APPENDIX W

INLAND RAIL

Geotechnical Factual Report

Part 2 of 2

HELIDON TO CALVERT ENVIRONMENTAL IMPACT STATEMENT

IR_1381

ARTC

The Australian Government is delivering Inland Rail through the Australian Rail Track Corporation (ARTC), in partnership with the private sector.

Appendix D
Laboratory Test Result Summary and Reports

HELIDON TO CALVERT ENVIRONMENTAL IMPACT STATEMENT

Summary of Laboratory Results [1]

Borehole	Sample ID	Depth (m)		USC	Material Description	Moisture Content	Plasticity				Grading										Shrink Swell			Aggressivity			Emerson	Slake Durability		Uniaxial Compressive Strength & Deformation[2]			Point Load		Brazilian Test	Particle Density	Degradation Factor	Aggregate Crushing Value
							LL	PL	PI	LS	Clay	Silt	Clay/Silt	Sand			Sand	Gravel			Gravel	Swell	Shrinkage	Shrink Swell Index	Soluble Sulfate	Chloride	pH	Class number	1st Cycle	2nd Cycle	UCS	Young's Modulus (Tangent)	Poisson Ratio (Tangent)	Axial Is(50)	Diametral Is(50)				
		From	To			%	%	%	%	%	2um	60um	%	fine	med	coarse	%	fine	med	coarse	%	%	%	%	mg/kg	mg/kg	-	-	%	%	MPa	GPa	-	MPa	MPa	MPa	t/m^3	-	%
330-01-BH2101	330-01-BH2101-C07000	70.00	71.00	-	SANDSTONE																										15.60	15.800	0.079			1.520			
330-01-BH2101	330-01-BH2101-C07000	70.20	70.33	-	SANDSTONE																													1.15	1.04				
330-01-BH2101	330-01-BH2101-C07000	70.33	70.47	-	SANDSTONE																													1.16	1.20				
330-01-BH2101	330-01-BH2101-C07000	70.47	70.60	-	SANDSTONE																													0.94	0.95				
330-01-BH2101	330-01-BH2101-C07000	70.60	70.73	-	SANDSTONE																													1.34	0.84				
330-01-BH2101	330-01-BH2101-C07000	70.73	70.86	-	SANDSTONE																													0.76	1.00				
330-01-BH2101	330-01-BH2101-C07200	72.00	72.90	-	SANDSTONE																															0.751			
330-01-BH2101	330-01-BH2101-C07200	72.03	72.15	-	SANDSTONE																													0.36	0.45				
330-01-BH2101	330-01-BH2101-C07200	72.20	72.36	-	SANDSTONE																										7.47	5.650	0.151						
330-01-BH2101	330-01-BH2101-C07200	72.36	72.49	-	SANDSTONE																													0.46	0.36				
330-01-BH2101	330-01-BH2101-C07200	72.49	72.61	-	SANDSTONE																													0.30	0.5				
330-01-BH2101	330-01-BH2101-C07200	72.61	72.74	-	SANDSTONE																													0.36	0.23				
330-01-BH2101	330-01-BH2101-C07200	72.74	72.81	-	SANDSTONE																													0.39	0.36				
330-01-BH2101	330-01-BH2101-C08100	81.00	82.00	-	SANDSTONE																															1.030			
330-01-BH2101	330-01-BH2101-C08100	81.26	81.42	-	SANDSTONE																										13.00	5.400	0.063						
330-01-BH2101	330-01-BH2101-C08100	81.43	81.53	-	SANDSTONE																													0.79	0.80				
330-01-BH2101	330-01-BH2101-C08100	81.53	81.63	-	SANDSTONE																													0.7	0.84				
330-01-BH2101	330-01-BH2101-C08100	81.63	81.74	-	SANDSTONE																													0.83	0.80				
330-01-BH2101	330-01-BH2101-C08100	81.74	81.84	-	SANDSTONE																													1.12	1.02				
330-01-BH2101	330-01-BH2101-C08100	81.84	81.93	-	SANDSTONE																													1.23	1.10				
330-01-BH2101	330-01-BH2101-C08610	86.10	86.18	-	SANDSTONE																													0.36	0.45				
330-01-BH2101	330-01-BH2101-C08610	86.18	86.34	-	SANDSTONE																										2.37	2.120	0.036						
330-01-BH2101	330-01-BH2101-C08610	86.34	86.42	-	SANDSTONE																													0.17	0.17				
330-01-BH2101	330-01-BH2101-C08610	86.42	86.49	-	SANDSTONE																													0.36	0.33				
330-01-BH2101	330-01-BH2101-C08610	86.49	86.57	-	SANDSTONE																													0.36	0.36				
330-01-BH2101	330-01-BH2101-C08610	86.57	86.66	-	SANDSTONE																													0.08	0.11				
330-01-BH2101	330-01-BH2101-C08700	87.00	87.50	-	SANDSTONE																															0.417			
330-01-BH2101	330-01-BH2101-C08700	87.07	87.21	-	SANDSTONE																										10.10	2.360	0.035						
330-01-BH2101	330-01-BH2101-C08700	87.21	87.28	-	SANDSTONE																													0.93	0.64				
330-01-BH2101	330-01-BH2101-C08700	87.28	87.35	-	SANDSTONE																													0.72	0.57				
330-01-BH2101	330-01-BH2101-C08700	87.35	87.42	-	SANDSTONE																													0.54	0.21				
330-01-BH2101	330-01-BH2101-C08700	87.42	87.50	-	SANDSTONE																													1.00	0.51				
330-01-BH2101	330-01-BH2101-C09100	91.00	91.70	-	SILTSTONE																															0.262			
330-01-BH2101	330-01-BH2101-C09100	91.05	91.15	-	SILTSTONE																													0.29	0.01				
330-01-BH2101	330-01-BH2101-C09100	91.21	91.27	-	SILTSTONE																													0.09	-				
330-01-BH2101	330-01-BH2101-C09100	91.32	91.42	-	SILTSTONE																													0.18	0.03				
330-01-BH2101	330-01-BH2101-C09100	91.47	91.51	-	SILTSTONE																													0.07	-				
330-01-BH2101	330-01-BH2101-C09100	91.59	91.70	-	SILTSTONE																													0.35	0.09				
330-01-BH2101	330-01-BH2101-C09500	95.00	95.70	-	SANDSTONE																															1.290			
330-01-BH2101	330-01-BH2101-C09600	96.00	96.90	-	SANDSTONE																										6.78	1.460	0.043						
330-01-BH2101	330-01-BH2101-C09600	96.05	96.20	-	SANDSTONE																													1.10	0.69				
330-01-BH2101	330-01-BH2101-C09600	96.21	96.31	-	SANDSTONE																													0.77	0.80				
330-01-BH2101	330-01-BH2101-C09600	96.31	96.41	-	SANDSTONE																													1.45	1.48				
330-01-BH2101	330-01-BH2101-C09600	96.42	96.52	-	SANDSTONE																													1.14	1.06				
330-01-BH2101	330-01-BH2101-C09600	96.52	96.63	-	SANDSTONE																													1.21	0.84				
330-01-BH2101	330-01-BH2101-C09600	96.63	96.73	-	SANDSTONE																															8.120			
330-01-BH2101	330-01-BH2101-C09970	99.70	99.90	-	SANDSTONE																										57.70	25.100	0.049						
330-01-BH2101	330-01-BH2101-C09970	99.70	99.86	-	SANDSTONE																													1.03	0.17				
330-01-BH2101	330-01-BH2101-C10460	104.69	104.80	-	SILTSTONE / MUDSTONE																													0.79	0.08				
330-01-BH2101	330-01-BH2101-C10460	104.80	104.90	-	SILTSTONE / MUDSTONE																															0.207			
330-01-BH2101	330-01-BH2101-C10820	108.20	109.00	-	SILTSTONE / SANDSTONE																													0.63	-				
330-01-BH2101	330-01-BH2101-C10820	108.41	108.45	-	SILTSTONE / SANDSTONE																													0.10	-				
330-01-BH2101	330-01-BH2101-C10820	108.58	108.63	-	SILTSTONE / SANDSTONE																													0.48	-				
330-01-BH2101	330-01-BH2101-C10820	108.82	108.86	-	SILTSTONE / SANDSTONE																													0.36	-				
330-01-BH2101	330-01-BH2101-C10820	108.86	108.90	-	SILTSTONE / SANDSTONE																													0.98	0.05				
330-01-BH2101	330-01-BH2101-C10820	108.90	109.00	-	SILTSTONE / SANDSTONE																															2.470			
330-01-BH2101	330-01-BH2101-C11400	114.00	115.00	-	SANDSTONE																										26.70	7.730	0.172						
330-01-BH2101	330-01-BH2101-C11400	114.00	114.17	-	SANDSTONE																													1.80	1.99				
330-01-BH2101	330-01-BH2101-C11400	114.16	114.25	-	SANDSTONE																													1.54	1.20				
330-01-BH2101	330-01-BH2101-C11400	114.25	114.37	-	SANDSTONE																													2.62	1.39				
330-01-BH2101	330-01-BH2101-C11400	114.37	114.50	-	SANDSTONE																													2.13	1.13				
330-01-BH2101	330-01-BH2101-C11400	114.50	114.62	-	SANDSTONE																													2.08	1.88				
330-01-BH2101	330-01-BH2101-C11400	114.62	114.75	-	SANDSTONE																															2.640			
330-01-BH2101	330-01-BH2101-C11700	117.00	117.90	-	SANDSTONE																										32.90	19.000	0.035						
330-01-BH2101	330-01-BH2101-C11700	117.00	117.17	-	SANDSTONE																															1.940			
330-01-BH2101	330-01-BH2101-C12030	120.30	120.90	-	SILTSTONE / SANDSTONE																													1.01	0.55				
330-01-BH2101	330-01-BH2101-C12030	120.33	120.42	-	SILTSTONE / SANDSTONE																													1.04	0.56				
330-01-BH2101	330-01-BH2101-C12030	120.53	120.63	-	SILTSTONE / SANDSTONE																													0.92	0.25				
330-01-BH2101	330-01-BH2101-C12030	120.63	120.71	-	SILTSTONE / SANDSTONE																													0.98	0.56				
330-01-BH2101	330-01-BH2101-C12030	120.71	120.77	-	SILTSTONE / SANDSTONE																													0.67	0.18				
330-01-BH2101	330-01-BH2101-C12030	120.81	120.90	-	SILTSTONE / SANDSTONE																																		
330-01-BH2102	330-01-BH2102-C00365	3.65	3.80	-	SANDSTONE																										7.67	2.670	0.107						
330-01-BH2102	330-01-BH2102-C00365	3.80	3.88	-	SANDSTONE																													0.18	0.28				
330-01-BH2102	330-01-BH2102-C00365	3.88	3.94	-	SANDSTONE																													0.53	0.31				
330-01-BH2102	330-01-BH2102-C00365	3.94	4.00	-	SANDSTONE																													0.43	0.38				
330-01-BH2102	330-01-BH2102-C00365	4.00	4.08	-	SANDSTONE																													0.85	0.27				

Summary of Laboratory Results [1]

Borehole	Sample ID	Depth (m)		USC	Material Description	Moisture Content	Plasticity				Grading										Shrink Swell			Aggressivity			Emerson	Slake Durability		Uniaxial Compressive Strength & Deformation[2]			Point Load		Brazilian Test	Particle Density	Degradation Factor	Aggregate Crushing Value
											Clay	Silt	Clay/Silt	Sand			Sand	Gravel			Gravel	Swell	Shrinkage	Shrink Swell Index	Soluble Sulfate	Chloride	pH	Class number	1st Cycle	2nd Cycle	UCS	Young's Modulus (Tangent)	Poisson Ratio (Tangent)	Axial Is(50)	Diametral Is(50)				
		From	To			%	LL	PL	PI	LS	2um	60um	%	fine	med	coarse	%	fine	med	coarse	%	%	%	%	mg/kg	mg/kg	-	-	%	%	MPa	GPa	-	MPa	MPa	MPa	t/m^3	-	%
330-01-BH2102	330-01-BH2102-C00365	4.08	4.14	-	SANDSTONE																												0.01	0.00				
330-01-BH2102	330-01-BH2102-C00420	4.20	5.00	-	MUDSTONE																								68.5	15.5									
330-01-BH2102	330-01-BH2102-C01020	10.20	11.00	-	SANDSTONE																														7.430			
330-01-BH2102	330-01-BH2102-C01020	10.24	10.38	-	SANDSTONE																										41.20	24.700	0.030						
330-01-BH2102	330-01-BH2102-C01020	10.38	10.45	-	SANDSTONE																												1.76	0.73				
330-01-BH2102	330-01-BH2102-C01020	10.45	10.52	-	SANDSTONE																												1.37	1.90				
330-01-BH2102	330-01-BH2102-C01020	10.52	10.60	-	SANDSTONE																												1.37	0.69				
330-01-BH2102	330-01-BH2102-C01020	10.60	10.69	-	SANDSTONE																												1.41	1.36				
330-01-BH2102	330-01-BH2102-C01020	10.69	10.78	-	SANDSTONE																												1.14	1.31				
330-01-BH2102	330-01-BH2102-C02046	20.50	20.60	-	MUDSTONE																												0.54	0.17				
330-01-BH2102	330-01-BH2102-C02046	20.60	20.68	-	MUDSTONE																												0.50	0.03				
330-01-BH2102	330-01-BH2102-C02046	20.68	20.76	-	MUDSTONE																												0.21	0.15				
330-01-BH2102	330-01-BH2102-C02046	20.76	20.85	-	MUDSTONE																												0.40	0.05				
330-01-BH2102	330-01-BH2102-C02046	20.85	20.95	-	MUDSTONE																												0.45	0.18				
330-01-BH2103	330-01-BH2103-S00050	0.50	0.95	CL	Sandy CLAY	7.3	35	14	21	11.5			54	22	17	7	46	0	0	0	0				20	<10	7.7	6											
330-01-BH2103	330-01-BH2103-S00350	3.50	3.95	CL	Sandy CLAY	13.8	33	15	18	9.5			36	15	25	16	56	1	7	0	8				20	<10	8.4	3											
330-01-BH2103	330-01-BH2103-U00600	6.00	6.29	CI	CLAY	23.8	50	20	30	13.0			78	13	6	3	22	0	0	0	0				140	<10	5.4	4											
330-01-BH2103	330-01-BH2103-C01700	17.00	17.15	-	SANDSTONE																										6.89	0.389	0.105						
330-01-BH2103	330-01-BH2103-C01700	17.15	17.38	-	SANDSTONE																												0.35	0.12				
330-01-BH2103	330-01-BH2103-C01738	17.38	17.60	-	SANDSTONE																																	
330-01-BH2103	330-01-BH2103-C01800	18.00	18.13	-	SANDSTONE																												0.30	0.21				
330-01-BH2103	330-01-BH2103-C01920	19.42	19.55	-	SANDSTONE																												0.17	0.16				
330-01-BH2103	330-01-BH2103-C01920	19.55	19.70	-	SANDSTONE																										3.53	0.321	0.098						
330-01-BH2103	330-01-BH2103-C02175	21.75	21.85	-	SILTSTONE																												0.20	0.16				
330-01-BH2103	330-01-BH2103-C02175	21.85	22.00	-	SILTSTONE																										3.98	0.329	0.106						
330-01-BH2103	330-01-BH2103-C02260	22.73	22.85	-	SANDSTONE																										3.52	0.283	0.232						
330-01-BH2103	330-01-BH2103-C02285	22.90	23.00	-	SANDSTONE																												0.44	0.15				
330-01-BH2103	330-01-BH2103-C02555	27.12	27.30	-	SANDSTONE																										5.63	1.180	0.087						
330-01-BH2103	330-01-BH2103-C02555	27.30	27.40	-	SANDSTONE																												1.24	0.66				
330-01-BH2103	330-01-BH2103-C02800	28.00	28.10	-	SANDSTONE																												0.40	0.44				
330-01-BH2103	330-01-BH2103-C02800	28.00	28.30	-	SANDSTONE																																	
330-01-BH2104	330-01-BH2104-S00050	0.50	0.95	CL	Sandy CLAY	9.3	32	16	16	6.5			47	22	25	6	53	0	0	0	0				<10	<10	6.9	6											
330-01-BH2104	330-01-BH2104-S00350	3.50	3.94	CL	Sandy CLAY	11.6	35	16	19	10.5			46	21	24	7	52	2	0	0	2				10	30	8.2												
330-01-BH2104	330-01-BH2104-S00800	8.00	8.45	CH	CLAY	20.1	58	23	35	16.5			98	1	1	0	2	0	0	0	0				40	260	9												
330-01-BH2104	330-01-BH2104-C01600	16.00	16.35	-	SANDSTONE																										3.04	0.087	0.406						
330-01-BH2104	330-01-BH2104-C01600	16.00	16.11	-	SANDSTONE																												0.26	0.20				
330-01-BH2104	330-01-BH2104-C01965	19.65	20.00	-	SANDSTONE																										1.91	0.067	0.471						
330-01-BH2104	330-01-BH2104-C01965	19.74	19.86	-	SANDSTONE																												0.34	0.32				
330-01-BH2104	330-01-BH2104-C02000	20.00	20.15	-	SANDSTONE																																	
330-01-BH2104	330-01-BH2104-C02152	21.52	22.10	-	SANDSTONE																										5.38	1.190	0.006						
330-01-BH2104	330-01-BH2104-C02152	21.86	21.96	-	SANDSTONE / CONGLOMERATE																												0.22	0.11				
330-01-BH2104	330-01-BH2104-C02346	23.46	23.59	-	SILTSTONE																												0.24	0.28				
330-01-BH2104	330-01-BH2104-C02492	24.92	25.00	-	SANDSTONE																																	
330-01-BH2104	330-01-BH2104-C02505	25.05	25.20	-	SANDSTONE																										31.50	16.800	0.099						
330-01-BH2104	330-01-BH2104-C02520	25.22	25.34	-	SANDSTONE																												0.33	1.42				
330-01-BH2104	330-01-BH2104-C02545	25.45	25.58	-	SANDSTONE																										17.70	18.900	0.062						
330-01-BH2104	330-01-BH2104-C02700	27.00	27.40	-	SANDSTONE																										12.50	1.560	0.378						
330-01-BH2104	330-01-BH2104-C02700	27.15	27.29	-	SANDSTONE																												1.42	0.75				
330-01-BH2104	330-01-BH2104-C03000	30.00	30.15	-	SILTSTONE																										14.60	1.370	0.100						
330-01-BH2104	330-01-BH2104-C03000	30.15	30.25	-	SILTSTONE																												0.77	0.42				
330-01-BH2203	330-01-BH2203-S00350	3.50	3.95	SC	Clayey SAND	10.8	22	13	9	3.0			19	13	39	27	79	2	0	0	2																		
330-01-BH2203	330-01-BH2203-S00500	5.00	5.45	CL	Sandy CLAY	15.9	31	12	19	10.0			47	15	27	9	51	2	0	0	2																		
330-01-BH2203	330-01-BH2203-S00650	6.50	6.90	SW	SAND																				<10	10	6.8												
330-01-BH2203	330-01-BH2203-S00950	9.50	9.77	SW	Gravelly SAND																				10	<10	6.5												
330-01-BH2203	330-01-BH2203-S01100	11.00	11.29	SW	Gravelly SAND																				10	<10	5.9												
330-01-BH2203	330-01-BH2203-C01500	15.00	16.00	-	SANDSTONE																										9.65	1.300	0.083	0.28	0.18				
330-01-BH2203	330-01-BH2203-C01650	16.50	17.50	-	CONGLOMERATE																										26.60	6.350	0.125	0.43	0.05				
330-01-BH2203	330-01-BH2203-C01850	18.50	19.00	-	CONGLOMERATE																												0.23	0.13				
330-01-BH2203	330-01-BH2203-C01950	19.50	20.00	-	CONGLOMERATE																										21.40	4.570	0.069						
330-01-BH2203	330-01-BH2203-C02000	20.00	20.50	-	CONGLOMERATE																												2	2.24				
330-01-BH2203	330-01-BH2203-C02200	22.00	23.00	-	SANDSTONE																										6.66	0.726	0.093	0.29	0.19				
330-01-BH2207	330-01-BH2207-S00050	0.50	0.95	SC	Clayey SAND	3.9	20	9	11	5.5			30	10	24	28	62	8	0	0	8				10	<10	5.8												
330-01-BH2207	330-01-BH2207-S00500	5.00	5.45	CL-CI	Sandy CLAY	10.0	35	14	21	10.0			38	20	35	7	62	0	0	0	0																		
330-01-BH2207	330-01-BH2207-S00650	6.50	6.65	CL-CI	Sandy CLAY																				40	220	9.6												
330-01-BH2207	330-01-BH2207-S00950	9.50	9.76	CL-CI	Sandy CLAY																				20	440	8.8												
330-01-BH2207	330-01-BH2207-C01150	11.50	12.00	-	SANDSTONE																												0.3	0.43				
330-01-BH2207	330-01-BH2207-C01200	12.00	12.50	-	SANDSTONE																										4.04	1.340	0.061						
330-01-BH2207	330-01-BH2207-C01350	13.50	14.00	-	SANDSTONE																												0.15	0.06				
330-01-BH2207	330-01-BH2207-C01400	14.00	14.50	-	SANDSTONE																										4.12	0.937	0.026						
330-01-BH2207	330-01-BH2207-C01550	15.50	16.00	-	SANDSTONE																												1.76	1.36				
330-01-BH2207	330-01-BH2207-C01650	16.50	17.00	-	SANDSTONE																												0.45	0.23				
330-01-BH2207	330-01-BH2207-C01700	17.00	17.50	-	SANDSTONE																										5.29	0.245	0.143						
330-01-BH2207	330-01-BH2207-C01950	19.50	20.00	-	SANDSTONE																												1.56	0.73				
330-01-BH2207	330-01-BH2207-C01950	20.00	20.50	-	SANDSTONE																										17.2	1.26	0.066						
330-01-BH2212	330-01-BH2212-S00050	0.50	0.95	CH	CLAY																				130	220	9.0												

Summary of Laboratory Results [1]

Borehole	Sample ID	Depth (m)		USC	Material Description	Moisture Content	Plasticity				Grading										Shrink Swell			Aggressivity			Emerson	Slake Durability		Uniaxial Compressive Strength & Deformation[2]			Point Load		Brazilian Test	Particle Density	Degradation Factor	Aggregate Crushing Value
							LL	PL	PI	LS	Clay	Silt	Clay/Silt	Sand			Sand	Gravel			Gravel	Swell	Shrinkage	Shrink Swell Index	Soluble Sulfate	Chloride	pH	Class number	1st Cycle	2nd Cycle	UCS	Young's Modulus (Tangent)	Poisson Ratio (Tangent)	Axial Is(50)	Diametral Is(50)				
		From	To			%	%	%	%	%	2um	60um	%	fine	med	coarse	%	fine	med	coarse	%	%	%	%	mg/kg	mg/kg	-	-	%	%	MPa	GPa	-	MPa	MPa	MPa	t/m^3	-	%
330-01-BH2212	330-01-BH2212-S00200	2.00	2.45	CH	CLAY	24.6	58	21	37	17.0			74	13	8	5	26	0	0	0	0																	
330-01-BH2212	330-01-BH2212-S00500	5.00	5.45	CH	CLAY	38.2	95	23	72	21.5			97	1	1	1	3	0	0	0	0																	
330-01-BH2212	330-01-BH2212-S00650	6.50	6.95	CH	CLAY																				20	920	9.2											
330-01-BH2212	330-01-BH2212-S01100	11.00	11.45	CH	CLAY	29.6	97	20	77	21.5			96	1	2	1	4	0	0	0	0																	
330-01-BH2212	330-01-BH2212-S02300	23.00	23.21	SW	SAND																				<10	70	9.7											
330-01-BH2212	330-01-BH2212-C02460	24.60	24.70	-	SANDSTONE																													0.72	0.74				
330-01-BH2212	330-01-BH2212-C02470	24.70	24.80	-	SANDSTONE																										8.28	1.400	0.047						
330-01-BH2212	330-01-BH2212-C02520	25.20	25.30	-	SANDSTONE																													0.11	0.1				
330-01-BH2216	330-01-BH2216-S00200	2.00	2.45	CH	CLAY	34.1	101	22	79	25.5			97	1	1	0	2	1	0	0	1				130	2870	8.8											
330-01-BH2216	330-01-BH2216-S00350	3.50	3.96	CH	CLAY																	0.1	2.6	1.5													
330-01-BH2216	330-01-BH2216-U00650	6.50	6.99	CH	Sandy CLAY																																SEE REPORT		
330-01-BH2216	330-01-BH2216-S00800	8.00	8.45	CH	CLAY	31.4	106	21	85	19.5			97	1	2	0	3	0	0	0	0																	
330-01-BH2216	330-01-BH2216-S01100	11.00	11.45	CH	Sandy CLAY																				10	400	8.9											
330-01-BH2216	330-01-BH2216-U01250	12.50	12.99	CH	Sandy CLAY																																SEE REPORT		
330-01-BH2216	330-01-BH2216-S01400	14.00	14.45	CL	Sandy CLAY	19.9	24	13	11	5.0			35	32	32	1	65	0	0	0	0																	
330-01-BH2216	330-01-BH2216-S01700	17.00	17.45	CI	Sandy CLAY																				<10	540	8.6											
330-01-BH2224	330-01-BH2224-S00350	3.50	3.95	CH	CLAY																				<10	10	8.7											
330-01-BH2224	330-01-BH2224-U00500	5.00	5.42	CH	CLAY	25.7	56	22	34	16.5			82	10	3	1	14	2	2	0	4																	
330-01-BH2224	330-01-BH2224-S00650	6.50	6.95	CH	CLAY																				<10	10	8.7											
330-01-BH2224	330-01-BH2224-S00950	9.50	9.95	SC	Clayey SAND																				<10	10	7.9											
330-01-BH2224	330-01-BH2224-S01100	11.00	11.45	SC	Clayey SAND	19.7	27	17	10	3.5			26	22	50	2	74	0	0	0	0																	
330-01-BH2224	330-01-BH2224-S01400	14.00	14.45	CI	Sandy CLAY	27.7	44	18	26	14.0			58	20	20	2	42	0	0	0	0																	
330-01-BH2224	330-01-BH2224-S01550	15.50	15.95	CL	Sandy CLAY	25.4	29	15	14	6.5			65	20	12	0	32	1	2	0	3																	
330-01-BH2224	330-01-BH2224-S01850	18.50	18.61	SC	Clayey SAND																				<10	20	8.3											
330-01-BH2224	330-01-BH2224-S02000	20.00	20.45	CI	CLAY	19	49	17	32	13.5			96	0	2	1	3	1	0	0	1																	
330-01-BH2224	330-01-BH2224-C02150	21.50	22.00	-	SANDSTONE																													0.44	0.31				
330-01-BH2224	330-01-BH2224-C02200	22.00	22.50	-	SANDSTONE																										6.05	0.492	0.169						
330-01-BH2224	330-01-BH2224-C02350	23.50	24.00	-	SANDSTONE																													6.41	4.27				
330-01-BH2224	330-01-BH2224-C02400	24.00	24.50	-	SANDSTONE																										5.01	3.290	0.026						
330-01-BH2224	330-01-BH2224-C02550	25.50	26.00	-	SANDSTONE																													0.36	0.11				
330-01-BH2224	330-01-BH2224-C02600	26.00	26.50	-	SANDSTONE																										7.04	0.410	0.151						
330-01-BH2227	330-01-BH2227-S00050	0.50	0.95	CH	CLAY																				40	320	8.4											
330-01-BH2227	330-01-BH2227-S00200	2.00	2.45	CH	CLAY	25.8	90	22	68	22.5			88	3	4	3	10	2	0	0	2																	
330-01-BH2227	330-01-BH2227-U00350	3.50	3.90	CH	CLAY	22.9	72	26	46	19.5			92	6	2	0	8	0	0	0	0																	
330-01-BH2227	330-01-BH2227-S00650	6.50	6.95	CH	CLAY																				40	240	9.3											
330-01-BH2227	330-01-BH2227-S00800	8.00	8.45	CH	CLAY	19.5	52	18	34	14.0			73	20	6	1	27	0	0	0	0																	
330-01-BH2227	330-01-BH2227-U01150	11.50	11.95	CH	Sandy CLAY	23.5	52	20	32	14.5			69	19	12	0	31	0	0	0	0																	
330-01-BH2227	330-01-BH2227-S01250	12.50	12.95	CL-CI	Sandy CLAY																				10	80	8.7											
330-01-BH2227	330-01-BH2227-U01400	14.00	14.45	CL-CI	Sandy CLAY	22.6	35	15	20	11.0			55	29	16	0	45	0	0	0	0																	
330-01-BH2227	330-01-BH2227-S01700	17.00	17.27	CI	Sandy CLAY	13.8	40	14	26	11.0			49	25	23	3	51	0	0	0	0																	
330-01-BH2227	330-01-BH2227-S01850	18.50	18.56	CI	Sandy CLAY																				<10	60	8.9											
330-01-BH2301	330-01-BH2301-C00260	2.60	2.70	-	SANDSTONE																													0.24	0.23				
330-01-BH2301	330-01-BH2301-C00330	3.30	3.40	-	SANDSTONE																													0.13	0.03				
330-01-BH2301	330-01-BH2301-C00430	4.30	4.40	-	SANDSTONE																										6.15	0.520	0.074						
330-01-BH2301	330-01-BH2301-C00440	4.40	4.50	-	SANDSTONE																													0.54	0.08				
330-01-BH2301	330-01-BH2301-C00500	5.00	6.00	-	SANDSTONE																							88.9	80.2										
330-01-BH2301	330-01-BH2301-C00560	5.60	5.70	-	SANDSTONE																													1.01	0.78				
330-01-BH2301	330-01-BH2301-C00730	7.30	7.40	-	SANDSTONE																										0.491	0.027	0.126						
330-01-BH2301	330-01-BH2301-C00760	7.60	7.70	-	SANDSTONE																													1.11	0.89				
330-01-BH2301	330-01-BH2301-C00770	7.70	7.80	-	SANDSTONE																										14.70	2.950	0.127						
330-01-BH2301	330-01-BH2301-C01000	10.00	11.00	-	SANDSTONE																							96.4	93.7										
330-01-BH2301	330-01-BH2301-C01130	11.30	11.40	-	SANDSTONE																													1.01	1.08				
330-01-BH2301	330-01-BH2301-C01140	11.40	11.50	-	SANDSTONE																										13.00	1.350	0.058						
330-01-BH2301	330-01-BH2301-C01300	13.00	15.50	-	SANDSTONE																															2.63	2	
330-01-BH2301	330-01-BH2301-C01450	14.50	14.60	-	SANDSTONE																													1.05	1.07				
330-01-BH2301	330-01-BH2301-C01600	16.00	16.10	-	SANDSTONE																													0.83	1.35				
330-01-BH2301	330-01-BH2301-C01780	17.80	17.90	-	SANDSTONE																													1.98	2.25				
330-01-BH2301	330-01-BH2301-C01900	19.00	19.10	-	SANDSTONE																													3.01	1.55				
330-01-BH2301	330-01-BH2301-C02130	21.30	21.40	-	CONGLOMERATE																													5.87	5.67				
330-01-BH2301	330-01-BH2301-C02170	21.66	21.81	-	CONGLOMERATE																										105.00	45.900	0.021						
330-01-BH2301	330-01-BH2301-C02550	25.50	25.60	-	SANDSTONE																													1.17	7.05				
330-01-BH2301	330-01-BH2301-C02930	29.30	29.40	-	CONGLOMERATE																													0.28	0.21				
330-01-BH2301	330-01-BH2301-C03030	30.30	30.40	-	SILTSTONE																													0.89	0.68				
330-01-BH2303	330-01-BH2303-C00240	2.40	2.50	-	SANDSTONE																													6.05	4				
330-01-BH2303	330-01-BH2303-C00250	2.50	2.60	-	SANDSTONE																										45.30	24.900	0.073						
330-01-BH2303	330-01-BH2303-C00340	3.40	4.90	-	SANDSTONE																															2.66	2	
330-01-BH2303	330-01-BH2303-C00500	5.00	6.00	-	SANDSTONE																							98.8	97.9										
330-01-BH2303	330-01-BH2303-C00570	5.70	5.80	-	SANDSTONE																													0.25	0.22				
330-01-BH2303	330-01-BH2303-C00710	7.10	7.20	-	SANDSTONE																													3.52	3.15				
330-01-BH2303	330-01-BH2303-C00720	7.20	7.30	-	SANDSTONE																										37.10	31.800	0.019						
330-01-BH2303	330-01-BH2303-C01000	10.00	11.00	-	SANDSTONE																							97.8	96.7										
330-01-BH2303	330-01-BH2303-C01040	10.40	10.50	-	SANDSTONE																													2.38	1.83				
330-01-BH2303	330-01-BH2303-C01050	10.50	10.60	-	SANDSTONE																										20.40	16.500	0.033						
330-01-BH2303	330-01-BH2303-C01340	13.40	13.50	-	SANDSTONE																													0.93	0.71				
330-01-BH2303	330-01-BH2303-C01470	14.70	14.80	-	SANDSTONE																													2.54	1.18				
330-01-BH2303	330-01-BH2303-C01480	14.80	14.90	-	SANDSTONE																										27.10	13.200	0.052						

