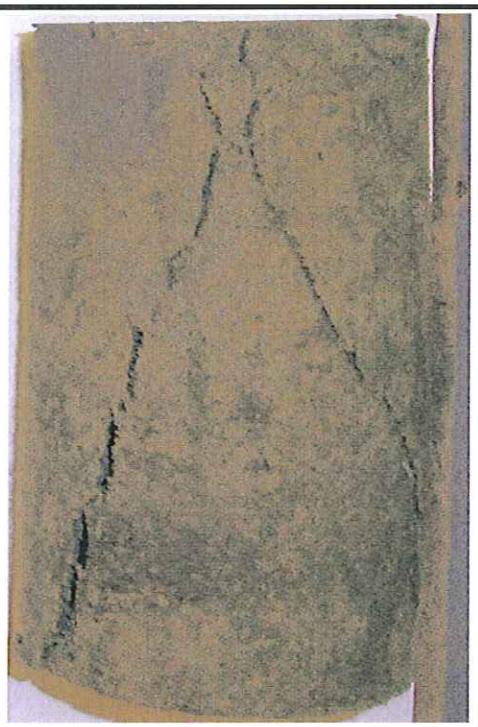
Depth: 356.4-357

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

Test Results

Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z3-B10, C89		2.37	4.7	144.3	133.8	7.9	225





Elastic Modulus (psi)*:	16,262

* using secant elastic modulus formula

UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: April 10, 2009

Client: CH2MHill

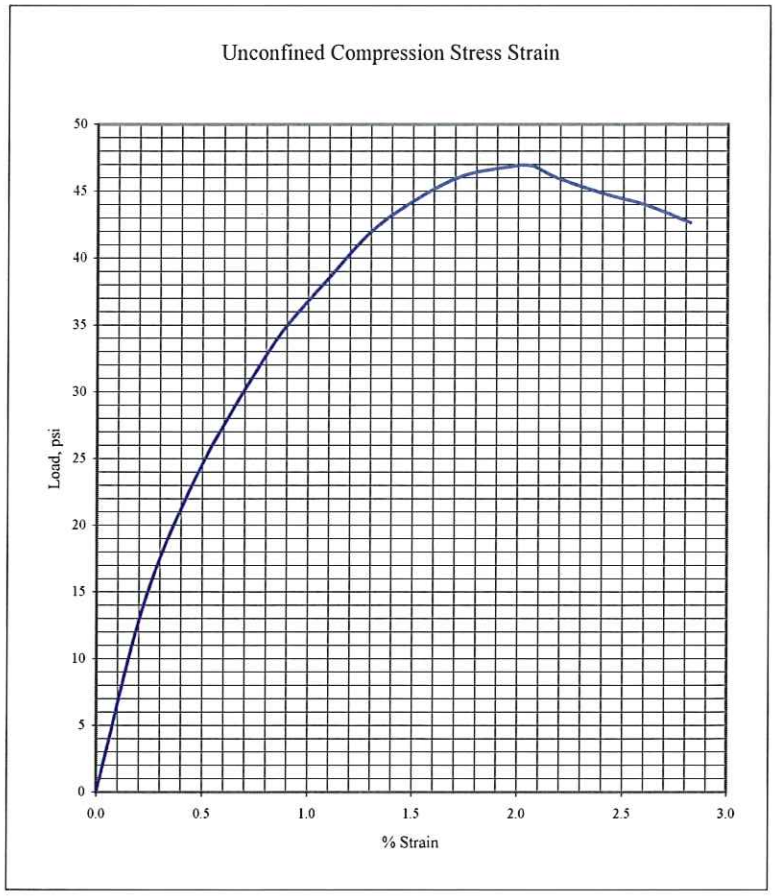
Material Type: Siltstone
Date Cast: n/a
Date Tested: 4/10/09
Age, Days: n/a

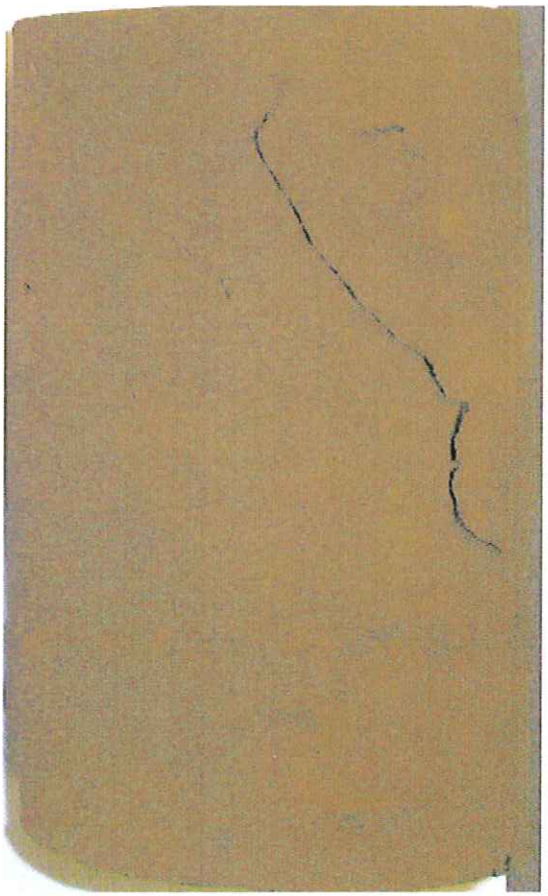
Depth: 208.9-209.8

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

Test Results

Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z3-B11, C42		2.39	4.6	134.1	112.4	19.3	47





Elastic Modulus (psi)*:	2276

*using secant elastic modulus formula

UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: April 10, 2009

Client: CH2MHill

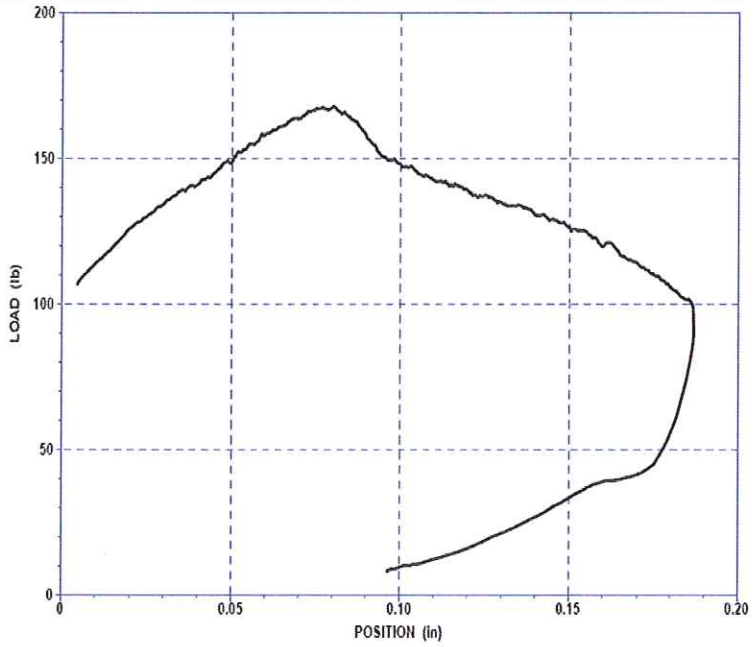
Material Type: Mudstone
Date Cast: n/a
Date Tested: 4/10/09
Age, Days: n/a

Depth: 226-226.7

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

Test Results

Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z3-B11, C46		2.40	4.8	136.2	118.8	14.7	38



Elastic Modulus (psi)*:	2168

*using secant elastic modulus formula

UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: April 10, 2009

Client: CH2MHill

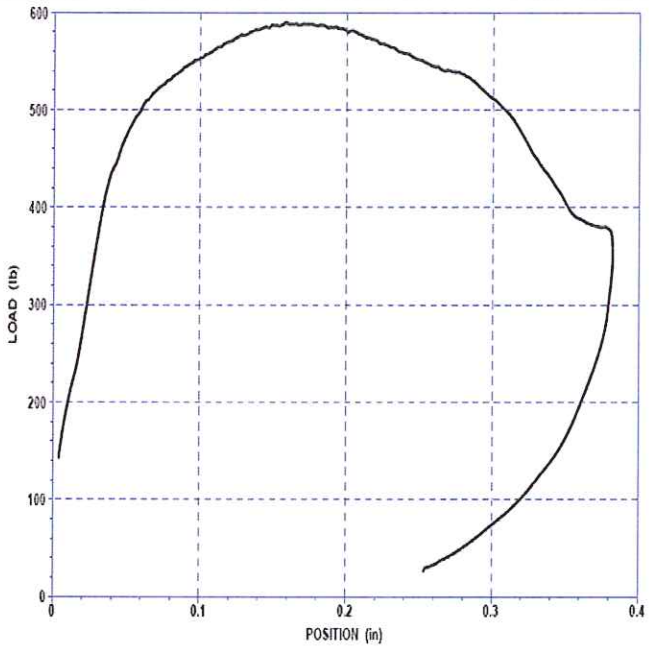
Material Type: Mudstone
Date Cast: n/a
Date Tested: 4/10/09
Age, Days: n/a

Depth: 245.25-246

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

Test Results

Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z3-B11, C49		2.40	4.5	140.3	124.3	12.9	131



Elastic Modulus (psi)*:	3311

*using secant elastic modulus formula

UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: April 10, 2009

Client: CH2MHill

Material Type: Mudstone
Date Cast: n/a
Date Tested: 4/10/09
Age, Days: n/a

Depth: 263-263.75

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

Test Results

Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z3-B11, C53		2.40	4.7	135.2	118.5	14.0	12

Sample broke before stress strain curve could be started. Unable to calculate Elastic Modulus.

Elastic Modulus (psi)*:	n/a

*using secant elastic modulus formula

Leighton

UNCONFINED COMPRESSIVE STRENGTH of COHESIVE SOIL

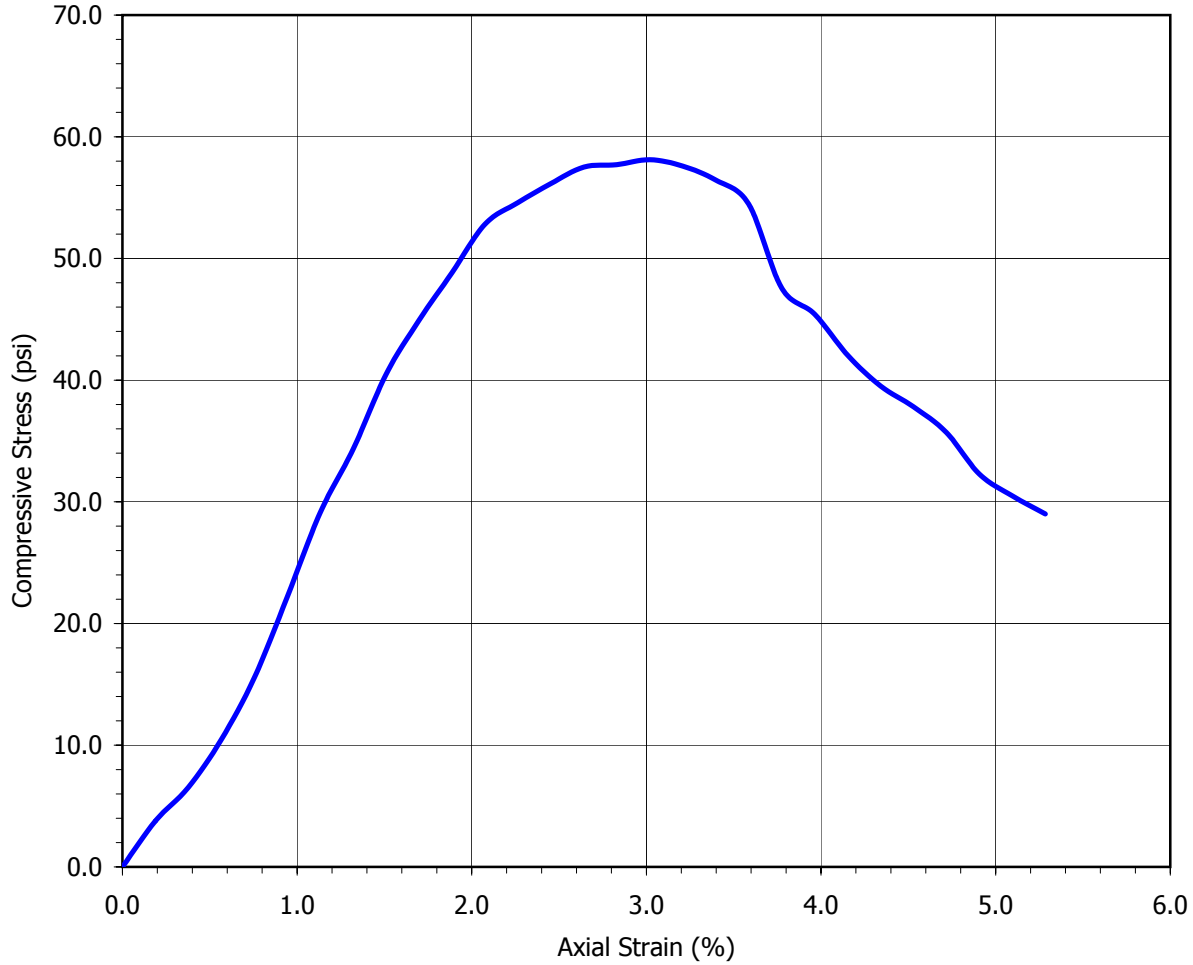
ASTM D 2166

Project Name:	SR-710 Tunnel Technical Study	Tested by:	A. Santos	Date:	05/10/09
Project No.:	378312.04.09.01	Checked by:	J. Ward	Date:	05/13/09
Boring No.:	R-09-Z3-B11	Sample Type:	Core		
Sample No.:	C-37	Depth (ft):	184.7-185.5		
Sample Description:	Olive brown lean clay'stone' (CL)				

Weight of Sample + Tube / Rings (g)	815.60
Weight of Tube / Rings (g)	0.00
Wet Weight of Soil + Container (g)	924.80
Dry Weight of Soil + Container (g)	778.30
Weight of Container (g)	111.20
Load Surcharge (lb)	2.20
Rate of Deformation (in/min)	0.012
Specific Gravity (Assumed)	2.70

Sample Measurements	
Diameter (in)	2.425
	2.435
	2.460
Area (sq.in.)	4.676
Height (in)	5.297
	5.298
	5.301

Axial Deformation (in.)	Load (lb.)	Compressive Stress (psi)	Axial Strain (%)
0.0000	0.0	0.00	0.000
0.0100	15.5	3.78	0.189
0.0200	28.5	6.54	0.377
0.0300	47.0	10.46	0.566
0.0400	71.0	15.54	0.755
0.0500	102.5	22.18	0.944
0.0600	135.5	29.12	1.132
0.0700	160.5	34.34	1.321
0.0800	190.0	40.48	1.510
0.0900	211.5	44.93	1.699
0.1000	230.5	48.83	1.887
0.1100	250.0	52.82	2.076
0.1200	259.0	54.60	2.265
0.1300	267.0	56.16	2.454
0.1400	274.0	57.51	2.642
0.1500	275.5	57.71	2.831
0.1600	278.0	58.11	3.020
0.1700	276.0	57.59	3.208
0.1800	271.0	56.44	3.397
0.1900	262.0	54.48	3.586
0.2000	229.0	47.58	3.775
0.2100	219.0	45.43	3.963
0.2200	203.0	42.06	4.152
0.2300	191.0	39.52	4.341
0.2400	183.0	37.81	4.530
0.2500	173.0	35.70	4.718
0.2600	156.5	32.27	4.91
0.2700	148.0	30.48	5.10
0.2800	141.0	29.01	5.28



Boring No.:	R-09-Z3-B11
Sample No.:	C-37
Depth (ft):	184.7-185.5
Soil Type:	Core
Sample Description:	Olive brown lean clay'stone' (CL)

Sample Diameter (in.)	2.440
Sample Height (in.)	5.299
Initial Moisture Content (%)	21.96
Dry Density (pcf)	102.8
Specific Gravity (assumed)	2.7
Saturation (%)	92.9
Rate of Deformation (in/min)	0.0120
Height / Diameter Ratio	2.17

At Failure

Compressive Strength (psi)	**58.11**
Axial Strain (%)	3.02

Leighton

Unconfined Compressive Strength of Cohesive Soil
ASTM D 2166

Project No.: **378312.04.09.01**

SR-710 Tunnel Technical Study

05/10/09

UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: April 2, 2009

Client: CH2MHill

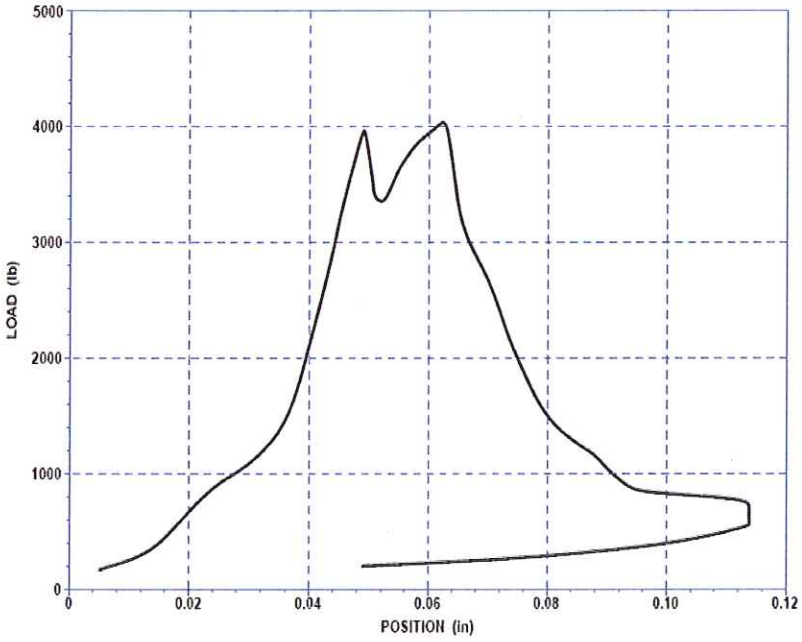
Material Type: Core
Date Cast: n/a
Date Tested: 4/2/09
Age, Days: n/a

Depth: 213.9-214.5

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

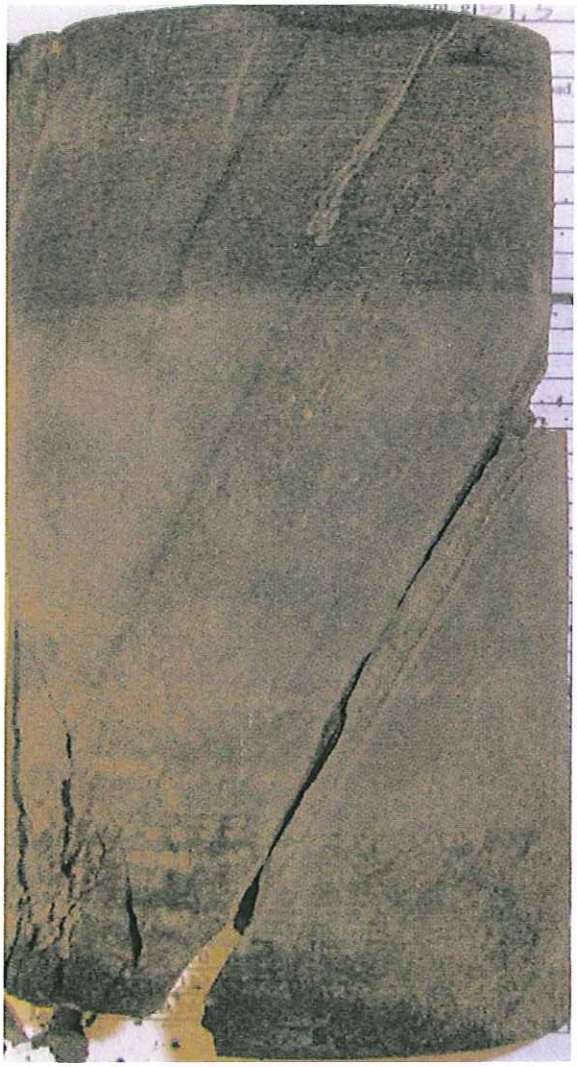
Test Results

Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z3-B12, C47		3.10	5.9	125.8	105.5	19.3	503



Elastic Modulus (psi)*:	47332

*using secant elastic modulus formula



UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: April 2, 2009

Client: CH2MHill

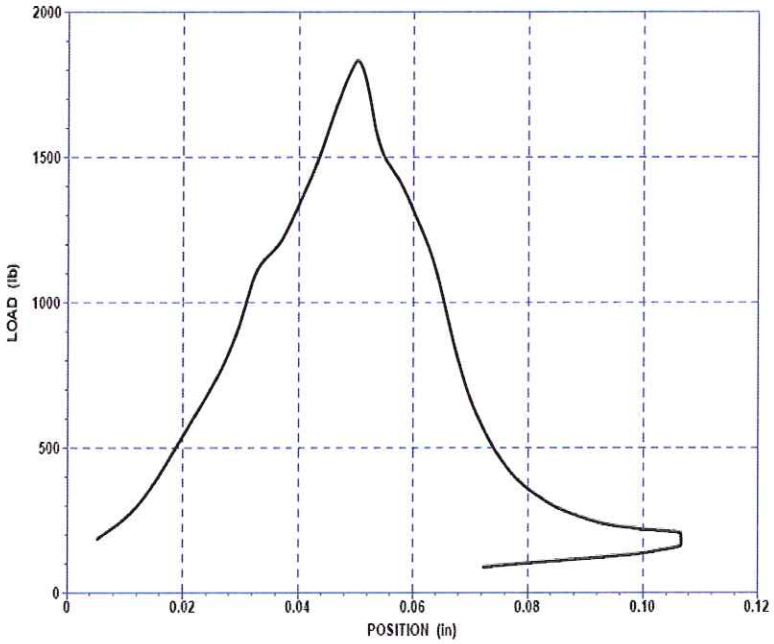
Material Type: Core
Date Cast: n/a
Date Tested: 4/2/09
Age, Days: n/a

Depth: 248.9-249.9

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

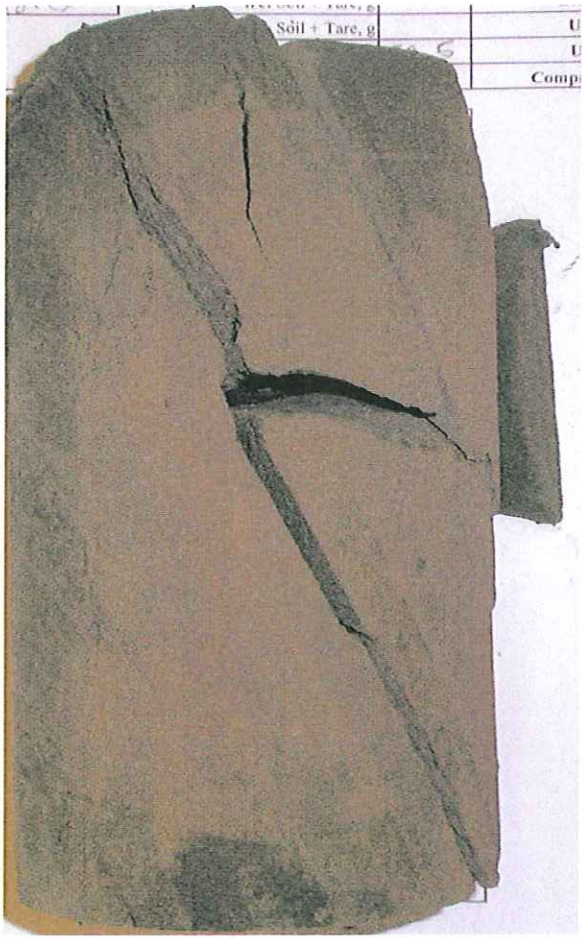
Test Results

Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z3-B12, C56		3.15	6.0	122.7	102.5	19.7	232