Summary of Laboratory Results [1]

Borehole	Sample ID	Depth (m)		USC	Material Description	Moisture Content	Plasticity				Grading										Shrink Swell			Aggressivity			Emerson	Slake Durability		Uniaxial Compressive Strength & Deformation[2]			Point Load		Brazilian Test	Particle Density	Degradation Factor	Aggregate Crushing Value
							LL	PL	PI	LS	Clay	Silt	Clay/Silt	Sand			Sand	Gravel			Gravel	Swell	Shrinkage	Shrink Swell Index	Soluble Sulfate	Chloride	pH	Class number	1st Cycle	2nd Cycle	UCS	Young's Modulus (Tangent)	Poisson Ratio (Tangent)	Axial Is(50)	Diametral Is(50)				
		From	To			%	%	%	%	%	2um	60um	%	fine	med	coarse	%	fine	med	coarse	%	%	%	%	mg/kg	mg/kg	-	-	%	%	MPa	GPa	-	MPa	MPa	MPa	t/m^3	-	%
330-01-BH2303	330-01-BH2303-C01750	17.50	17.60	-	SANDSTONE																													0.39	0.36				
330-01-BH2303	330-01-BH2303-C01870	18.70	18.80	-	SANDSTONE																													1.34	1.66				
330-01-BH2303	330-01-BH2303-C02220	22.20	22.30	-	SANDSTONE																													0.31	0.11				
330-01-BH2303	330-01-BH2303-C02230	22.30	22.40	-	SANDSTONE																											2.19	0.377	0.056						
330-01-BH2306	330-01-BH2306-S00050	0.50	0.95	CH	CLAY	15.0	60	19	41	16.5												8.9	1.6	3.3				2											
330-01-BH2306	330-01-BH2306-C00440	4.40	4.51	-	SANDSTONE																													0.34	0.29				
330-01-BH2306	330-01-BH2306-C00440	4.51	4.67	-	SANDSTONE																											11.90	5.080	5.210						
330-01-BH2306	330-01-BH2306-C00650	6.59	6.72	-	SANDSTONE / SILTSTONE																													0.15	0.82				
330-01-BH2306	330-01-BH2306-C01250	11.00	17.00	-	SANDSTONE																																SEE REPORTS		41.2
330-01-BH2306	330-01-BH2306-C01150	11.54	11.58	-	SANDSTONE																													1.51					
330-01-BH2306	330-01-BH2306-C01150	11.58	11.64	-	SANDSTONE																														0.83				
330-01-BH2306	330-01-BH2306-C01150	11.64	11.79	-	SANDSTONE																											22.40	8.280	8.490						
330-01-BH2306	330-01-BH2306-C01250	12.50	13.00	-	SANDSTONE																									94.8	90.5								
330-01-BH2306	330-01-BH2306-C01500	15.55	15.65	-	SANDSTONE																													0.91	1.28				
330-01-BH2306	330-01-BH2306-C01500	15.65	15.79	-	SANDSTONE																											2.91	0.210	0.179						
330-01-BH2306	330-01-BH2306-C01850	18.79	18.84	-	SANDSTONE																													0.47					
330-01-BH2306	330-01-BH2306-C01850	18.89	18.97	-	SANDSTONE																														0.36				
330-01-BH2306	330-01-BH2306-C01900	19.09	19.23	-	SANDSTONE																													0.13	0.27				
330-01-BH2306	330-01-BH2306-C02100	21.00	21.50	-	SANDSTONE																									90.6	84.4								
330-01-BH2306	330-01-BH2306-C02150	21.58	21.71	-	SANDSTONE																											8.39	2.94	1.86						
330-01-BH2306	330-01-BH2306-C02150	21.71	21.87	-	SANDSTONE																													0.30	0.48				
330-01-BH2306	330-01-BH2306-C02400	23.83	23.97	-	SANDSTONE																											1.67	0.236	0.278						
330-01-BH2306	330-01-BH2306-C02400	24.39	24.51	-	SANDSTONE																													0.90	0.53				
330-01-DH2503	330-01-DH2503-S00050	0.50	0.95	CH	Sandy CLAY	23.5	56	22	34	16.0			70	10	15	4	29	1	0	0	1							5											
330-01-DH2503	330-01-DH2503-S00200	2.00	2.45	CI	Sandy CLAY	15.6	36	17	19	8.0			62	22	15	1	38	0	0	0	0							3											
330-01-DH2503	330-01-DH2503-S00350	3.50	3.95	CI	CLAY	22.9	37	19	18	8.5			71	21	8	0	29	0	0	0	0							5											
330-01-DH2503	330-01-DH2503-U00650	6.50	6.89	CI	Sandy CLAY	15.2	41	14	27	13.5			51	11	28	10	49	0	0	0	0	1.7	3.1	2.2															

Notes:

1.The test results summarised here are quoted verbatim from the laboratory testing reports presented in Appendix D, without interpretation or bias. The Designer should make their own interpretation of the raw data presented on the test reports before deciding whether to accept the results for design purposes.

2. For the UCS testing results, some particular issues that have been noted from observation of the laboratory test reports, which may affect the validity of some of the test results, include:

a. Concave upwards profiles of the axial stress / strain curves for some of the tests;

b. Divergence of the “Axial 1” and “Axial 2” stress / strain curves for some of the tests;

c. Apparent influence of pre-existing plane(s) of weakness in some of the samples; and

d. Poisson’s Ratio results are considered to be generally lower, and in some cases higher, than expected based on our previous experience.

Grading

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

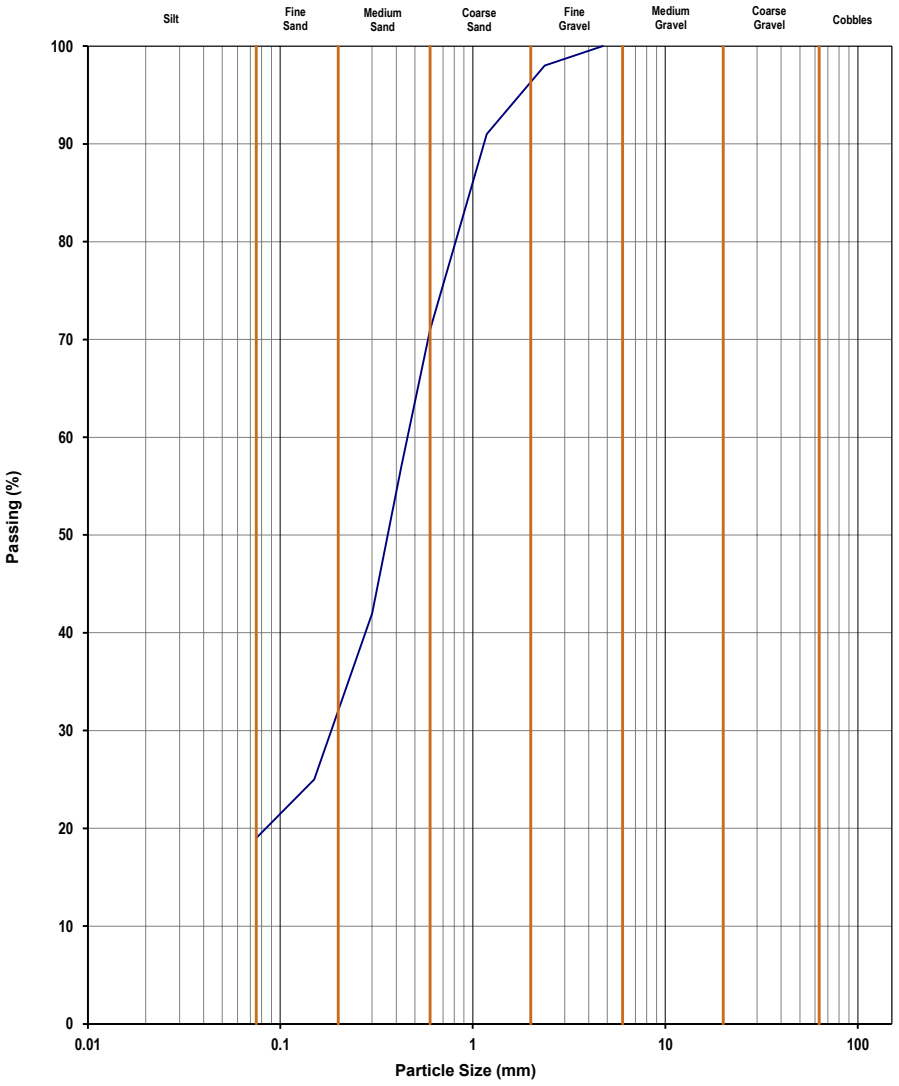
Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Method: AS 1289 3.6.1 , 2.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101403-G
		Request No	1893802_H2C_TR1
Address	PO Box 1734 MILTON BC QLD 4064	**Test Date**	20/11/2018
		Report Date	28/11/2018
Project	Inland Rail Package 13		
Project No	1893802	**Client Sample No**	330-01-BH2203-S00350
Bore Hole	330-01-BH2203	**Depth From (m)** 3.5	**Depth To (m)** 3.95
Description	SPT		

Sieve Size (mm)	Passing %
150.0	
75.0	
63.0	
53.0	
37.5	
26.5	
19.0	
13.2	
9.5	
6.7	
4.75	100
2.36	98
1.18	91
0.600	71
0.425	57
0.300	42
0.150	25
0.075	19



NOTES/REMARKS: -

Moisture Content 10.8%

Sample/s supplied by the client

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory

G. Hamilton

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

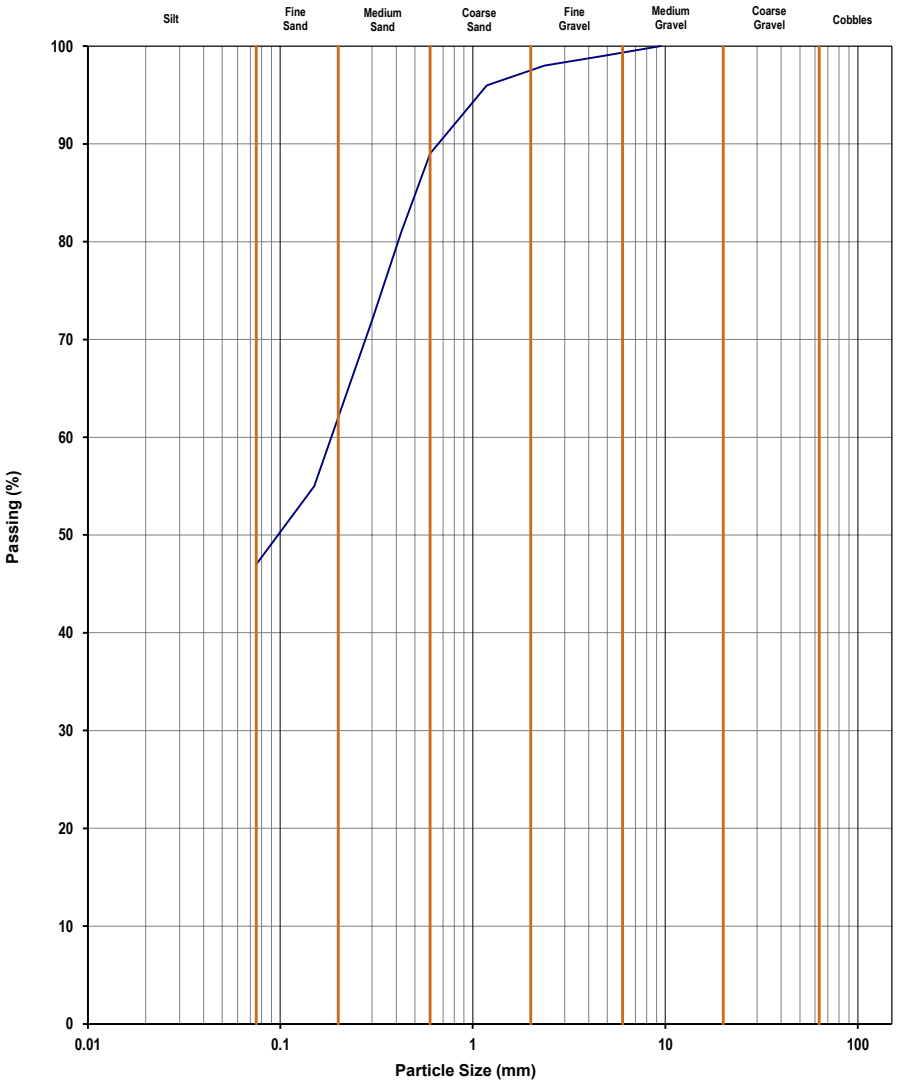
Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Method: AS 1289 3.6.1 , 2.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101404-G
		Request No	1893802_H2C_TR1
Address	PO Box 1734 MILTON BC QLD 4064	**Test Date**	20/11/2018
		Report Date	28/11/2018
Project	Inland Rail Package 13		
Project No	1893802	**Client Sample No**	330-01-BH2203-S00500
Bore Hole	330-01-BH2203	**Depth From (m)** 5	**Depth To (m)** 5.45
Description	SPT		

Sieve Size (mm)	Passing %
150.0	
75.0	
63.0	
53.0	
37.5	
26.5	
19.0	
13.2	
9.5	
6.7	100
4.75	99
2.36	98
1.18	96
0.600	89
0.425	81
0.300	72
0.150	55
0.075	47



NOTES/REMARKS: -

Moisture Content 15.9%

Sample/s supplied by the client

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory
Authorised Signatory
G. Hamilton

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

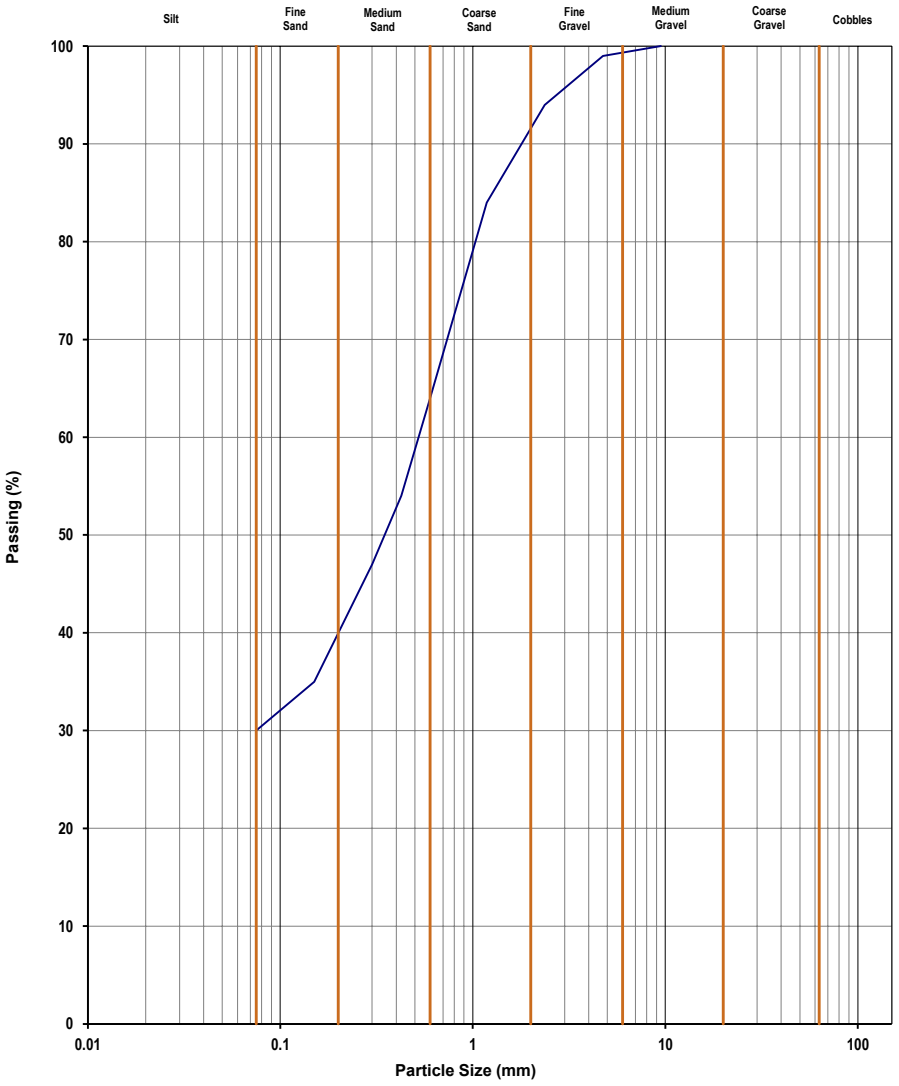
Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Method: AS 1289 3.6.1 , 2.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101419-G
		Request No	1893802_H2C_TR1
Address	PO Box 1734 MILTON BC QLD 4064	**Test Date**	20/11/2018
		Report Date	28/11/2018
Project	Inland Rail Package 13		
Project No	1893802	**Client Sample No**	330-01-BH2207-S00050
Bore Hole	330-01-BH2207	**Depth From (m)** 0.5	**Depth To (m)** 0.95
Description	SPT		

Sieve Size (mm)	Passing %
150.0	
75.0	
63.0	
53.0	
37.5	
26.5	
19.0	
13.2	
9.5	
6.7	100
4.75	99
2.36	94
1.18	84
0.600	64
0.425	54
0.300	47
0.150	35
0.075	30



NOTES/REMARKS: -

Moisture Content 3.9%

Sample/s supplied by the client

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory

G. Hamilton

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

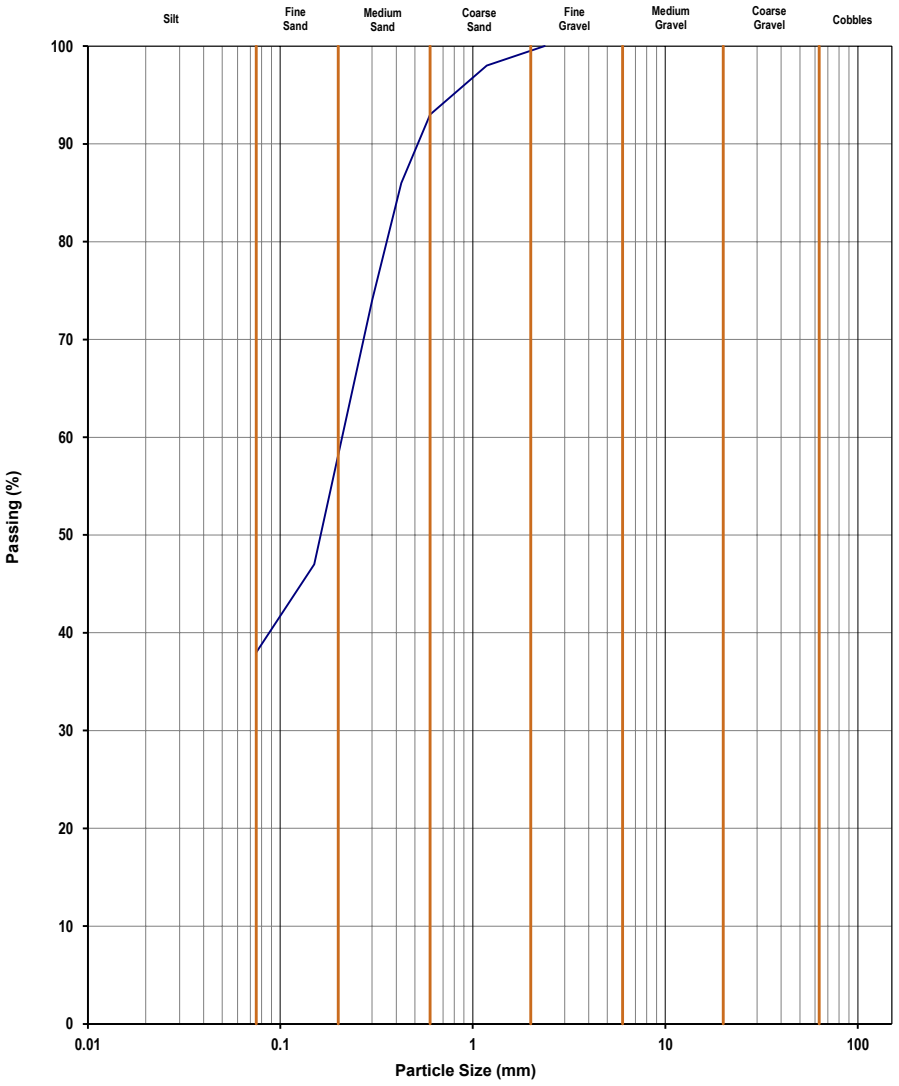
Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Method: AS 1289 3.6.1 , 2.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101422-G
		Request No	1893802_H2C_TR1
Address	PO Box 1734 MILTON BC QLD 4064	**Test Date**	20/11/2018
		Report Date	28/11/2018
Project	Inland Rail Package 13		
Project No	1893802	**Client Sample No**	330-01-BH2207-S00500
Bore Hole	330-01-BH2207	**Depth From (m)** 5	**Depth To (m)** 5.45
Description	SPT		

Sieve Size (mm)	Passing %
150.0	
75.0	
63.0	
53.0	
37.5	
26.5	
19.0	
13.2	
9.5	
6.7	
4.75	
2.36	100
1.18	98
0.600	93
0.425	86
0.300	74
0.150	47
0.075	38



NOTES/REMARKS: -

Moisture Content 10%

Sample/s supplied by the client

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory
Authorised Signatory
G. Hamilton

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

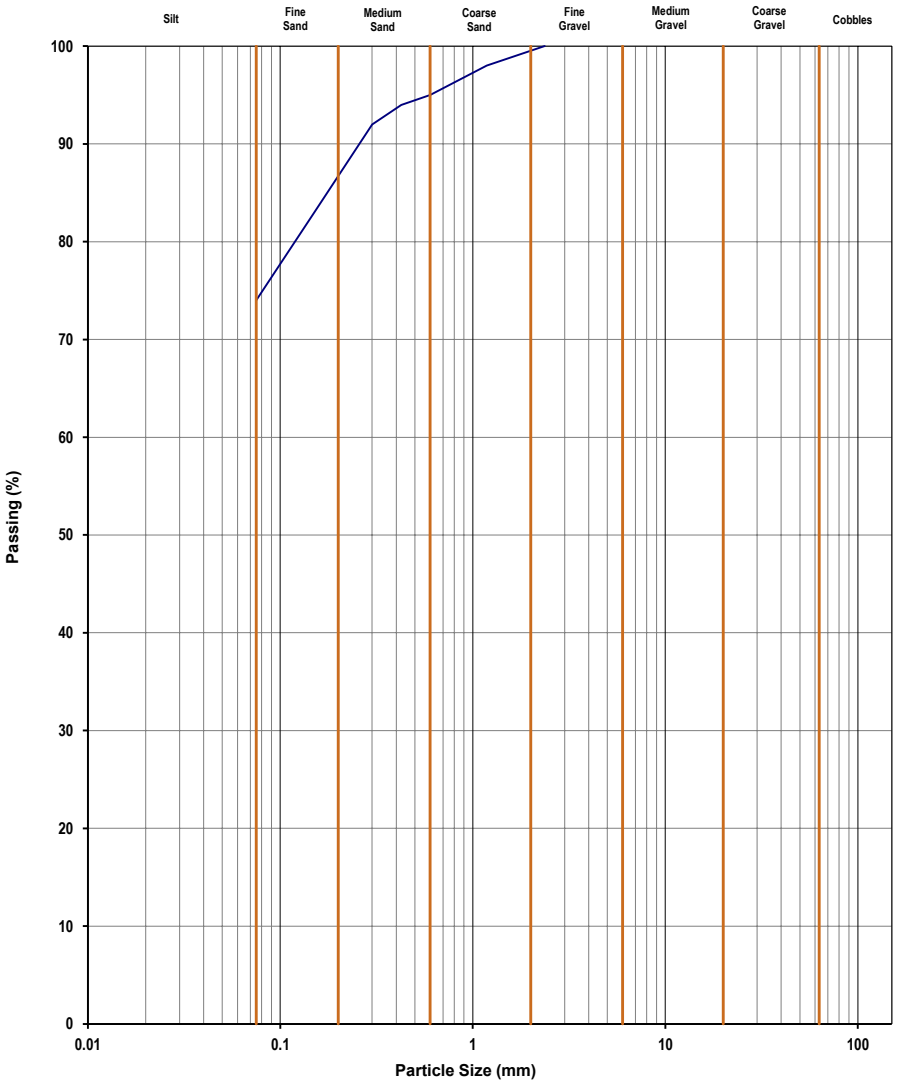
Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Method: AS 1289 3.6.1 , 2.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101437-G
		Request No	1893802_H2C_TR1
Address	PO Box 1734 MILTON BC QLD 4064	**Test Date**	20/11/2018
		Report Date	28/11/2018
Project	Inland Rail Package 13		
Project No	1893802	**Client Sample No**	330-01-BH2212-S00200
Bore Hole	330-01-BH2212	**Depth From (m)** 2	**Depth To (m)** 2.45
Description	SPT		

Sieve Size (mm)	Passing %
150.0	
75.0	
63.0	
53.0	
37.5	
26.5	
19.0	
13.2	
9.5	
6.7	
4.75	
2.36	100
1.18	98
0.600	95
0.425	94
0.300	92
0.150	83
0.075	74



NOTES/REMARKS: -

Moisture Content 24.6%

Sample/s supplied by the client

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory

G. Hamilton

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

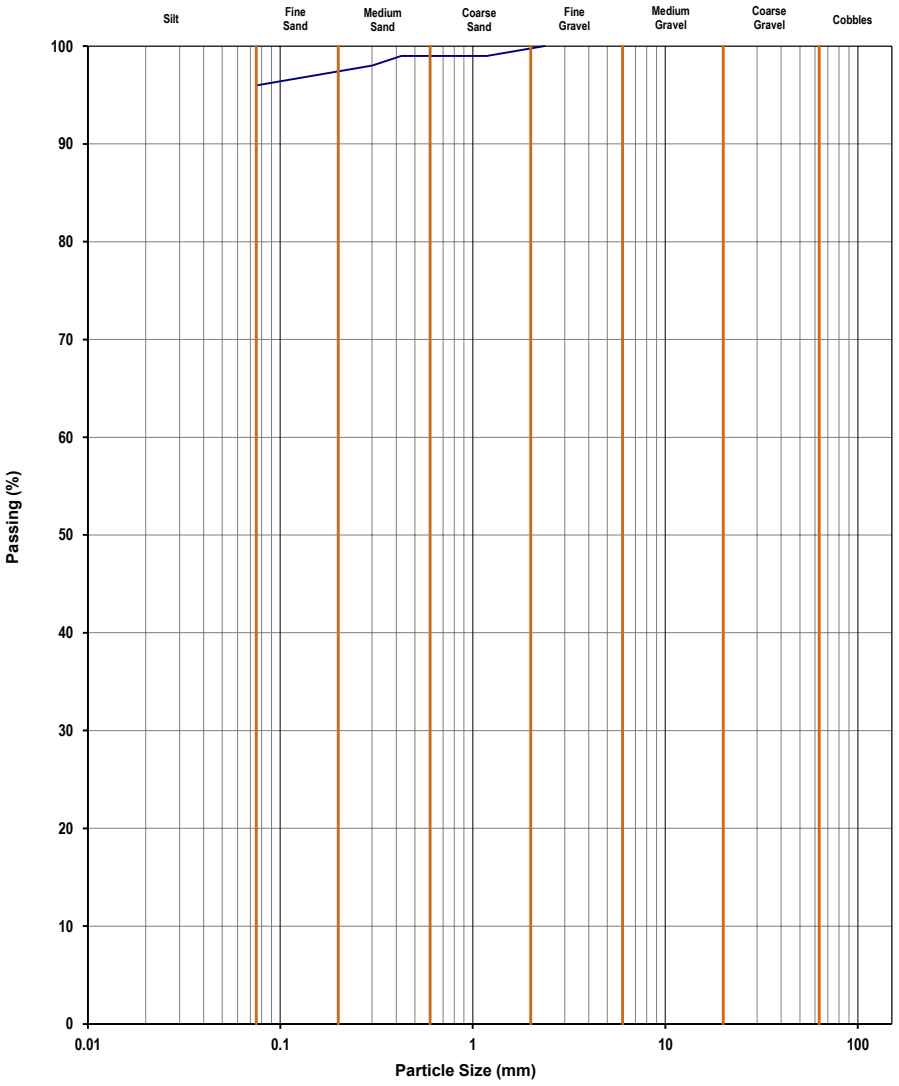
Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Method: AS 1289 3.6.1 , 2.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101443-G
		Request No	1893802_H2C_TR1
Address	PO Box 1734 MILTON BC QLD 4064	**Test Date**	20/11/2018
		Report Date	28/11/2018
Project	Inland Rail Package 13		
Project No	1893802	**Client Sample No**	330-01-BH2212-S01100
Bore Hole	330-01-BH2212	**Depth From (m)** 11	**Depth To (m)** 11.45
Description	SPT		

Sieve Size (mm)	Passing %
150.0	
75.0	
63.0	
53.0	
37.5	
26.5	
19.0	
13.2	
9.5	
6.7	
4.75	
2.36	100
1.18	99
0.600	99
0.425	99
0.300	98
0.150	97
0.075	96



NOTES/REMARKS: -

Moisture Content 29.6%

Sample/s supplied by the client

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory
Authorised Signatory
G. Hamilton

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

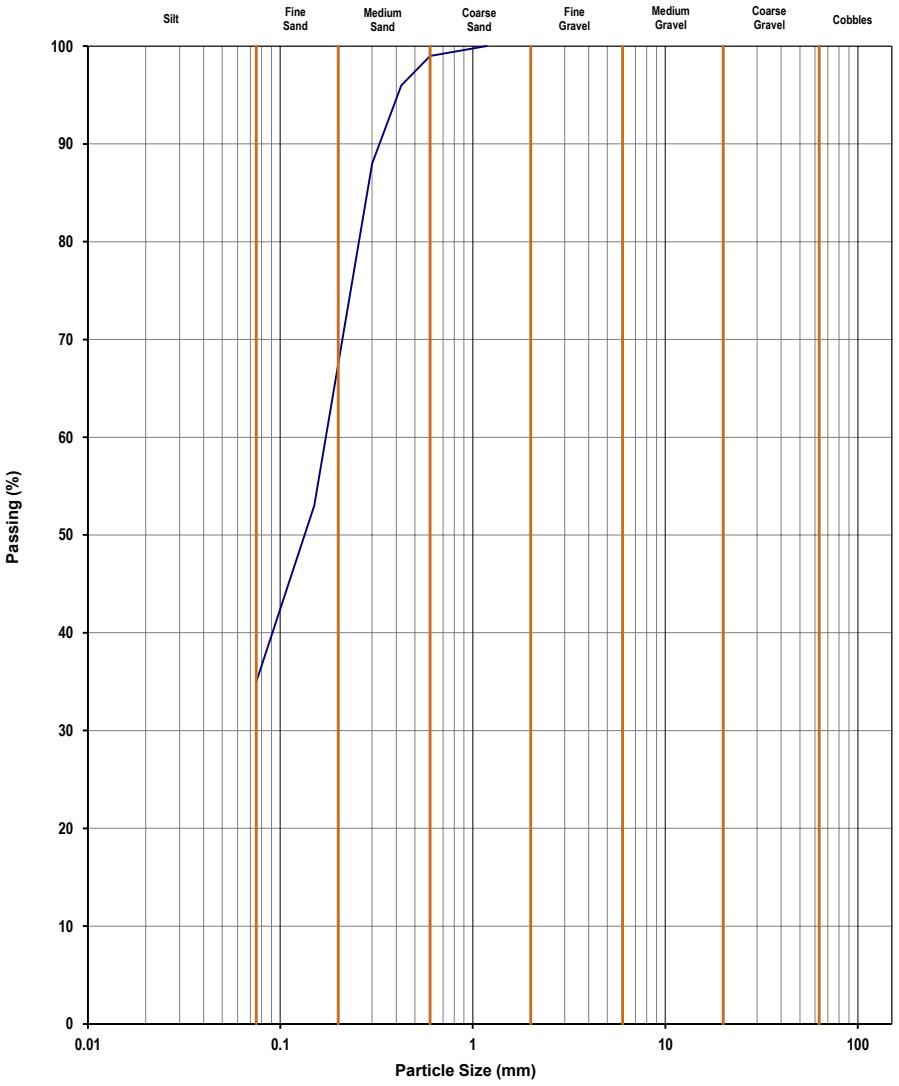
Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Method: AS 1289 3.6.1 , 2.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101464-G
		Request No	1893802_H2C_TR1
Address	PO Box 1734 MILTON BC QLD 4064	**Test Date**	20/11/2018
		Report Date	28/11/2018
Project	Inland Rail Package 13		
Project No	1893802	**Client Sample No**	330-01-BH2216-S01400
Bore Hole	330-01-BH2216	**Depth From (m)** 14	**Depth To (m)** 14.45
Description	SPT		

Sieve Size (mm)	Passing %
150.0	
75.0	
63.0	
53.0	
37.5	
26.5	
19.0	
13.2	
9.5	
6.7	
4.75	
2.36	
1.18	100
0.600	99
0.425	96
0.300	88
0.150	53
0.075	35



NOTES/REMARKS: -

Moisture Content 19.9%

Sample/s supplied by the client

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory
G. Hamilton

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

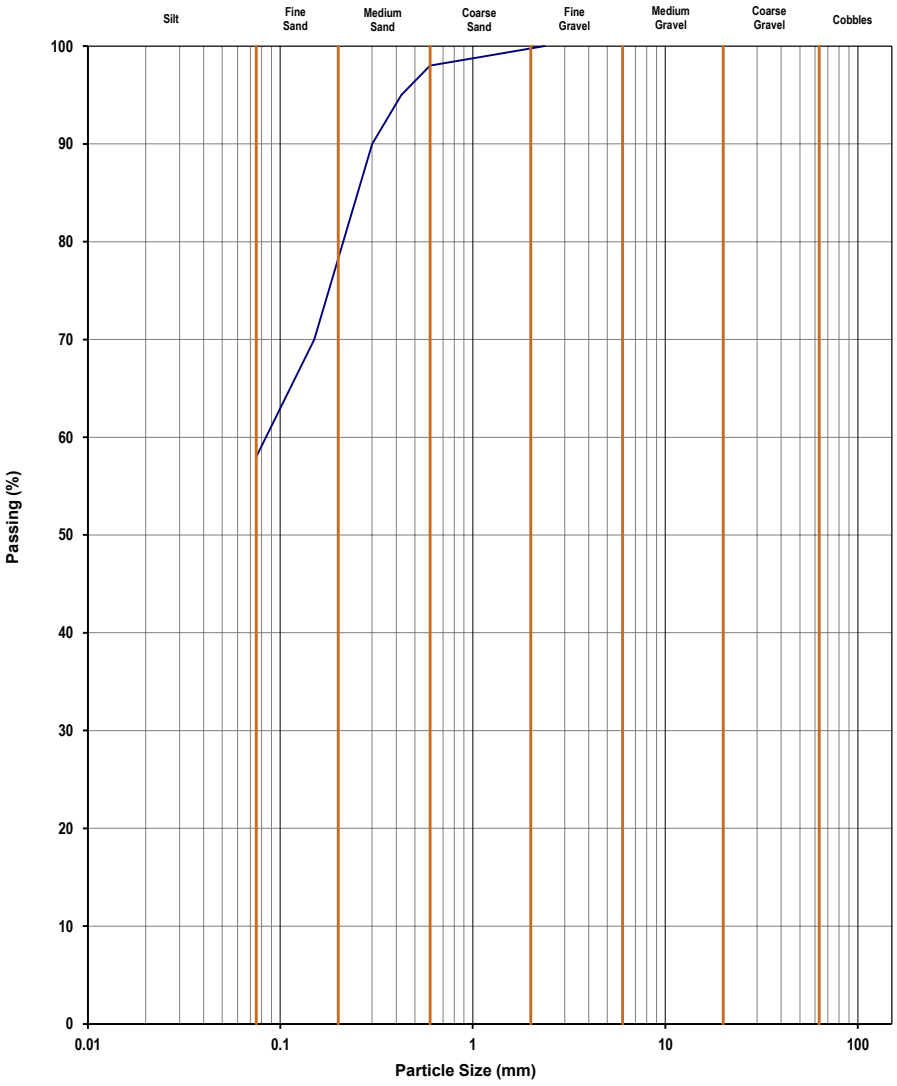
Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Method: AS 1289 3.6.1 , 2.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101480-G
		Request No	1893802_H2C_TR1
Address	PO Box 1734 MILTON BC QLD 4064	**Test Date**	20/11/2018
		Report Date	28/11/2018
Project	Inland Rail Package 13		
Project No	1893802	**Client Sample No**	330-01-BH2224-S01400
Bore Hole	330-01-BH2224	**Depth From (m)** 14	**Depth To (m)** 14.45
Description	SPT		

Sieve Size (mm)	Passing %
150.0	
75.0	
63.0	
53.0	
37.5	
26.5	
19.0	
13.2	
9.5	
6.7	
4.75	
2.36	100
1.18	99
0.600	98
0.425	95
0.300	90
0.150	70
0.075	58



NOTES/REMARKS: -

Moisture Content 27.7%

Sample/s supplied by the client

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory

G. Hamilton

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

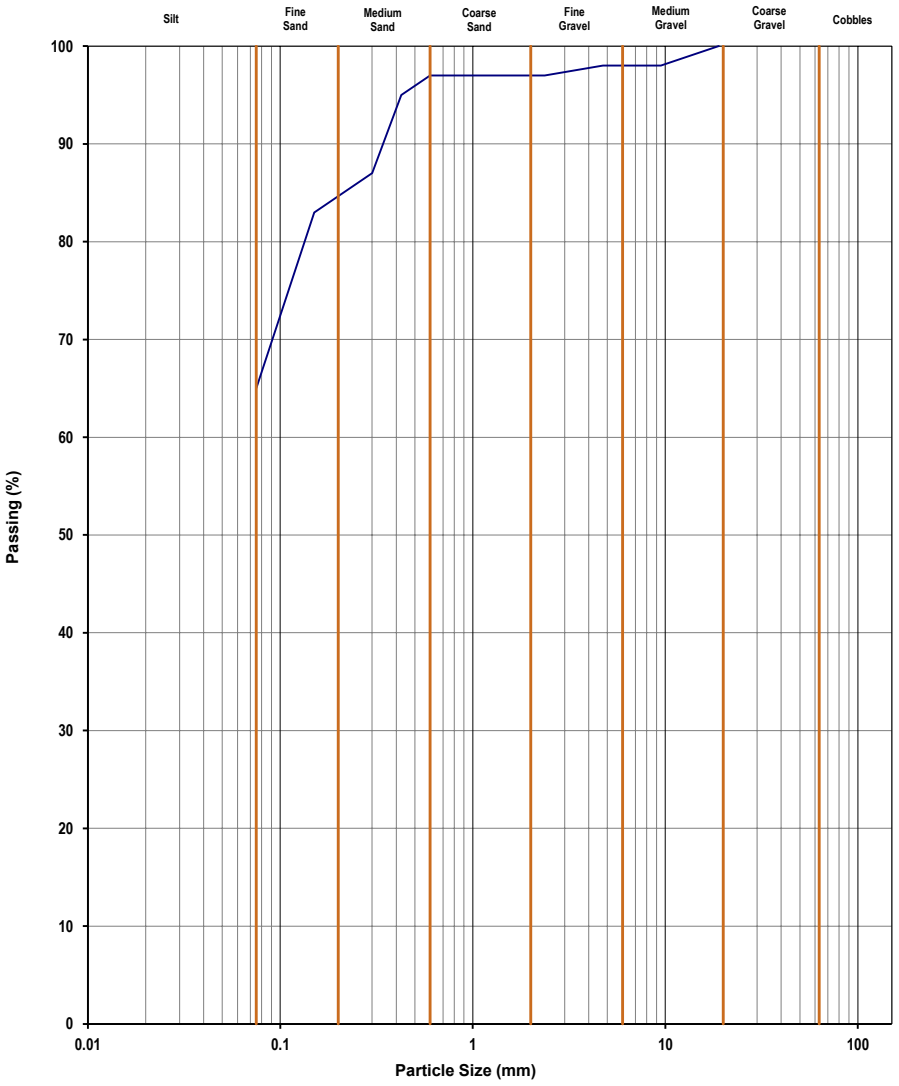
Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Method: AS 1289 3.6.1 , 2.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101481-G
		Request No	1893802_H2C_TR1
Address	PO Box 1734 MILTON BC QLD 4064	**Test Date**	20/11/2018
		Report Date	28//11/18
Project	Inland Rail Package 13		
Project No	1893802	**Client Sample No**	330-01-BH2224-S01550
Bore Hole	330-01-BH2224	**Depth From (m)** 15.5	**Depth To (m)** 15.95
Description	SPT		

Sieve Size (mm)	Passing %
150.0	
75.0	
63.0	
53.0	
37.5	
26.5	
19.0	100
13.2	99
9.5	98
6.7	98
4.75	98
2.36	97
1.18	97
0.600	97
0.425	95
0.300	87
0.150	83
0.075	65



NOTES/REMARKS: -

Moisture Content 25.4%

Sample/s supplied by the client

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory

G. Hamilton

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

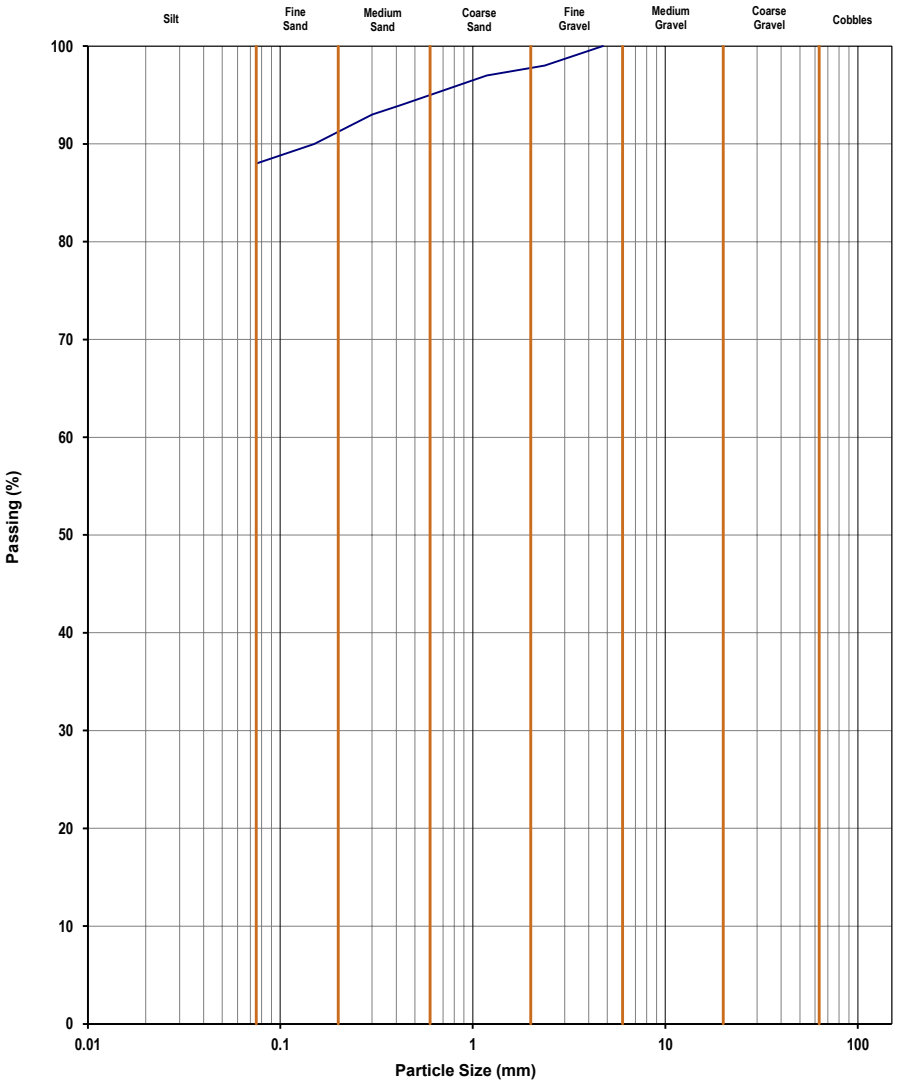
Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Method: AS 1289 3.6.1 , 2.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101492-G
		Request No	1893802_H2C_TR1
Address	PO Box 1734 MILTON BC QLD 4064	**Test Date**	20/11/2018
		Report Date	28/11/2018
Project	Inland Rail Package 13		
Project No	1893802	**Client Sample No**	330-01-BH2227-S00200
Bore Hole	330-01-BH2227	**Depth From (m)** 2	**Depth To (m)** 2.45
Description	SPT		

Sieve Size (mm)	Passing %
150.0	
75.0	
63.0	
53.0	
37.5	
26.5	
19.0	
13.2	
9.5	
6.7	
4.75	100
2.36	98
1.18	97
0.600	95
0.425	94
0.300	93
0.150	90
0.075	88



NOTES/REMARKS: -

Moisture Content 25.8%

Sample/s supplied by the client

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory

G. Hamilton

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

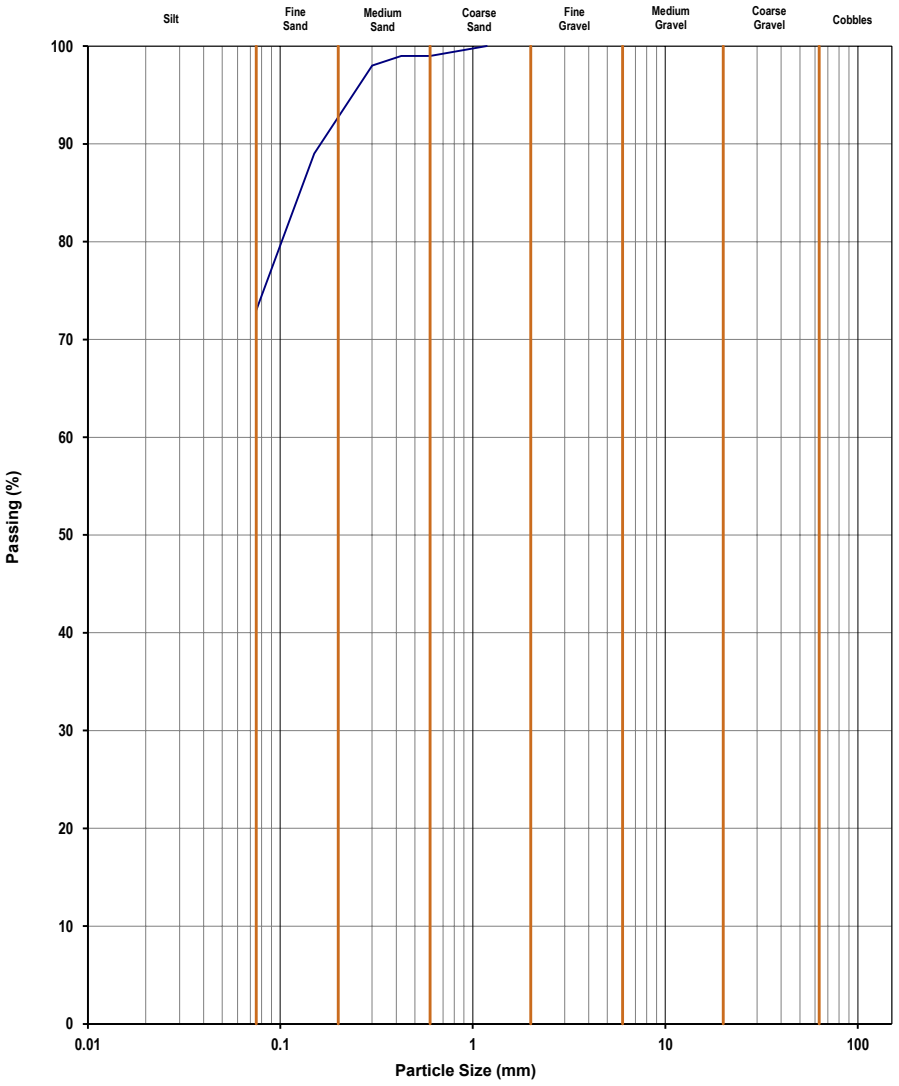
Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Method: AS 1289 3.6.1 , 2.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101496-G
		Request No	1893802_H2C_TR1
Address	PO Box 1734 MILTON BC QLD 4064	**Test Date**	20/11/2018
		Report Date	28/11/2018
Project	Inland Rail Package 13		
Project No	1893802	**Client Sample No**	330-01-BH2227-S00800
Bore Hole	330-01-BH2227	**Depth From (m)** 8	**Depth To (m)** 8.45
Description	SPT		

Sieve Size (mm)	Passing %
150.0	
75.0	
63.0	
53.0	
37.5	
26.5	
19.0	
13.2	
9.5	
6.7	
4.75	
2.36	
1.18	100
0.600	99
0.425	99
0.300	98
0.150	89
0.075	73



NOTES/REMARKS: -

Moisture Content 19.5%

Sample/s supplied by the client

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory
Authorised Signatory
G. Hamilton