Elastic Modulus (psi)*:	27241

*using secant elastic modulus formula



UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: April 2, 2009

Client: CH2MHill

Material Type: Shale
Date Cast: n/a
Date Tested: 4/2/09
Age, Days: n/a

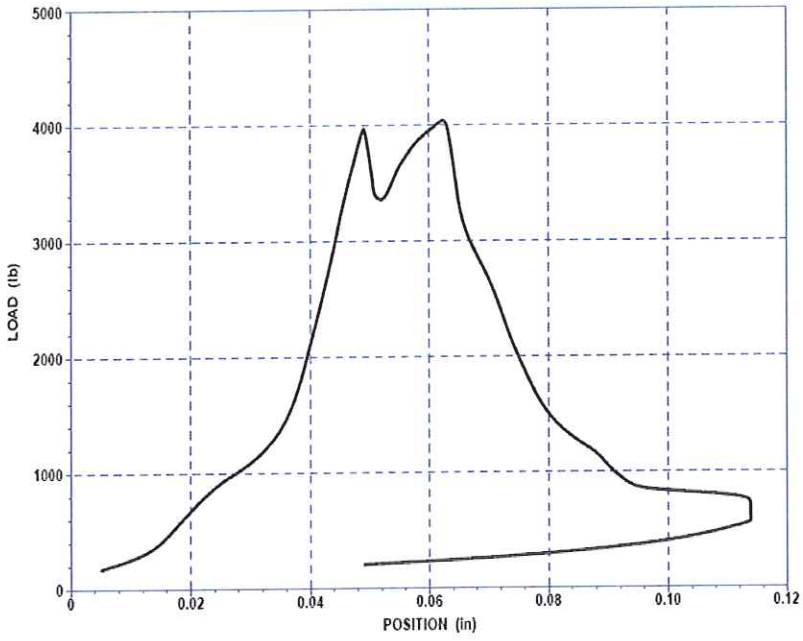
Depth: 213.9-214.5

Test Method: ASTM D4832, D1633, D7012

Moisture Condition At Testing: Ambient

Test Results

Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z3-B12, C47		3.10	5.9	125.8	105.5	19.3	503



Elastic Modulus (psi)*:	47332

*using secant elastic modulus formula

UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: April 2, 2009

Client: CH2MHill

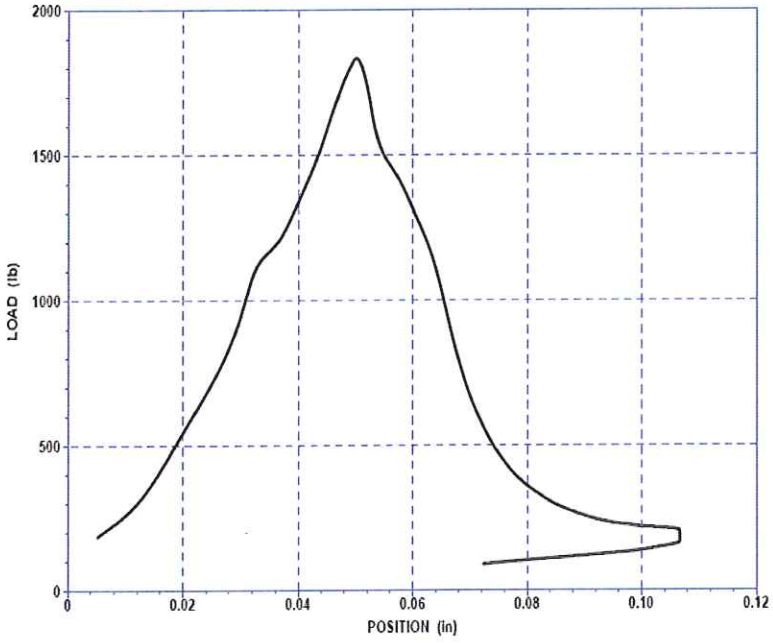
Material Type: Shale
Date Cast: n/a
Date Tested: 4/2/09
Age, Days: n/a

Depth: 248.9-249.9

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

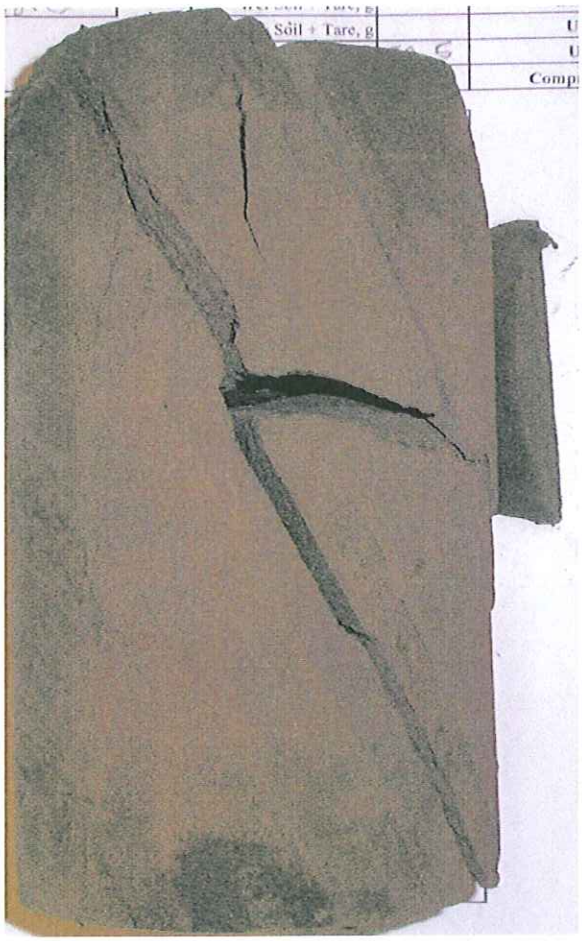
Test Results

Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z3-B12, C56		3.15	6.0	122.7	102.5	19.7	232



Elastic Modulus (psi)*:	27241

*using secant elastic modulus formula



Leighton

UNCONFINED COMPRESSIVE STRENGTH of COHESIVE SOIL

ASTM D 2166

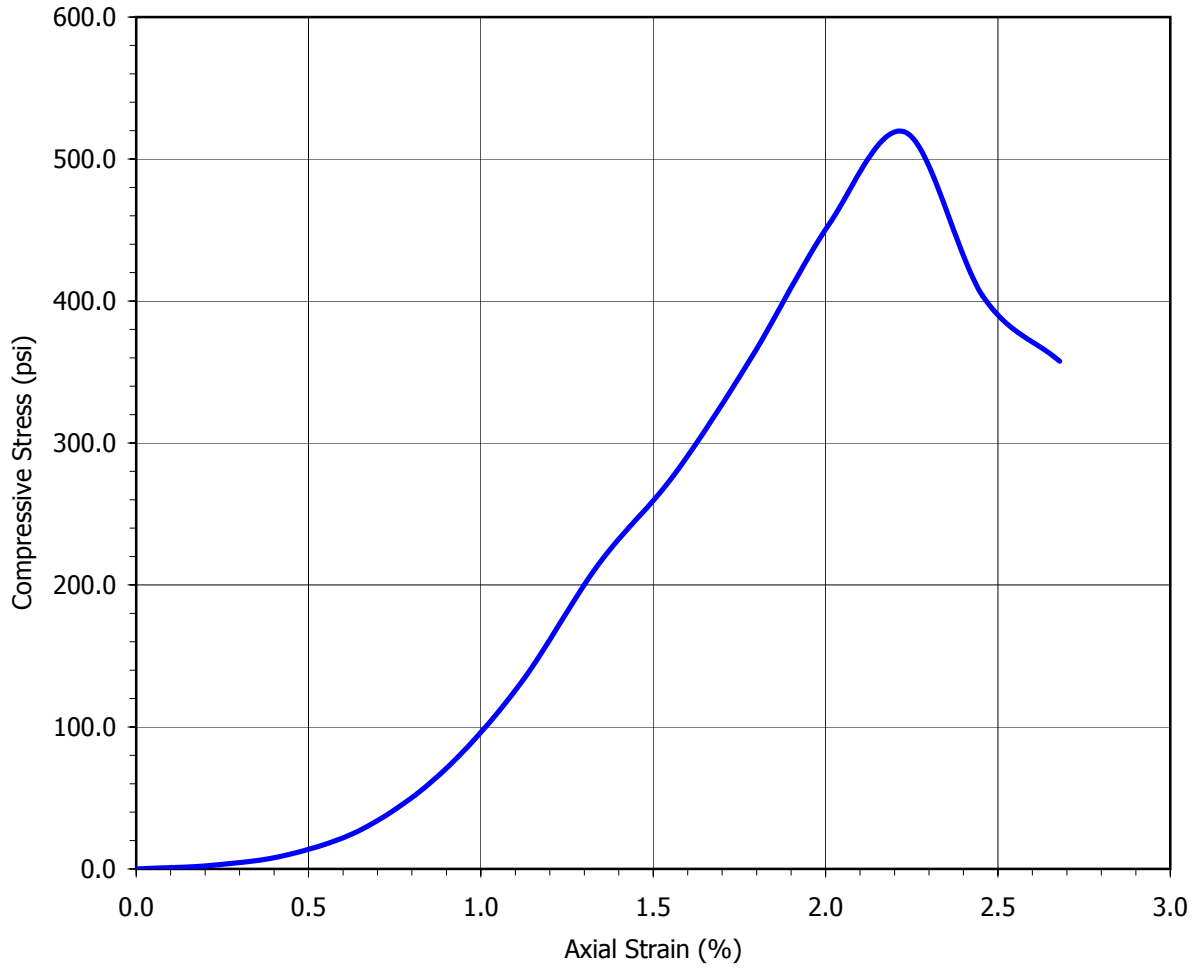
Project Name: SR-710 Tunnel Technical Study
Tested by: A. Santos
Date: 05/11/09
Project No.: 378312.04.09.01
Checked by: J. Ward
Date: 05/27/09
Boring No.: R-09-Z3-B12
Sample Type: Core
Sample No.: C61
Depth (ft): 267.5-269.9
Sample Description: Dark olive gray shale

Weight of Sample + Tube / Rings (g)	1038.40
Weight of Tube / Rings (g)	0.00
Wet Weight of Soil + Container (g)	1104.50
Dry Weight of Soil + Container (g)	1001.60
Weight of Container (g)	109.40
Load Surcharge (lb)	2.20
Rate of Deformation (in/min)	0.012
Specific Gravity (Assumed)	2.70

Sample Measurements	
Diameter (in)	3.155
	3.160
	3.155
Area (sq.in.)	7.826
Height (in)	4.469
	4.480
	4.489

Axial Deformation (in.)	Load (lb.)	Compressive Stress (psi)	Axial Strain (%)
0.0000	0.0	0.00	0.000
0.0100	18.5	2.64	0.223
0.0200	79.0	10.33	0.447
0.0300	233.0	29.85	0.670
0.0400	545.0	69.29	0.893
0.0500	1035.0	131.05	1.116
0.0600	1695.0	213.96	1.340
0.0700	2211.0	278.38	1.563
0.0800	2872.0	360.70	1.786
0.0900	3622.0	453.78	2.009
0.1000	4150.0	518.71	2.233
0.1100	3236.0	403.60	2.456
0.1200	2873.0	357.54	2.679

Axial Deformation (in.)	Load (lb.)	Compressive Stress (psi)	Axial Strain (%)



Boring No.:	R-09-Z3-B12
Sample No.:	C61
Depth (ft):	267.5-269.9
Soil Type:	Core
Sample Description:	Dark olive gray shale

Sample Diameter (in.)	3.157
Sample Height (in.)	4.479
Initial Moisture Content (%)	11.53
Dry Density (pcf)	101.2
Specific Gravity (assumed)	2.7
Saturation (%)	46.8
Rate of Deformation (in/min)	0.0120
Height / Diameter Ratio	1.42

At Failure

Compressive Strength (psi)	**518.71**
Axial Strain (%)	2.23

Leighton

Unconfined Compressive Strength of Cohesive Soil
ASTM D 2166

Project No.: **378312.04.09.01**

SR-710 Tunnel Technical Study

05/11/09

Leighton

UNCONFINED COMPRESSIVE STRENGTH of COHESIVE SOIL

ASTM D 2166

Project Name: SR-710 Tunnel Technical Study
Project No.: 378312.04.09.01
Boring No.: R-09-Z3-B12
Sample No.: C44
Sample Description: Olive gray silty sand'stone' (SM)

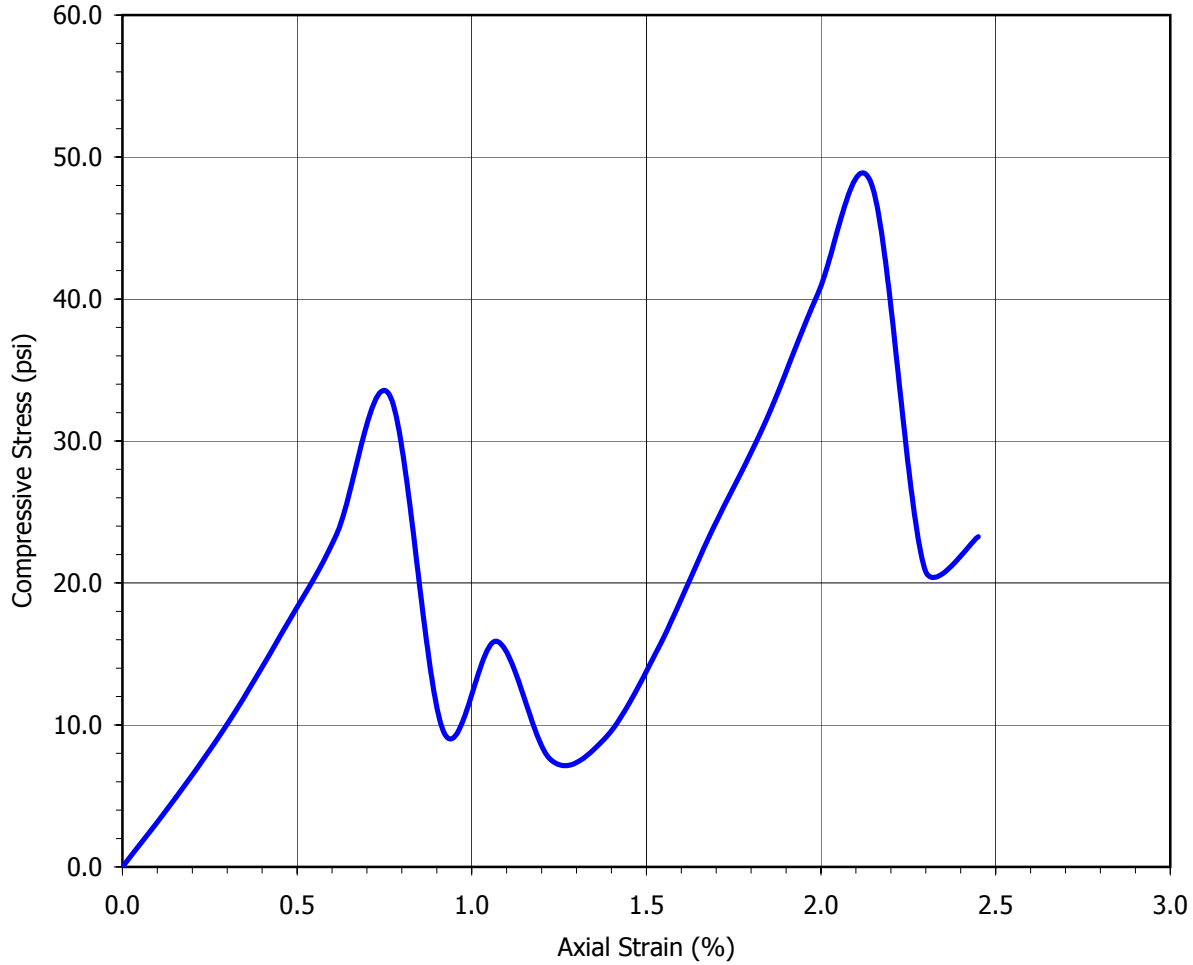
Tested by: A. Santos Date: 06/04/09
Checked by: J. Ward Date: 06/06/09
Sample Type: Core
Depth (ft): 201.5-202.8

Weight of Sample + Tube / Rings (g)	1487.10
Weight of Tube / Rings (g)	0.00
Wet Weight of Soil + Container (g)	1589.10
Dry Weight of Soil + Container (g)	1381.60
Weight of Container (g)	108.41
Load Surcharge (lb)	2.20
Rate of Deformation (in/min)	0.012
Specific Gravity (Assumed)	2.70

Sample Measurements	
Diameter (in)	3.202
	3.225
	3.210
Area (sq.in.)	8.105
Height (in)	6.542
	6.520
	6.530

Axial Deformation (in.)	Load (lb.)	Compressive Stress (psi)	Axial Strain (%)
0.0000	0.0	0.00	0.000
0.0100	37.5	4.89	0.153
0.0200	81.5	10.30	0.306
0.0300	133.0	16.61	0.459
0.0400	188.5	23.39	0.613
0.0500	269.0	33.21	0.766
0.0600	76.0	9.56	0.919
0.0700	128.0	15.89	1.072
0.0800	60.0	7.58	1.225
0.0900	71.5	8.97	1.378
0.1000	123.5	15.27	1.531
0.1100	191.5	23.50	1.684
0.1200	255.0	31.15	1.838
0.1300	331.5	40.35	1.991
0.1400	396.5	48.14	2.144
0.1500	172.0	21.00	2.297
0.1600	191.0	23.25	2.450

Axial Deformation (in.)	Load (lb.)	Compressive Stress (psi)	Axial Strain (%)



Boring No.:	R-09-Z3-B12
Sample No.:	C44
Depth (ft):	201.5-202.8
Soil Type:	Core
Sample Description:	Olive gray silty sand'stone' (SM)

Sample Diameter (in.)	3.212
Sample Height (in.)	6.530
Initial Moisture Content (%)	16.30
Dry Density (pcf)	92.0
Specific Gravity (assumed)	2.7
Saturation (%)	53.0
Rate of Deformation (in/min)	0.0120
Height / Diameter Ratio	2.03

At Failure

Compressive Strength (psi)	**48.14**
Axial Strain (%)	2.14

Note: peaks in stress-strain graph correspond to the compressive strength of individual diagonal layers

Leighton

Unconfined Compressive Strength of Cohesive Soil
ASTM D 2166

Project No.: **378312.04.09.01**

SR-710 Tunnel Technical Study

06/04/09

Leighton

UNCONFINED COMPRESSIVE STRENGTH of COHESIVE SOIL

ASTM D 2166

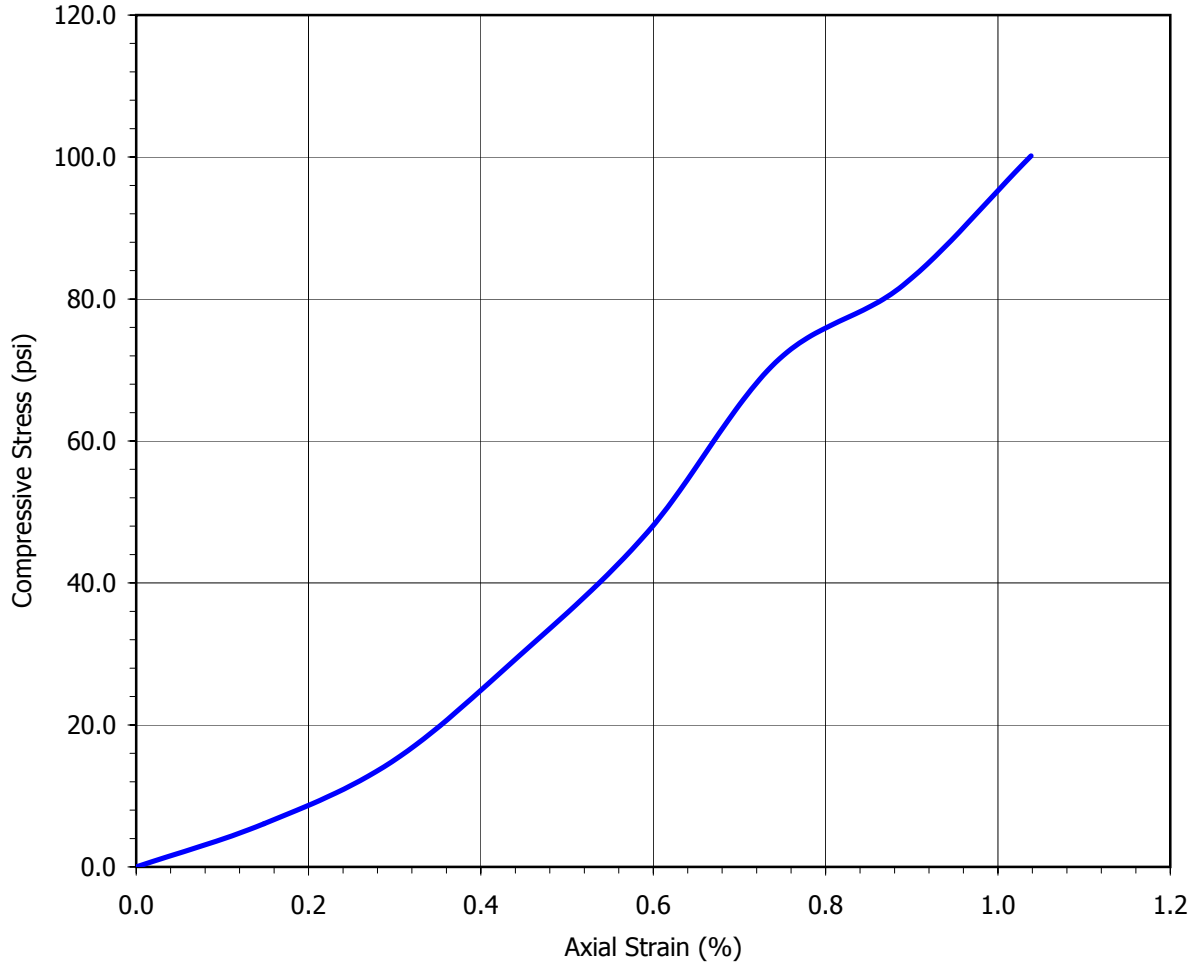
Project Name:	SR-710 Tunnel Technical Study		Tested by:	A. Santos	Date: 04/16/09
Project No.:	378312.04.09.01		Checked by:	J. Ward	Date: 04/20/09
Boring No.:	R-09-Z3-B12		Sample Type:	Core	
Sample No.:	C40		Depth (ft):	185.8-190.8	
Sample Description:	Dark olive shale				

Weight of Sample + Tube / Rings (g)	1550.30
Weight of Tube / Rings (g)	0.00
Wet Weight of Soil + Container (g)	1648.00
Dry Weight of Soil + Container (g)	1386.60
Weight of Container (g)	107.10
Load Surcharge (lb)	2.20
Rate of Deformation (in/min)	0.020
Specific Gravity (Assumed)	2.70