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

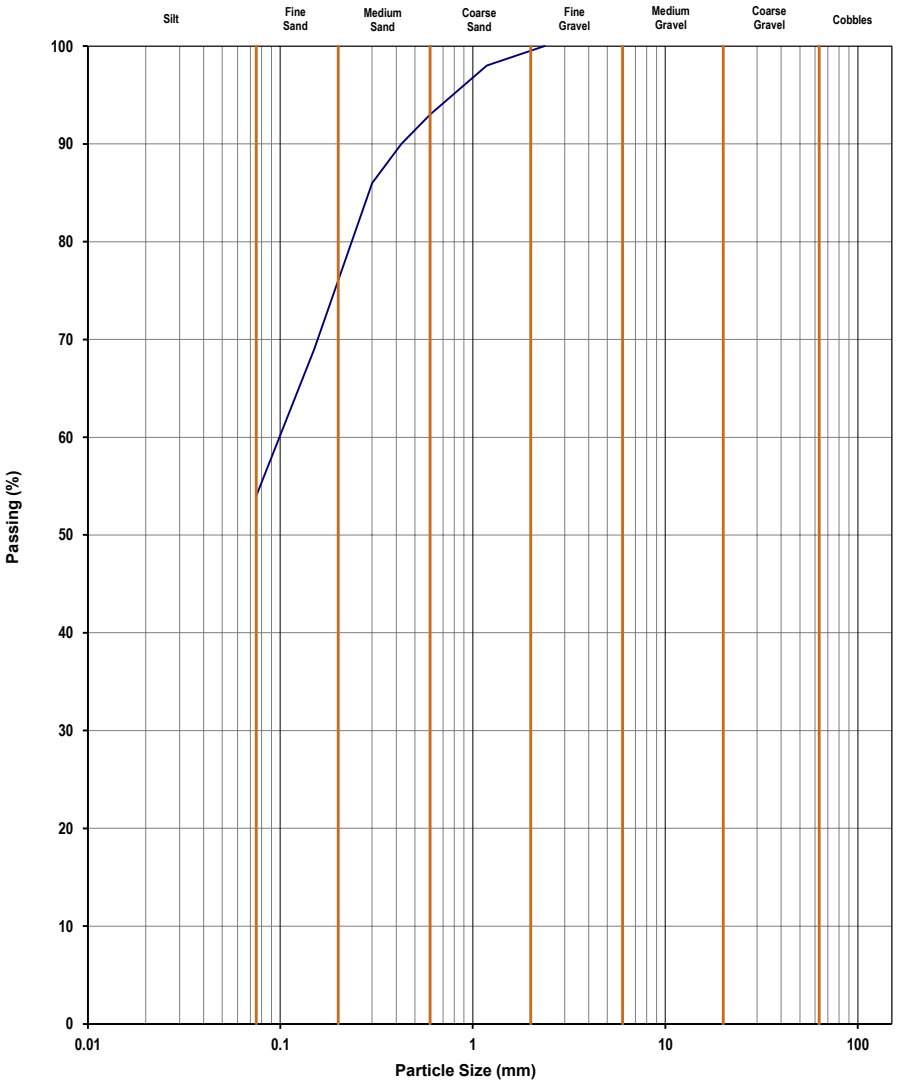
Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Method: AS 1289 3.6.1 , 2.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101713-G
		Request No	1893802_H2C_TR2
Address	PO Box 1734 MILTON BC QLD 4064	**Test Date**	3/12/18-5/12/18
		Report Date	5/12/2018
Project	Inland Rail Package 13		
Project No	1893802	**Client Sample No**	330-01-BH2103-S00050
Bore Hole	330-01-BH2103	**Depth From (m)** 0.5	**Depth To (m)** 0.95
Description	SPT		

Sieve Size (mm)	Passing %
150.0	
75.0	
63.0	
53.0	
37.5	
26.5	
19.0	
13.2	
9.5	
6.7	
4.75	
2.36	100
1.18	98
0.600	93
0.425	90
0.300	86
0.150	69
0.075	54



NOTES/REMARKS: -

Moisture Content 7.3%

Sample/s supplied by the client

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory

G. Hamilton

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

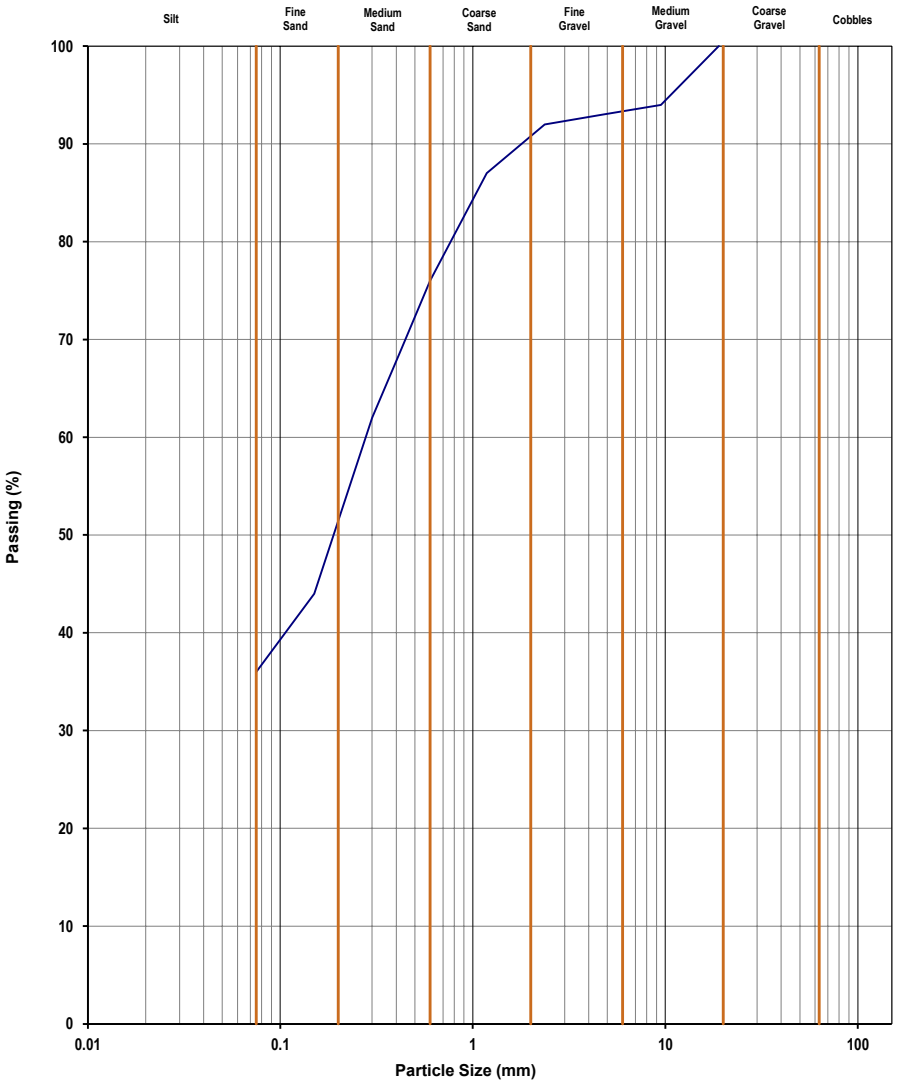
Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Method: AS 1289 3.6.1 , 2.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101715-G
		Request No	1893802_H2C_TR2
Address	PO Box 1734 MILTON BC QLD 4064	**Test Date**	3/12/18-5/12/18
		Report Date	5/12/2018
Project	Inland Rail Package 13		
Project No	1893802	**Client Sample No**	330-01-BH2103-S00350
Bore Hole	330-01-BH2103	**Depth From (m)** 3.5	**Depth To (m)** 3.95
Description	SPT		

Sieve Size (mm)	Passing %
150.0	
75.0	
63.0	
53.0	
37.5	
26.5	
19.0	100
13.2	95
9.5	94
6.7	93
4.75	93
2.36	92
1.18	87
0.600	76
0.425	69
0.300	62
0.150	44
0.075	36



NOTES/REMARKS: -

Moisture Content 13.7%

Sample/s supplied by the client

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory

G. Hamilton

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

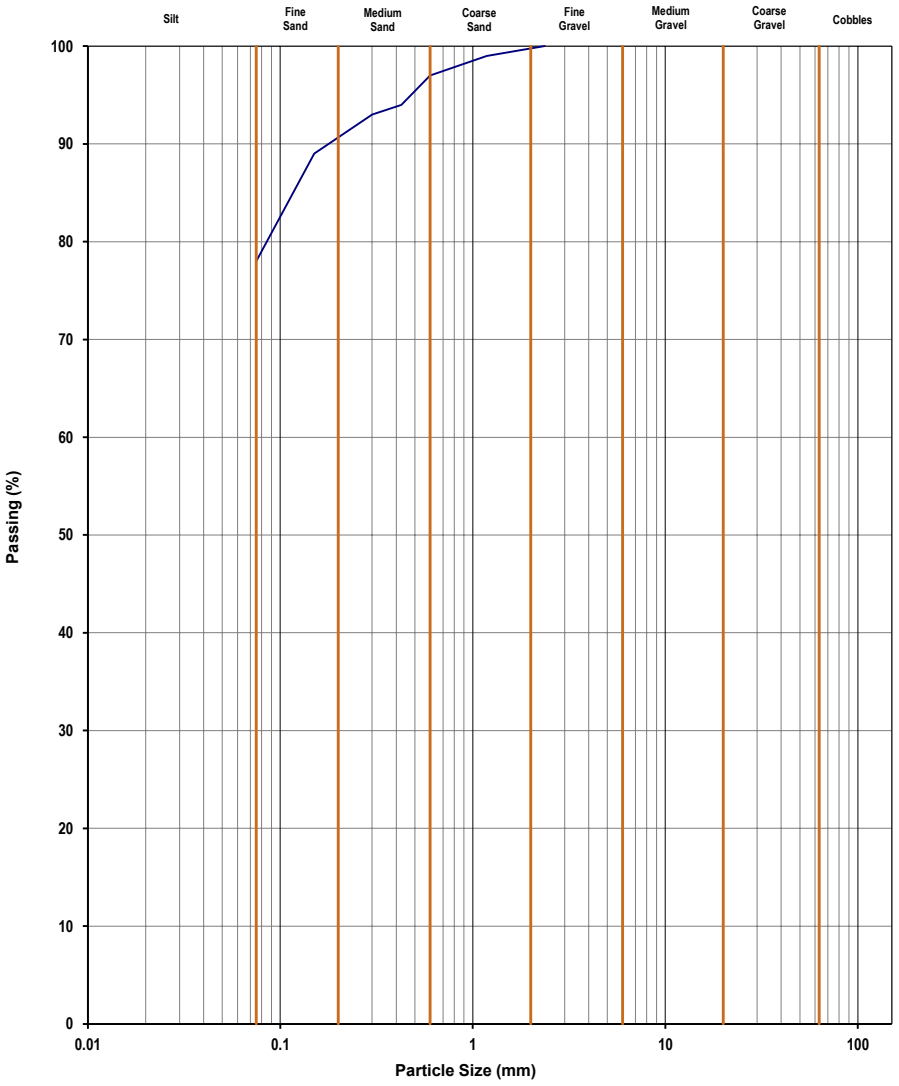
Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Method: AS 1289 3.6.1 , 2.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101717-G
		Request No	1893802_H2C_TR2
Address	PO Box 1734 MILTON BC QLD 4064	**Test Date**	3/12/18-5/12/18
		Report Date	5/12/2018
Project	Inland Rail Package 13		
Project No	1893802	**Client Sample No**	330-01-BH2103-U00600
Bore Hole	330-01-BH2103	**Depth From (m)** 6	**Depth To (m)** 6.29
Description	U		

Sieve Size (mm)	Passing %
150.0	
75.0	
63.0	
53.0	
37.5	
26.5	
19.0	
13.2	
9.5	
6.7	
4.75	
2.36	100
1.18	99
0.600	97
0.425	94
0.300	93
0.150	89
0.075	78



NOTES/REMARKS: -

Moisture Content 23.8%

Sample/s supplied by the client

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory
Authorised Signatory
G. Hamilton

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

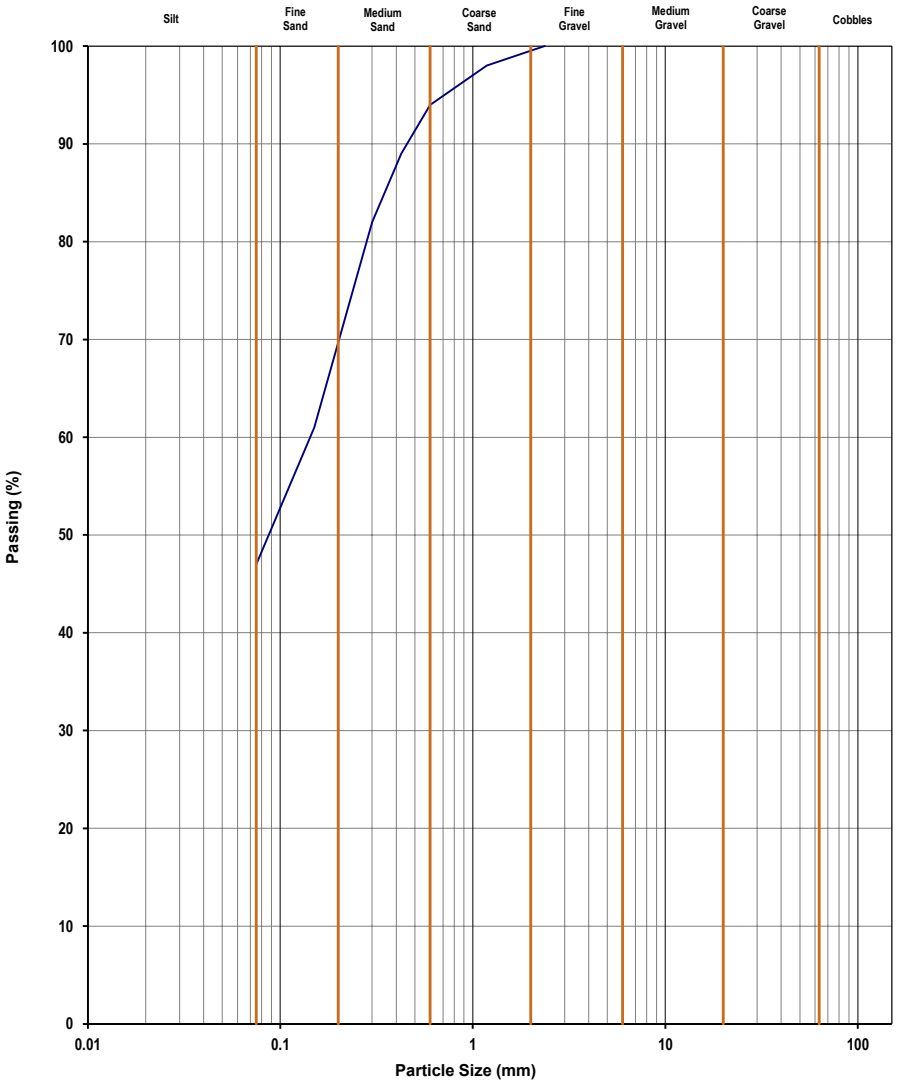
Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Method: AS 1289 3.6.1 , 2.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101740-G
		Request No	1893802_H2C_TR2
Address	PO Box 1734 MILTON BC QLD 4064	**Test Date**	30/11/18-4/12/18
		Report Date	4/12/2018
Project	Inland Rail Package 13		
Project No	1893802	**Client Sample No**	330-01-BH2104-S00050
Bore Hole	330-01-BH2104	**Depth From (m)** 0.5	**Depth To (m)** 0.95
Description	SPT		

Sieve Size (mm)	Passing %
150.0	
75.0	
63.0	
53.0	
37.5	
26.5	
19.0	
13.2	
9.5	
6.7	
4.75	
2.36	100
1.18	98
0.600	94
0.425	89
0.300	82
0.150	61
0.075	47



NOTES/REMARKS: -

Moisture Content 9.3%

Sample/s supplied by the client

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory

G. Hamilton

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

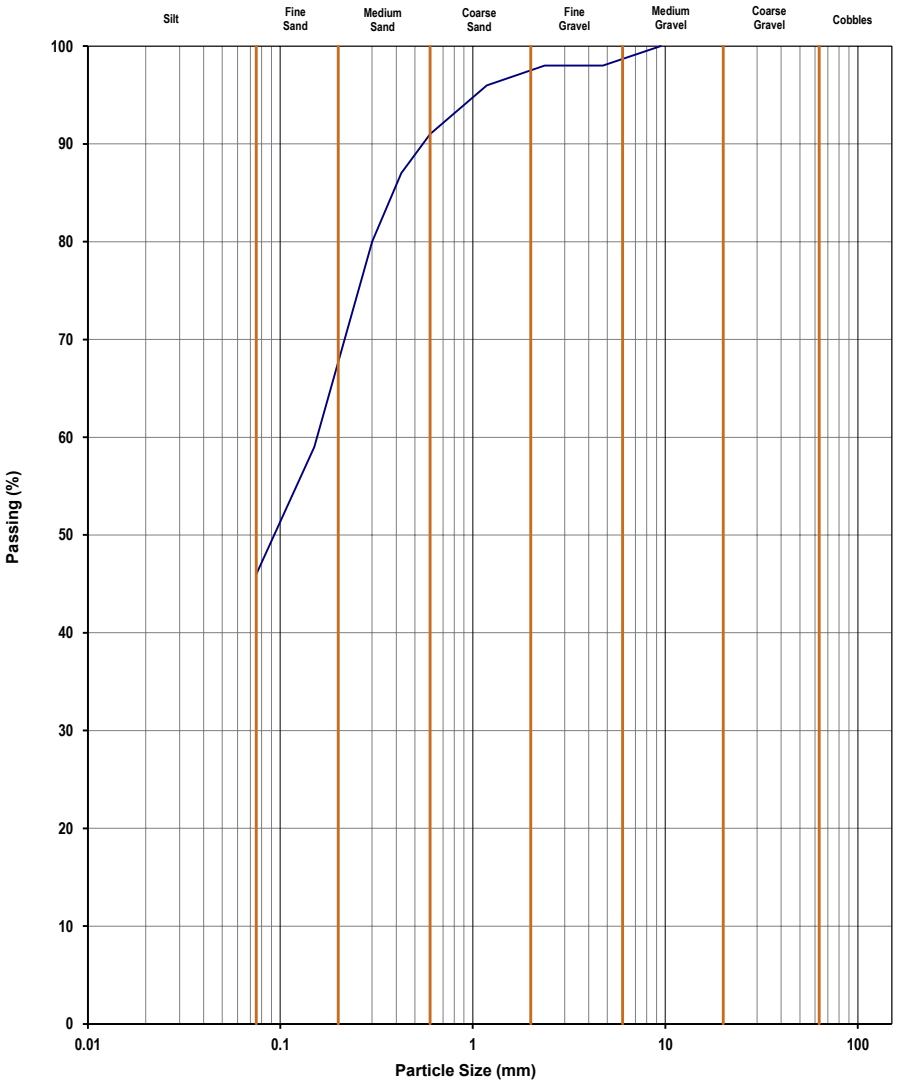
Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Method: AS 1289 3.6.1 , 2.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101742-G
		Request No	1893802_H2C_TR2
Address	PO Box 1734 MILTON BC QLD 4064	**Test Date**	30/12/18-4/12/18
		Report Date	4/12/2018
Project	Inland Rail Package 13		
Project No	1893802	**Client Sample No**	330-01-BH2104-S00350
Bore Hole	330-01-BH2104	**Depth From (m)** 3.5	**Depth To (m)** 3.94
Description	SPT		

Sieve Size (mm)	Passing %
150.0	
75.0	
63.0	
53.0	
37.5	
26.5	
19.0	
13.2	
9.5	
6.7	100
4.75	98
2.36	98
1.18	96
0.600	91
0.425	87
0.300	80
0.150	59
0.075	46



NOTES/REMARKS: -

Moisture Content 11.6%

Sample/s supplied by the client

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory
G. Hamilton

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

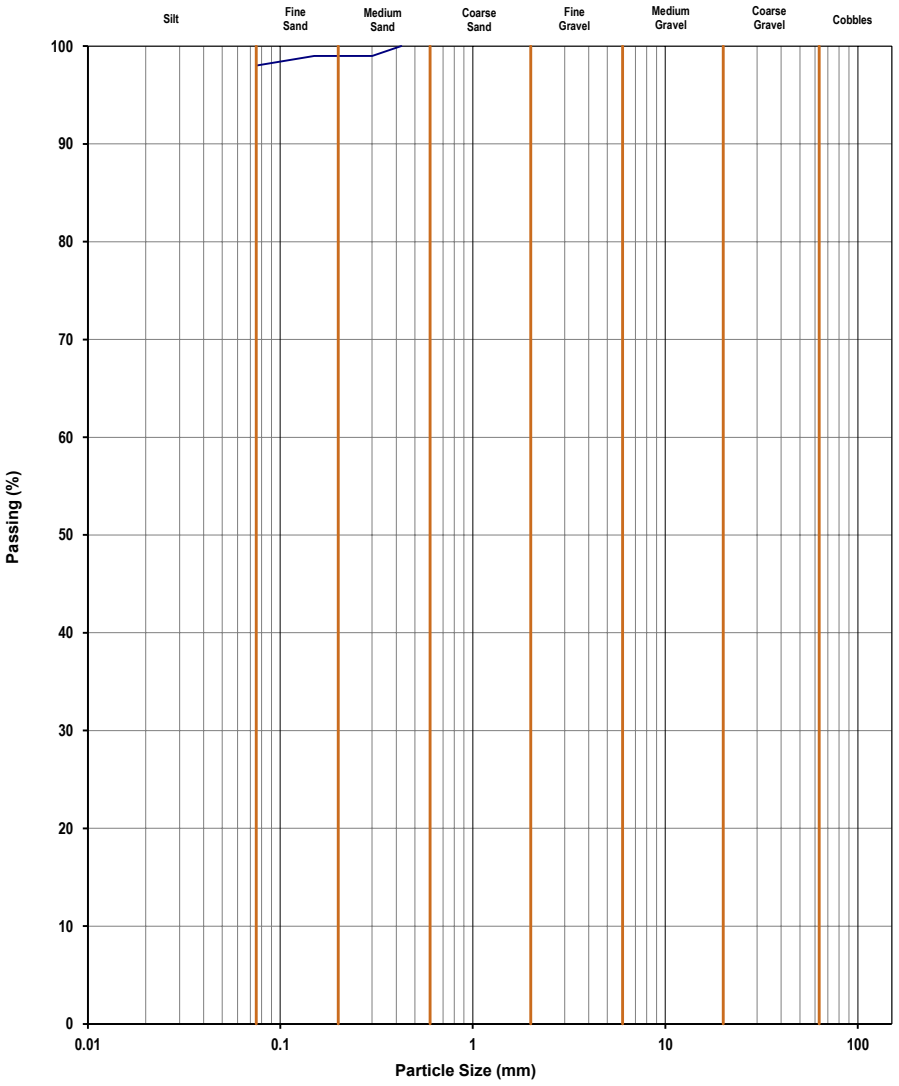
Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Method: AS 1289 3.6.1 , 2.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101745-G
		Request No	1893802_H2C_TR2
Address	PO Box 1734 MILTON BC QLD 4064	**Test Date**	30/11/18-4/12/18
		Report Date	4/12/2018
Project	Inland Rail Package 13		
Project No	1893802	**Client Sample No**	330-01-BH2104-S00800
Bore Hole	330-01-BH2104	**Depth From (m)** 8	**Depth To (m)** 8.45
Description	SPT		

Sieve Size (mm)	Passing %
150.0	
75.0	
63.0	
53.0	
37.5	
26.5	
19.0	
13.2	
9.5	
6.7	
4.75	
2.36	
1.18	
0.600	
0.425	100
0.300	99
0.150	99
0.075	98



NOTES/REMARKS: -

Moisture Content 20.1%

Sample/s supplied by the client

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory
G. Hamilton

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

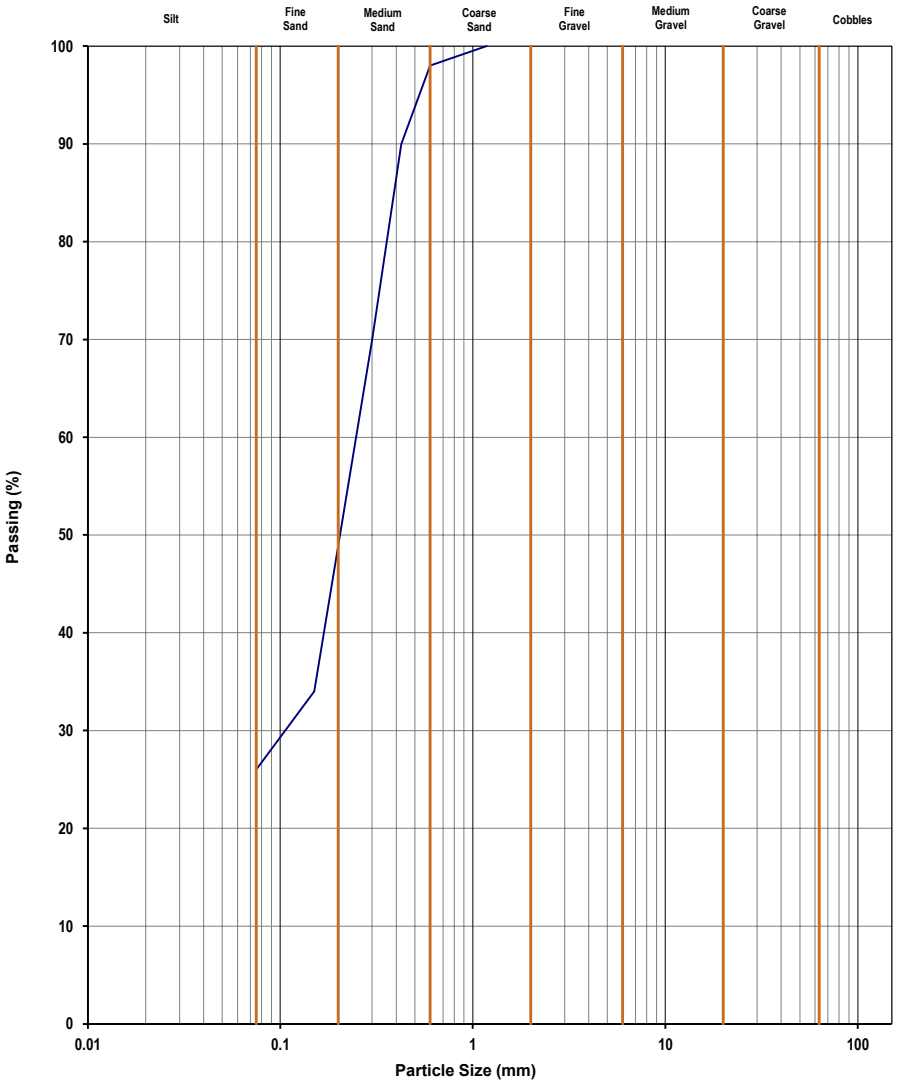
Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Method: AS 1289 3.6.1 , 2.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101478-G
		Request No	1893802_H2C_TR1
Address	PO Box 1734 MILTON BC QLD 4064	**Test Date**	20/11/18-30/11/18
		Report Date	30/11/2018
Project	Inland Rail Package 13		
Project No	1893802	**Client Sample No**	330-01-BH2224-S01100
Bore Hole	330-01-BH2224	**Depth From (m)** 11	**Depth To (m)** 11.45
Description	SPT		

Sieve Size (mm)	Passing %
150.0	
75.0	
63.0	
53.0	
37.5	
26.5	
19.0	
13.2	
9.5	
6.7	
4.75	
2.36	
1.18	100
0.600	98
0.425	90
0.300	70
0.150	34
0.075	26