Sample Measurements	
Diameter (in)	3.190
	3.150
	3.130
Area (sq.in.)	7.826
Height (in)	6.735
	6.736
	6.751

Axial Deformation (in.)	Load (lb.)	Compressive Stress (psi)	Axial Strain (%)
0.0000	0.0	0.00	0.000
0.0100	45.5	6.09	0.148
0.0200	114.0	14.80	0.297
0.0300	232.0	29.79	0.445
0.0400	369.0	47.15	0.593
0.0500	558.0	71.05	0.742
0.0600	645.0	81.96	0.890
0.0700	790.0	100.17	1.038
0.0800			
0.0900			
0.1000			
0.1100			
0.1200			
0.1300			
0.1400			
0.1500			
0.1600			
0.1700			
0.1800			
0.1900			
0.2000			
0.2100			
0.2200			
0.2300			
0.2400			
0.2500			

Axial Deformation (in.)	Load (lb.)	Compressive Stress (psi)	Axial Strain (%)
0.2600			
0.2700			
0.2800			
0.2900			
0.3000			
0.3100			
0.3200			
0.3300			
0.3400			
0.3500			
0.3600			
0.3700			
0.3800			
0.3900			
0.4000			
0.4100			
0.4200			
0.4300			
0.4400			
0.4500			



Boring No.:	R-09-Z3-B12
Sample No.:	C40
Depth (ft):	185.8-190.8
Soil Type:	Core
Sample Description:	Dark olive shale

Sample Diameter (in.)	3.157
Sample Height (in.)	6.741
Initial Moisture Content (%)	20.43
Dry Density (pcf)	93.0
Specific Gravity (assumed)	2.7
Saturation (%)	67.9
Rate of Deformation (in/min)	0.0200
Height / Diameter Ratio	2.14

At Failure

Compressive Strength (psi)	**100.17**
Axial Strain (%)	1.04

Leighton

Unconfined Compressive Strength of Cohesive Soil
ASTM D 2166

Project No.: **378312.04.09.01**

SR-710 Tunnel Technical Study

04/16/09

UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: April 22, 2009

Client: CH2MHill

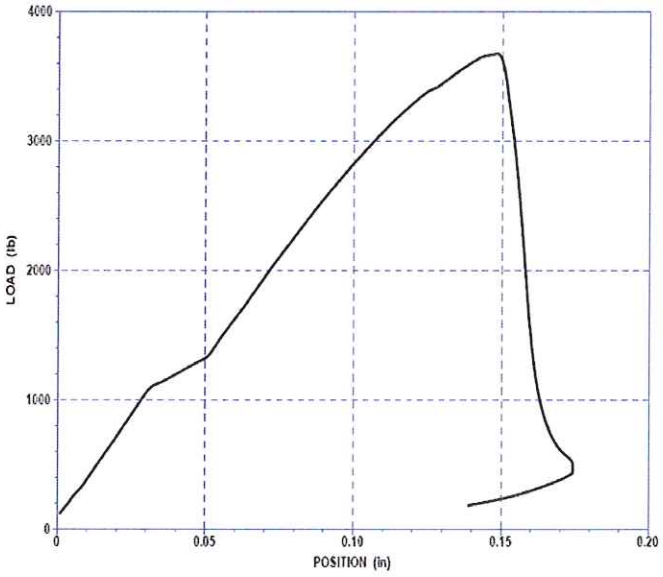
Material Type: Siltstone
Date Cast: n/a
Date Tested: 4/22/09
Age, Days: n/a

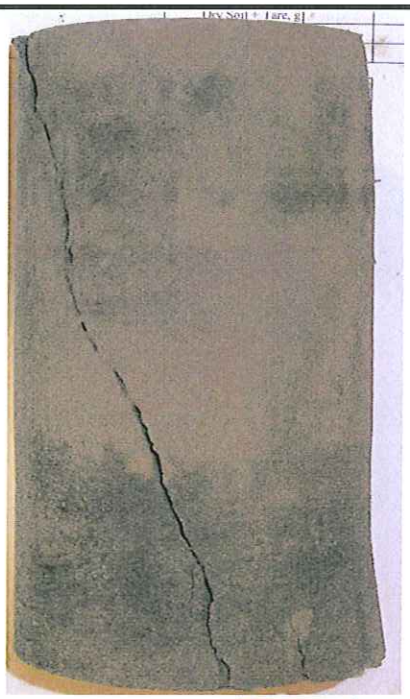
Depth: 156.3-157.1

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

Test Results

Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z4-B4, C28		3.22	6.5	123.1	104.9	17.4	451





Elastic Modulus (psi)*:	19,445

* using secant elastic modulus formula

UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: April 22, 2009

Client: CH2MHill

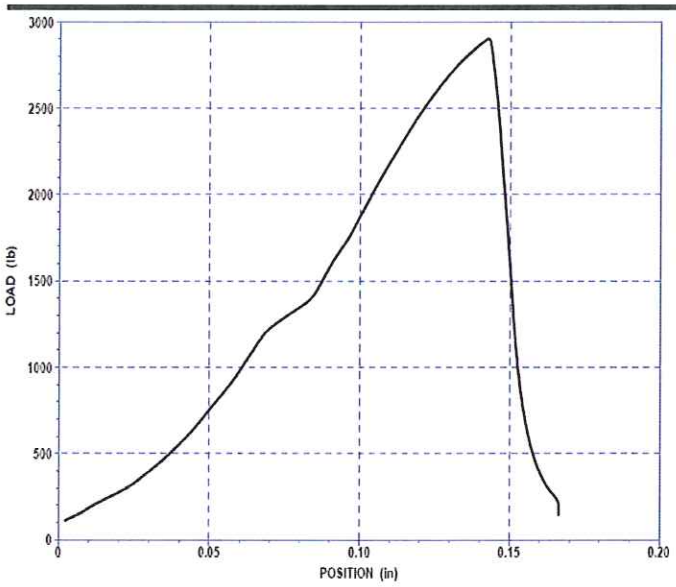
Material Type: Siltstone
Date Cast: n/a
Date Tested: 4/22/09
Age, Days: n/a

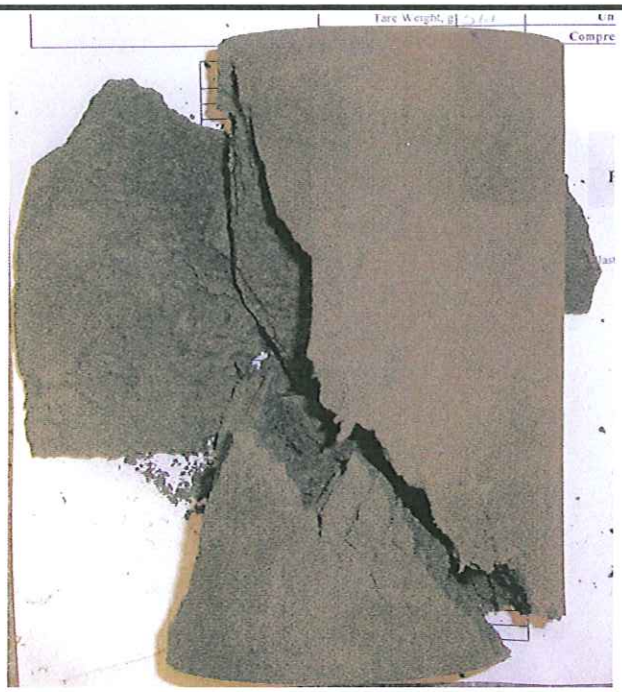
Depth: 198.5-199.5

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

Test Results

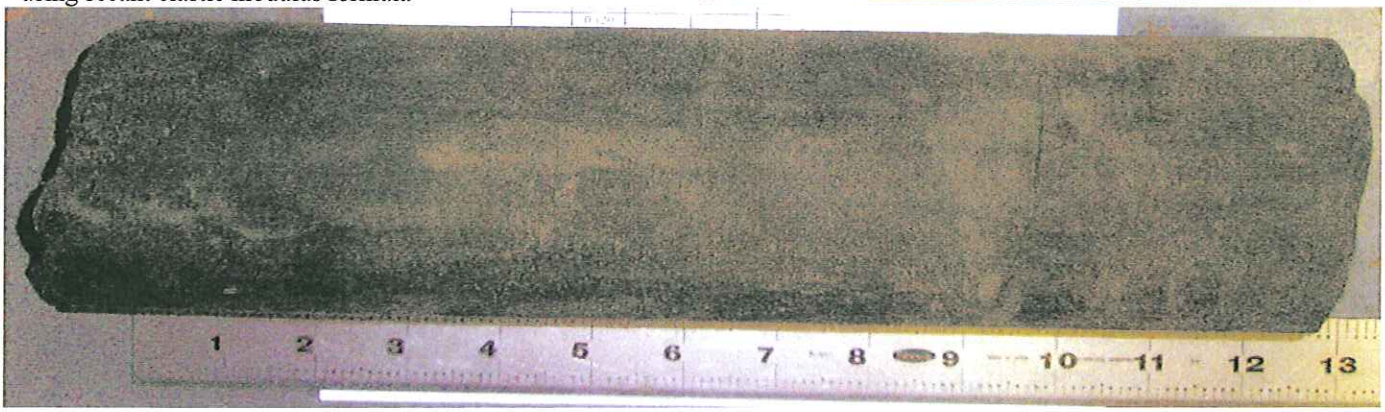
Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z4-B4, C35		3.25	6.4	122.1	103.2	18.3	351





Elastic Modulus (psi)*:	15,617

* using secant elastic modulus formula



UNCONFINED COMPRESSIVE STRENGTH

SIERRA TESTING LABORATORIES, INC.
GEOTECHNICAL AND MATERIALS TESTING SERVICES

Project Name: SR-710 Tunnel Technical Study
Project No.: 09-144
Report Date: April 22, 2009

Client: CH2MHill

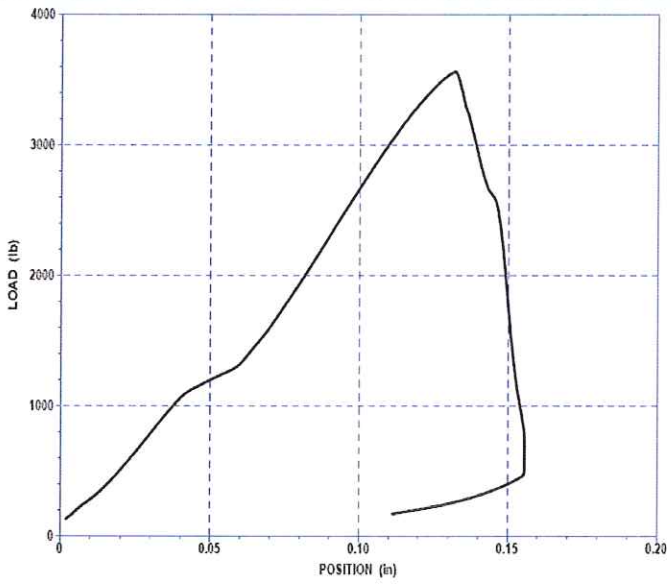
Material Type: Siltstone
Date Cast: n/a
Date Tested: 4/22/09
Age, Days: n/a

Depth: 235-235

Test Method: ASTM D4832, D1633, D7012
Moisture Condition At Testing: Ambient

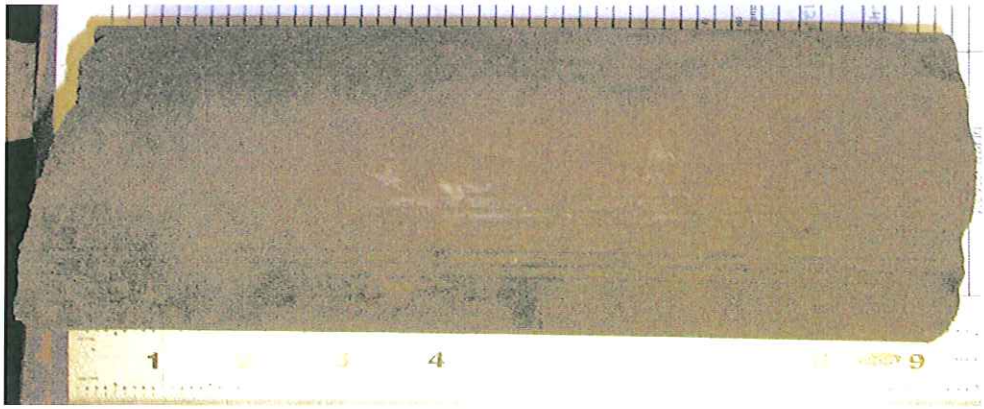
Test Results

Sample ID.	Sample Location	Diameter, in.	Height, in.	Wet Unit Weight, pcf	Dry Unit Weight, pcf	Moisture Content, %	Unconfined Compressive Strength, psi
R-09-Z4-B4, C40		3.20	6.3	120.0	105.6	13.7	444



Elastic Modulus (psi)*:	21,073

* using secant elastic modulus formula



Leighton

UNCONFINED COMPRESSIVE STRENGTH of COHESIVE SOIL

ASTM D 2166

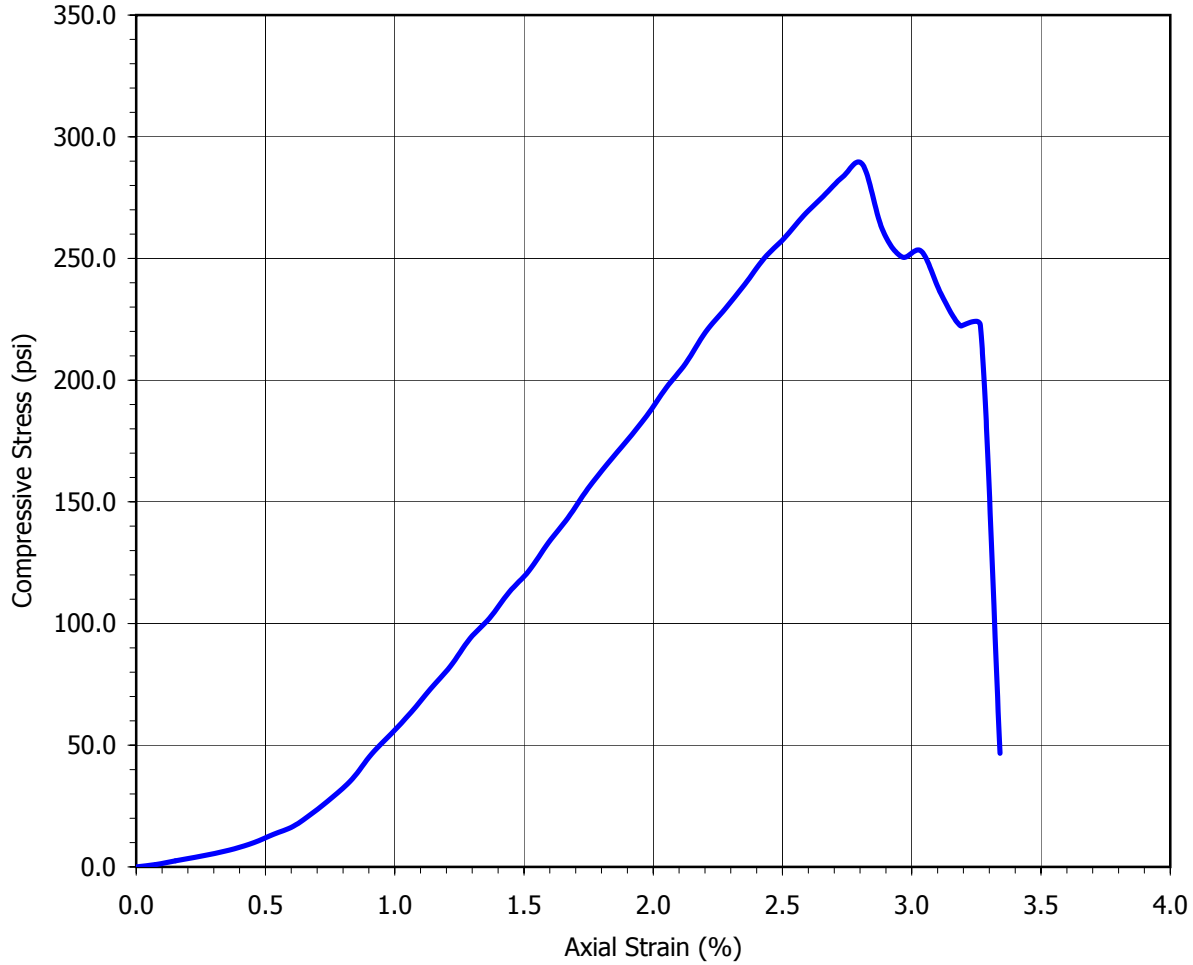
Project Name:	SR-710 Tunnel Technical Study		Tested by:	A. Santos	Date: 04/29/09
Project No.:	378312.04.09.01		Checked by:	J. Ward	Date: 04/30/09
Boring No.:	R-09-Z4-B4		Sample Type:	Core	
Sample No.:	C-24		Depth (ft):	126.5-127.3	
Sample Description:	Dark olive silt'stone' (ML)				

Weight of Sample + Tube / Rings (g)	1754.60
Weight of Tube / Rings (g)	0.00
Wet Weight of Soil + Container (g)	1692.40
Dry Weight of Soil + Container (g)	1429.30
Weight of Container (g)	110.70
Load Surcharge (lb)	2.20
Rate of Deformation (in/min)	0.012
Specific Gravity (Assumed)	2.70

Sample Measurements	
Diameter (in)	3.265
	3.250
	3.252
Area (sq.in.)	8.325
Height (in)	6.583
	6.580
	6.592

Axial Deformation (in.)	Load (lb.)	Compressive Stress (psi)	Axial Strain (%)
0.0000	0.0	0.00	0.000
0.0050	6.0	0.98	0.076
0.0100	18.5	2.48	0.152
0.0150	30.5	3.92	0.228
0.0200	44.0	5.53	0.304
0.0250	60.0	7.44	0.380
0.0300	81.5	10.01	0.456
0.0350	110.0	13.41	0.532
0.0400	137.5	16.68	0.607
0.0450	184.0	22.21	0.683
0.0500	238.0	28.63	0.759
0.0550	301.0	36.12	0.835
0.0600	388.0	46.45	0.911
0.0650	458.0	54.74	0.987
0.0700	532.0	63.49	1.063
0.0750	614.0	73.18	1.139
0.0800	692.0	82.38	1.215
0.0850	789.0	93.82	1.291
0.0900	860.0	102.16	1.367
0.0950	951.0	112.85	1.443
0.1000	1026.0	121.64	1.519
0.1050	1125.0	133.24	1.595
0.1100	1212.0	143.42	1.671
0.1150	1314.0	155.35	1.747
0.1200	1402.0	165.60	1.822
0.1250	1484.0	175.14	1.898

Axial Deformation (in.)	Load (lb.)	Compressive Stress (psi)	Axial Strain (%)
0.1300	1571.0	185.25	1.97
0.1350	1671.0	196.87	2.05
0.1400	1758.0	206.95	2.13
0.1450	1868.0	219.71	2.20
0.1500	1951.0	229.28	2.28
0.1550	2038.0	239.31	2.35
0.1600	2132.0	250.14	2.43
0.1650	2203.0	258.26	2.51
0.1700	2285.0	267.65	2.58
0.1750	2354.0	275.51	2.66
0.1800	2425.0	283.59	2.73
0.1850	2470.0	288.63	2.81
0.1900	2245.0	262.15	2.89
0.1950	2148.0	250.64	2.96
0.2000	2169.0	252.89	3.04
0.2050	2021.0	235.47	3.11
0.2100	1909.0	222.26	3.19
0.2150	1913.0	222.55	3.27
0.2200	400.0	46.70	3.34



Boring No.:	R-09-Z4-B4
Sample No.:	C-24
Depth (ft):	126.5-127.3
Soil Type:	Core
Sample Description:	Dark olive silt'stone' (ML)

Sample Diameter (in.)	3.256
Sample Height (in.)	6.585
Initial Moisture Content (%)	19.95
Dry Density (pcf)	101.7
Specific Gravity (assumed)	2.7
Saturation (%)	82.0
Rate of Deformation (in/min)	0.0120
Height / Diameter Ratio	2.02

At Failure

Compressive Strength (psi)	**288.63**
Axial Strain (%)	2.81

Leighton

Unconfined Compressive Strength of Cohesive Soil
ASTM D 2166

Project No.: **378312.04.09.01**

SR-710 Tunnel Technical Study

04/29/09

Earth Mechanics Institute

Client: CH2MHILL

Project Number: 378312.04.09.01

Project Name: SR-710 Tunnel Technical Study

Colorado School of Mines

Mining Engineering Department

Date: 4/17/2009 Sample ID	Rock Type	Cerchar Abrasivity Index
R-09-Z3-B1_C-57@264.1	Igneous	4.2
R-09-Z3-B4_C-52@249.5-250.1	Igneous	2.6
R-09-Z3-B6_C-29@195.7	Igneous	3.9

Pictures of Samples Before and After
Cerchar Abrasivity Index Test

Project Name: SR-710 Tunnel Technical Study
Project No.: 378312.04.09.01
Sample ID: R-09-Z3-B1_C-57@264.1

Before

After

Pictures of Samples Before and After
Cerchar Abrasivity Index Test

Project Name: SR-710 Tunnel Technical Study
Project No.: 378312.04.09.01
Sample ID: R-09-Z3-B4_C-52@249.5-250.1

Before

After

Pictures of Samples Before and After
Cerchar Abrasivity Index Test

Project Name: SR-710 Tunnel Technical Study
Project No.: 378312.04.09.01
Sample ID: R-09-Z3-B6_C-29@195.7

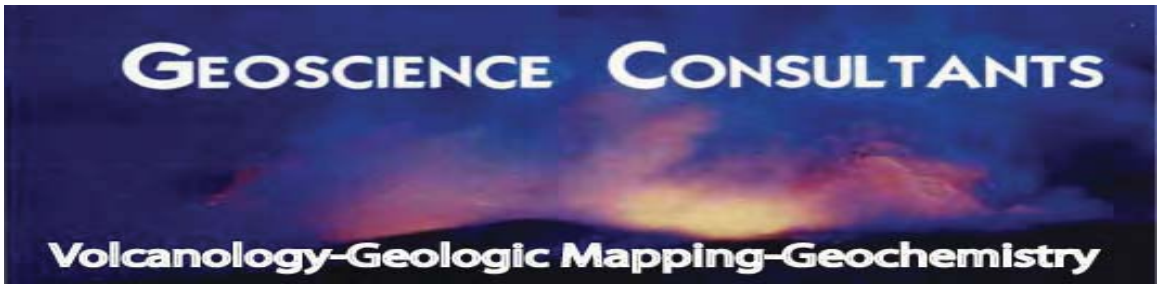
Before

After

Petrographic Thin Section Analysis

SR-710 Tunnel Technical Study
Los Angeles County, California

Prepared by:



Gene Smith
Racheal Johnsen

August 3, 2009

Summary of preparation, analytical procedures, and major rock types found:

We examined twenty-six core samples from borings used to characterize subsurface geology for the SR 710 project. Core samples were broken to fist-size samples or, if too weak, sent as whole core to Quality Thin Sections in Tucson, Arizona for preparation of 30 micron thick petrographic sections. Once the sections were returned to the university, each of the sections was analyzed using a Nikon Labophot Pol transmitted light petrographic microscope with a 10 power ocular and either a 2 or 4 power objective.