NOTES/REMARKS: -

Moisture Content 19.7%

Sample/s supplied by the client

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory
G. Hamilton

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

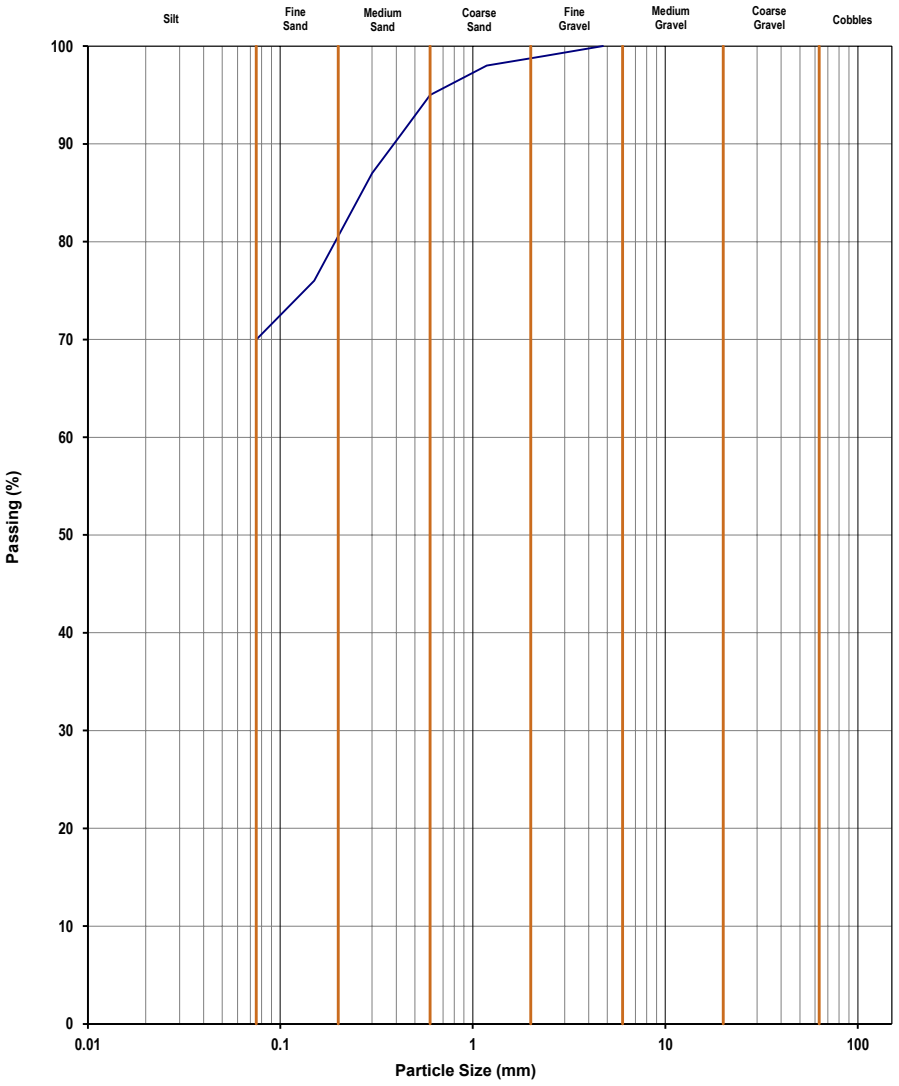
Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Method: AS 1289 3.6.1 , 2.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101568-G
		Request No	1893802_H2C_TR1
Address	PO Box 1734 MILTON BC QLD 4064	**Test Date**	20/11/18-30/11/18
		Report Date	30/11/2018
Project	Inland Rail Package 13		
Project No	1893802	**Client Sample No**	330-01-DH2503-S00050
Bore Hole	330-01-DH2503	**Depth From (m)** 0.5	**Depth To (m)** 0.95
Description	SPT		

Sieve Size (mm)	Passing %
150.0	
75.0	
63.0	
53.0	
37.5	
26.5	
19.0	
13.2	
9.5	
6.7	
4.75	100
2.36	99
1.18	98
0.600	95
0.425	91
0.300	87
0.150	76
0.075	70



NOTES/REMARKS: -

Moisture Content 23.5%

Sample/s supplied by the client

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory
Authorised Signatory
G. Hamilton

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

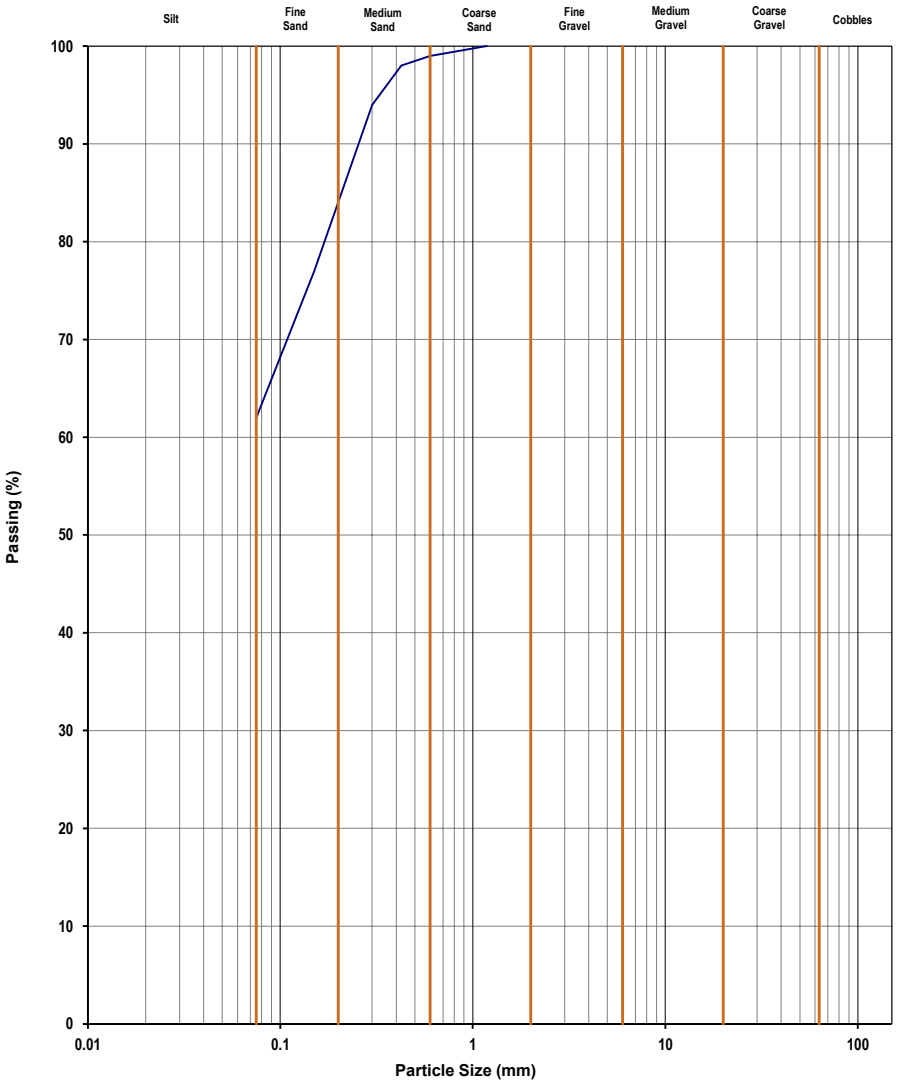
Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Method: AS 1289 3.6.1 , 2.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101569-G
		Request No	1893802_H2C_TR1
Address	PO Box 1734 MILTON BC QLD 4064	**Test Date**	20/11/18-30/11/18
		Report Date	30/11/2018
Project	Inland Rail Package 13		
Project No	1893802	**Client Sample No**	330-01-DH2503-S00200
Bore Hole	330-01-DH2503	**Depth From (m)** 2	**Depth To (m)** 2.45
Description	SPT		

Sieve Size (mm)	Passing %
150.0	
75.0	
63.0	
53.0	
37.5	
26.5	
19.0	
13.2	
9.5	
6.7	
4.75	
2.36	
1.18	100
0.600	99
0.425	98
0.300	94
0.150	77
0.075	62



NOTES/REMARKS: -

Moisture Content 15.6%

Sample/s supplied by the client

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory

G. Hamilton

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

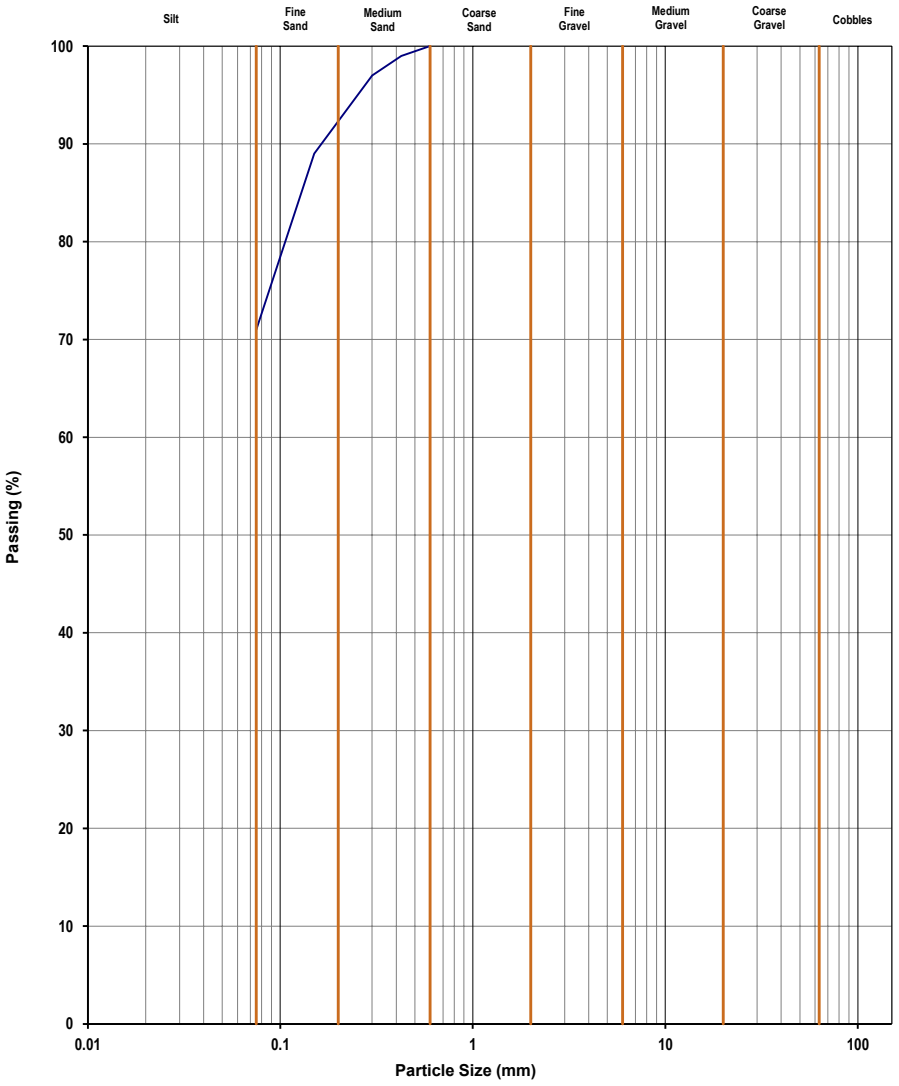
Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Method: AS 1289 3.6.1 , 2.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101570-G
		Request No	1893802_H2C_TR1
Address	PO Box 1734 MILTON BC QLD 4064	**Test Date**	20/11/18-30/11/18
		Report Date	30/11/2018
Project	Inland Rail Package 13		
Project No	1893802	**Client Sample No**	330-01-DH2503-S00350
Bore Hole	330-01-DH2503	**Depth From (m)** 3.5	**Depth To (m)** 3.95
Description	SPT		

Sieve Size (mm)	Passing %
150.0	
75.0	
63.0	
53.0	
37.5	
26.5	
19.0	
13.2	
9.5	
6.7	
4.75	
2.36	
1.18	
0.600	100
0.425	99
0.300	97
0.150	89
0.075	71



NOTES/REMARKS: -

Moisture Content 22.9%

Sample/s supplied by the client

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory

G. Hamilton

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

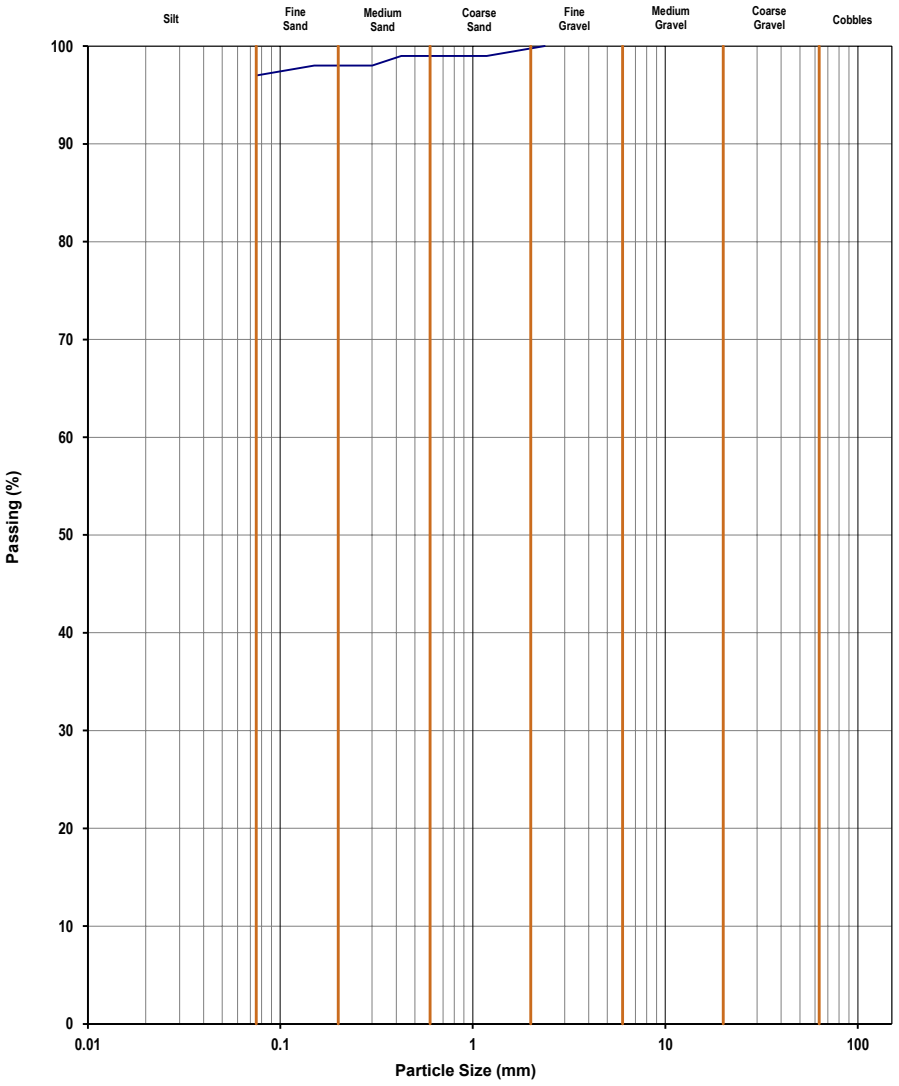
Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Method: AS 1289 3.6.1 , 2.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101439-G
		Request No	1893802_H2C_TR1
Address	PO Box 1734 MILTON BC QLD 4064	**Test Date**	30/11/2018
		Report Date	3/12/2018
Project	Inland Rail Package 13		
Project No	1893802	**Client Sample No**	330-01-BH2212-S00500
Bore Hole	330-01-BH2212	**Depth From (m)** 5	**Depth To (m)** 5.45
Description	SPT		

Sieve Size (mm)	Passing %
150.0	
75.0	
63.0	
53.0	
37.5	
26.5	
19.0	
13.2	
9.5	
6.7	
4.75	
2.36	100
1.18	99
0.600	99
0.425	99
0.300	98
0.150	98
0.075	97



NOTES/REMARKS: -

Moisture Content 38.2%

Sample/s supplied by the client

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory
Authorised Signatory
G. Hamilton

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

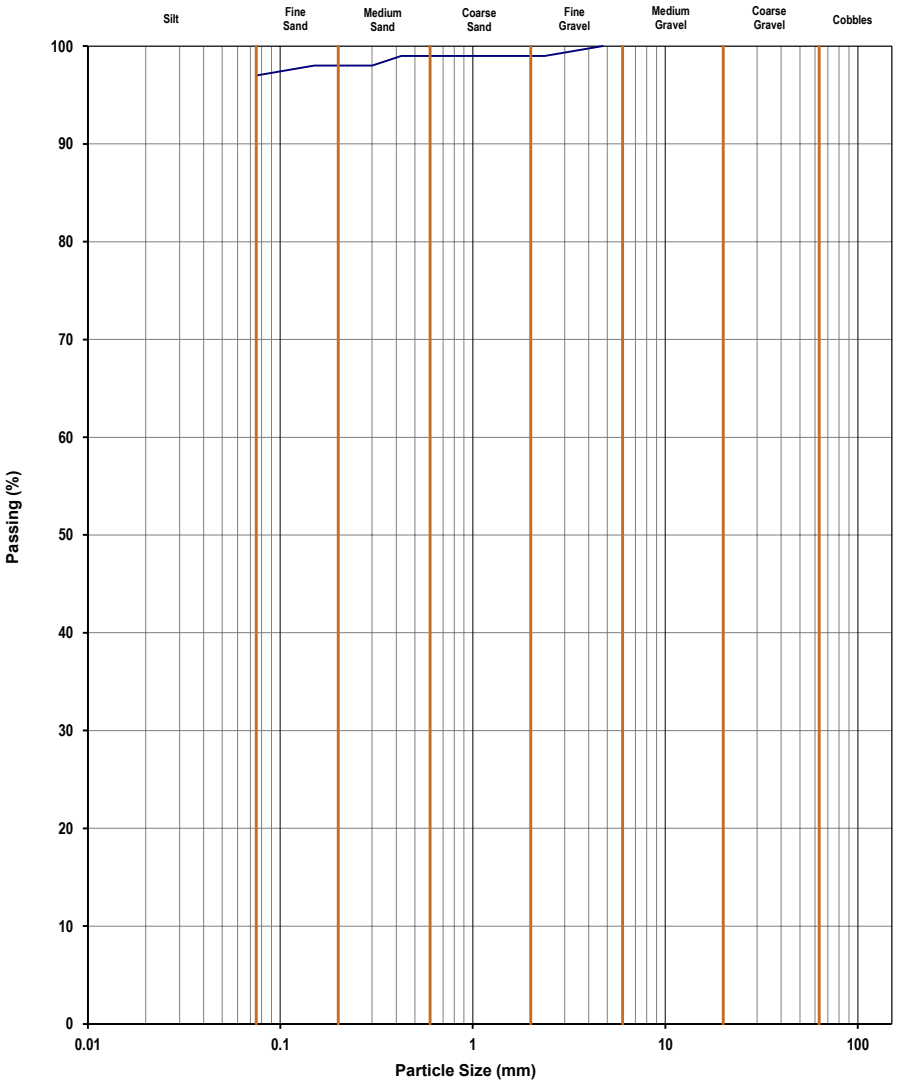
Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Method: AS 1289 3.6.1 , 2.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101456-G
		Request No	1893802_H2C_TR1
Address	PO Box 1734 MILTON BC QLD 4064	**Test Date**	30/11/2018
		Report Date	3/12/2018
Project	Inland Rail Package 13		
Project No	1893802	**Client Sample No**	330-01-BH2216-S00200
Bore Hole	330-01-BH2216	**Depth From (m)** 2	**Depth To (m)** 2.45
Description	SPT		

Sieve Size (mm)	Passing %
150.0	
75.0	
63.0	
53.0	
37.5	
26.5	
19.0	
13.2	
9.5	
6.7	
4.75	100
2.36	99
1.18	99
0.600	99
0.425	99
0.300	98
0.150	98
0.075	97



NOTES/REMARKS: -

Moisture Content 34.1%

Sample/s supplied by the client

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory

G. Hamilton

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

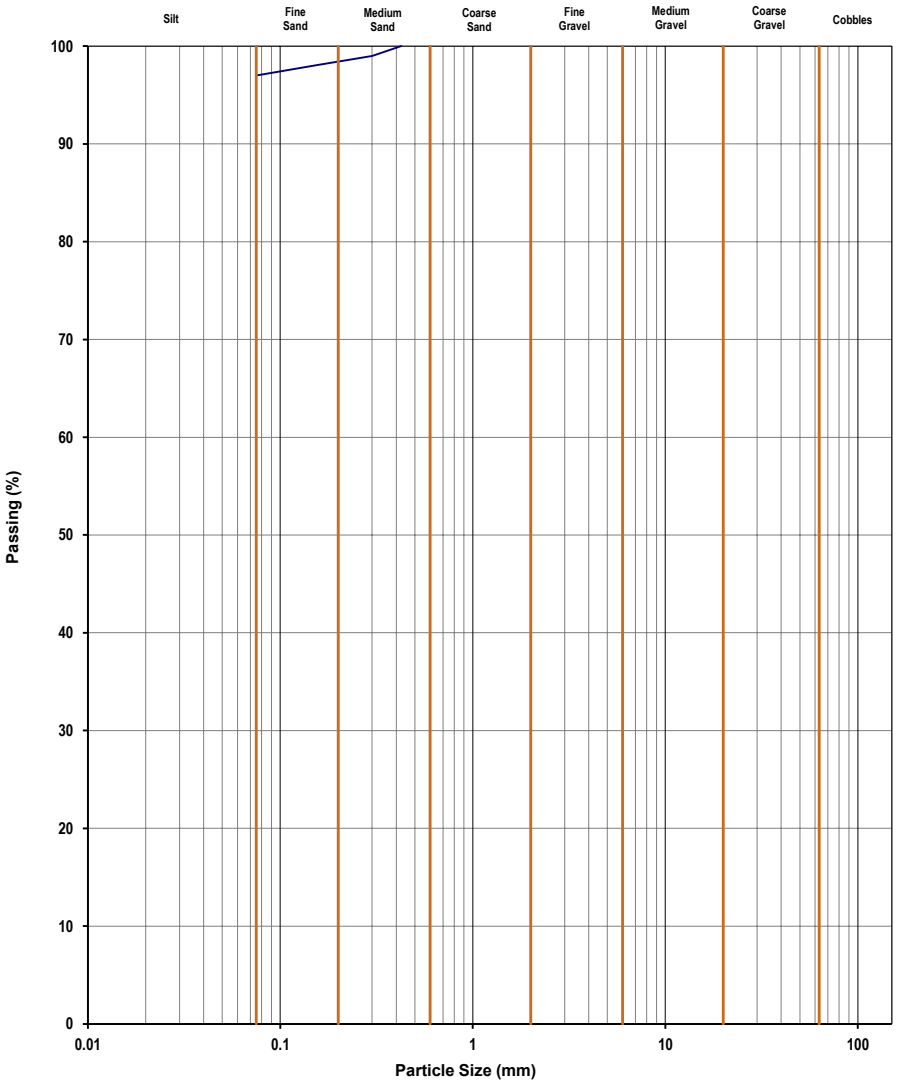
Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Method: AS 1289 3.6.1 , 2.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101460-G
		Request No	1893802_H2C_TR1
Address	PO Box 1734 MILTON BC QLD 4064	**Test Date**	30/11/2018
		Report Date	3/12/2018
Project	Inland Rail Package 13		
Project No	1893802	**Client Sample No**	330-01-BH2216-S00800
Bore Hole	330-01-BH2216	**Depth From (m)** 8	**Depth To (m)** 8.45
Description	SPT		

Sieve Size (mm)	Passing %
150.0	
75.0	
63.0	
53.0	
37.5	
26.5	
19.0	
13.2	
9.5	
6.7	
4.75	
2.36	
1.18	
0.600	
0.425	100
0.300	99
0.150	98
0.075	97



NOTES/REMARKS: -

Moisture Content 31.4%

Sample/s supplied by the client

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory

G. Hamilton

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

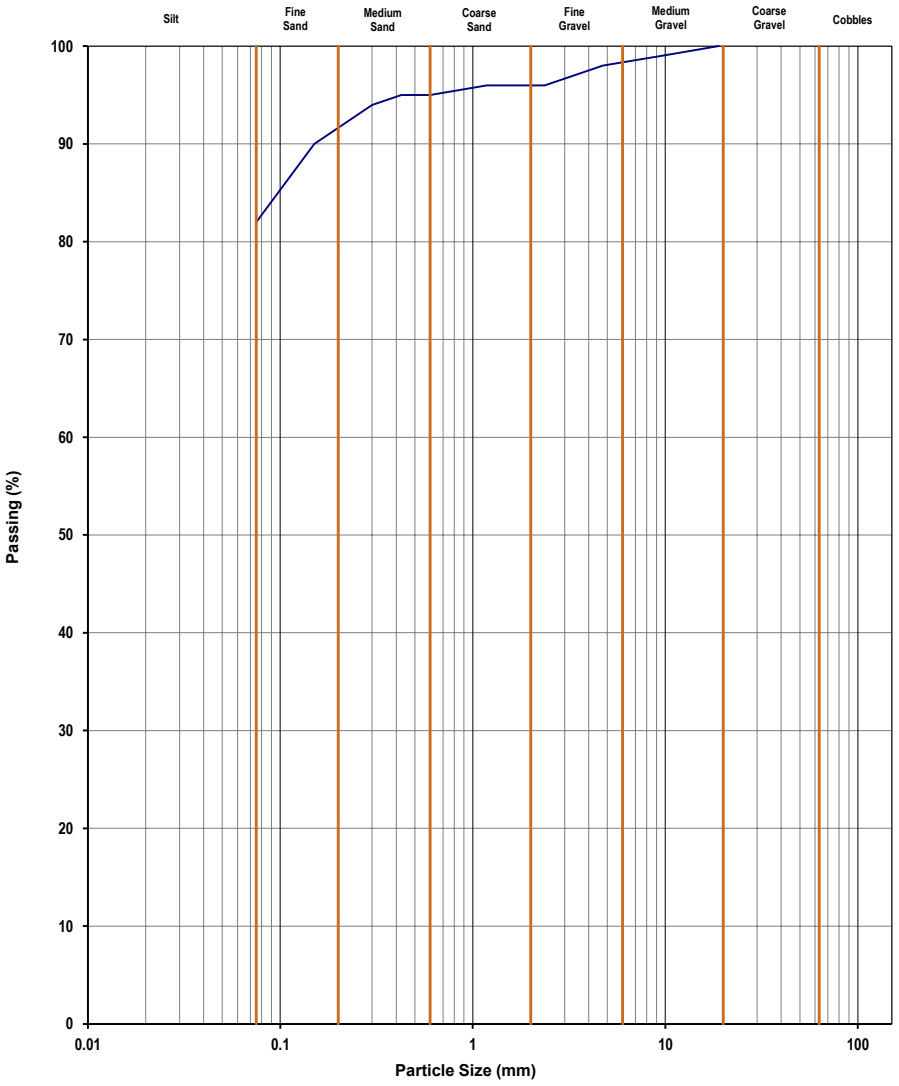
Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Method: AS 1289 3.6.1 , 2.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101474-G
		Request No	1893802_H2C_TR1
Address	PO Box 1734 MILTON BC QLD 4064	**Test Date**	30/11/2018
		Report Date	3/12/2018
Project	Inland Rail Package 13		
Project No	1893802	**Client Sample No**	330-01-BH2224-U00500
Bore Hole	330-01-BH2224	**Depth From (m)** 5	**Depth To (m)** 5.42
Description	U		

Sieve Size (mm)	Passing %
150.0	
75.0	
63.0	
53.0	
37.5	
26.5	
19.0	
13.2	100
9.5	99
6.7	98
4.75	98
2.36	96
1.18	96
0.600	95
0.425	95
0.300	94
0.150	90
0.075	82



NOTES/REMARKS: -

Moisture Content 25.7%

Sample/s supplied by the client

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory

G. Hamilton

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

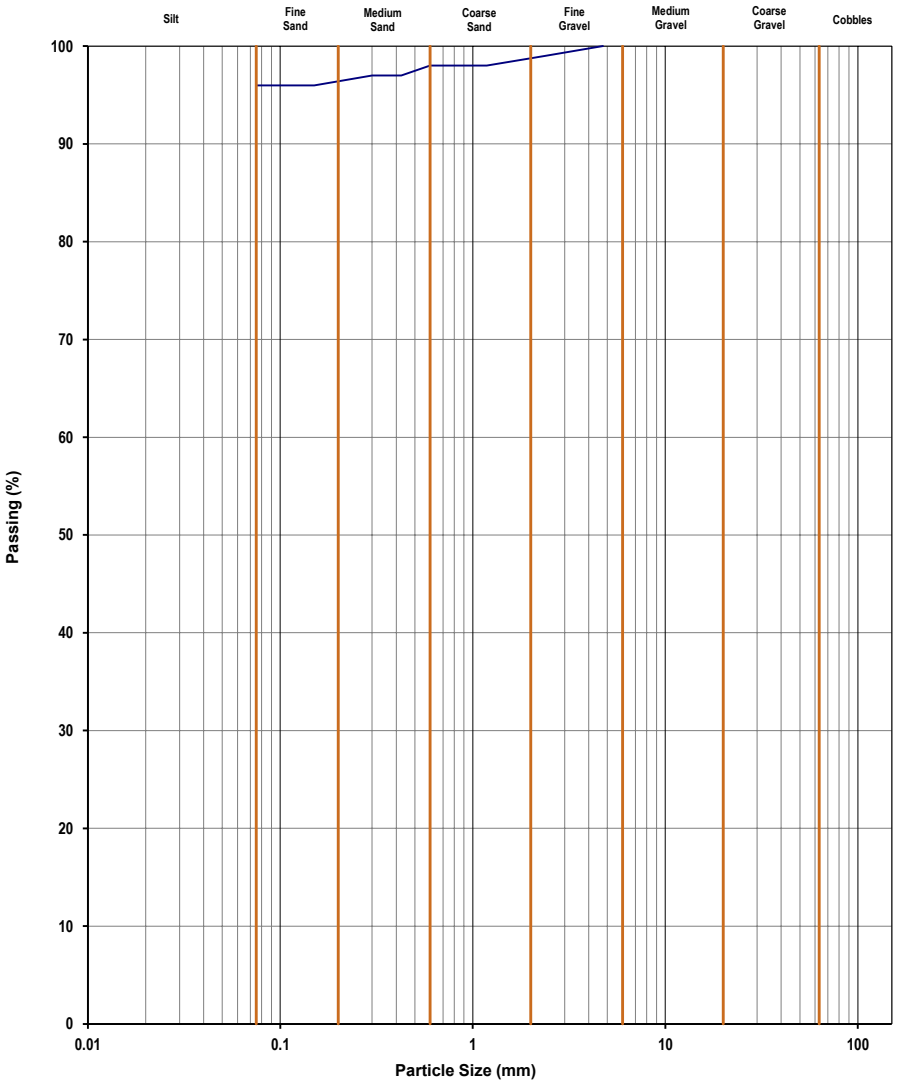
Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Method: AS 1289 3.6.1 , 2.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101484-G
		Request No	1893802_H2C_TR1
Address	PO Box 1734 MILTON BC QLD 4064	**Test Date**	30/11/2018
		Report Date	3/12/2018
Project	Inland Rail Package 13		
Project No	1893802	**Client Sample No**	330-01-BH2224-S02000
Bore Hole	330-01-BH2224	**Depth From (m)** 20	**Depth To (m)** 20.45
Description	SPT		

Sieve Size (mm)	Passing %
150.0	
75.0	
63.0	
53.0	
37.5	
26.5	
19.0	
13.2	
9.5	
6.7	
4.75	100
2.36	99
1.18	98
0.600	98
0.425	97
0.300	97
0.150	96
0.075	96



NOTES/REMARKS: -

Moisture Content 19%

Sample/s supplied by the client

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory
Authorised Signatory
G. Hamilton

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

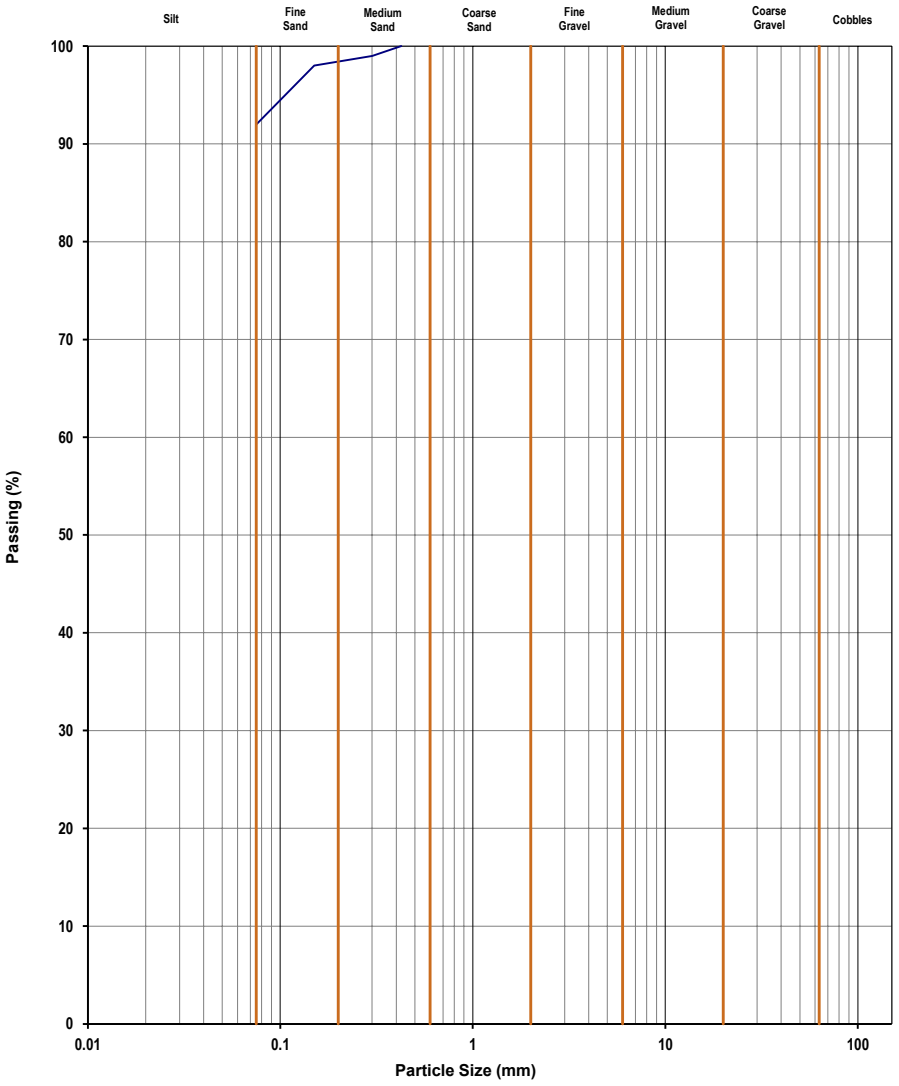
Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Method: AS 1289 3.6.1 , 2.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101493-G
		Request No	1893802_H2C_TR1
Address	PO Box 1734 MILTON BC QLD 4064	**Test Date**	30/11/2018
		Report Date	3/12/2018
Project	Inland Rail Package 13		
Project No	1893802	**Client Sample No**	330-01-BH2227-U00350
Bore Hole	330-01-BH2227	**Depth From (m)** 3.5	**Depth To (m)** 3.9
Description	U		

Sieve Size (mm)	Passing %
150.0	
75.0	
63.0	
53.0	
37.5	
26.5	
19.0	
13.2	
9.5	
6.7	
4.75	
2.36	
1.18	
0.600	
0.425	100
0.300	99
0.150	98
0.075	92



NOTES/REMARKS: -

Moisture Content 22.9%

Sample/s supplied by the client

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory
Authorised Signatory
G. Hamilton

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

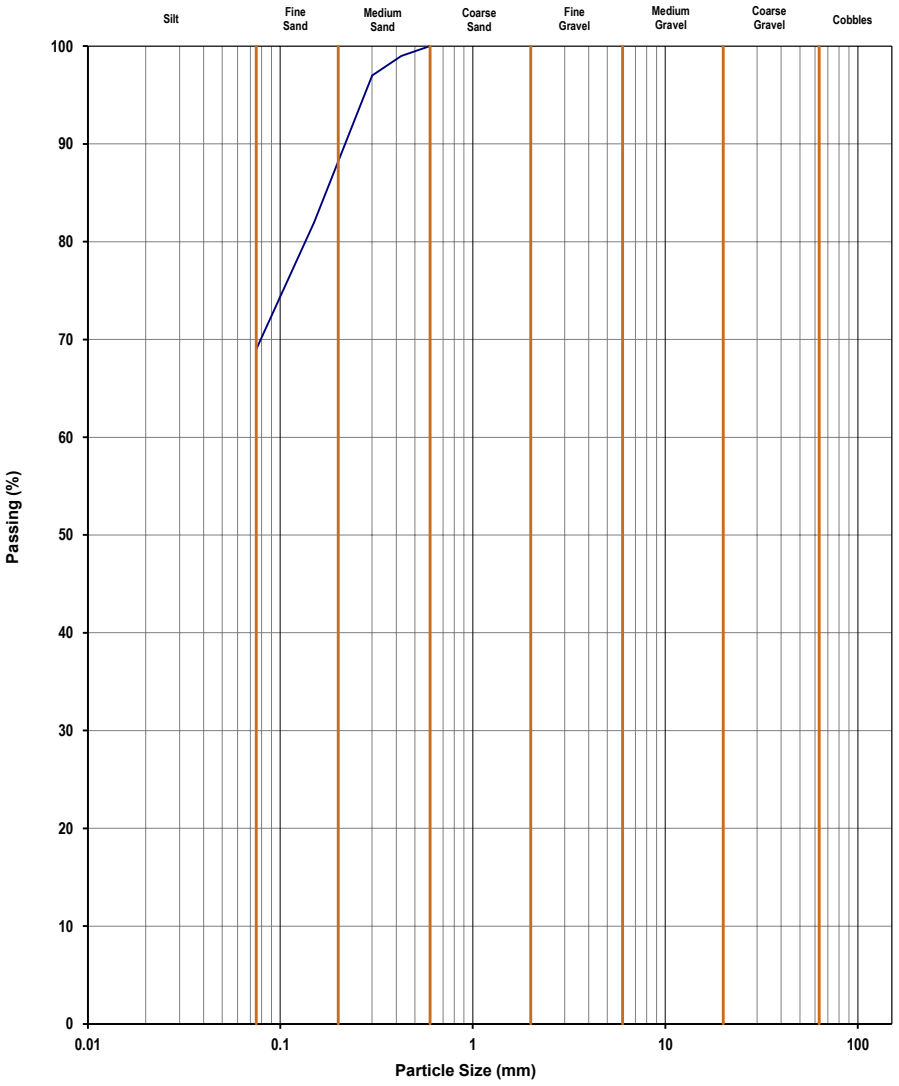
Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Method: AS 1289 3.6.1 , 2.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101499-G
		Request No	1893802_H2C_TR1
Address	PO Box 1734 MILTON BC QLD 4064	**Test Date**	30/11/2018
		Report Date	3/12/2018
Project	Inland Rail Package 13		
Project No	1893802	**Client Sample No**	330-01-BH2227-U01150
Bore Hole	330-01-BH2227	**Depth From (m)** 11.5	**Depth To (m)** 11.95
Description	U		

Sieve Size (mm)	Passing %
150.0	
75.0	
63.0	
53.0	
37.5	
26.5	
19.0	
13.2	
9.5	
6.7	
4.75	
2.36	
1.18	
0.600	100
0.425	99
0.300	97
0.150	82
0.075	69



NOTES/REMARKS: -

Moisture Content 23.5%

Sample/s supplied by the client

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory
Authorised Signatory
G. Hamilton

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

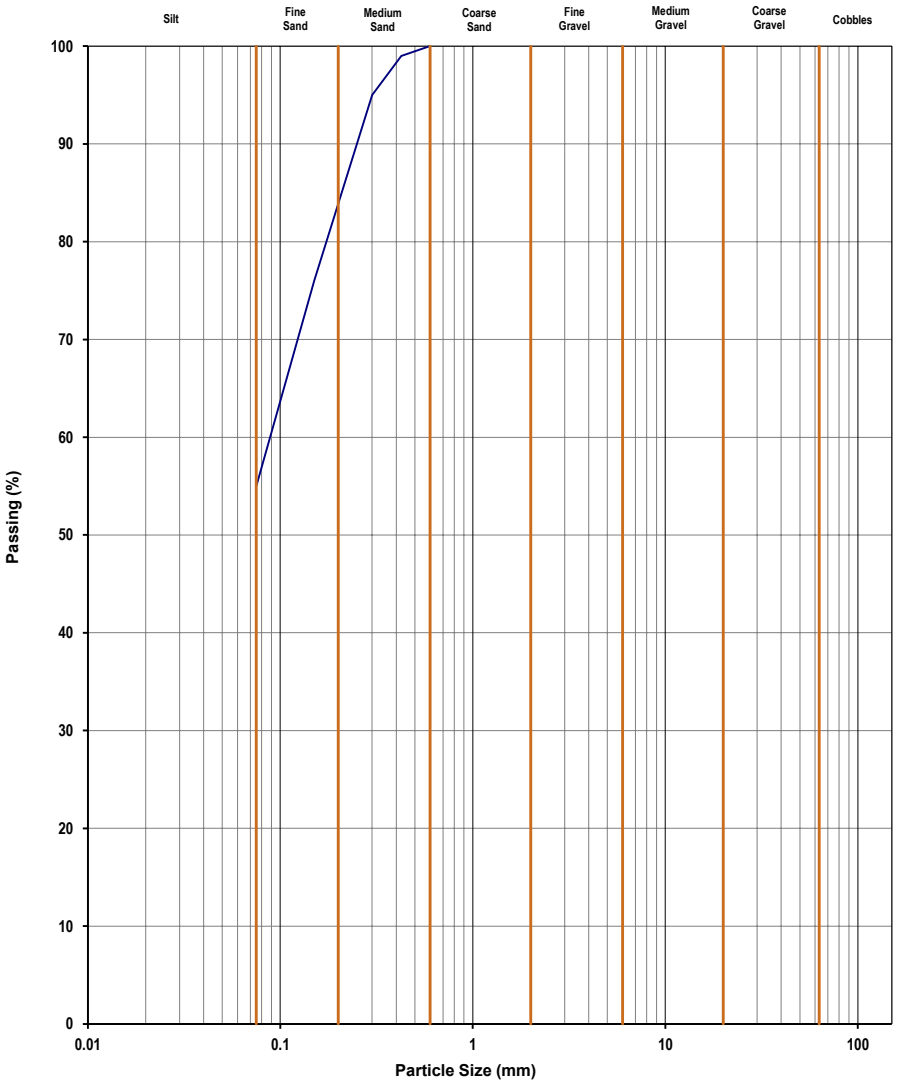
Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Method: AS 1289 3.6.1 , 2.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101501-G
		Request No	1893802_H2C_TR1
Address	PO Box 1734 MILTON BC QLD 4064	**Test Date**	30/11/2018
		Report Date	3/12/2018
Project	Inland Rail Package 13		
Project No	1893802	**Client Sample No**	330-01-BH2227-U01400
Bore Hole	330-01-BH2227	**Depth From (m)** 14	**Depth To (m)** 14.45
Description	U		

Sieve Size (mm)	Passing %
150.0	
75.0	
63.0	
53.0	
37.5	
26.5	
19.0	
13.2	
9.5	
6.7	
4.75	
2.36	
1.18	
0.600	100
0.425	99
0.300	95
0.150	76
0.075	55



NOTES/REMARKS: -

Moisture Content 22.6%

Sample/s supplied by the client

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory

G. Hamilton

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

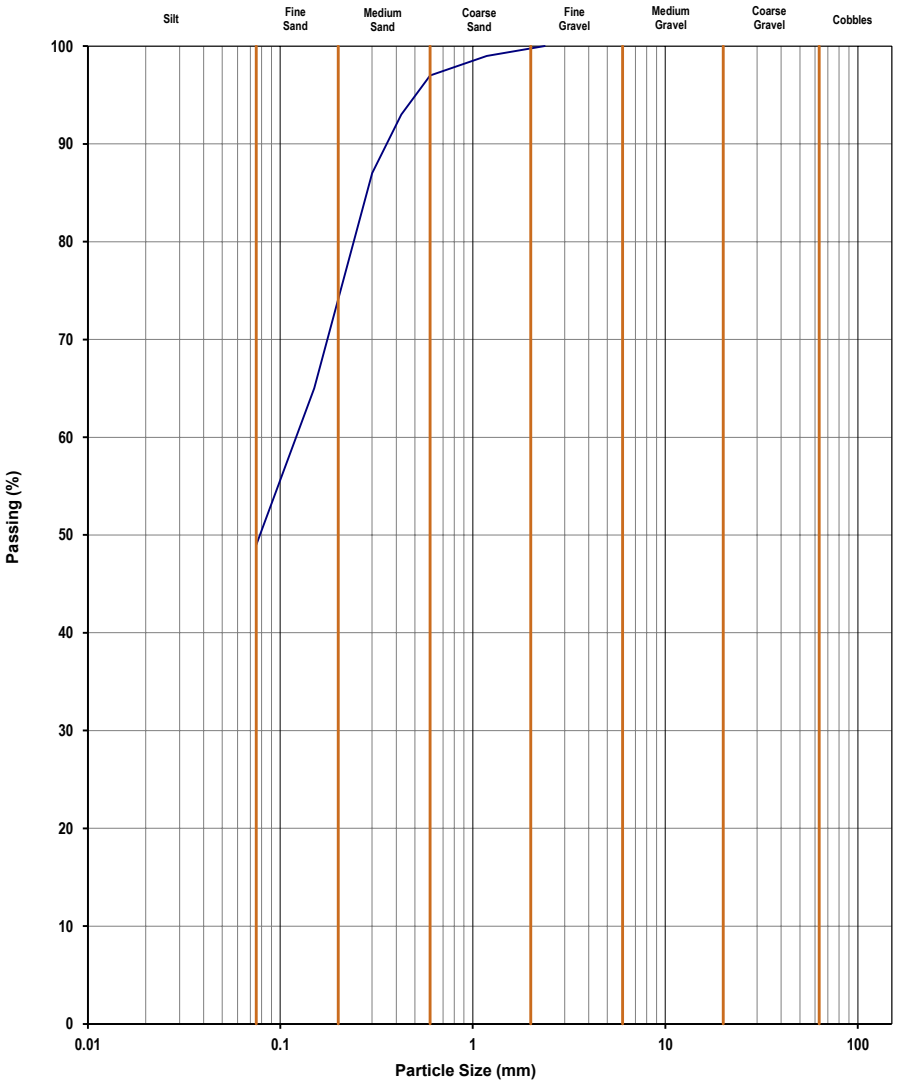
Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Method: AS 1289 3.6.1 , 2.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101503-G
		Request No	1893802_H2C_TR1
Address	PO Box 1734 MILTON BC QLD 4064	**Test Date**	30/11/2018
		Report Date	3/12/2018
Project	Inland Rail Package 13		
Project No	1893802	**Client Sample No**	330-01-BH2227-S01700
Bore Hole	330-01-BH2227	**Depth From (m)** 17	**Depth To (m)** 17.27
Description	SPT		

Sieve Size (mm)	Passing %
150.0	
75.0	
63.0	
53.0	
37.5	
26.5	
19.0	
13.2	
9.5	
6.7	
4.75	
2.36	100
1.18	99
0.600	97
0.425	93
0.300	87
0.150	65
0.075	49



NOTES/REMARKS: -

Moisture Content 13.8%

Sample/s supplied by the client

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory
G. Hamilton

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

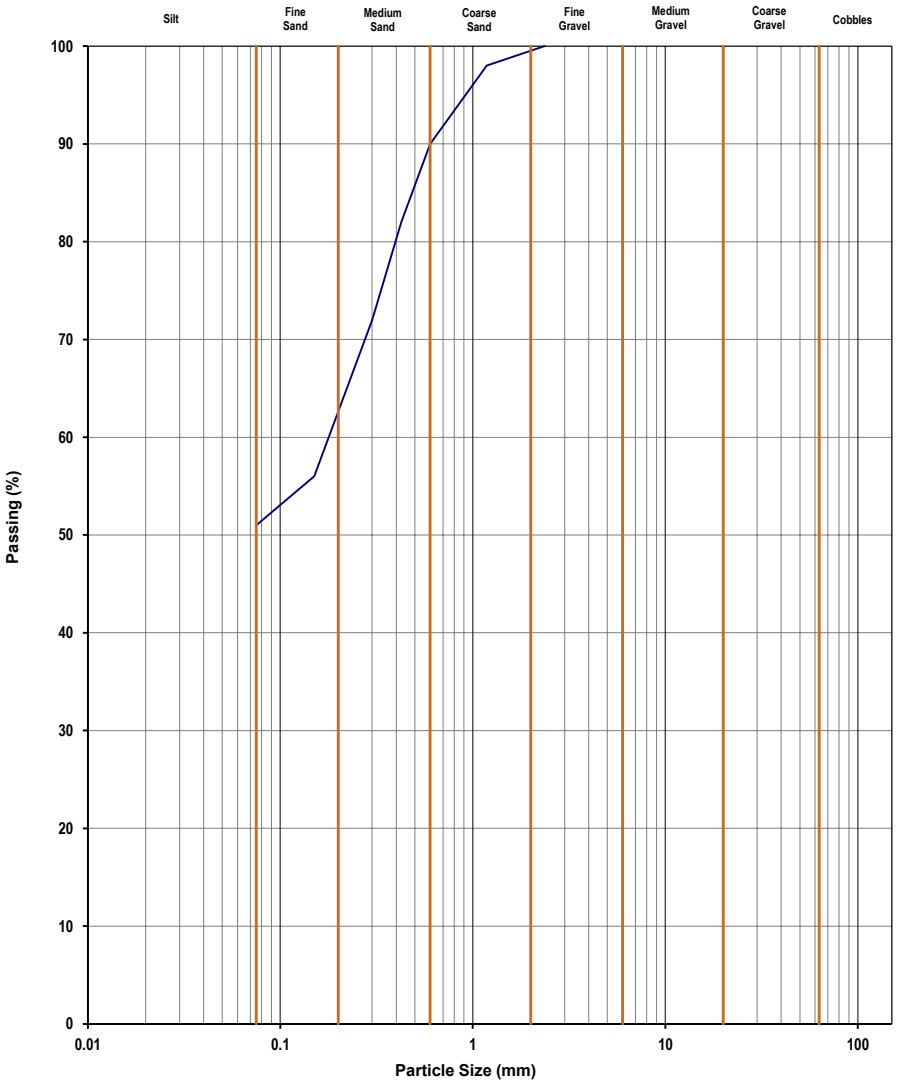
Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

PARTICLE SIZE DISTRIBUTION TEST REPORT

Test Method: AS 1289 3.6.1 , 2.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101572-G
		Request No	1893802_H2C_TR1
Address	PO Box 1734 MILTON BC QLD 4064	**Test Date**	30/11/2018
		Report Date	3/12/2018
Project	Inland Rail Package 13		
Project No	1893802	**Client Sample No**	330-01-DH2503-U00650
Bore Hole	330-01-DH2503	**Depth From (m)** 6.5	**Depth To (m)** 6.89
Description	U		

Sieve Size (mm)	Passing %
150.0	
75.0	
63.0	
53.0	
37.5	
26.5	
19.0	
13.2	
9.5	
6.7	
4.75	
2.36	100
1.18	98
0.600	90
0.425	82
0.300	72
0.150	56
0.075	51



NOTES/REMARKS: -

Moisture Content 15.2%

Sample/s supplied by the client

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory
Authorised Signatory
G. Hamilton

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Atterberg Limits

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

ATTERBERG LIMITS TEST REPORT

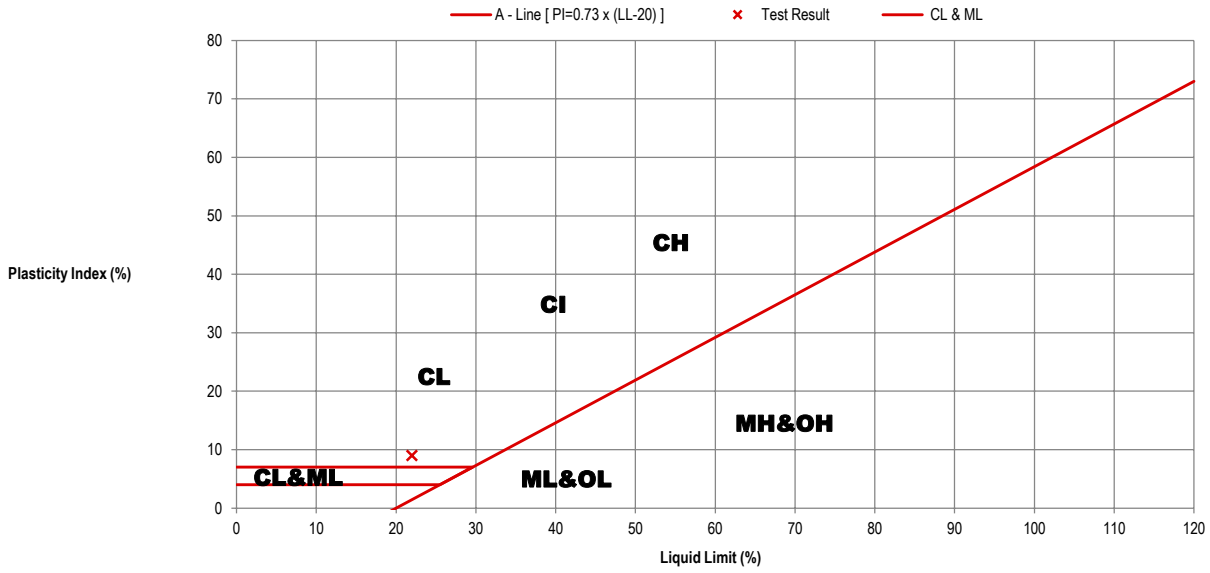
Test Method: AS 1289 2.1.1, 3.1.2, 3.2.1, 3.3.1, 3.4.1

Client	Golder Associates Pty Limited	**Report No.**	GA101403-AL
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR1
		Test Date	27/11/2018
Project	Inland Rail Package 13	**Report Date**	30/11/2018
Project No.	1893802	**Client Sample No.**	330-01-BH2203-S00350
Bore Hole	330-01-BH2203	**Depth From (m)**	3.5
		Depth To (m)	3.95
Description	SPT		

RESULTS OF TESTING

Liquid Limit (%)	**22**	
Plastic Limit (%)	**13**	
Plasticity Index (%)	**9**	
Linear Shrinkage (%)	**3.0**	**Curling Ocurred**
Moisture Content (%)	**10.8**	
Preparation Method	**Dry Sieved and Oven Dried**	

Plasticity Chart



Remarks:

Sample/s supplied by client

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory

C. Park

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

ATTERBERG LIMITS TEST REPORT

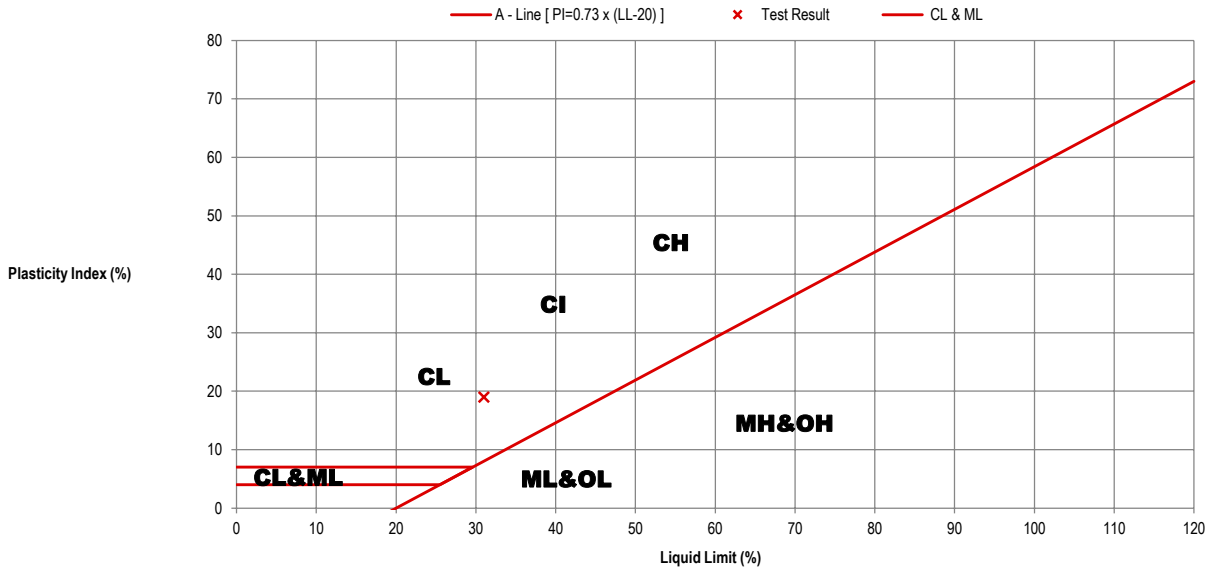
Test Method: AS 1289 2.1.1, 3.1.2, 3.2.1, 3.3.1, 3.4.1