The petrographic microscope is used to identify minerals and rock textures. The microscope uses both plane polarized and polarized light to determine the optical properties of minerals. In plane polarized light, mineral textures and color are best observed. A particularly interesting phenomena observed in plane polarized light is pleochroism. This term refers to the change in color of a mineral depending on its optical orientation. For example, the mineral biotite can change color from light brown to dark brown. Pleochroism is very helpful for identifying certain minerals. Polarized light viewing allows for the determination of optical properties including the mineral crystallography. Using cross-polars, interference colors can be observed. These colors are formed by the interference of light waves as they pass through two optical polars oriented at right angles to each other. Because interference colors are very distinctive they are an important tool for mineral identification. Samples are first viewed in plane polarized and then polarized light. Mineral size is determined by comparison with a stage micrometer. Mineral abundances are estimated by visual observation. Photomicrographs of each thin section were taken at either 20x or 40x magnification for inclusion in the report.

Rock types found in the thin sections include: immature arkosic sandstone, siltstone, mudstone, shale, quartz-bearing diorite, quartz monzonite, and brecciated quartz monzonite. One sample of mylonite may reflect a shear zone related to faulting.

R-09-Z1B4 287-287.2’

Siltstone/very fine-grained sandstone

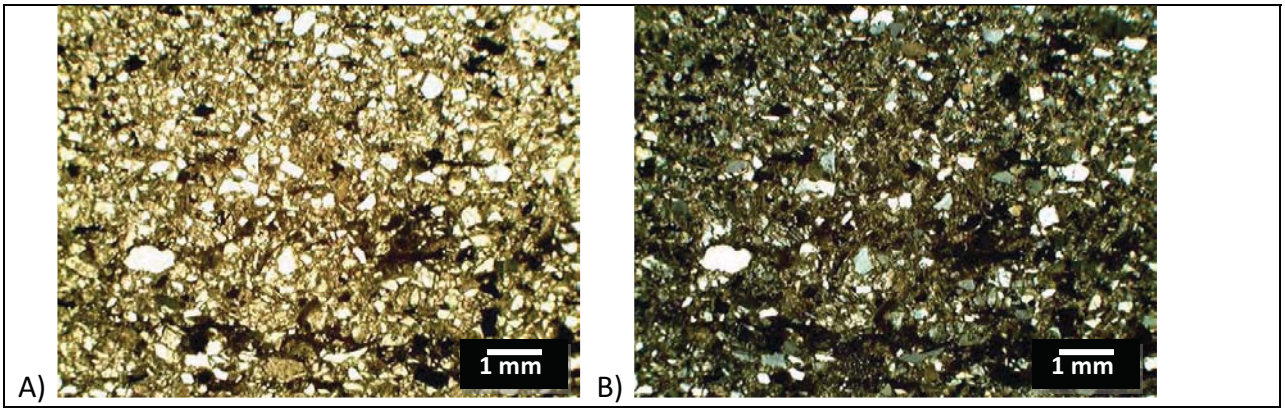


Figure 1. Photomicrographs of R-09-Z1B4 283-287.2' in A) Plane-polarized light and B) Cross-polarized light. 20x magnification. Scale bar approximate.

Large pieces of opaque material cover about 15% of the slide. The matrix is composed predominantly of calcite with some 2-3 mm thick hematite layers. Slide contains shells and plagioclase, potassium feldspar, biotite, and quartz fragments. There is a small (1-2 mm diameter) quartzite clast.

Plagioclase/Potassium feldspar – difficult to distinguish the feldspars at this size; <0.5 mm, grains are broken (anhedral) and some exhibit albite twinning

Quartz – <0.5 mm, broken (anhedral), has biotite inclusions

Biotite – anhedral to subhedral, shows evidence of strain, pleochroic medium to dark brown

Mineral	**Percentage**
Matrix	20
Plagioclase/Potassium feldspar	40
Quartz	15
Biotite	10
Opaques	15

R-09-Z1B5 455.2-455.8'

Coarse-grained granitic arkosic sandstone with crystal and rock fragments up to 3 mm in size

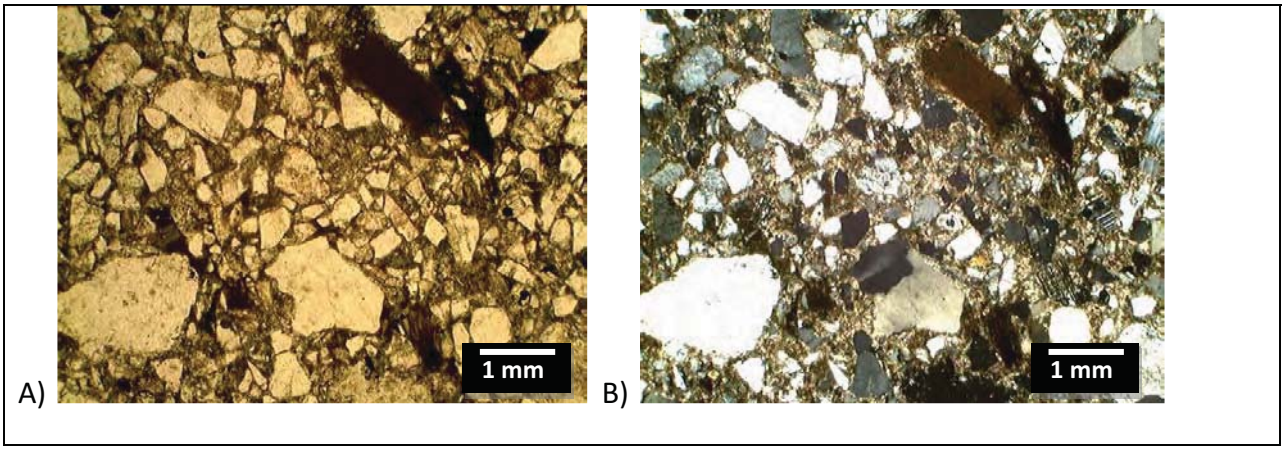


Figure 2. Photomicrograph of R-09-Z1B5 455.2-455.8'. A) Section in plane polarized light at 40x magnification. B) Section in cross-polarized light at 40x magnification. Scale bar approximate.

Quartz – highly fractured and anhedral (no crystal faces). Cut by veins of calcite. Shows undulatory extinction (evidence of strain).

Plagioclase – fractured anhedral grains with albite twinning. Grains up to 1 mm in size isolated in matrix.

Orthoclase – anhedral grains up to 2 mm in size with well developed perthitic texture.

Biotite – small (<0.5 mm) subhedral (one or two crystal faces remain) grains isolated in the matrix. Pleochroic light brown to dark brown. Chlorite occurs rarely as an alteration of biotite.

Muscovite – subhedral to euhedral grains up to 1 mm in length.

Iron oxide – very small (<1 mm) anhedral opaque grains (black in color). Probably magnetite or ilmenite.

Comments:

Crystals and rock fragments are surrounded by matrix mainly composed of calcite. Grains are almost completely broken from any rock fragments. The degree of disaggregation is more complete than most of the other arkosic samples.

Percentages of total rock:

-

Quartz	12
Plagioclase	14
Potassium feldspar	19
Biotite	2
Iron Oxide	1
Muscovite	<1
Chlorite	<1
Matrix	50

R-09-Z1B6 324.4-325.1'

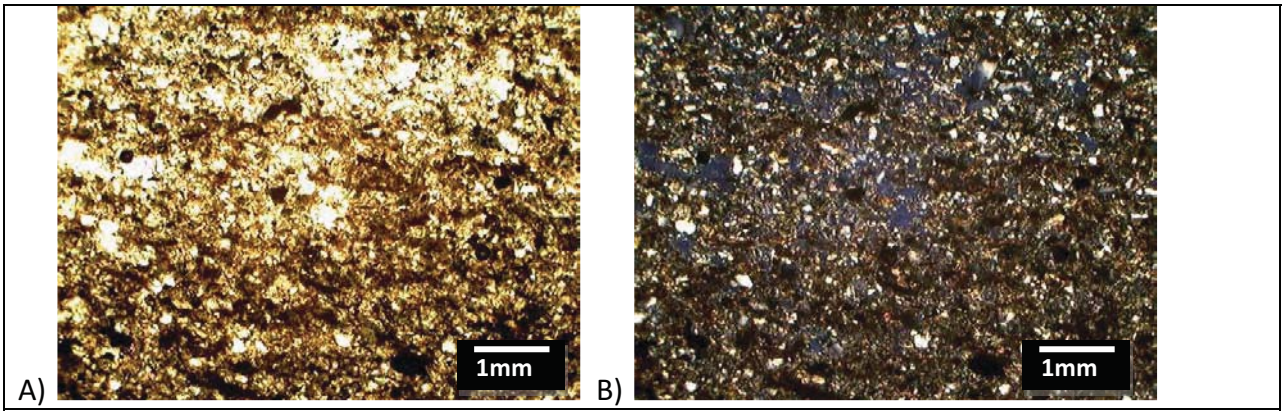


Figure 3. Photomicrograph of R-09-Z1B6 324.4-325.1'. A) Section in plane polarized light at 40x magnification. B) Section in cross-polarized light at 40x magnification. Scale bar approximate.

Finely bedded siltstone. Bedding at the millimeter scale and composed of iron oxide rich bands alternating with iron oxide poor bands. Matrix minerals are not identifiable but probably fine grained clay minerals and iron oxide.

Quartz – very small (<1 mm) grains. Grains vary from round to splinter shaped and are completely surrounded by fine grained matrix.

Plagioclase – a few small (<1 mm) anhedral grains showing albite twinning.

Chlorite – very small anhedral to subhedral grains, pleochroic light green to dark green.

Iron oxide – both reddish hematite and opaque (black) magnetite are present.

Matrix is composed of fine grained clays minerals, iron oxide and minor calcite. Larger grains are surrounded in matrix. Banding prominent in hand specimen is poorly seen in thin section. It is composed mainly of iron oxide rich and iron oxide poor bands. Quartz appears to be equally distributed throughout the slide and its abundance is not controlled by bedding.

Comments:

A fine-grained siltstone close to shale in texture.

Percentages of total rock:

Quartz	20
Plagioclase	2
Chlorite	<1
Iron oxide	1
Matrix	76

R-09-Z1B7 249.2-249.8’

Immature plagioclase-rich sandstone: Arkosic sandstone

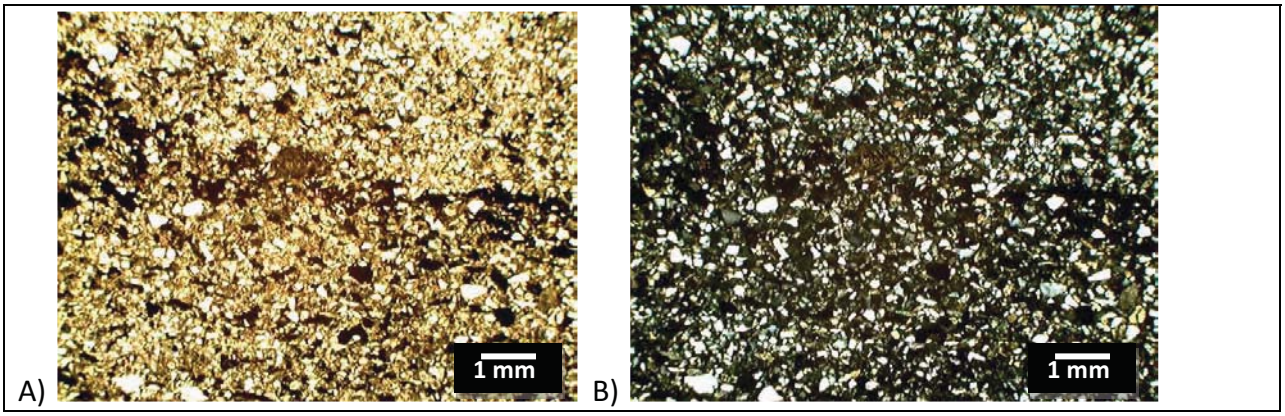


Figure 4. Photomicrographs of R-09-Z1B7 249.2-249.8' in A) Plane-polarized light and B) Cross-polarized light. 20x magnification. Scale bar approximate.

Finely bedded, includes small laminated layers of hematite cement with opaque iron oxide and rare fossils (2%); Matrix within laminated layers nearly 95%, but in rest of section matrix comprises <5% of slide; minor amount of calcite; includes fragments of minerals—mostly plagioclase.

Biotite – 0.5-1 mm, anhedral to subhedral, shows evidence of strain, altering to chlorite, pleochroic medium to dark brown

Chlorite – alteration product of biotite

Quartz – <0.5 mm, anhedral to subhedral, fractured

Plagioclase – angular (anhedral), mostly <0.5 mm, some grains 1-1.5 mm, exhibits carlsbad and albite twinning, some grains zoned

Muscovite – subhedral, high birefringence

Mineral	**Percentage**
Biotite	30
Chlorite	1
Quartz	20
Plagioclase	41
Muscovite	<1
Calcite	2

R-09-Z1B8 147.5-147.9'

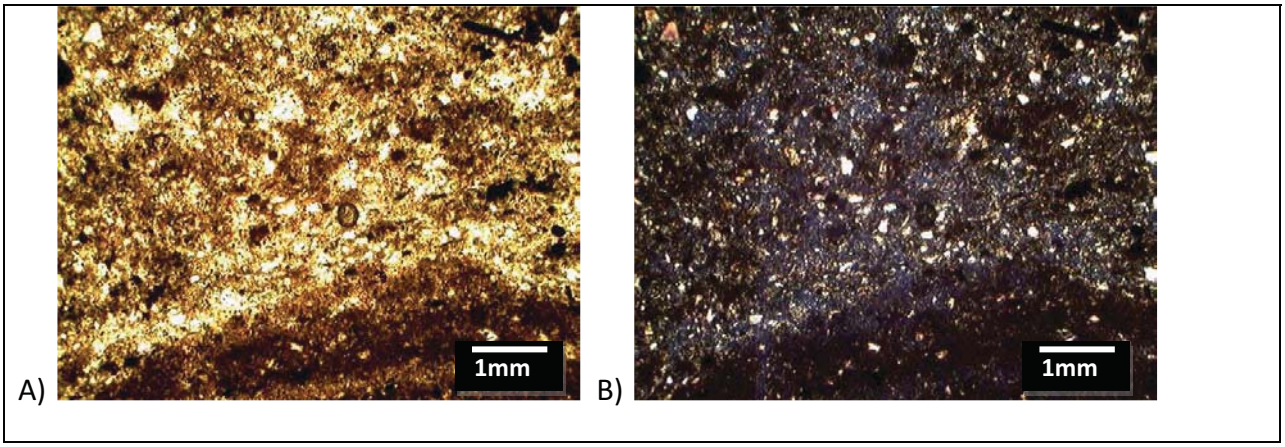


Figure 5. Photomicrograph of R-09-Z1B8 147.5-147.9'. A) Section in plane polarized light at 40x magnification. B) Section in cross-polarized light at 40x magnification. Scale bar approximate.

Siltstone with red-brown iron oxide rich matrix. Finely bedded/laminated.

Quartz – abundant small (<1 mm) angular grains embedded in fine grained iron oxide rich matrix.

Plagioclase – rare small (<1mm) angular grains showing albite twinning.

Chlorite – small (<1 mm) grains, angular, green color but pleochroic light green to darker green.

Iron oxide – present as both iron oxide in matrix and irregular grains of opaque iron oxide (probably magnetite) up to 1 mm in size.

Comments:

Matrix contains irregular streaks of darker iron oxide possibly mixed with organic material. Grains are matrix supported.

Percentages of total rock:

Quartz	20
Plagioclase	<1
Chlorite	<1
Matrix with iron oxide	78

R-09-Z2B2 230-230.2’

Brecciated plutonic rock – Quartz monzonite or diorite source

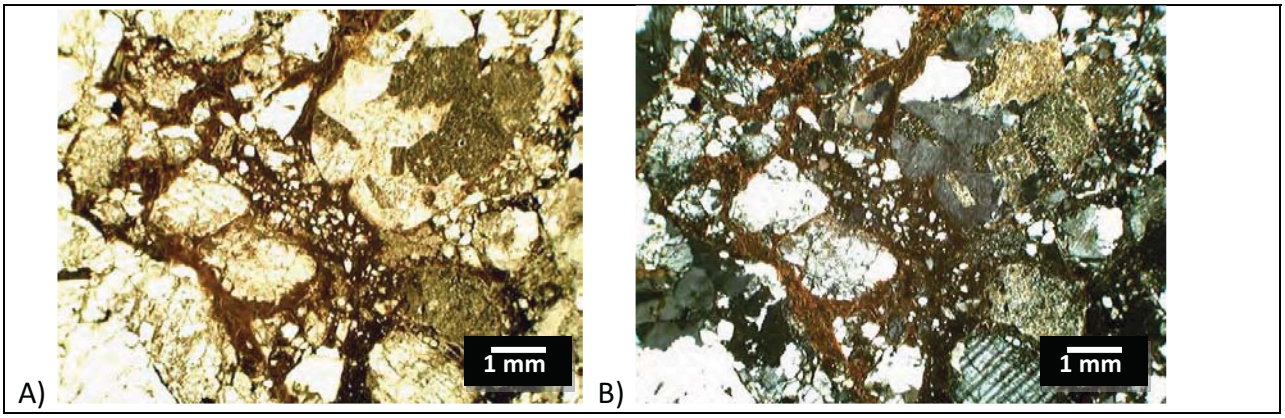


Figure 6. Photomicrographs of R-09-Z2B2 230-230.2' in A) Plane-polarized light and B) Cross-polarized light. 20x magnification. Scale bar approximate.

Hematite matrix with large clasts of quartz monzonite and broken single grains.

Potassium feldspar – 3-4 mm, anhedral, altering to sericite, sometimes twinned

Plagioclase – 1.5 mm, fragmented, anhedral, some grains zoned, many exhibiting albite twins

Quartz – fractured, anhedral, showing undulatory extinction

Biotite – <1.5 mm, altering to chlorite, shows evidence of strain, subhedral, pleochroic light to medium brown

Titanite (Sphene) – <0.5 mm, subhedral, high relief

Chlorite – alteration product of biotite

Hornblende – found in some of the fragments

Mineral	**Percentage**
Matrix	40
Potassium feldspar	25
Plagioclase	20
Quartz	7
Biotite	5
Titanite	1
Chlorite	1
Hornblende	1

R-09-Z2B3 116-116.4’

Finely laminated siltstone/sandstone

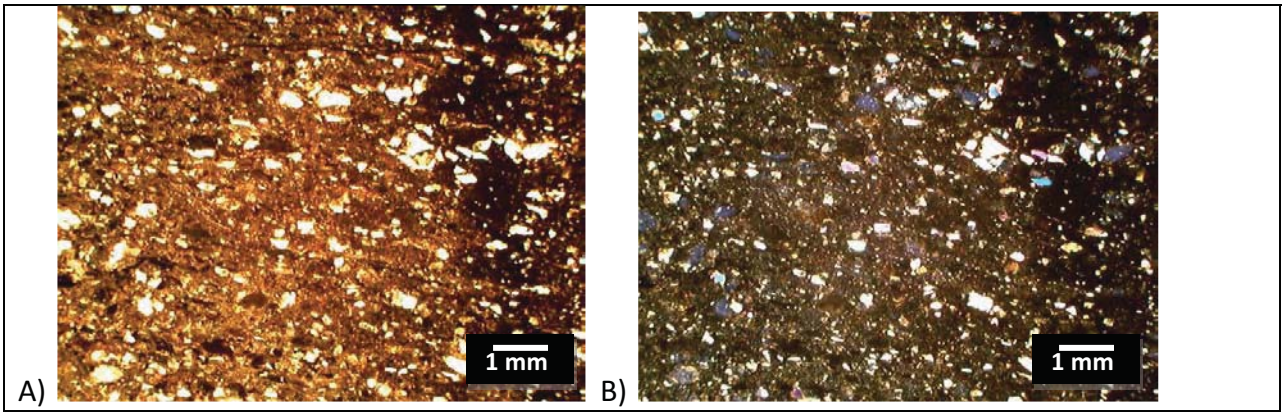


Figure 7. Photomicrographs of R-09-Z2B3 116-116.4' in A) Plane-polarized light and B) Cross-polarized light. 20x magnification. Scale bar approximate.

Matrix has hematite and possibly clay minerals as primary cement. Rock includes plagioclase and quartz and a large vein of hematite crosses much of the slide.

Plagioclase – <0.5 mm, broken (anhedral), albite twinning

Quartz – <0.5 mm, broken (anhedral)

Mineral	**Percentage**
Matrix	70
Plagioclase	18
Quartz	12

R-09-Z2B4 319-319.3'

Mudstone/Siltstone

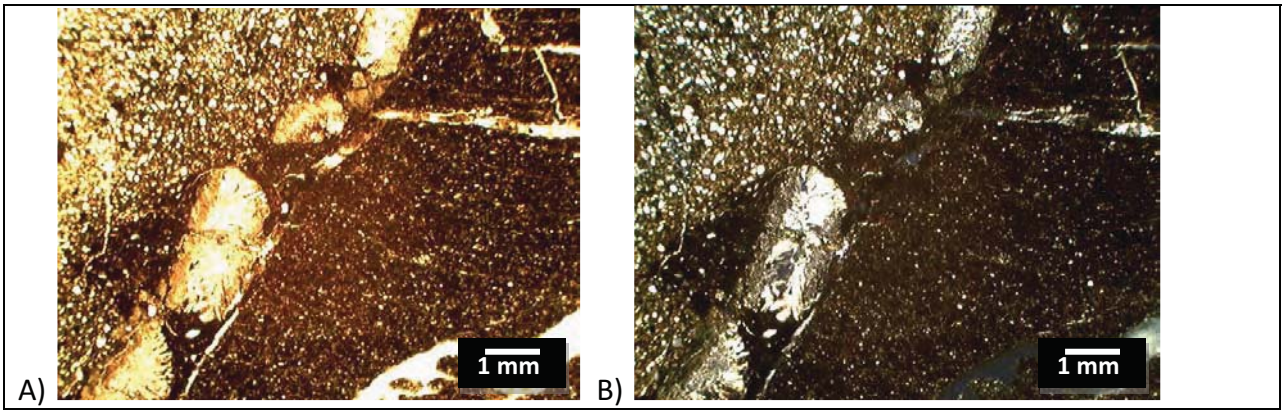


Figure 8. Photomicrographs of R-09-Z2B4 319-319.3' in A) Plane-polarized light and B) Cross-polarized light. 20x magnification. Scale bar approximate.

Finely laminated with iron oxide (hematite) and clay cement/matrix. Contains very small fragments of quartz and plagioclase that are difficult to distinguish except where plagioclase is twinned. Black iron oxide (magnetite or ilmenite) constitutes less than one percent of the slide.

Sample contains a large lens of sandstone containing angular fragments of quartz (80%), plagioclase (20%), and a very small amount of hornblende (<1%).

Border between sandstone lens and mudstone has nodules containing radiating crystals. These have not been positively identified, but could be calcite or some form of silica.

Mineral assemblage of mudstone:

Mineral	**Percentage**
Matrix	>95
Quartz and plagioclase	<5

Mineral assemblage of sandstone lens:

Mineral	**Percentage**
Quartz	80
Plagioclase	20
Hornblende	<1

R-09-Z2B5 231.8-232’

Mudstone

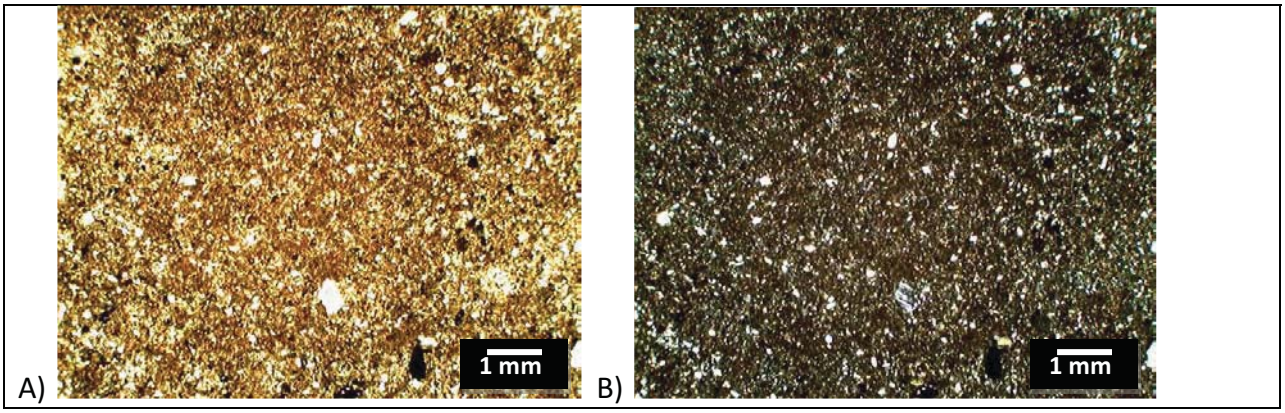


Figure 9. Photomicrographs of R-09-Z2B5 231.8-232' in A) Plane-polarized light and B) Cross-polarized light. 20x magnification. Scale bar approximate.

Sample is mostly massive with very vague indication of bedding. Cement is hematite and comprises about 20% of the rock. Grains are mostly too small to identify, but they appear to be predominantly plagioclase and quartz. There are a few 0.5 mm diameter plagioclase grains. There are some grains of biotite which are altering to chlorite and a couple of potassium feldspar grains. There are gastropods and shell fragments. Opaque iron oxide covers about 2% of the slide.

R-09-Z3B1 174.0'

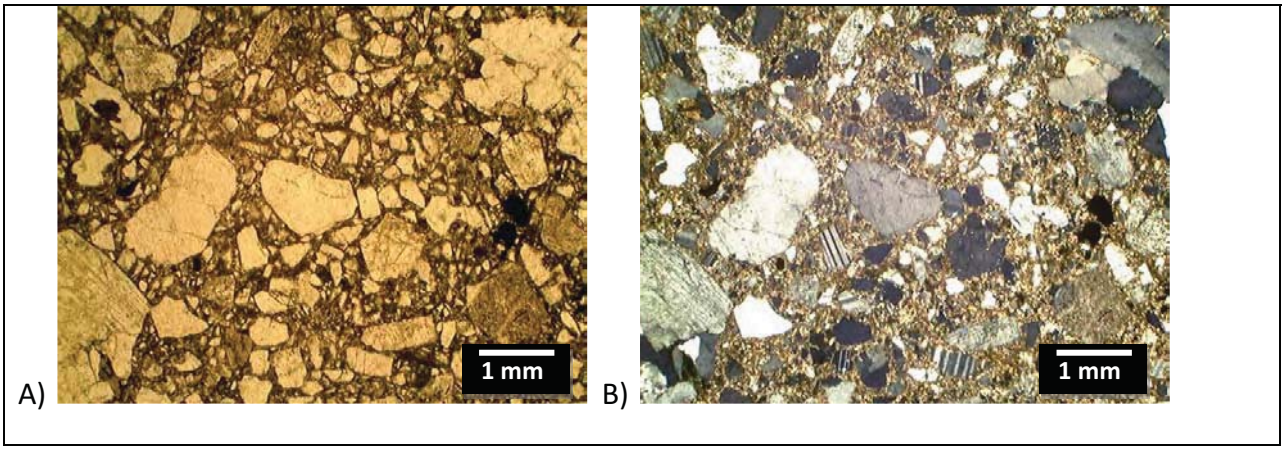


Figure 10. Photomicrograph of R-09-Z3B1 174.0'. A) Section in plane polarized light at 40x magnification. B) Section in cross-polarized light at 40x magnification. Scale bar approximate.

Coarse-grained granitic arkosic sandstone with crystal and rock fragments up to 2 mm in size. Rock fragments of diorite and sandstone.

Quartz – highly fractured and anhedral. Cut by veins of calcite. Shows undulatory extinction.

Plagioclase – fractured anhedral grains with albite twinning. Grains up to 2 mm, intergrown with quartz or isolated in matrix.

Potassium feldspar (probably orthoclase) – altered anhedral grains up to 2 mm in size. Show irregular extinction and alteration to sericite (a fine grained mica).

Biotite – small (<0.5 mm) subhedral grains intergrown in rock fragments with quartz and feldspar. Pleochroic light brown to dark brown.

Titanite (sphene) – small (<1 mm) grains isolated in matrix. No more than two grains observed in thin section.

Iron oxide – very small (<1 mm) anhedral opaque grains (black in color). Probably magnetite or ilmenite.

Comments:

Crystals and rock fragments form most of the rock. Matrix is composed of fine to medium grained calcite. The rock represents erosion of a quartz diorite source rock and based on grain size and mineralogy is close its source area.

Percentages of total rock:

-

Quartz	23
Plagioclase	35
Potassium feldspar	8
Biotite	2
Iron Oxide	1
Titanite	<1
Matrix mainly composed of calcite	30

R-09-Z3B1 178.6-179.2'

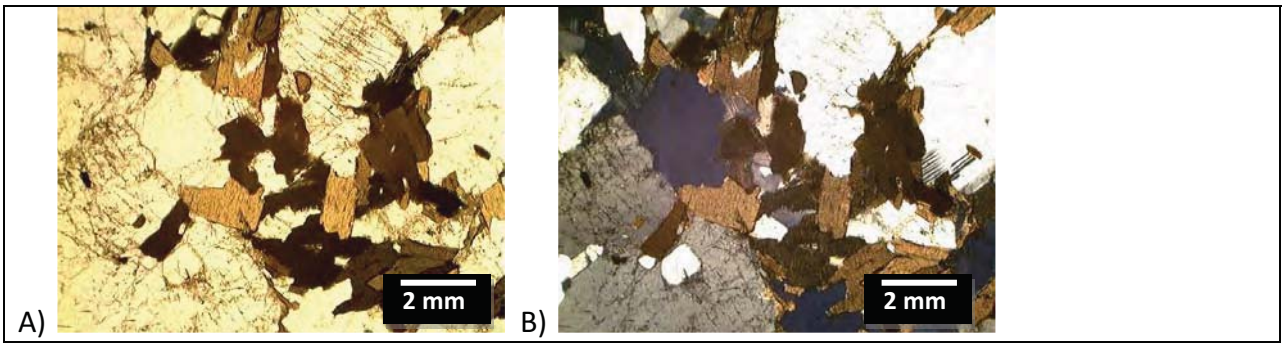


Figure 11. Photomicrograph of R-09-Z3B1 178.6-179.2'. A) Section in plane polarized light at 40x magnification. B) Section in cross-polarized light at 40x magnification. Scale bar approximate.

Quartz Diorite – Plutonic rock with allotriomorphic-granular texture (poorly formed grains with an interlocking relationship with each other).

Quartz – anhedral grains (up to 4 mm) with undulatory extinction.

Plagioclase – very large (up to 5 mm) anhedral to subhedral grains with albite twinning.

Biotite – anhedral grains (1 to 2 mm in size) showing pleochroism from light brown to dark brown. Biotite is locally altered to chlorite.

Hornblende – anhedral to subhedral grains (3 to 4 mm in size) pleochroic green brown to dark green. Hornblende is commonly associated with biotite crystals and in places it appears that biotite is replacing hornblende.

Chlorite – commonly an alteration of biotite—green, small (1 mm) and anhedral.

Titanite (sphene) – several large (up to 4 mm) subhedral grains. High relief and highly fractured.

Iron oxide – small anhedral opaque grains. Either magnetite or ilmenite.

Comments:

A relatively unaltered plutonic rock best classified as a quartz diorite. This rock is very similar to R-09-Z3-B6 195.5' except the feldspars are more abundant.

Percentages of total rock:

Quartz	14
Plagioclase	35
Biotite	30
Hornblende	20
Chlorite	<1
Titanite	<1
Iron Oxide	<1

R-09-Z3B1 238.8-239.2’

Brecciated Quartz Monzonite

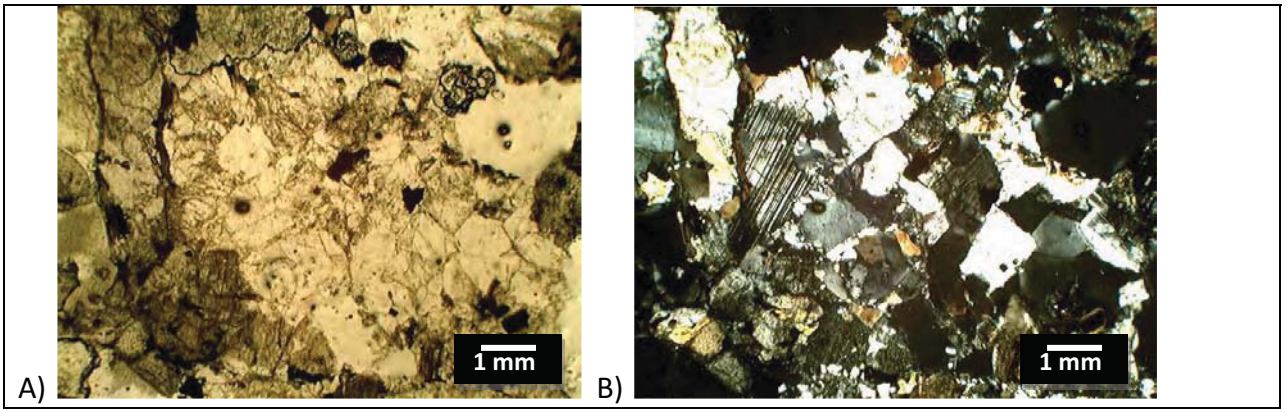


Figure 12. Photomicrographs of R-09-Z3B1 238.8-239.2' in A) Plane-polarized light and B) Cross-polarized light. 20x magnification. Scale bar approximate.

Rock highly fractured and altered. Biotite is the primary mafic mineral. Other minerals include plagioclase, potassium feldspar, and quartz.

Biotite – 1-3 mm, anhedral to subhedral, altering to chlorite

Plagioclase – 2-5 mm, anhedral to subhedral, altered, exhibits albite and carlsbad twinning, sometimes zoned

Potassium feldspar – 3-5 mm, anhedral, altering to sericite

Quartz – 1-5 mm, anhedral, exhibits undulatory extinction, contains inclusions of apatite

Mineral	**Percentage**
Biotite	10
Plagioclase	49
Potassium feldspar	25
Quartz	15
Chlorite	1
Opaques	<1

R-09-Z3B2 122-123’

Mylonite – Sheared granitic or metamorphic rock

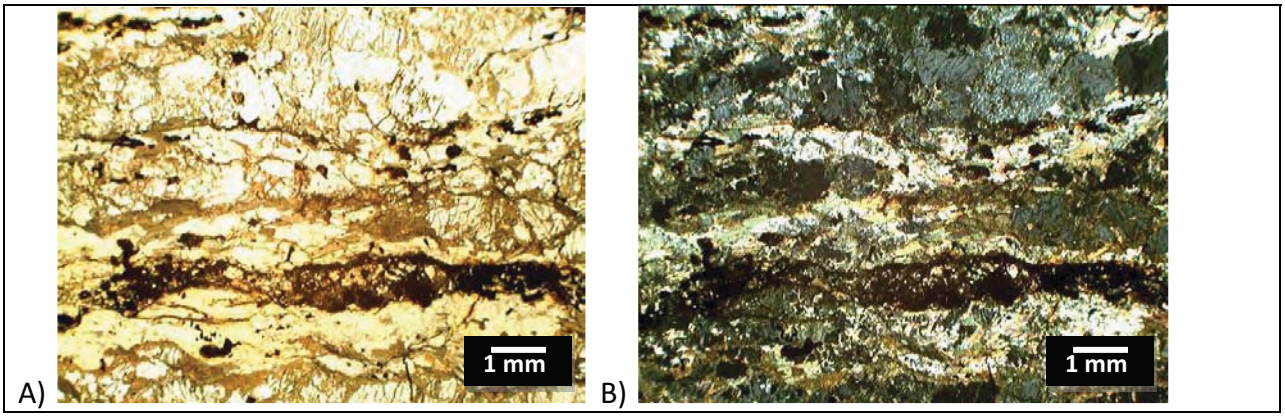


Figure 13. Photomicrographs of R-09-Z3B2 122-123' in A) Plane-polarized light and B) Cross-polarized light. 20x magnification. Scale bar approximate.

Intense shearing with secondary growth of biotite and muscovite. Orthoclase feldspar is broken but remains as augen (rounded grains) or lenses in the mylonite. One part of the slide is relatively unaltered, but has intergrown muscovite and biotite.

Potassium feldspar (orthoclase) – lenses of augen; grains internally broken, some grains show replacement of orthoclase by muscovite and fine-grained biotite/chlorite; larger grains show weak exsolution; fractures in orthoclase are perpendicular to the shearing direction

Biotite – subhedral grains in matrix, pleochroic light to medium brown, sometimes altered to chlorite

Muscovite – large subhedral grains, growing at about 30 degrees to or in the direction of shear

Chlorite – alteration product of biotite, light to medium green pleochroism

Iron oxide –as opaque magnetite/ilmenite and as reddish hematite in fractures

Mineral	**Percentage**
Potassium feldspar (orthoclase)	40
Biotite	30
Muscovite	26
Chlorite	2
Iron oxide	2

R-09-Z3B2 228.1-228.3'

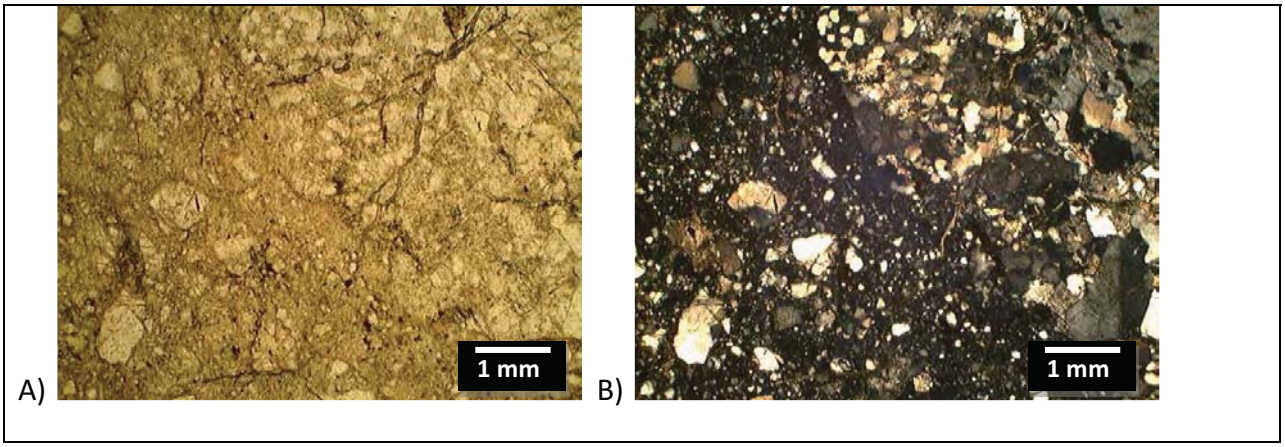


Figure 14. Photomicrograph of R-09-Z3B2 228.1-228.3'. A) Section in plane polarized light at 40x magnification. B) Section in cross-polarized light at 40x magnification. Scale bar approximate.

Coarse grained granitic arkosic sandstone with crystal and brecciated rock fragments up to 6 mm in size

Quartz – highly fractured and anhedral grains with undulatory extinction. Grains are broken and commonly crossed by veins of calcite and grains of chlorite

Potassium feldspar (probably orthoclase) – highly altered broken and fractured anhedral grains up to 2 mm in size. Show irregular extinction, perthitic texture, and alteration to fine grained mica (sericite).

Muscovite – rare small (<0.5 mm) subhedral grains.

Chlorite – subhedral, green to light green in color, probably formed by the alteration of biotite.

Iron oxide – very small (<1 mm) anhedral opaque grains (black in color). Probably magnetite or ilmenite.

Calcite – common in veins and matrix.

Comments:

Crystals and rock fragments form most of the rock. Matrix is composed of fine to medium grained calcite. Rock fragments and grains are intensely fractured. Because calcite cement fills fractures, the brecciation occurred after deposition but before being infiltrated with calcite.

Percentages of total rock:

-

Quartz	32
Potassium feldspar	20
Muscovite	<1
Iron Oxide	1
Chlorite	2
Matrix	45

R-09-Z3B4 235-235.4'

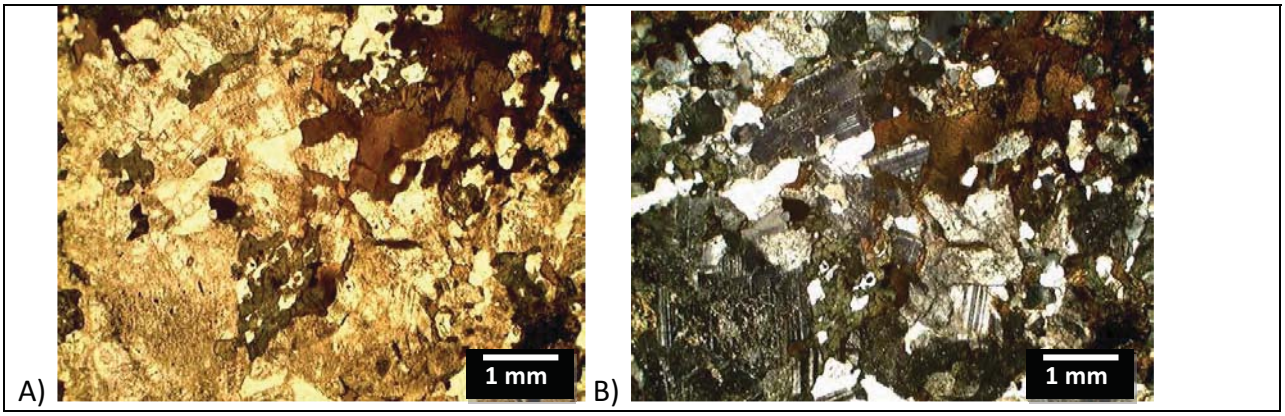


Figure 15. Photomicrograph of R-09-Z3B4 235-235.4'. A) Section in plane polarized light at 40x magnification. B) Section in cross-polarized light at 40x magnification. Scale bar approximate.

Quartz Diorite – Plutonic rock with allotriomorphic-granular texture.

Quartz – anhedral grains (up to 2 mm) with undulatory extinction and showing embayed margins.

Plagioclase – large (up to 5 mm) interlocking anhedral to subhedral grains with albite twinning.

Biotite – anhedral grains (1 to 2 mm in size) showing pleochroism from light brown to dark brown. Biotite is locally altered to chlorite.

Hornblende – anhedral to subhedral grains (2 mm in size) pleochroic green brown to dark green.

Chlorite – commonly an alteration of biotite—green, up to 2 mm in size and anhedral.

Iron oxide – small anhedral opaque grains. Either magnetite or ilmenite.

Comments:

An altered quartz diorite with feldspars commonly altered to fine-grained mica (sericite) and veins of calcite. Differs from the other Quartz Diorite samples in that the quartz is smaller and feldspar is more abundant.

Percentages of total rock:

Quartz	8
Plagioclase	42
Biotite	18
Hornblende	29
Chlorite	2
Iron Oxide	<1
Calcite	1

R-09-Z3B5 324-324.4'

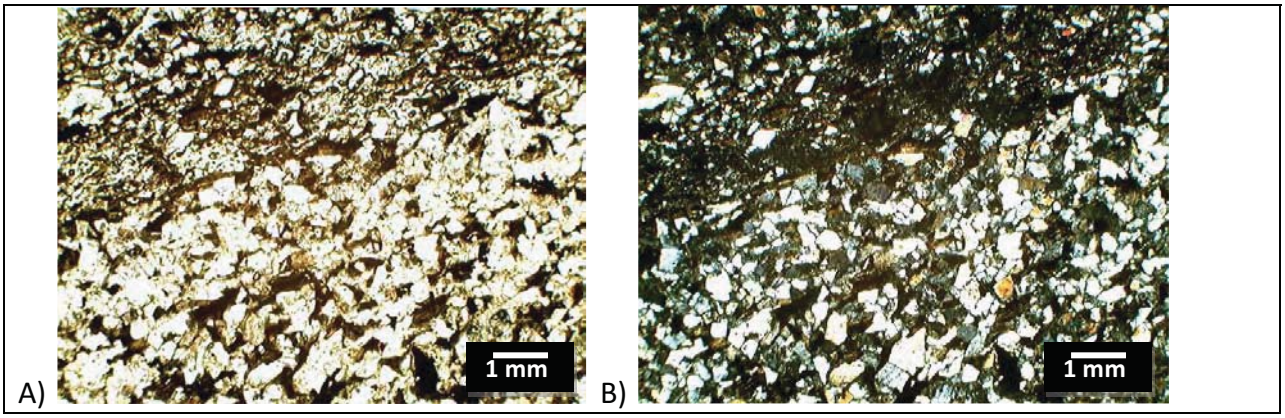


Figure 16. Photomicrograph of R-09-Z3B5 324-324.4'. A) Section in plane polarized light at 20x magnification. B) Section in cross-polarized light at 20x magnification. Scale bar approximate.

Arkosic sandstone interbedded with siltstone

Grain supported arkosic sandstone containing angular grains of quartz, plagioclase, and biotite. Biotite is commonly aligned parallel to bedding.

Quartz – broken grains <1 mm in size. Grains show undulatory extinction.
Plagioclase – angular grains exhibiting albite twinning. Plagioclase grains are usually smaller than quartz.

Biotite – shredded grains commonly aligned parallel to bedding. Pleochroic light brown to nearly black; biotite altering to chlorite.

Iron oxide (opaques) – angular opaque grains up to 1 mm in size.

Mineral	**Percentage**
Quartz	70
Plagioclase	25
Biotite	4
Iron oxide	1

R-09-Z3B6 195.5'

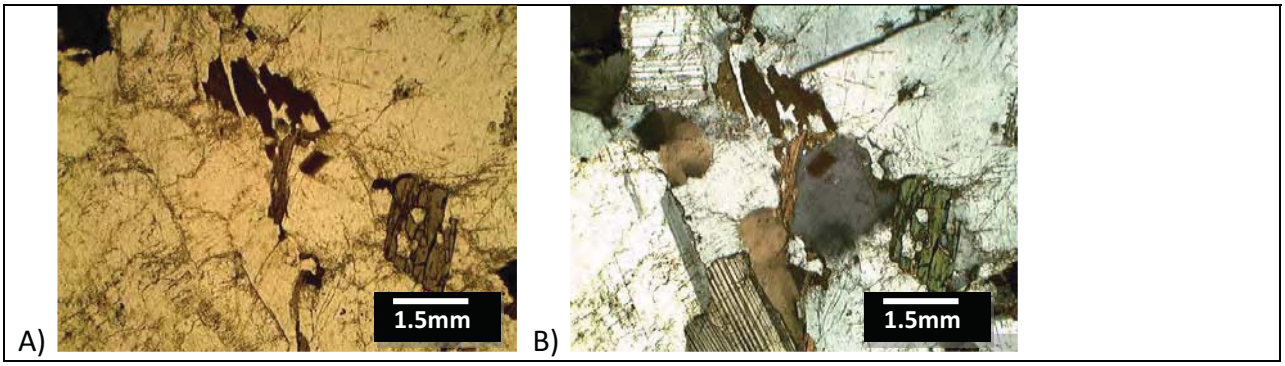


Figure 17. Photomicrograph of R-09-Z3B6 195.5'. A) Section in plane polarized light at 40x magnification. B) Section in cross-polarized light at 40x magnification. Scale bar approximate.

Quartz Diorite – Plutonic rock with allotriomorphic-granular texture (poorly formed grains with an interlocking relationship with each other).

Quartz – anhedral large grains (up to 3 mm). Polycrystalline (composed of intergrown crystals) with undulatory extinction.

Plagioclase – very large (up to 5 mm) anhedral grains with albite twinning.

Biotite – anhedral grains (1 to 2 mm in size) showing pleochroism from light brown to dark brown.

Hornblende – anhedral to subhedral grains (3- 4 mm in size) pleochroic green brown to dark green. Hornblende is commonly broken and surrounded by swarms of biotite crystals (perhaps representing a reaction rim).

Chlorite – commonly an alteration of hornblende—green, small (1 mm) and anhedral.

Titanite (sphene) – several large (up to 4 mm) anhedral grains. High relief (stands out in slide) and highly fractured.

Iron oxide – small anhedral opaque grains. Either magnetite or ilmenite.

Comments:

A relatively unaltered plutonic rock best classified as a quartz diorite.

Percentages of total rock:

Quartz	20
Plagioclase	30
Biotite	25
Hornblende	24
Chlorite	<1
Titanite	<1
Iron Oxide	<1

R-09-Z3B6 257.8-258.2'

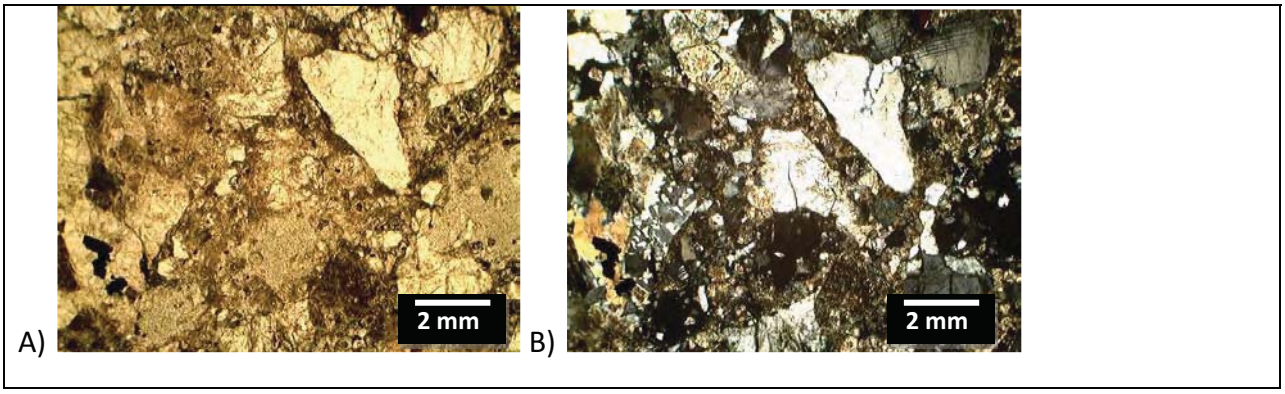


Figure 18. Photomicrograph of R-09-Z3B6 257.8-258.2'. A) Section in plane polarized light at 40x magnification. B) Section in cross-polarized light at 40x magnification. Scale bar approximate.

Highly fractured and brecciated Quartz Diorite with grains cemented by calcite.

Quartz – anhedral grains (up to 4 mm) with undulatory extinction and polycrystalline texture. Quartz is commonly intergrown with plagioclase.

Plagioclase – very large (up to 5 mm) anhedral to subhedral grains with albite twinning.

Orthoclase – large grains (up to 4 mm) showing perthitic texture and Carlsbad twins.

Biotite – anhedral grains (1 to 2 mm in size) showing pleochroism from light brown to dark brown. Biotite is locally altered to chlorite.

Hornblende – anhedral to subhedral grains (3- 4 mm in size) pleochroic green brown to dark green.

Chlorite – commonly an alteration of biotite—green, small (1 mm) and anhedral.

Titanite (sphene) – several large (up to 4 mm) subhedral to euhedral (well formed) grains. High relief and highly fractured.

Iron oxide – small anhedral opaque grains. Either magnetite or ilmenite.

Xenoliths (or clasts) of fine grained volcanic rock containing plagioclase and hornblende phenocrysts? It is unclear whether these are foreign inclusions (xenoliths) or clasts.

Calcite – abundant as cement about grains and rock fragments. Fine grained (<1 mm) crystals.

Comments:

This rock is either a brecciated Quartz Diorite or a coarse grained arkosic conglomerate. In the first case the rock would have been fractured and broken without transport. In the second case fragments were transported a short distance from the source and deposited.

Percentages of total rock:

Quartz	13
Plagioclase	45
Orthoclase	20
Biotite	10
Hornblende	3
Chlorite	<1
Titanite	<1
Iron Oxide	<1
Xenoliths	<1
Calcite	5

R-09-Z3B7 263.2-263.6'

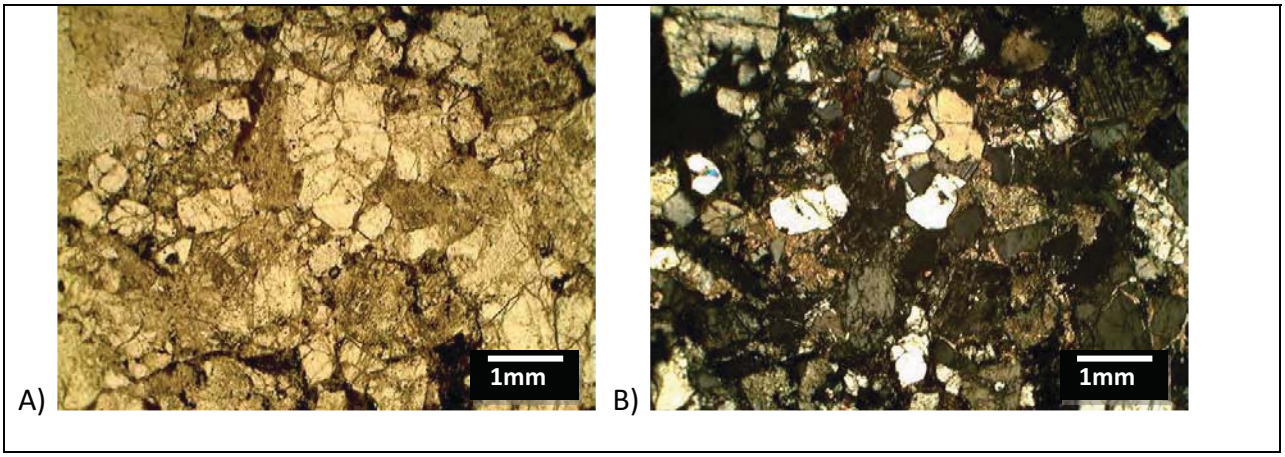


Figure 19. Photomicrographs of R-09-Z3B7 263.2'. A) Section in plane polarized light at 40x magnification. B) Section in cross-polarized light at 40x magnification. Scale bar approximate.

Coarse-grained granitic arkosic sandstone with crystal and rock fragments up to 2 mm in size

Quartz – highly fractured and anhedral (no crystal faces). Cut by veins of calcite. Shows undulatory extinction (evidence of strain).

Plagioclase – fractured anhedral grains with albite twinning. Grains up to 0.7 mm intergrown with quartz or isolated in matrix.

Potassium feldspar (probably orthoclase) – highly altered anhedral grains up to 1 mm in size. Show irregular extinction and alteration to sericite (a fine grained mica).

Biotite – small (<0.5 mm) subhedral (one or two crystal faces remain) grains intergrown in rock fragments with quartz and feldspar. Pleochroic light brown to dark brown.

Iron oxide – very small (<1 mm) anhedral opaque grains (black in color). Probably magnetite or ilmenite.

Comments:

Crystals and rock fragments form most of the rock. Matrix is composed of fine to medium grained calcite. The rock represents erosion of a quartz monzonite source rock and based on grain size and mineralogy is close its source area.

Percentages of total rock:

-

Quartz	48
Plagioclase	40
Potassium feldspar	5
Biotite	2
Iron Oxide	1
Matrix	3

R-09-Z3B8 215.7-216'

Very fine-grained arkosic sandstone/Greywacke

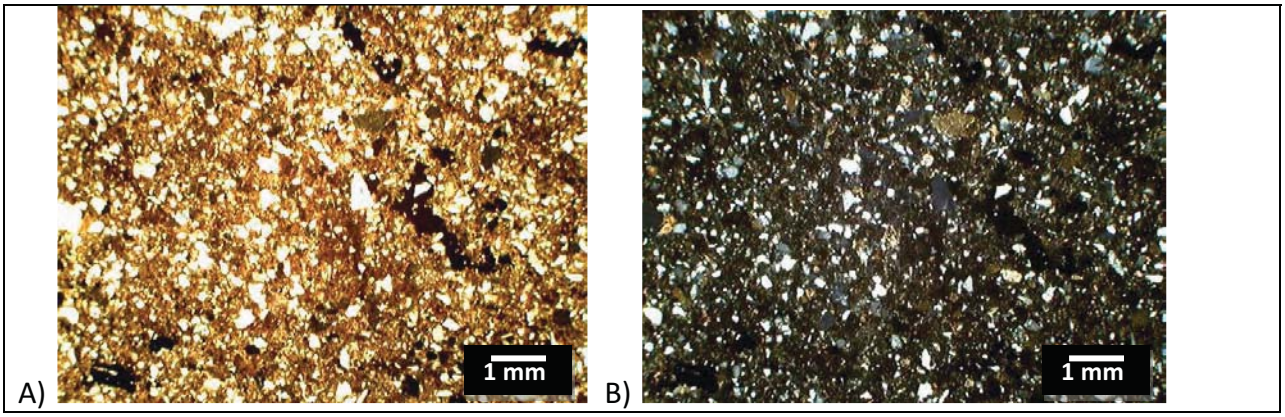


Figure 20. Photomicrographs of R-09-Z3B8 215.7-216' in A) Plane-polarized light and B) Cross-polarized light. 20x magnification. Scale bar approximate.

Matrix composed of hematite and contains calcite and rare shell fragments.

Quartz – <0.5 mm, fragmented (anhedral) and fractured

Plagioclase – <0.5 mm, fragmented (anhedral), some grains exhibit albite twinning

Hornblende and clinopyroxene – ~0.5 mm, anhedral to subhedral, difficult to distinguish

Calcite – found as alteration of pyroxene and in vugs, also in shell (?) fragments

Mineral	**Percentage**
Matrix	53
Quartz	17
Plagioclase	15
Hornblende and clinopyroxene	2
Calcite	8
Opaques (Magnetite?)	5

R-09-Z3B9 282.5-282.8’

Plutonic igneous rock – Quartz Monzonite

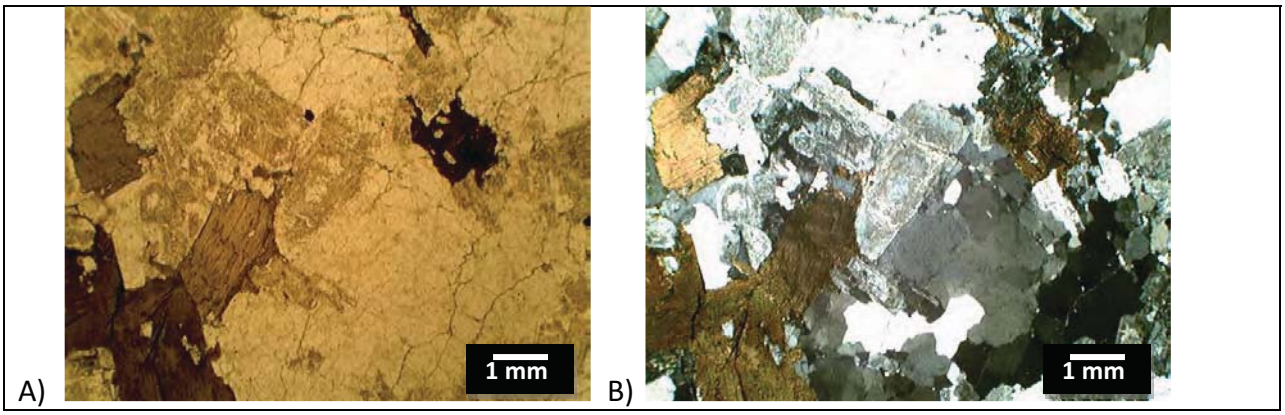


Figure 21. Photomicrographs of R-09-Z3B9 282.5-282.8' in A) Plane-polarized light and B) Cross-polarized light. 20x magnification. Scale bar approximate.

Biotite – 1-4 mm, subhedral (preservation of some crystal faces), pleochroic light to medium brown, shows evidence of strain, some grains are altering to chlorite.

Hornblende – 1.5-2 mm, anhedral (none of original crystal form preserved), pleochroic medium to dark brown

Plagioclase – 2 mm, anhedral to subhedral, albite and Carlsbad twins, some grains zoned

Potassium feldspar – 2-3 mm, subhedral, altering to sericite

Quartz – individual grains 1 mm, intergrown, anhedral, most show undulatory extinction, some have titanite (sphene) inclusions

Chlorite – 1 mm, anhedral, alteration product of biotite

Calcite – some formation in veins

Mineral	**Percentage**
Biotite	15
Hornblende	5
Plagioclase	25
Potassium feldspar	35
Quartz	18
Chlorite	1
Calcite	1
Iron oxide (Magnetite or Ilmenite)	<1

R-09-Z3B10 306.8-307’

Coarse-grained arkosic sandstone

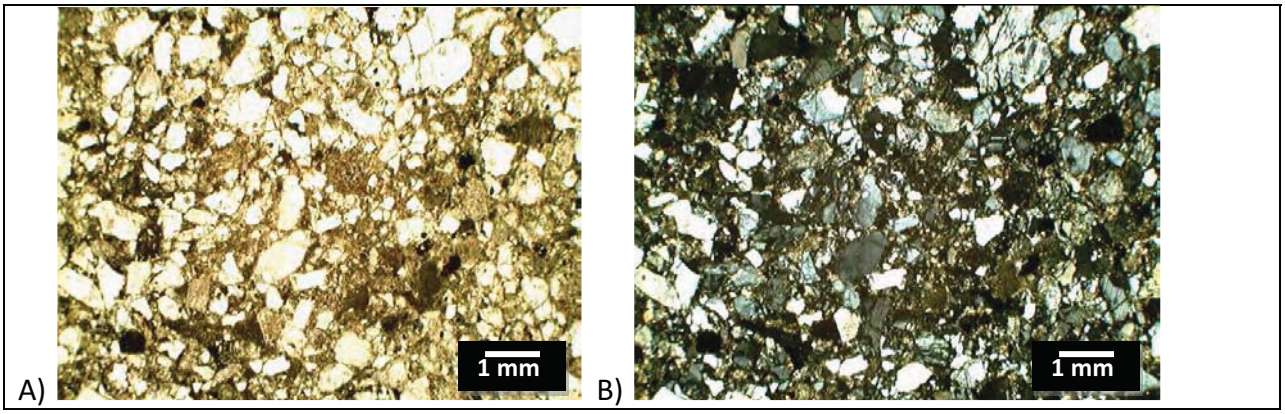


Figure 22. Photomicrographs of R-09-Z3B10 306.8-307' in A) Plane-polarized light and B) Cross-polarized light. 20x magnification. Scale bar approximate.

Matrix composed of calcite and some hematite. Opaque iron oxides (magnetite and ilmenite) ubiquitous in section.

Plagioclase – 1 mm, angular (anhedral), many grains exhibit albite twinning and some are zoned

Quartz – 0.5-1 mm, angular (anhedral), intergrown, many grains show undulatory extinction

Potassium feldspar – 1 mm, angular (anhedral) grains, some with no twins, some with tartan twinning (microcline), often altering to sericite

Biotite – 0.5-0.75 mm, subhedral, mostly altered to chlorite

Chlorite – found as an alteration product of biotite

Mineral	**Percentage**
Matrix	5
Plagioclase	48
Quartz	14
Potassium feldspar	20
Biotite	10
Chlorite	1
Opaques	2

R-09-Z3B11 210.1-210.6’

Siltstone/Sandstone

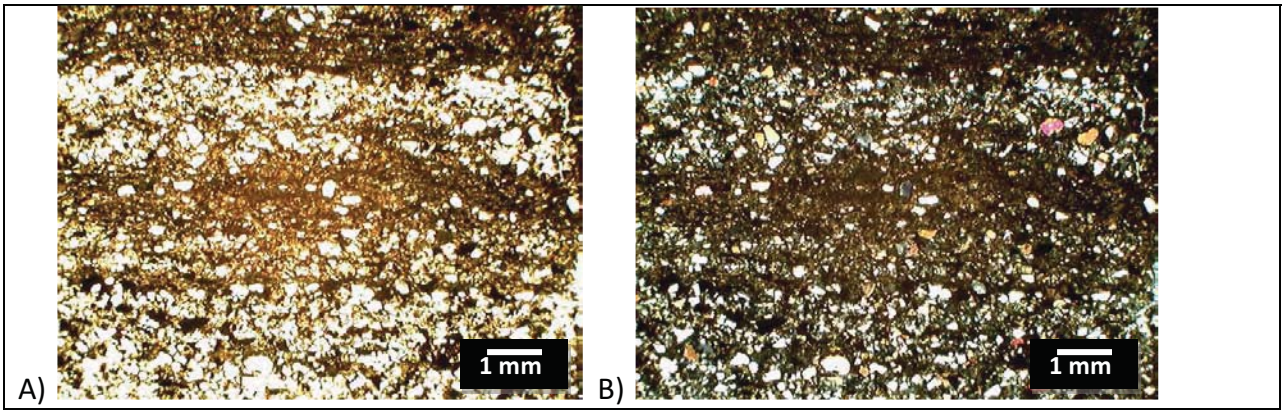


Figure 23. Photomicrographs of R-09-Z3B11 210.1-210.6' in A) Plane-polarized light and B) Cross-polarized light. 20x magnification. Scale bar approximate.

Section contains alternating layers of siltstone and sandstone:

Siltstone has hematite matrix, is finely laminated, and contains 40 to 80% matrix, depending on the layer. Grains include plagioclase and quartz. Plagioclase is often twinned and is angular; quartz is also angular (broken) and exhibits undulatory extinction.

Sandstone contains nearly no matrix, just a small amount of hematite and calcite. The sandstone layers are 2-4 mm thick and are composed of plagioclase (60%) and quartz (40%).

Entire slide is fractured. Both sandstone and siltstone layers contain a small amount of opaque iron oxides.

R-09-Z3B11 232-232.6’

Mudstone

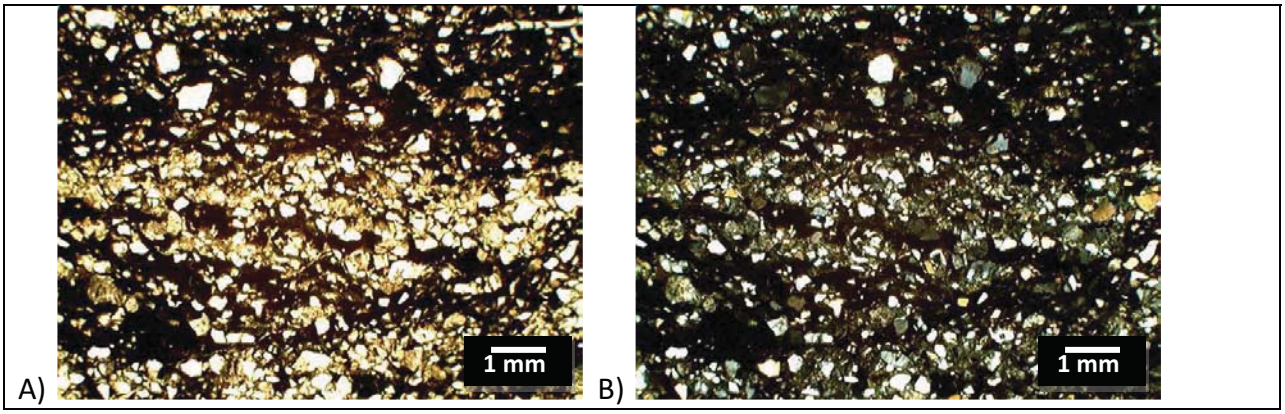


Figure 24. Photomicrographs of R-09-Z3B11 232-232.6' in A) Plane-polarized light and B) Cross-polarized light. 20x magnification. Scale bar approximate.

Alternating light and dark layers. Darker layers are finely laminated with hematite and clay cement. Lighter layers lack structure and have a calcite cement with a bit of hematite. Grains are often imbricated and highly fragmented. Chlorite alteration of minerals is common.

Biotite – <0.5 mm, subhedral, altering to chlorite, shows evidence of strain, pleochroic medium to dark brown

Chlorite – alteration product of biotite, pleochroic pink to green

Plagioclase/Potassium feldspar – <0.5 mm, difficult to distinguish between the feldspars, some grains exhibit albite twinning, angular (anhedral)

Quartz – anhedral, fractured

Muscovite – anhedral, high birefringence, clear in plane-polarized light

Mineral	**Percentage**
Matrix	15
Biotite	20
Chlorite	5
Plagioclase/Potassium feldspar	45
Quartz	10
Muscovite	5

R-09-Z3B12 239-239.8'

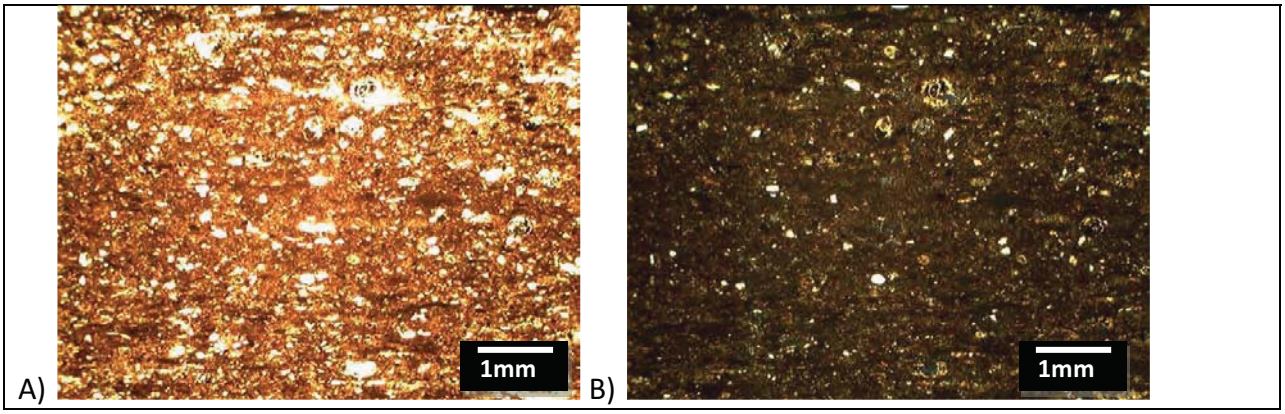


Figure 25. Photomicrograph of R-09-Z3B12 239-239.8'. A) Section in plane polarized light at 40x magnification. B) Section in cross-polarized light at 40x magnification. Scale bar approximate.

Fine-grained shale or siltstone. Planar bedded with bedding at the millimeter scale. Bedding is defined by lens shaped areas of iron oxide, calcite and quartz. Several beds (1 mm in width) are composed entirely of very small quartz grains.

Quartz – rounded to splinter shaped grains surrounded by matrix.

Plagioclase – angular grains showing albite twinning. Grains are surrounded by matrix.

Calcite – forms lens shaped aggregates aligned along bedding planes. Also found in permineralized gastropods and shell fragments.

Iron oxide – the major mineral in the matrix is reddish in color. Small grains of opaque angular magnetite are also present.

Matrix – bedding at the millimeter scale mostly composed of iron oxide and calcite, but some thin beds are composed entirely of very fine quartz grains.

Percentages of total rock:

Quartz	12
Plagioclase	<1
Calcite	8
Matrix composed on iron oxide	79

R-09-Z4B4 200.5-201'

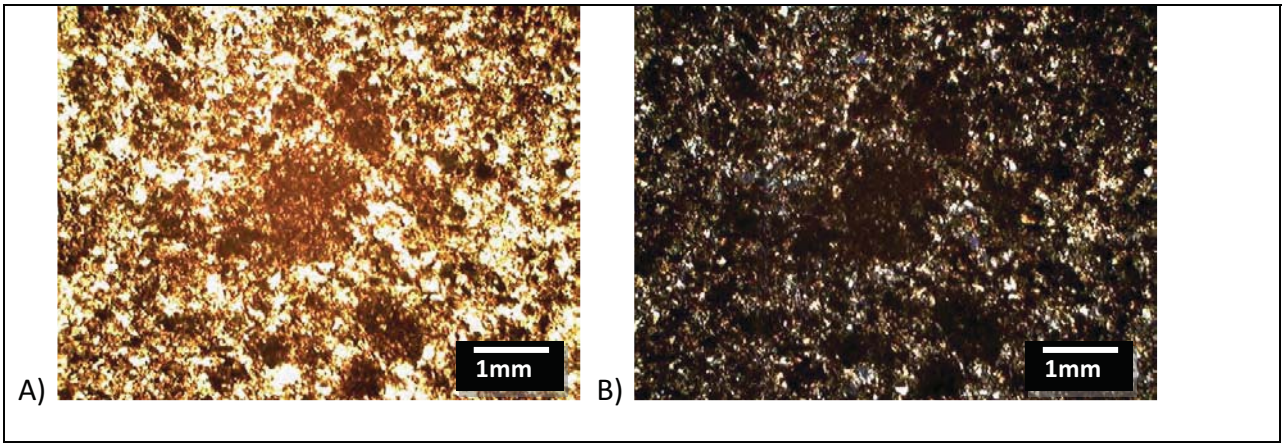


Figure 26. Photomicrograph of R-09-Z4B4 200.5-201'. A) Section in plane polarized light at 40x magnification. B) Section in cross-polarized light at 40x magnification. Scale bar approximate.

Siltstone with red-brown iron oxide rich matrix.

Quartz – small (<1 mm) angular grains embedded in fine grained iron oxide rich matrix.

Plagioclase – rare small (< 1mm) angular grains showing albite twinning.

Chlorite – (<1 mm) grains, angular, green color but pleochroic light green to darker green.

Iron oxide – present as both iron oxide in matrix and irregular grains of opaque iron oxide (probably magnetite) up to 1 mm in size. Opaque iron oxide also occurs as irregular clots randomly distributed in matrix.

Comments:

Matrix contains irregular clots of darker opaque iron oxide.

Percentages of total rock:

Quartz	12
Plagioclase	<1
Chlorite	<1
Matrix with iron oxide	86

Petrographic Report #WUK

May 18, 2009

for

Hubert Law
Earth Mechanics, Inc.
17660 Newhope St., Ste. E
Fountain Valley, CA 92708

by

Michael DePangher, Ph.D.
Spectrum Petrographics, Inc.

Key to Petrographic and Photomicrographic Descriptions

Clay minerals common in altered rocks must often be identified by X-ray diffraction either because their optic properties are not diagnostic or because they are too fine grained to be reliably identified by optical methods. The term "clay" is used herein to denote fine grained phyllosilicates in general. Under ideal conditions, it is often possible to optically discriminate between 4 major groups: kaolinite, smectite, mica (including illite), and chlorite. This is done whenever conditions permit.

The term "sericite" is applied to fine grained colorless phyllosilicates that show upper 2nd order maximum interference colors. These could include muscovite, illite, paragonite, lepidolite, margarite, clintonite, pyrophyllite, and talc. The term "intermediate clay" is applied to fine grained very pale or colorless phyllosilicates that show upper 1st order maximum interference colors. These are probably dominated by chlorite, smectite, and mixed-layer illite/smectite.

The term "opaques" is used to refer to all materials opaque (and sometimes semi-opaque) to transmitted light. The term "FEOH" is herein used to indicate fine grained, yellowish to reddish brown, earthy materials of varying opacity in transmitted light. FEOH is probably mostly Fe oxy-hydroxides but may sometimes include sphalerite, realgar, orpiment, jarosite, a number of Mn oxy-hydroxides, and organic matter.

A question mark after a rock or mineral name in a petrographic description means that there is uncertainty about the identification of that rock or mineral.

Particle size distributions are given as (A-B µm), where A and B are the median and largest particle sizes, respectively, in microns. A question mark (?) in the position of A or B indicates that the value of A or B was indeterminate, probably because of excessively large or small particle size or statistically insignificant numbers of particles.

Mineral abundances are visual estimates for an entire slide. For multi-lithologic materials (cuttings, etc...), mineralogy, textures, and alteration are described only for the dominant lithology.

Section preparation codes are as follows: (1) Format: 27 x 46 mm, 51 x 76 mm, or 1" round; (2) Finish: standard lapping (STD) or polished (POL); (3) Stains: sodium cobaltinitrite (SCN), alizarin red S (ARS), potassium ferricyanide (PF), and barium chloride + potassium rhodizonate (BCPR); and (4) Cover: none, permanent Loctite acrylic (PLA), or removable Canada Balsam (RCB).

Photomicrograph captions/labels contain the following items of information in consecutive order separated by forward slashes: (1) sample identification; (2) film roll number; (3) frame number; (4) illumination; (5) field of view (FOV); and (6) the job identification number. "PPL" indicates plane-polarized light; "XPL indicates cross-polarized light; "R" indicates reflected light. "550" means that a 550 nanometer wavelength plate was inserted in the light path. "C" indicates that the substage condenser was in (sometimes used for Fe-oxides). "O" indicates substage condenser in an oblique position. These various illuminations can be combined. "CON" indicates conoscopic illumination. POL means that a polarizing filter was used with the lens, and DAY means the sample was photographed in diffused daylight.

Features on photomicrographs are indicated by the number of the feature in the ALTERATION section of the text or by a mineral name abbreviation: **Q**uartz, **P**lagioclase, **K**-feldspar, **ser**icite, **b**io**t**ite, **fe**rroan **c**al**c**ite, **act**inolite.

For hypertext links to images to function properly, the images must reside in the same folder as the report.

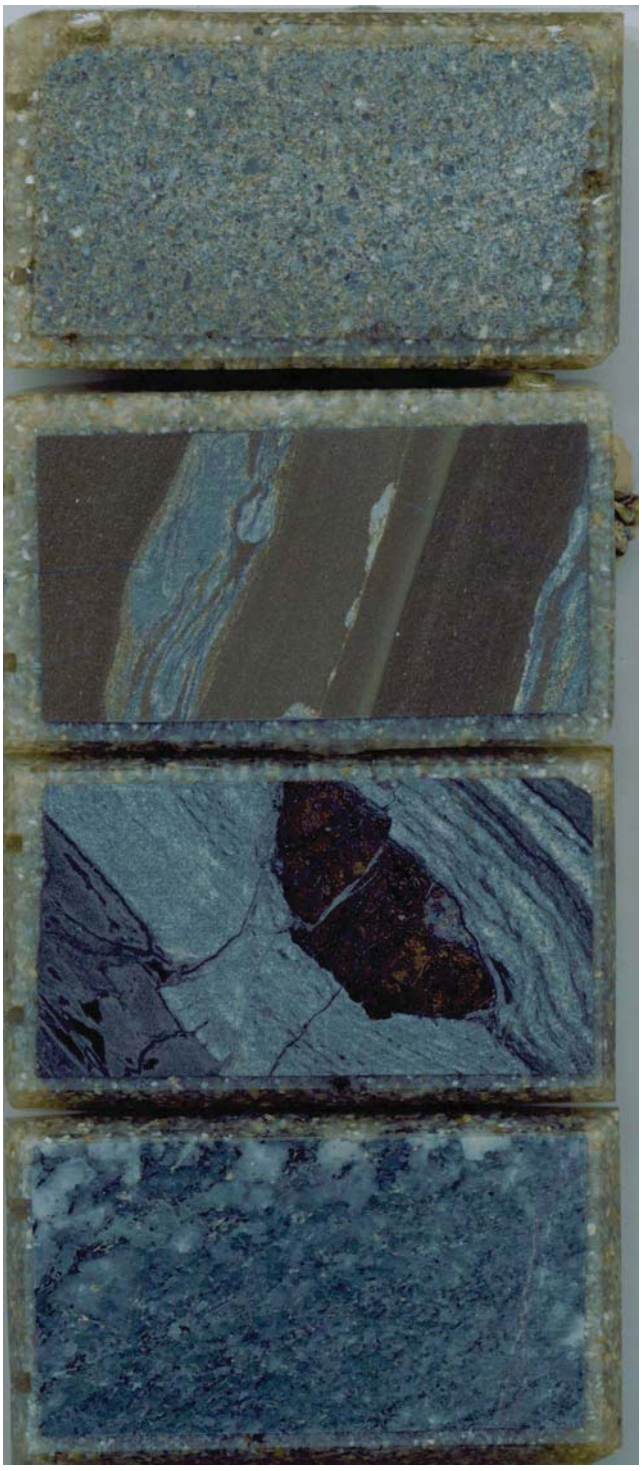
Comments

R-09-Z1B3-104

R-09-Z1B3-154

R-09-Z2B1-129

R-09-Z3B3-271



SAMPLE # **R-09-Z1B3-104**

ROCK NAME ALTERED SANDSTONE -- probably formed by alteration (secondary dolomite + clay + ferroan dolomite) of a fine to medium lithic arkose (McBride, 1963) protolith, probably derived from a source area dominated by quartz monzonite.

MINERALS Quartz (28%) + plagioclase (28%) + K-feldspar (26%) + biotite (10%) + dolomite (5%) + clay (2%) + ferroan dolomite (1%) + collophane (<1%) + muscovite (<1%) + garnet (<1%).

TEXTURES Clastic sedimentary, non-directed fabric.

Detrital Framework Grains (94%) are angular, 250-2120 µm, monocrystalline [quartz (25%) + plagioclase (25%) + K-feldspar (25%)] + polycrystalline lithic fragments of quartz monzonite (5%) + various volcanic rocks (3%) + carbonate (1%). Contacts between grains are tangential.

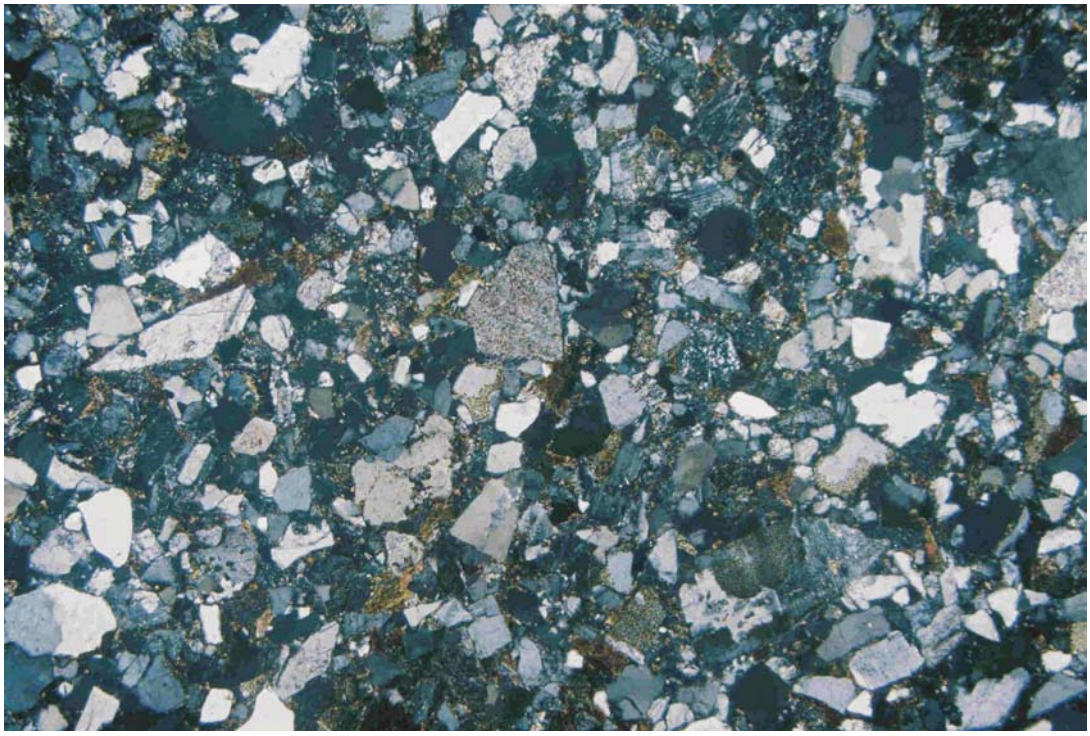
Matrix (0%) was not observed.

Cement (6%) is composed of dolomite + ferroan dolomite.

ALTERATION The following alteration features are present but of indeterminate relative ages: (1) plagioclase weakly altered to clay.

SECTIONING Format: 27 x 46 mm Finish: STD Stains: SCN (top ½) + [ARS + PF] (right ½) Cover: PLA

PHOTOS **R-09-Z1B3-104** 09015_02.jpg/XPL/FOV = 4.00 x 5.83 mm/WUK ALTERED SANDSTONE showing typical appearance.



SAMPLE # **R-09-Z1B3-154**

ROCK NAME CARBONACEOUS SILTY CLAYSTONE

MINERALS Clay (50%) + carbonaceous matter (15%) + quartz (15%) + K-feldspar (15%) + opaques (5%).

TEXTURES Clastic sedimentary. Fine laminae define a moderately directed fabric.

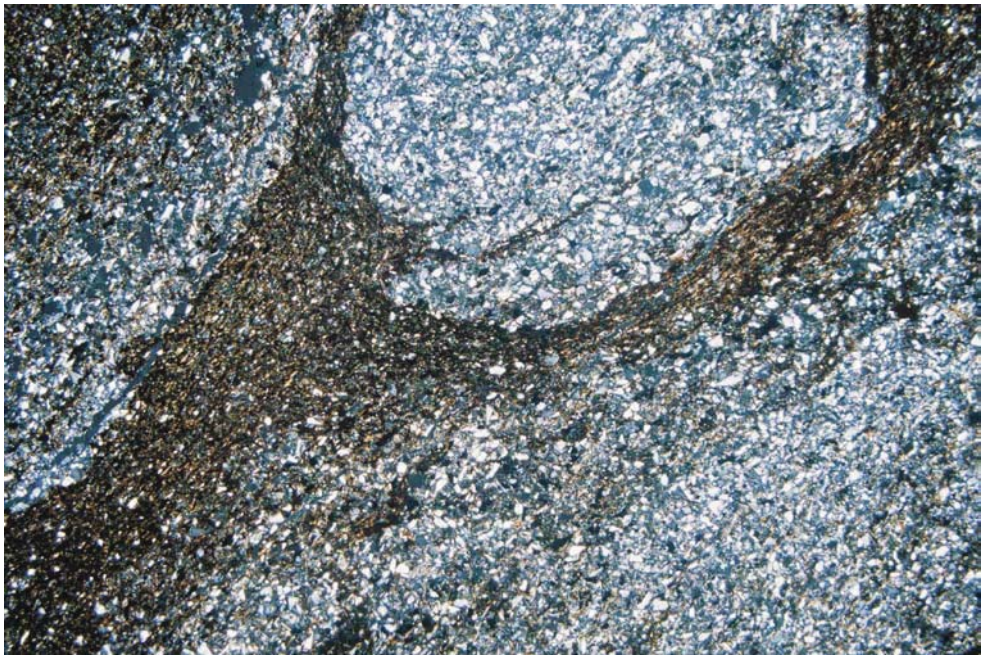
Detrital Framework Grains (30%) are angular, 50-100 µm, monocrystalline [quartz (15%) + K-feldspar (15%)]. Contacts between grains are floating.

Matrix/Cement (0%) is composed of clay + carbonaceous matter + opaques.

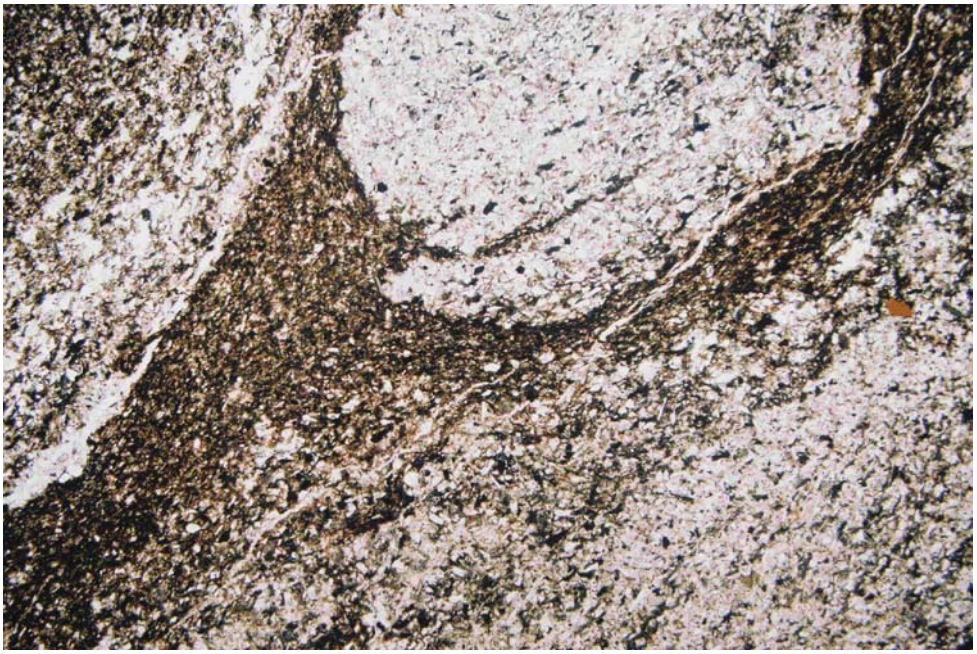
ALTERATION The following alteration features are also present but of indeterminate relative ages: (1) weak deformation, possibly as a soft sediment.

SECTIONING Format: 27 x 46 mm Finish: STD Stains: SCN (top ½) + [ARS + PF] (right ½) Cover: PLA

PHOTOS **R-09-Z1B3-154** 9015_04.jpg/XPL/FOV = 4.00 x 5.83 mm/WUK CARBONACEOUS SILTY CLAYSTONE showing typical finely laminated appearance (same view as 09015_05.jpg).



R-09-Z1B3-154 09015_05.jpg/PPL/FOV = 4.00 x 5.83 mm/WUK CARBONACEOUS SILTY CLAYSTONE showing typical finely laminated appearance (same view as 09015_04.jpg).



SAMPLE # **R-09-Z2B1-129**

ROCK NAME ALTERED SANDSTONE -- probably formed by alteration (secondary calcite + ferroan dolomite) and cataclasis of a very fine to fine feldspathic litharenite (McBride, 1963) protolith.

MINERALS Collophane (19%) + calcite (17%) + ferroan dolomite (13%) + quartz (13%) + K-feldspar (12%) + carbonaceous matter (10%) + clay (10%) + biotite (5%) + opaques (<1%).

TEXTURES Clastic sedimentary. Fine bedding defines a weakly directed fabric.

Detrital Framework Grains (50%) are angular, 125-400 µm, monocrystalline [quartz (13%) + K-feldspar (12%) + biotite (5%)] + a single large lithic fragment (?) of polycrystalline fossiliferous collophane (20%). Contacts between grains are floating to tangential.

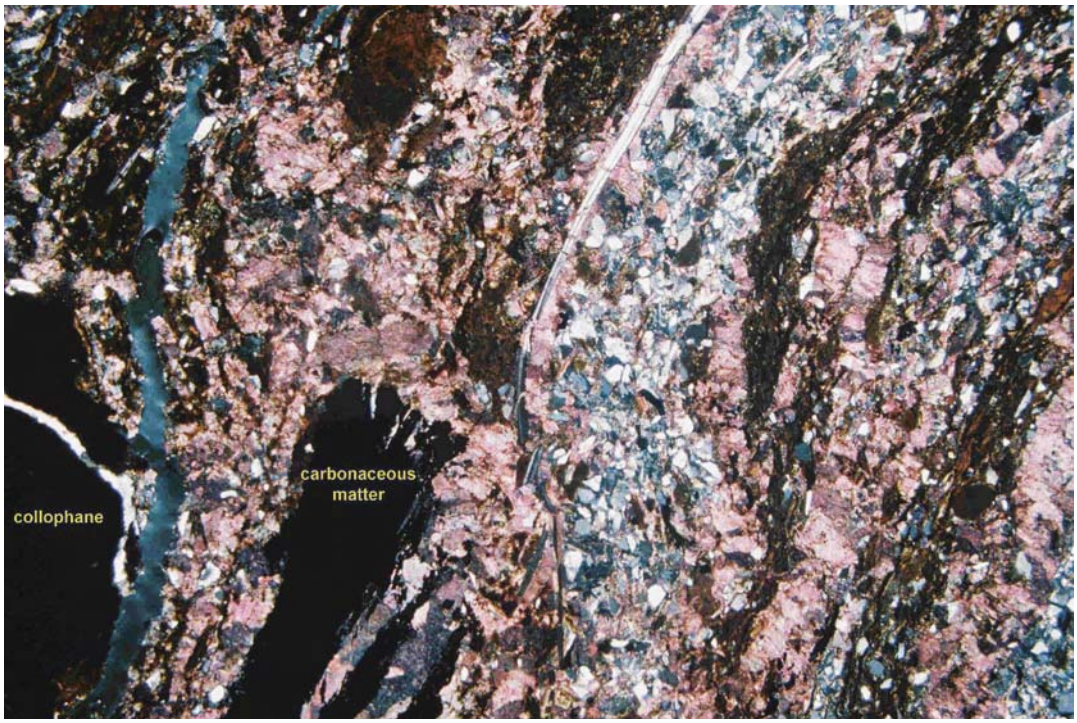
Matrix (20%) is composed of clay + carbonaceous matter + opaques.

Cement (30%) is composed of calcite + ferroan dolomite.

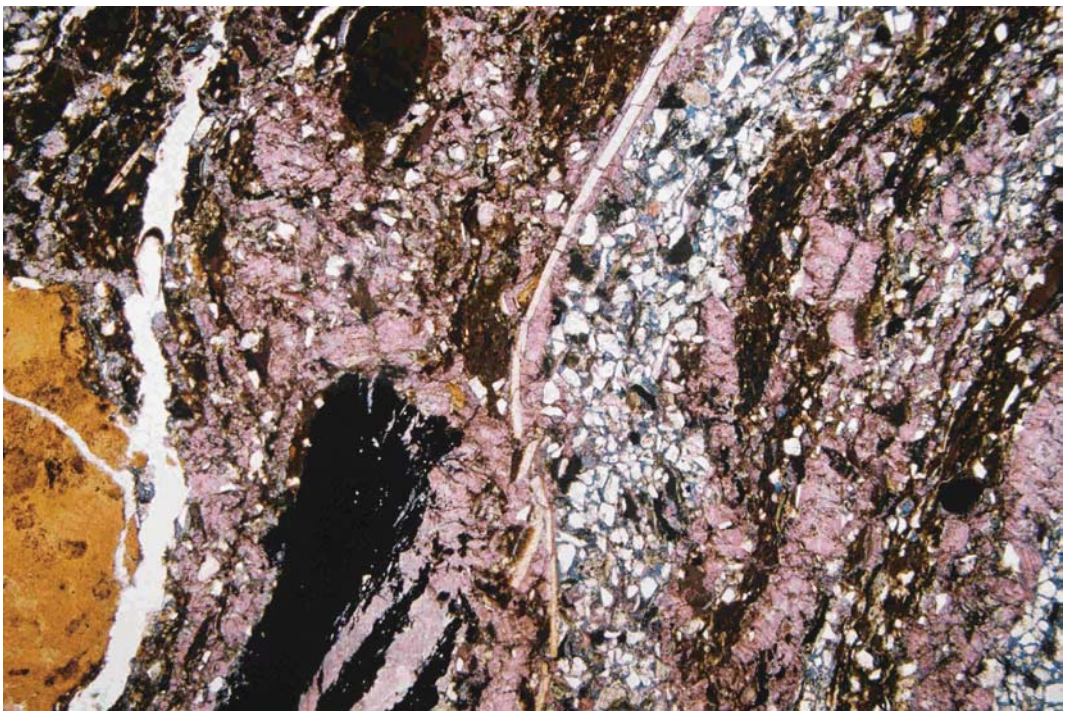
ALTERATION Alteration features in relative chronological order from oldest to youngest are: (1) veins and cement of calcite + ferroan dolomite; and (2) cataclasis.

SECTIONING Format: 27 x 46 mm Finish: STD Stains: SCN (top ½) + [ARS + PF] (right ½) Cover: PLA

PHOTOS **R-09-Z2B1-129** 9015_06m.jpg/XPL/FOV = 4.00 x 5.83 mm/WUK ALTERED SANDSTONE showing typical appearance (same view as 09015_07.jpg).



R-09-Z2B1-129 09015_07.jpg/PPL/FOV = 4.00 x 5.83 mm/WUK ALTERED SANDSTONE showing typical appearance (same view as 09015_06m.jpg).



SAMPLE # **R-09-Z3B3-271**

ROCK NAME ALTERED DIORITE -- probably formed by hydrothermal alteration (secondary chlorite + clay + calcite/ferroan calcite + rutile + apatite + opaques + clinozoisite) of a fine grained diorite shallow intrusive.

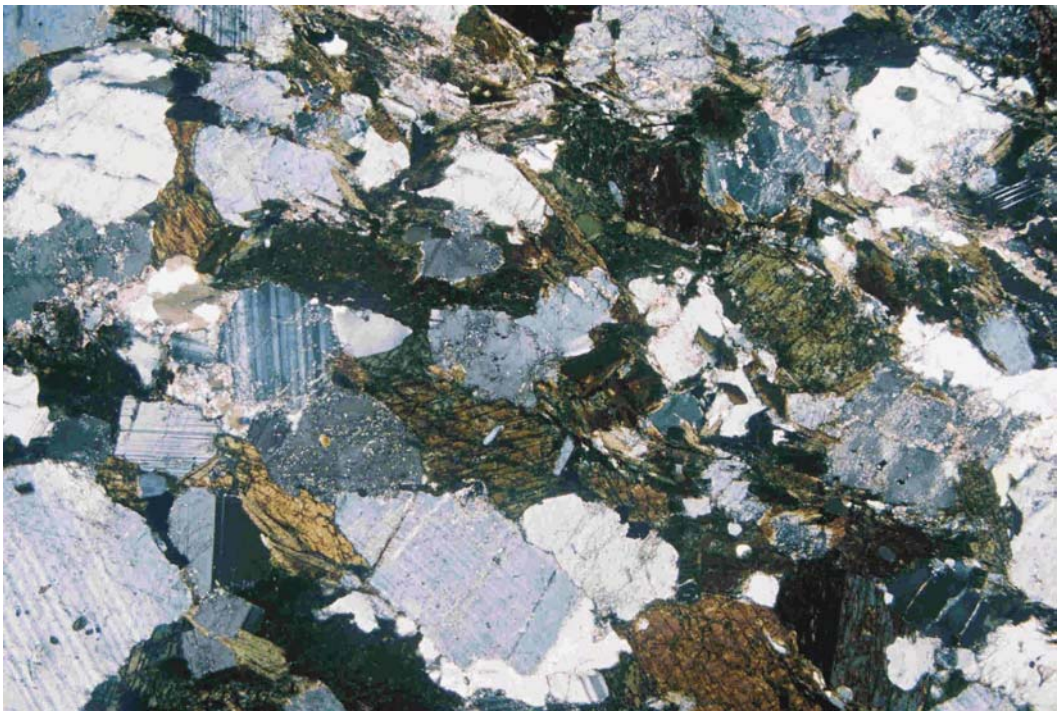
MINERALS Plagioclase (40%) + hornblende (29%) + chlorite (8%) + quartz (8%) + biotite (5%) + clay (3%) + calcite/ferroan calcite (3%) + K-feldspar (1%) + rutile (1%) + apatite (1%) + opaques (1%) + clinozoisite (<1%).

TEXTURES Phaneritic, holocrystalline, allotriomorphic, fine grained. Very weak deformation has produced a weakly directed fabric.

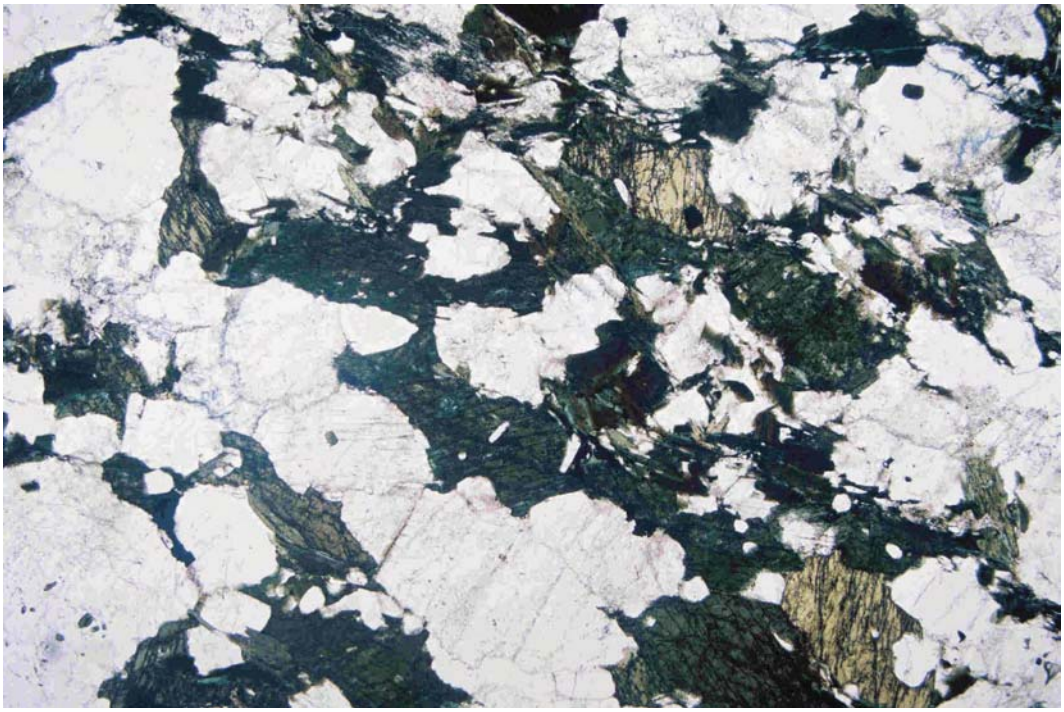
ALTERATION The following alteration features are also present but of indeterminate relative ages: (1) plagioclase weakly altered to clay; (2) hornblende moderately altered to chlorite + ferroan calcite + rutile ± apatite ± clinozoisite; (3) biotite weakly altered to chlorite + rutile + opaques; and (4) veins of calcite + chlorite.

SECTIONING Format: 27 x 46 mm Finish: STD Stains: SCN (top 1/2) + [ARS + PF] (right 1/2) Cover: PLA

PHOTOS **R-09-Z3B3-271** 9015_08.jpg/XPL/FOV = 4.00 x 5.83 mm/WUK ALTERED DIORITE showing typical appearance (same view as 09015_09.jpg).



R-09-Z3B3-271 09015_09.jpg/PPL/FOV = 4.00 x 5.83 mm/WUK ALTERED DIORITE showing typical appearance (same view as 09015_08.jpg).



Calscience
Environmental
Laboratories, Inc.

April 15, 2009

Ravee Raveendra
CH2M Hill
6 Hutton Centre Drive, Suite 700
Santa Ana, CA 92707-5735

Subject: **Calscience Work Order No.: 09-04-0712**
Client Reference: SR-710 Tunnel Technical Study / 932236

Dear Client:

Enclosed is an analytical report for the above-referenced project. The samples included in this report were received 4/8/2009 and analyzed in accordance with the attached chain-of-custody.

Unless otherwise noted, all analytical testing was accomplished in accordance with the guidelines established in our Quality Systems Manual, applicable standard operating procedures, and other related documentation. The original report of subcontracted analysis, if any, is provided herein, and follows the standard Calscience data package. The results in this analytical report are limited to the samples tested and any reproduction thereof must be made in its entirety.

If you have any questions regarding this report, please do not hesitate to contact the undersigned.

Sincerely,

Calscience Environmental
Laboratories, Inc.
Virendra Patel
Project Manager

Calscience Environmental Laboratories, Inc.

Analytical Report

CH2M Hill		Date Received:	04/08/09
6 Hutton Centre Drive, Suite 700		Work Order No:	09-04-0712
Santa Ana, CA 92707-5735		Preparation:	EPA 3550B
		Method:	EPA 8015B (M)
		Units:	mg/kg

Project: SR-710 Tunnel Technical Study / 932236

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
Z1-B7-259'	**09-04-0712-1-A**	**04/08/09 10:00**	**Solid**	**GC 3**	**04/09/09**	**04/10/09 16:22**	**090409B05**

Parameter	Result	RL	DF	Qual	Parameter	Result	RL	DF	Qual
C6	ND		160		C21-C22	2700		160	
C7	ND		160		C23-C24	2100		160	
C8	ND		160		C25-C28	5100		160	
C9-C10	110		160		C29-C32	4200		160	
C11-C12	460		160		C33-C36	3000		160	
C13-C14	1100		160		C37-C40	2800		160	
C15-C16	2000		160		C41-C44	1900		160	
C17-C18	2200		160		C6-C44 Total	30000	800	160	
C19-C20	2600		160						

Surrogates:	REC (%)	Control Limits	Qual
Decachlorobiphenyl	244	61-145	2

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
Z1-B7-273'	**09-04-0712-2-A**	**04/08/09 10:00**	**Solid**	**GC 3**	**04/09/09**	**04/10/09 17:00**	**090409B05**

Parameter	Result	RL	DF	Qual	Parameter	Result	RL	DF	Qual
C6	ND		160		C21-C22	1400		160	
C7	ND		160		C23-C24	1100		160	
C8	ND		160		C25-C28	3000		160	
C9-C10	48		160		C29-C32	2800		160	
C11-C12	230		160		C33-C36	2100		160	
C13-C14	590		160		C37-C40	1800		160	
C15-C16	1100		160		C41-C44	1400		160	
C17-C18	1200		160		C6-C44 Total	18000	800	160	
C19-C20	1400		160						

Surrogates:	REC (%)	Control Limits	Qual
Decachlorobiphenyl	192	61-145	2

RL - Reporting Limit , DF - Dilution Factor , Qual - Qualifiers

Calscience Environmental Laboratories, Inc.

Analytical Report

CH2M Hill		Date Received:	04/08/09
6 Hutton Centre Drive, Suite 700		Work Order No:	09-04-0712
Santa Ana, CA 92707-5735		Preparation:	EPA 3550B
		Method:	EPA 8015B (M)
		Units:	mg/kg

Project: SR-710 Tunnel Technical Study / 932236

Client Sample Number	Lab Sample Number	Date/Time Collected	Matrix	Instrument	Date Prepared	Date/Time Analyzed	QC Batch ID
Z1-B7-295'	**09-04-0712-3-A**	**04/08/09 10:00**	**Solid**	**GC 3**	**04/09/09**	**04/10/09 17:40**	**090409B05**

Parameter	Result	RL	DF	Qual	Parameter	Result	RL	DF	Qual
C6	ND		160		C21-C22	1700		160	
C7	ND		160		C23-C24	1300		160	
C8	ND		160		C25-C28	3600		160	
C9-C10	48		160		C29-C32	3900		160	
C11-C12	190		160		C33-C36	2900		160	
C13-C14	590		160		C37-C40	2300		160	
C15-C16	1000		160		C41-C44	1800		160	
C17-C18	1500		160		C6-C44 Total	22000	800	160	
C19-C20	1500		160						

Surrogates:	REC (%)	Control Limits	Qual
Decachlorobiphenyl	265	61-145	2

Method Blank	**099-12-275-2,616**	**N/A**	**Solid**	**GC 3**	**04/09/09**	**04/10/09 00:47**	**090409B05**

Parameter	Result	RL	DF	Qual
TPH as Diesel	ND	5.0	1	

Surrogates:	REC (%)	Control Limits	Qual
Decachlorobiphenyl	101	61-145	

RL - Reporting Limit , DF - Dilution Factor , Qual - Qualifiers

Calscience Environmental Laboratories, Inc.

Quality Control - Spike/Spike Duplicate

CH2M Hill
6 Hutton Centre Drive, Suite 700
Santa Ana, CA 92707-5735

Date Received: 04/08/09
Work Order No: 09-04-0712
Preparation: EPA 3550B
Method: EPA 8015B (M)

Project SR-710 Tunnel Technical Study / 932236

Quality Control Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	MS/MSD Batch Number
09-04-0595-1	**Solid**	**GC 3**	**04/09/09**	**04/10/09**	**090409S05**

Parameter	MS %REC	MSD %REC	%REC CL	RPD	RPD CL	Qualifiers
TPH as Diesel	90	82	64-130	4	0-15	

RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Quality Control - LCS/LCS Duplicate

CH2M Hill
6 Hutton Centre Drive, Suite 700
Santa Ana, CA 92707-5735

Date Received: N/A
Work Order No: 09-04-0712
Preparation: EPA 3550B
Method: EPA 8015B (M)

Project: SR-710 Tunnel Technical Study / 932236

Quality Control Sample ID	Matrix	Instrument	Date Prepared	Date Analyzed	LCS/LCSD Batch Number
099-12-275-2,616	**Solid**	**GC 3**	**04/09/09**	**04/10/09**	**090409B05**

Parameter	LCS %REC	LCSD %REC	%REC CL	RPD	RPD CL	Qualifiers
TPH as Diesel	104	104	75-123	1	0-12	

RPD - Relative Percent Difference , CL - Control Limit

Calscience Environmental Laboratories, Inc.

Glossary of Terms and Qualifiers

Work Order Number: 09-04-0712

Qualifier	Definition
*	See applicable analysis comment.
1	Surrogate compound recovery was out of control due to a required sample dilution, therefore, the sample data was reported without further clarification.
2	Surrogate compound recovery was out of control due to matrix interference. The associated method blank surrogate spike compound was in control and, therefore, the sample data was reported without further clarification.
3	Recovery of the Matrix Spike (MS) or Matrix Spike Duplicate (MSD) compound was out of control due to matrix interference. The associated LCS and/or LCSD was in control and, therefore, the sample data was reported without further clarification.
4	The MS/MSD RPD was out of control due to matrix interference. The LCS/LCSD RPD was in control and, therefore, the sample data was reported without further clarification.
5	The PDS/PDSD associated with this batch of samples was out of control due to a matrix interference effect. The associated batch LCS/LCSD was in control and, hence, the associated sample data was reported with no further corrective action required.
A	Result is the average of all dilutions, as defined by the method.
B	Analyte was present in the associated method blank.
C	Analyte presence was not confirmed on primary column.
E	Concentration exceeds the calibration range.
H	Sample received and/or analyzed past the recommended holding time.
J	Analyte was detected at a concentration below the reporting limit and above the laboratory method detection limit. Reported value is estimated.
ME	LCS Recovery Percentage is within LCS ME Control Limit range.
N	Nontarget Analyte.
ND	Parameter not detected at the indicated reporting limit.
Q	Spike recovery and RPD control limits do not apply resulting from the parameter concentration in the sample exceeding the spike concentration by a factor of four or greater.
U	Undetected at the laboratory method detection limit.
X	% Recovery and/or RPD out-of-range.
Z	Analyte presence was not confirmed by second column or GC/MS analysis.

Calscience Environmental Laboratories, Inc.
7440 LINCOLN WAY
GARDEN GROVE, CA 92841-1432
TEL: (714) 895-5494 . FAX: (714) 894-7501

CHAIN OF CUSTODY RECORD

DATE:

PAGE: 1 OF 1

LABORATORY CLIENT: CH2M HILL
ADDRESS: 6 Hutton Centre Drive, Suite 700
CITY: Santa Ana, CA 92707
TEL: 714-435-6248 FAX: 714-424-2149 E-MAIL: ravee.raveendra@ch2m.com

CLIENT PROJECT NAME / NUMBER: SR-710 Tunnel Tech Study
P.O. NO.: 932236
PROJECT CONTACT: Ravee Raveendra
QUOTE NO.:
SAMPLER(S): (SIGNATURE)
LAB USE ONLY: 04-0712

TURNAROUND TIME
☐ SAME DAY ☐ 24 HR ☐ 48HR ☐ 72 HR ☒ 5 DAYS ☐ 10 DAYS

SPECIAL REQUIREMENTS (ADDITIONAL COSTS MAY APPLY)
☐ RWQCB REPORTING ☒ ARCHIVE SAMPLES

SPECIAL INSTRUCTIONS
Coring was performed on 1/26/09 and the sample was collected from rock core on 4/8/09

REQUESTED ANALYSIS

LAB USE ONLY	SAMPLE ID	LOCATION/ DESCRIPTION	SAMPLING DATE	SAMPLING TIME	Matrix	#Cont	Please list tests required	TPH(C6-C44)			
1	Z1-B7-259'	Z1-B7	04/08/09	10:00	Soil	1		X			
2	Z1-B7-273'	Z1-B7	04/08/09	10:00	Soil	1		X			
3	Z1-B7-295'	Z1-B7	04/08/09	10:00	Soil	1		X			

Relinquished by: (Signature) 4/8/09	Received by: (Signature)	Date: 04/08/09	Time: 1545
Relinquished by: (Signature)	Received by: (Signature) Peggy A. CEL	Date: 04/09/09	Time: 18:15
Relinquished by: (Signature)	Received by: (Signature)	Date:	Time:

Calscience Environmental Laboratories, Inc.

WORK ORDER #: 09-04-0 7 7 8

SAMPLE RECEIPT FORM

Cooler 1 of 1

CLIENT: CH2M HILL

DATE: 04/08/09

TEMPERATURE: (Criteria: 0.0 °C – 6.0 °C, not frozen)

Temperature 1.8 °C - 0.2 °C (CF) = 1.6 °C ☑ Blank ☐ Sample

☐ Sample(s) outside temperature criteria (PM/APM contacted by: ________).

☐ Sample(s) outside temperature criteria but received on ice/chilled on same day of sampling.

☐ **Received at ambient temperature, placed on ice for transport by Courier.**

Ambient Temperature: ☐ Air ☐ Filter ☐ Metals Only ☐ PCBs Only Initial: RG

CUSTODY SEALS INTACT:

☐ Cooler ☐ ________ ☐ No (Not Intact) ☑ Not Present ☐ N/A Initial: RG

☐ Sample ☐ ________ ☐ No (Not Intact) ☑ Not Present Initial: PS

SAMPLE CONDITION:	Yes	No	N/A
Chain-Of-Custody (COC) document(s) received with samples	☑	☐	☐
COC document(s) received complete	☑	☐	☐
☐ Collection date/time, matrix, and/or # of containers logged in based on sample labels.			
☐ COC not relinquished. ☐ No date relinquished. ☐ No time relinquished.			
Sampler's name indicated on COC	☐	☑	☐
Sample container label(s) consistent with COC	☑	☐	☐
Sample container(s) intact and good condition	☑	☐	☐
Correct containers and volume for analyses requested	☑	☐	☐
Analyses received within holding time	☑	☐	☐
Proper preservation noted on COC or sample container	☐	☐	☑
☐ Unpreserved vials received for Volatiles analysis			
Volatile analysis container(s) free of headspace	☐	☐	☑
Tedlar bag(s) free of condensation	☐	☐	☑

CONTAINER TYPE:

Solid: ☐4ozCGJ ☑8ozCGJ (2-3) ☑16ozCGJ (-1) ☐Sleeve ☐EnCores® ☐TerraCores® ☐________

Water: ☐VOA ☐VOAh ☐VOAna2 ☐125AGB ☐125AGBh ☐125AGBp ☐1AGB ☐1AGBna2 ☐1AGBs ☐500AGB ☐500AGJ ☐500AGJs ☐250AGB ☐250CGB ☐250CGBs ☐1PB ☐500PB ☐500PBna ☐250PB ☐250PBn ☐125PB ☐125PBznna ☐100PBsterile ☐100PBna2 ☐_____ ☐_____ ☐_____

Air: ☐Tedlar® ☐Summa® ☐______ **Sludge/Other:** ☐________ **Checked/Labeled by:** PS

Container: C: Clear A: Amber P: Plastic G: Glass J: Jar (Wide-mouth) B: Bottle (Narrow-mouth) **Reviewed by:** KM

Preservative: h: HCL n: HNO3 na2: $Na_2S_2O_3$ Na: NaOH p: H_3PO_4 s: H_2SO_4 znna: $ZnAc_2$+NaOH **Scanned by:** PS