Client	Golder Associates Pty Limited	**Report No.**	GA101404-AL
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR1
		Test Date	27/11/2018
Project	Inland Rail Package 13	**Report Date**	30/11/2018
Project No.	1893802	**Client Sample No.**	330-01-BH2203-S00500
Bore Hole	330-01-BH2203	**Depth From (m)** 5	**Depth To (m)** 5.45
Description	SPT		

RESULTS OF TESTING

Liquid Limit (%)	**31**	
Plastic Limit (%)	**12**	
Plasticity Index (%)	**19**	
Linear Shrinkage (%)	**10.0**	**Curling Ocurred**
Moisture Content (%)	**15.9**	
Preparation Method	**Dry Sieved and Oven Dried**	

Plasticity Chart



Remarks:

Sample/s supplied by client

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory

C. Park

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

ACCURATE QUALITY RESULTS FOR TOMORROW'S ENGINEERING

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

ATTERBERG LIMITS TEST REPORT

Test Method: AS 1289 2.1.1, 3.1.2, 3.2.1, 3.3.1, 3.4.1

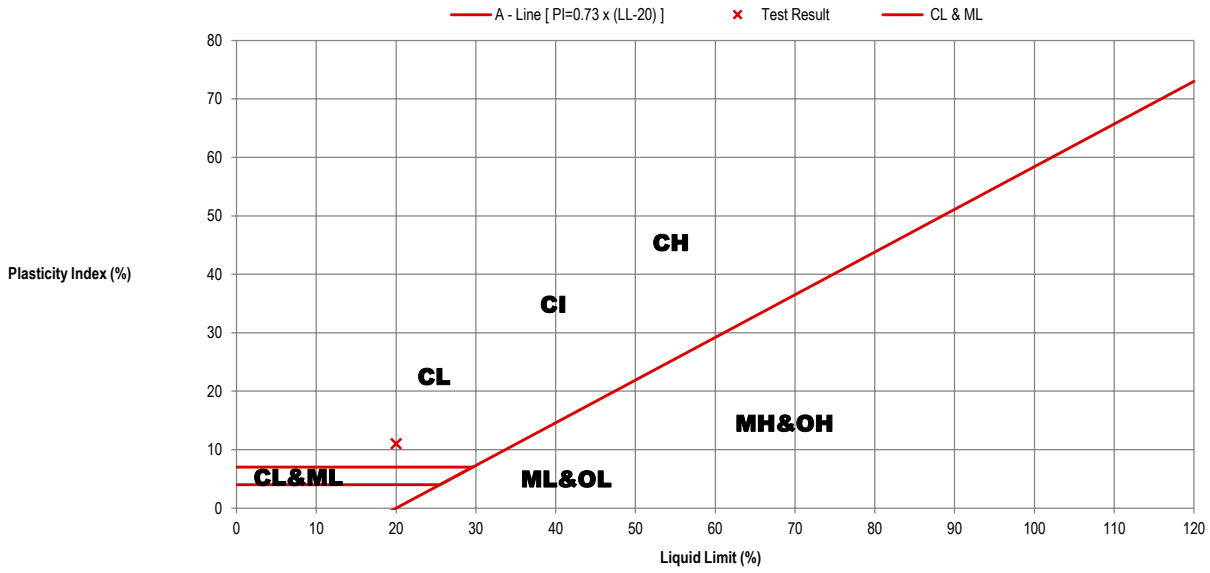
Client	Golder Associates Pty Limited	**Report No.**	GA101419-AL
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR1
		Test Date	28/11/2018
Project	Inland Rail Package 13	**Report Date**	30/11/2018

Project No.	1893802	**Client Sample No.**	330-01-BH2207-S00050		
Bore Hole	330-01-BH2207	**Depth From (m)**	0.5	**Depth To (m)**	0.95
Description	SPT				

RESULTS OF TESTING

Liquid Limit (%)	**20**	
Plastic Limit (%)	**9**	
Plasticity Index (%)	**11**	
Linear Shrinkage (%)	**5.5**	**Curling Ocurred**
Moisture Content (%)	**3.9**	
Preparation Method	**Dry Sieved and Oven Dried**	

Plasticity Chart



Remarks:

Sample/s supplied by client

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory

C. Park

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

ATTERBERG LIMITS TEST REPORT

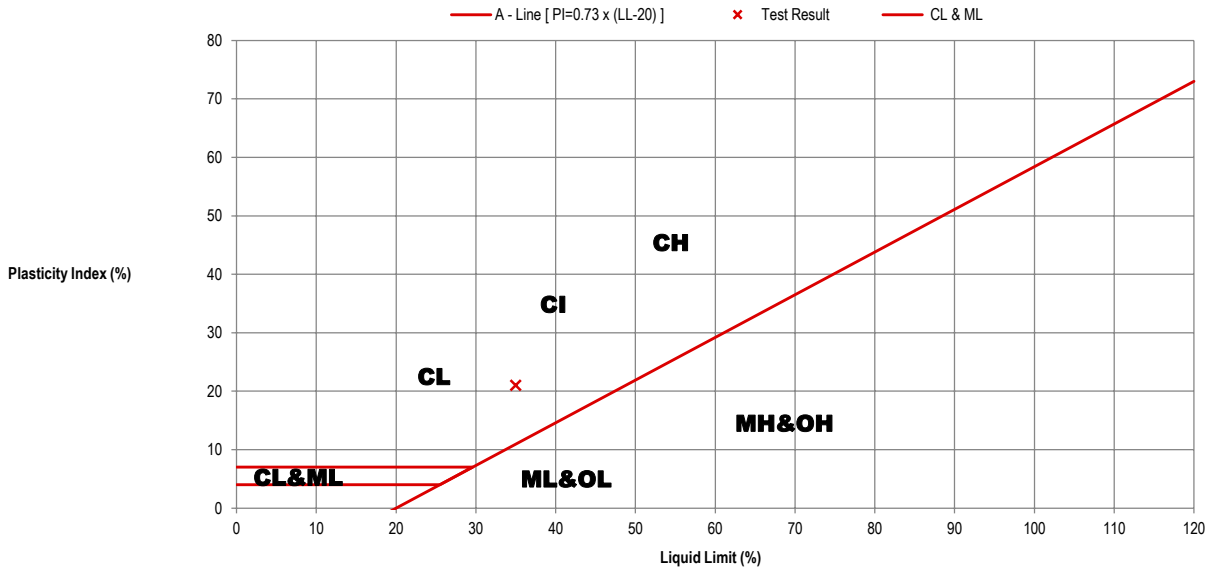
Test Method: AS 1289 2.1.1, 3.1.2, 3.2.1, 3.3.1, 3.4.1

Client	Golder Associates Pty Limited	**Report No.**	GA101422-AL
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR1
		Test Date	28/11/2018
Project	Inland Rail Package 13	**Report Date**	30/11/2018
Project No.	1893802	**Client Sample No.**	330-01-BH2207-S00500
Bore Hole	330-01-BH2207	**Depth From (m)**	5
		Depth To (m)	5.45
Description	SPT		

RESULTS OF TESTING

Liquid Limit (%)	**35**	
Plastic Limit (%)	**14**	
Plasticity Index (%)	**21**	
Linear Shrinkage (%)	**10.0**	**Curling Ocurred**
Moisture Content (%)	**10.0**	
Preparation Method	**Dry Sieved and Oven Dried**	

Plasticity Chart



Remarks:

Sample/s supplied by client

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory

C. Park

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

ACCURATE QUALITY RESULTS FOR TOMORROW'S ENGINEERING

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

ATTERBERG LIMITS TEST REPORT

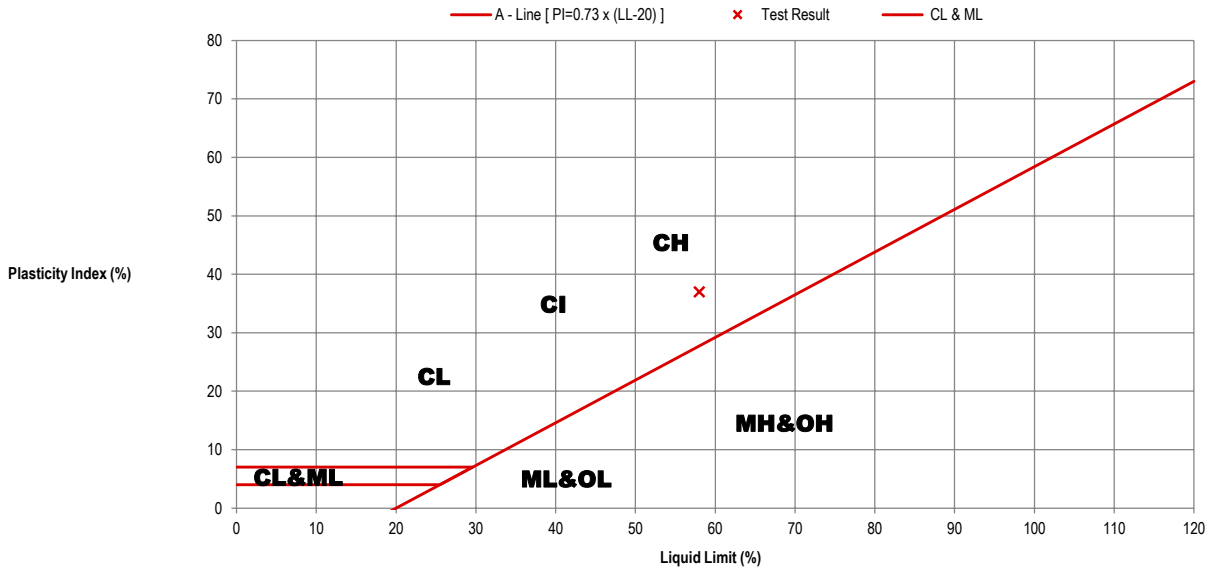
Test Method: AS 1289 2.1.1, 3.1.2, 3.2.1, 3.3.1, 3.4.1

Client	Golder Associates Pty Limited	**Report No.**	GA101437-AL
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR1
		Test Date	28/11/2018
Project	Inland Rail Package 13	**Report Date**	30/11/2018
Project No.	1893802	**Client Sample No.**	330-01-BH2212-S00200
Bore Hole	330-01-BH2212	**Depth From (m)**	2
Depth To (m)	2.45
Description	SPT		

RESULTS OF TESTING

Liquid Limit (%)	**58**	
Plastic Limit (%)	**21**	
Plasticity Index (%)	**37**	
Linear Shrinkage (%)	**17.0**	**Curling Ocurred**
Moisture Content (%)	**24.6**	
Preparation Method	**Dry Sieved and Oven Dried**	

Plasticity Chart



Remarks:

Sample/s supplied by client

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory

C. Park

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

ATTERBERG LIMITS TEST REPORT

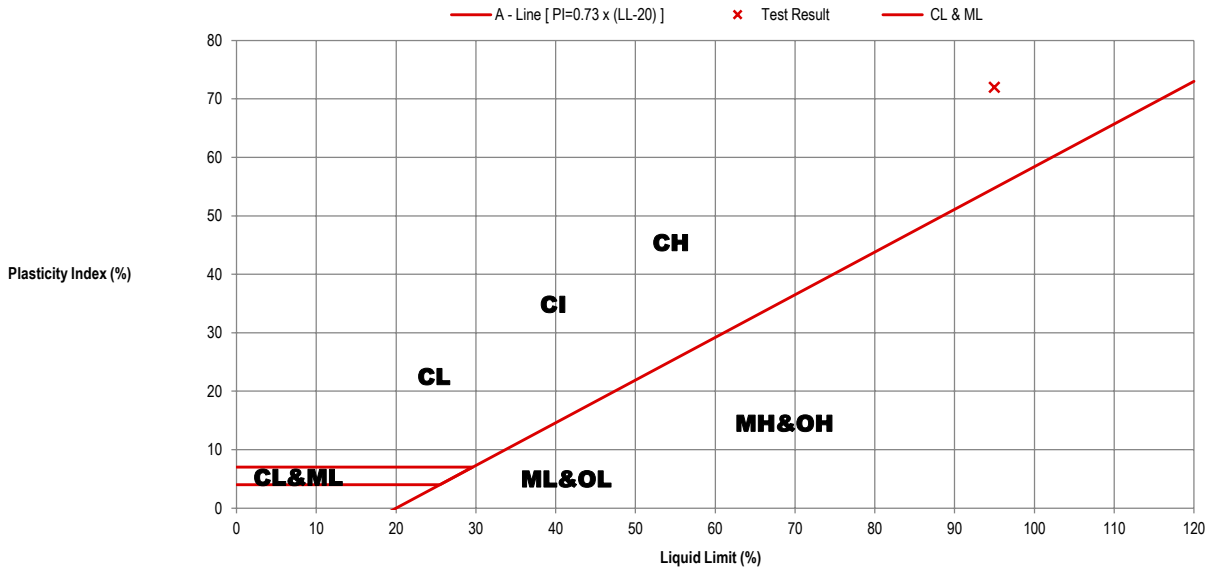
Test Method: AS 1289 2.1.1, 3.1.2, 3.2.1, 3.3.1, 3.4.1

Client	Golder Associates Pty Limited	**Report No.**	GA101439-AL
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR1
		Test Date	28/11/2018
Project	Inland Rail Package 13	**Report Date**	30/11/2018
Project No.	1893802	**Client Sample No.**	330-01-BH2212-S00500
Bore Hole	330-01-BH2212	**Depth From (m)**	5
Depth To (m)	5.45
Description	SPT		

RESULTS OF TESTING

Liquid Limit (%)	**95**	
Plastic Limit (%)	**23**	
Plasticity Index (%)	**72**	
Linear Shrinkage (%)	**21.5**	**Cracking & Curling Ocurred**
Moisture Content (%)	**38.2**	
Preparation Method	**Dry Sieved and Oven Dried**	

Plasticity Chart



Remarks:

Sample/s supplied by client

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory

C. Park

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

ACCURATE QUALITY RESULTS FOR TOMORROW'S ENGINEERING

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

ATTERBERG LIMITS TEST REPORT

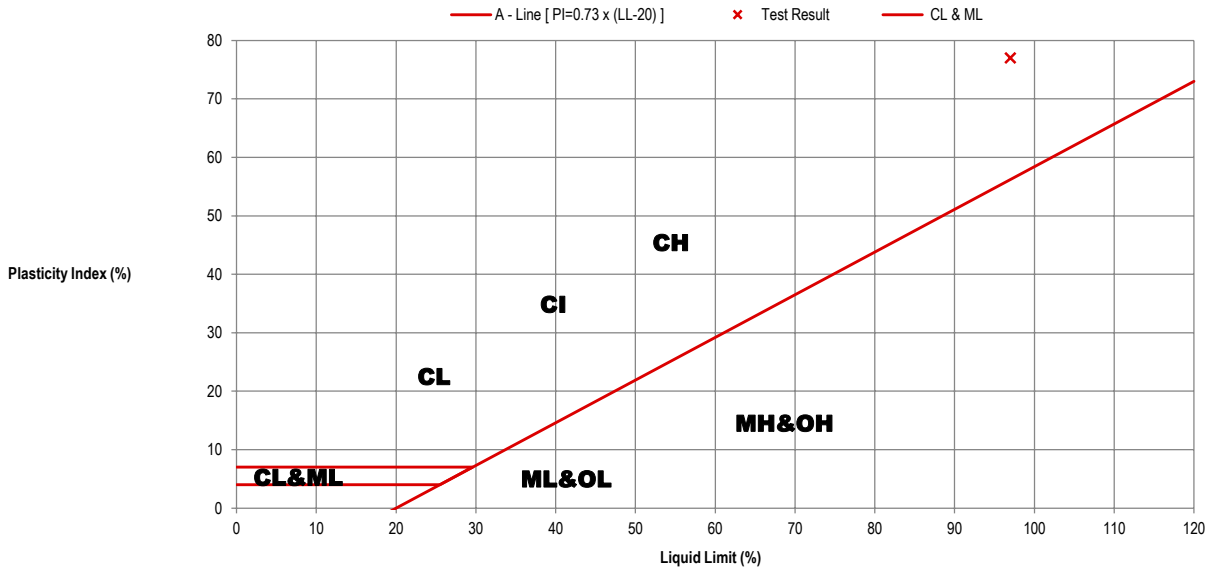
Test Method: AS 1289 2.1.1, 3.1.2, 3.2.1, 3.3.1, 3.4.1

Client	Golder Associates Pty Limited	**Report No.**	GA101443-AL
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR1
		Test Date	28/11/2018
Project	Inland Rail Package 13	**Report Date**	30/11/2018
Project No.	1893802	**Client Sample No.**	330-01-BH2212-S01100
Bore Hole	330-01-BH2212	**Depth From (m)**	11
		Depth To (m)	11.45
Description	SPT		

RESULTS OF TESTING

Liquid Limit (%)	**97**	
Plastic Limit (%)	**20**	
Plasticity Index (%)	**77**	
Linear Shrinkage (%)	**21.5**	**Cracking & Curling Ocurred**
Moisture Content (%)	**29.6**	
Preparation Method	**Dry Sieved and Oven Dried**	

Plasticity Chart



Remarks:

Sample/s supplied by client

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory

C. Park

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

ACCURATE QUALITY RESULTS FOR TOMORROW'S ENGINEERING

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

ATTERBERG LIMITS TEST REPORT

Test Method: AS 1289 2.1.1, 3.1.2, 3.2.1, 3.3.1, 3.4.1

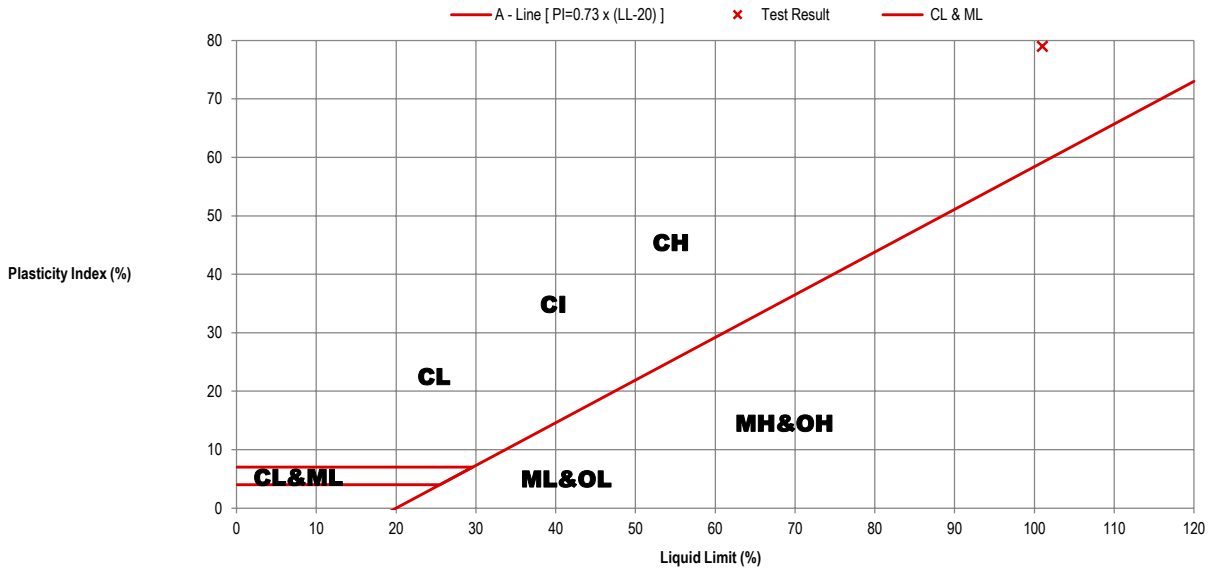
Client	Golder Associates Pty Limited	**Report No.**	GA101456-AL
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR1
		Test Date	28/11/2018
Project	Inland Rail Package 13	**Report Date**	30/11/2018

Project No.	1893802	**Client Sample No.**	330-01-BH2216-S00200		
Bore Hole	330-01-BH2216	**Depth From (m)**	2	**Depth To (m)**	2.45
Description	SPT				

RESULTS OF TESTING

Liquid Limit (%)	**101**	
Plastic Limit (%)	**22**	
Plasticity Index (%)	**79**	
Linear Shrinkage (%)	**25.5**	**Cracking & Curling Ocurred**
Moisture Content (%)	**34.1**	
Preparation Method	**Dry Sieved and Oven Dried**	

Plasticity Chart



Remarks:

Sample/s supplied by client

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory

C. Park

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

ACCURATE QUALITY RESULTS FOR TOMORROW'S ENGINEERING

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

ATTERBERG LIMITS TEST REPORT

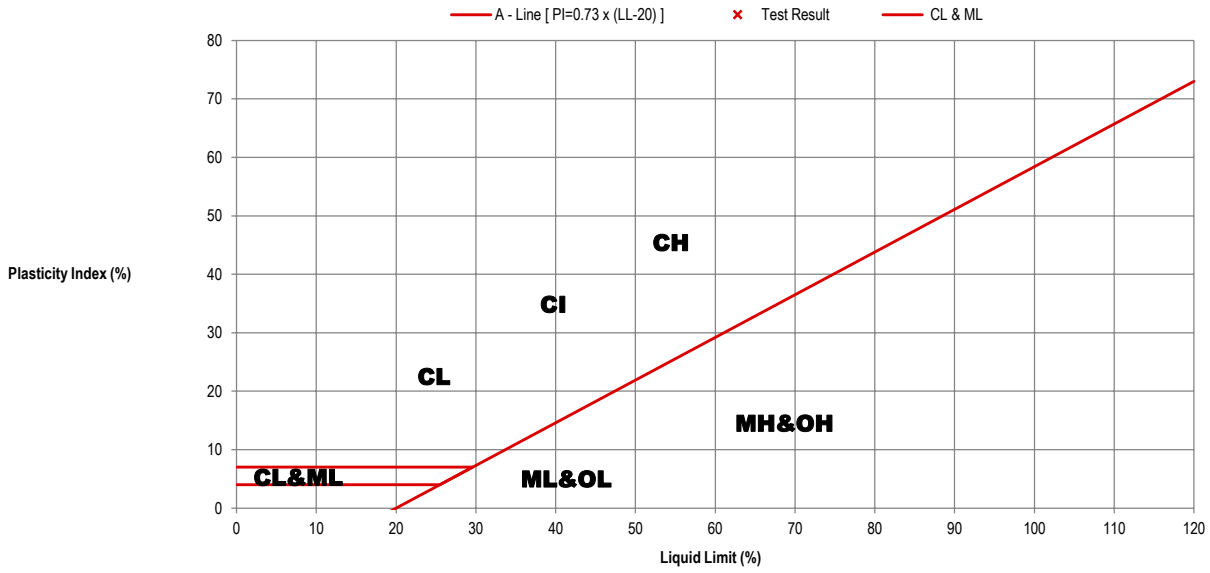
Test Method: AS 1289 2.1.1, 3.1.2, 3.2.1, 3.3.1, 3.4.1

Client	Golder Associates Pty Limited	**Report No.**	GA101460-AL
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR1
		Test Date	28/11/2018
Project	Inland Rail Package 13	**Report Date**	30/11/2018
Project No.	1893802	**Client Sample No.**	330-01-BH2216-S00800
Bore Hole	330-01-BH2216	**Depth From (m)** 8	**Depth To (m)** 8.45
Description	SPT		

RESULTS OF TESTING

Liquid Limit (%)	**106**	
Plastic Limit (%)	**21**	
Plasticity Index (%)	**85**	
Linear Shrinkage (%)	**19.5**	**Curling Ocurred**
Moisture Content (%)	**31.4**	
Preparation Method	**Dry Sieved and Oven Dried**	

Plasticity Chart



Remarks:

Sample/s supplied by client

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory

C. Park

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

ATTERBERG LIMITS TEST REPORT

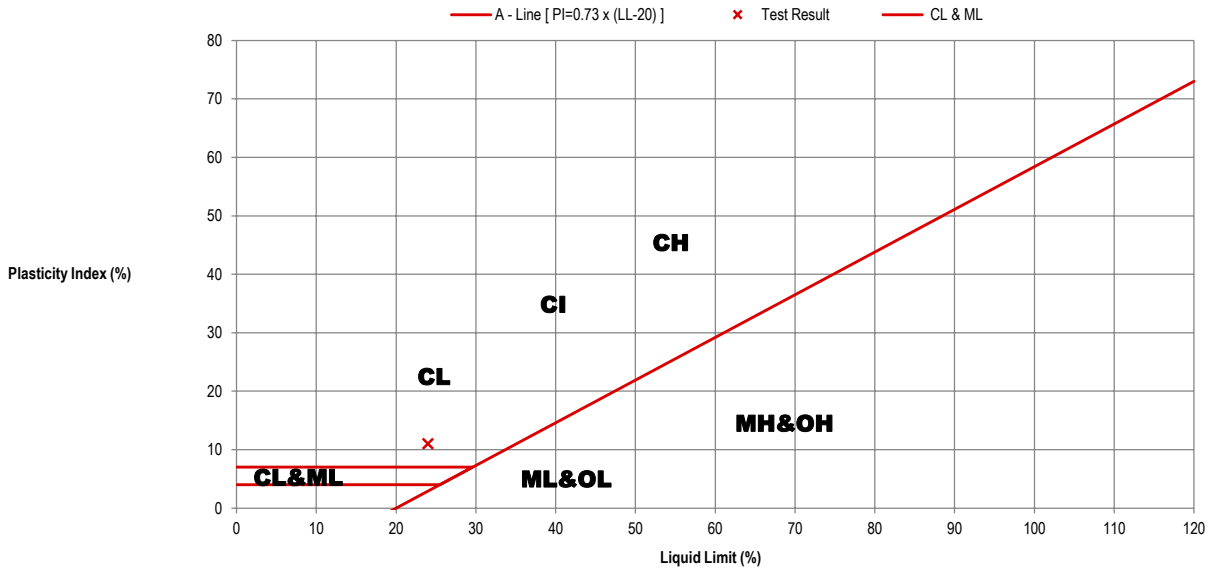
Test Method: AS 1289 2.1.1, 3.1.2, 3.2.1, 3.3.1, 3.4.1

Client	Golder Associates Pty Limited	**Report No.**	GA101464-AL
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR1
		Test Date	27/11/2018
Project	Inland Rail Package 13	**Report Date**	30/11/2018
Project No.	1893802	**Client Sample No.**	330-01-BH2216-S01400
Bore Hole	330-01-BH2216	**Depth From (m)** 14	**Depth To (m)** 14.45
Description	SPT		

RESULTS OF TESTING

Liquid Limit (%)	**24**	
Plastic Limit (%)	**13**	
Plasticity Index (%)	**11**	
Linear Shrinkage (%)	**5.0**	**Curling Ocurred**
Moisture Content (%)	**19.9**	
Preparation Method	**Dry Sieved and Oven Dried**	

Plasticity Chart



Remarks:

Sample/s supplied by client

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory

C. Park

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

ACCURATE QUALITY RESULTS FOR TOMORROW'S ENGINEERING

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

ATTERBERG LIMITS TEST REPORT

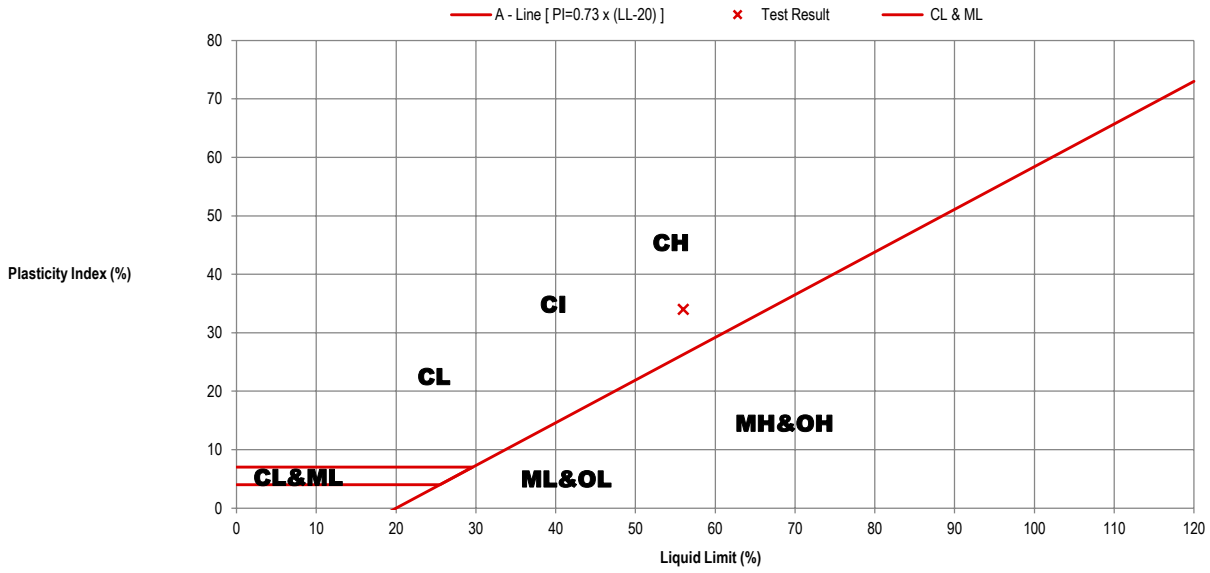
Test Method: AS 1289 2.1.1, 3.1.2, 3.2.1, 3.3.1, 3.4.1

Client	Golder Associates Pty Limited	**Report No.**	GA101474-AL
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR1
		Test Date	27/11/2018
Project	Inland Rail Package 13	**Report Date**	30/11/2018
Project No.	1893802	**Client Sample No.**	330-01-BH2224-U00500
Bore Hole	330-01-BH2224	**Depth From (m)**	5
		Depth To (m)	5.42
Description	U		

RESULTS OF TESTING

Liquid Limit (%)	**56**	
Plastic Limit (%)	**22**	
Plasticity Index (%)	**34**	
Linear Shrinkage (%)	**16.5**	**Curling Ocurred**
Moisture Content (%)	**25.7**	
Preparation Method	**Dry Sieved and Oven Dried**	

Plasticity Chart



Remarks:

Sample/s supplied by client

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory

C. Park

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

ATTERBERG LIMITS TEST REPORT

Test Method: AS 1289 2.1.1, 3.1.2, 3.2.1, 3.3.1, 3.4.1

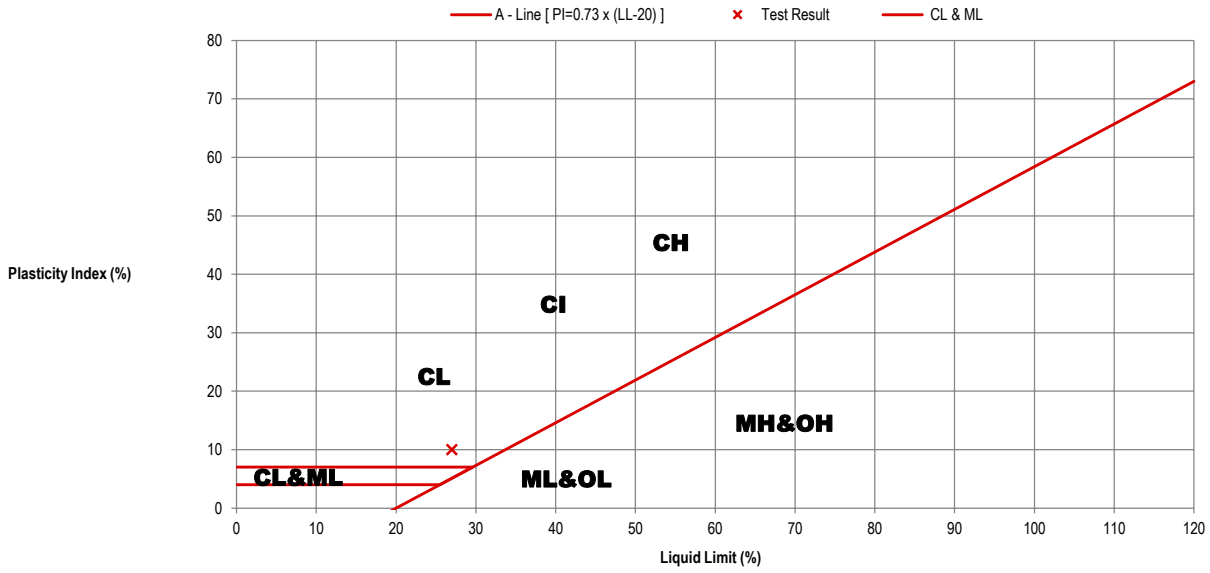
Client	Golder Associates Pty Limited	**Report No.**	GA101478-AL
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR1
		Test Date	27/11/2018
Project	Inland Rail Package 13	**Report Date**	30/11/2018

Project No.	1893802	**Client Sample No.**	330-01-BH2224-S01100		
Bore Hole	330-01-BH2224	**Depth From (m)**	11	**Depth To (m)**	11.45
Description	SPT				

RESULTS OF TESTING

Liquid Limit (%)	**27**	
Plastic Limit (%)	**17**	
Plasticity Index (%)	**10**	
Linear Shrinkage (%)	**3.5**	**Curling Ocurred**
Moisture Content (%)	**19.7**	
Preparation Method	**Dry Sieved and Oven Dried**	

Plasticity Chart



Remarks:

Sample/s supplied by client

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory

C. Park

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

ACCURATE QUALITY RESULTS FOR TOMORROW'S ENGINEERING

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

ATTERBERG LIMITS TEST REPORT

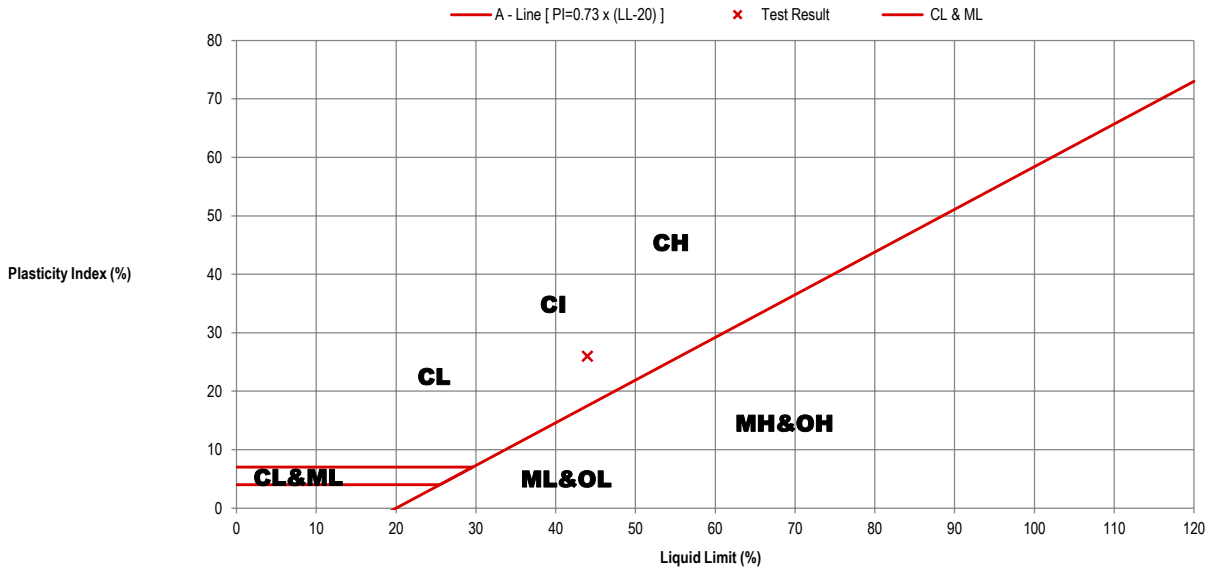
Test Method: AS 1289 2.1.1, 3.1.2, 3.2.1, 3.3.1, 3.4.1

Client	Golder Associates Pty Limited	**Report No.**	GA101480-AL
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR1
		Test Date	28/11/2018
Project	Inland Rail Package 13	**Report Date**	30/11/2018
Project No.	1893802	**Client Sample No.**	330-01-BH2224-S01400
Bore Hole	330-01-BH2224	**Depth From (m)**	14
Description	SPT	**Depth To (m)**	14.45

RESULTS OF TESTING

Liquid Limit (%)	**44**	
Plastic Limit (%)	**18**	
Plasticity Index (%)	**26**	
Linear Shrinkage (%)	**14.0**	**Curling Ocurred**
Moisture Content (%)	**27.7**	
Preparation Method	**Dry Sieved and Oven Dried**	

Plasticity Chart



Remarks:

Sample/s supplied by client

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory

C. Park

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

ATTERBERG LIMITS TEST REPORT

Test Method: AS 1289 2.1.1, 3.1.2, 3.2.1, 3.3.1, 3.4.1

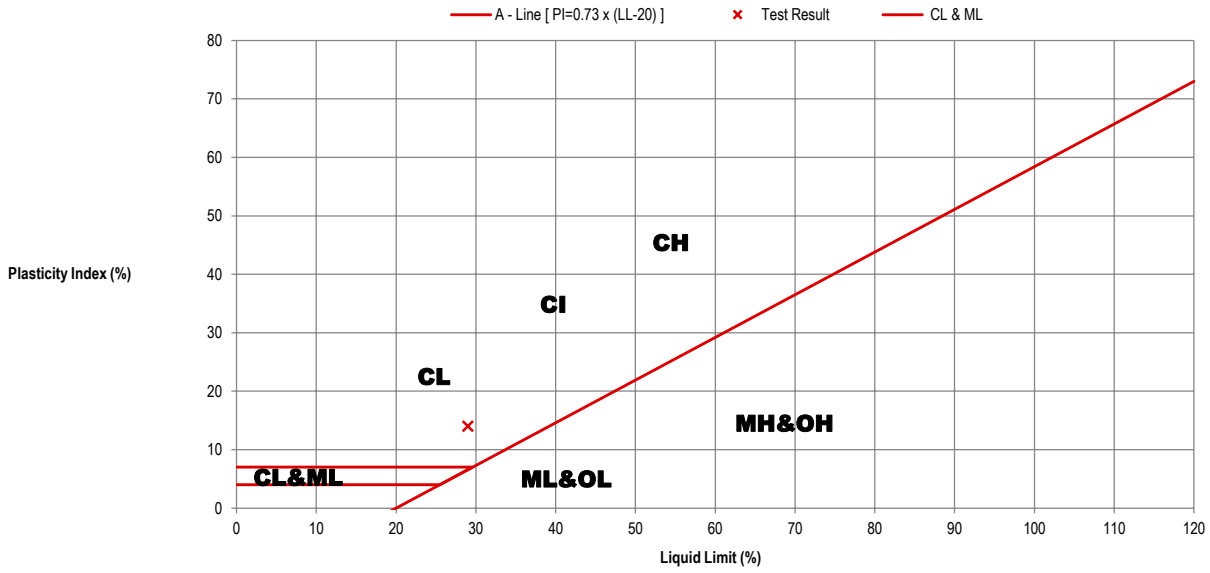
Client	Golder Associates Pty Limited	**Report No.**	GA101481-AL
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR1
		Test Date	28/11/2018
Project	Inland Rail Package 13	**Report Date**	30/11/2018

Project No.	1893802	**Client Sample No.**	330-01-BH2224-S01550		
Bore Hole	330-01-BH2224	**Depth From (m)**	15.5	**Depth To (m)**	15.95
Description	SPT				

RESULTS OF TESTING

Liquid Limit (%)	**29**	
Plastic Limit (%)	**15**	
Plasticity Index (%)	**14**	
Linear Shrinkage (%)	**6.5**	**Curling Ocurred**
Moisture Content (%)	**25.4**	
Preparation Method	**Dry Sieved and Oven Dried**	

Plasticity Chart



Remarks:

Sample/s supplied by client

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory

C. Park

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

ATTERBERG LIMITS TEST REPORT

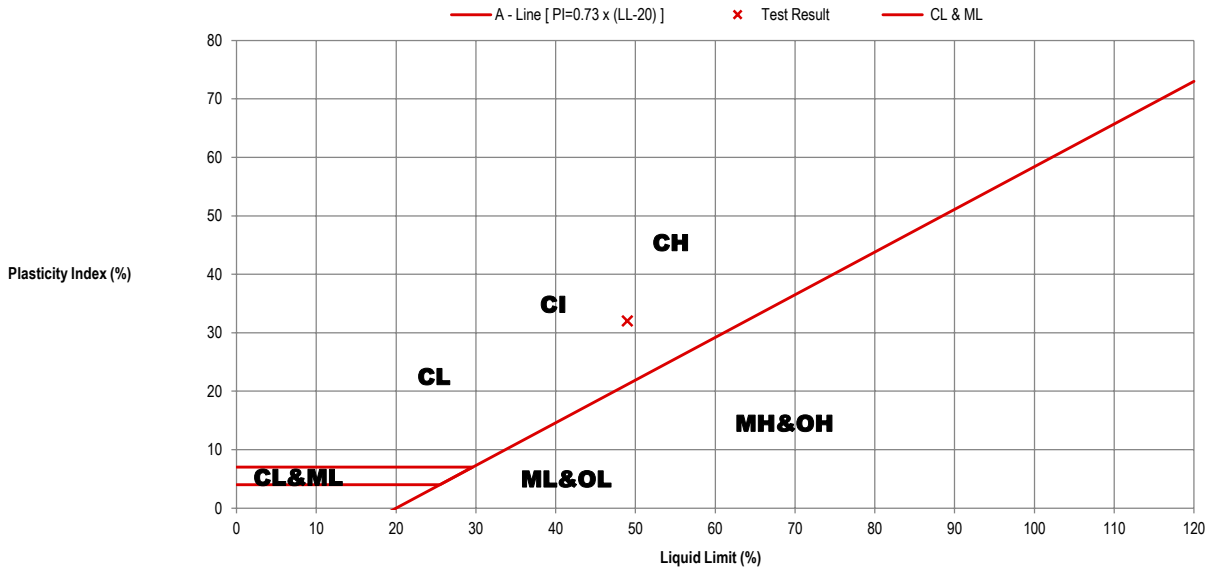
Test Method: AS 1289 2.1.1, 3.1.2, 3.2.1, 3.3.1, 3.4.1

Client	Golder Associates Pty Limited	**Report No.**	GA101484-AL
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR1
		Test Date	28/11/2018
Project	Inland Rail Package 13	**Report Date**	30/11/2018
Project No.	1893802	**Client Sample No.**	330-01-BH2224-S02000
Bore Hole	330-01-BH2224	**Depth From (m)**	20
		Depth To (m)	20.45
Description	SPT		

RESULTS OF TESTING

Liquid Limit (%)	**49**	
Plastic Limit (%)	**17**	
Plasticity Index (%)	**32**	
Linear Shrinkage (%)	**13.5**	**Curling Ocurred**
Moisture Content (%)	**19.0**	
Preparation Method	**Dry Sieved and Oven Dried**	

Plasticity Chart



Remarks:

Sample/s supplied by client

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory

C. Park

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

ATTERBERG LIMITS TEST REPORT

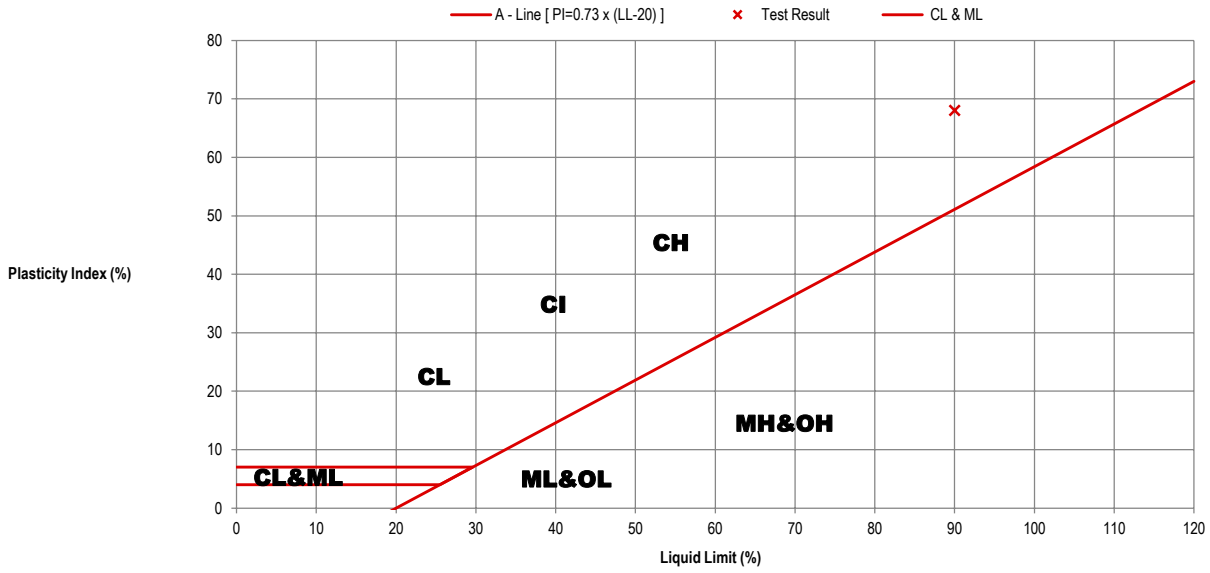
Test Method: AS 1289 2.1.1, 3.1.2, 3.2.1, 3.3.1, 3.4.1

Client	Golder Associates Pty Limited	**Report No.**	GA101492-AL
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR1
		Test Date	28/11/2018
Project	Inland Rail Package 13	**Report Date**	30/11/2018
Project No.	1893802	**Client Sample No.**	330-01-BH2227-S00200
Bore Hole	330-01-BH2227	**Depth From (m)**	2
Description	SPT	**Depth To (m)**	2.45

RESULTS OF TESTING

Liquid Limit (%)	**90**	
Plastic Limit (%)	**22**	
Plasticity Index (%)	**68**	
Linear Shrinkage (%)	**22.5**	**Cracking & Curling Ocurred**
Moisture Content (%)	**25.8**	
Preparation Method	**Dry Sieved and Oven Dried**	

Plasticity Chart



Remarks:

Sample/s supplied by client

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory

C. Park

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

ATTERBERG LIMITS TEST REPORT

Test Method: AS 1289 2.1.1, 3.1.2, 3.2.1, 3.3.1, 3.4.1

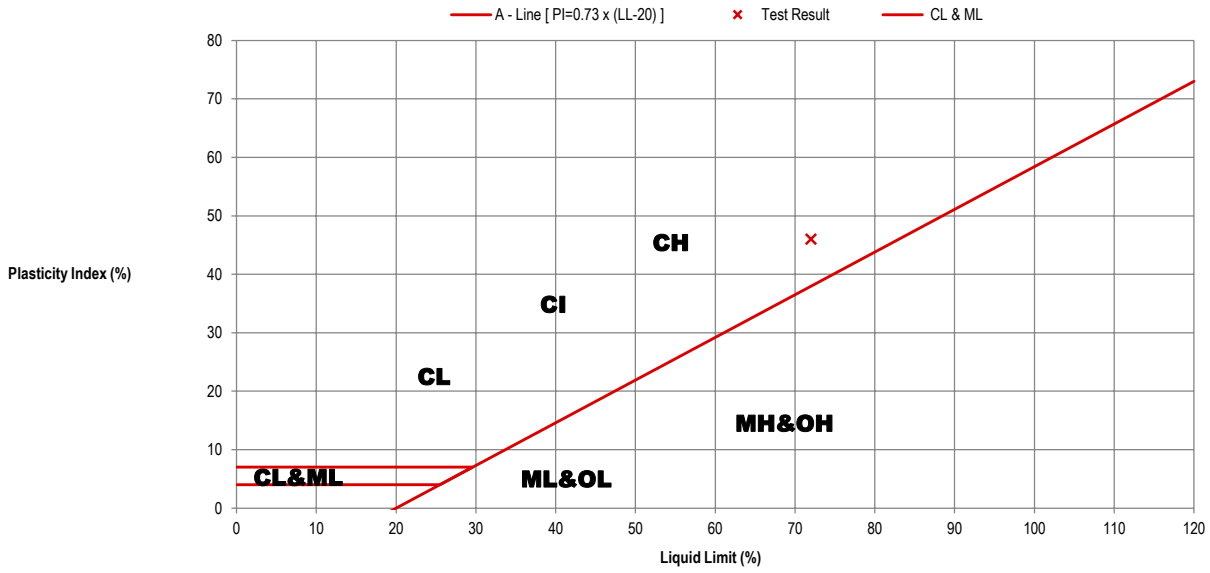
Client	Golder Associates Pty Limited	**Report No.**	GA101493-AL
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR1
		Test Date	27/11/2018
Project	Inland Rail Package 13	**Report Date**	30/11/2018

Project No.	1893802	**Client Sample No.**	330-01-BH2227-U00350		
Bore Hole	330-01-BH2227	**Depth From (m)**	3.5	**Depth To (m)**	3.9
Description	U				

RESULTS OF TESTING

Liquid Limit (%)	**72**	
Plastic Limit (%)	**26**	
Plasticity Index (%)	**46**	
Linear Shrinkage (%)	**19.5**	**Curling Ocurred**
Moisture Content (%)	**22.9**	
Preparation Method	**Dry Sieved and Oven Dried**	

Plasticity Chart



Remarks:

Sample/s supplied by client

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory

C. Park

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

ATTERBERG LIMITS TEST REPORT

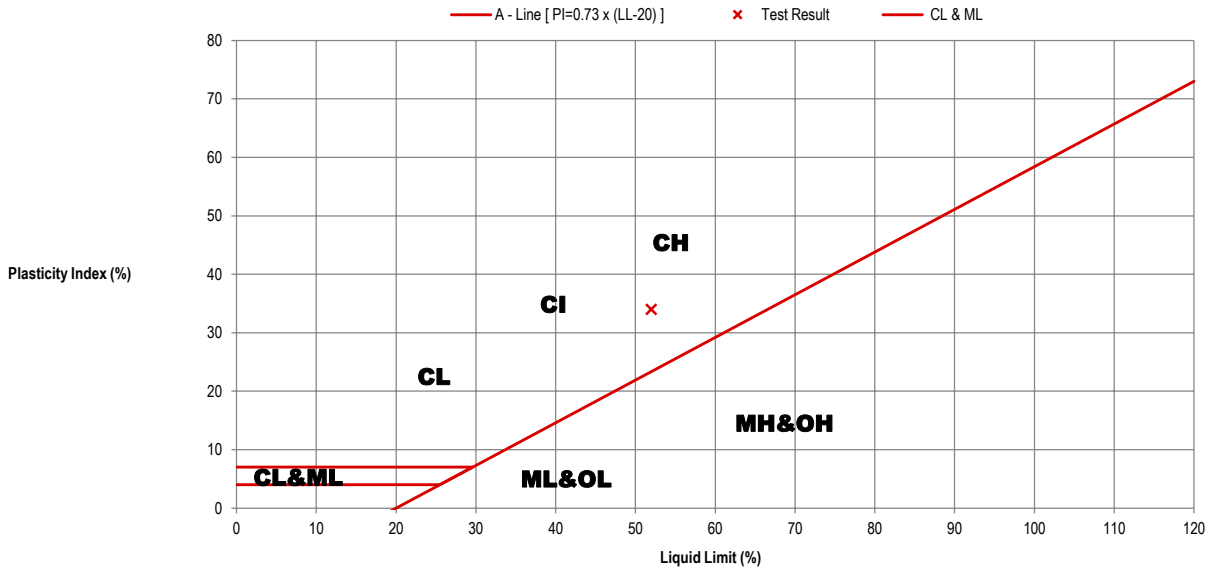
Test Method: AS 1289 2.1.1, 3.1.2, 3.2.1, 3.3.1, 3.4.1

Client	Golder Associates Pty Limited	**Report No.**	GA101496-AL
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR1
		Test Date	28/11/2018
Project	Inland Rail Package 13	**Report Date**	30/11/2018
Project No.	1893802	**Client Sample No.**	330-01-BH2227-S00800
Bore Hole	330-01-BH2227	**Depth From (m)**	8
		Depth To (m)	8.45
Description	SPT		

RESULTS OF TESTING

Liquid Limit (%)	**52**	
Plastic Limit (%)	**18**	
Plasticity Index (%)	**34**	
Linear Shrinkage (%)	**14.0**	**Curling Ocurred**
Moisture Content (%)	**19.5**	
Preparation Method	**Dry Sieved and Oven Dried**	

Plasticity Chart



Remarks:

Sample/s supplied by client

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory

C. Park

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

ATTERBERG LIMITS TEST REPORT

Test Method: AS 1289 2.1.1, 3.1.2, 3.2.1, 3.3.1, 3.4.1

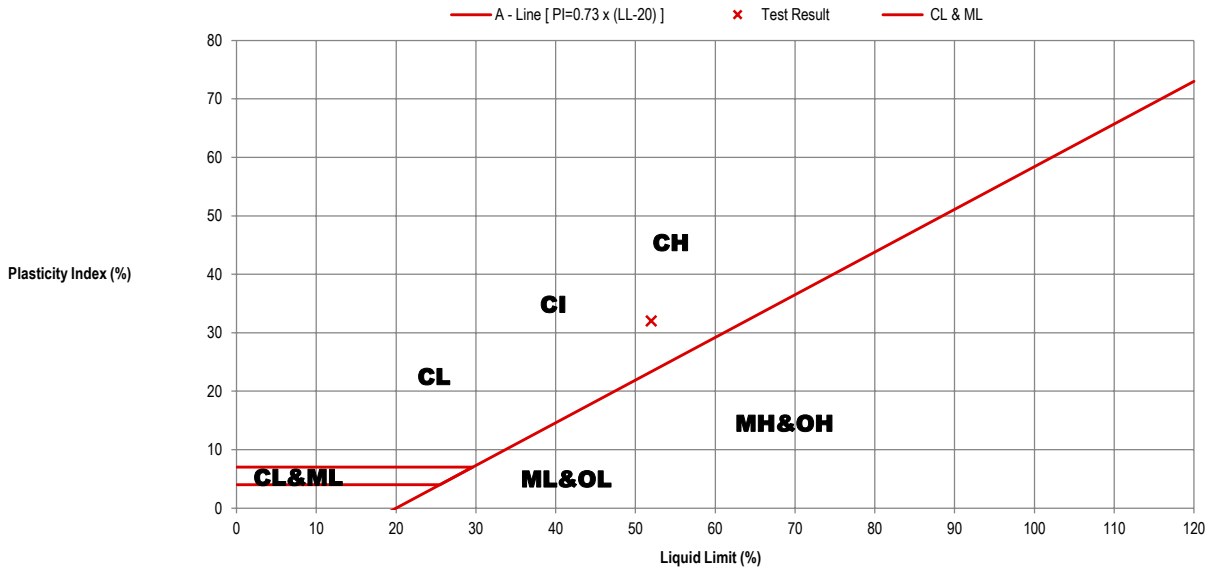
Client	Golder Associates Pty Limited	**Report No.**	GA101499-AL
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR1
		Test Date	27/11/2018
Project	Inland Rail Package 13	**Report Date**	30/11/2018

Project No.	1893802	**Client Sample No.**	330-01-BH2227-U01150		
Bore Hole	330-01-BH2227	**Depth From (m)**	11.5	**Depth To (m)**	11.95
Description	U				

RESULTS OF TESTING

Liquid Limit (%)	**52**	
Plastic Limit (%)	**20**	
Plasticity Index (%)	**32**	
Linear Shrinkage (%)	**14.5**	**Curling Ocurred**
Moisture Content (%)	**23.5**	
Preparation Method	**Dry Sieved and Oven Dried**	

Plasticity Chart



Remarks:

Sample/s supplied by client

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory

C. Park

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

ACCURATE QUALITY RESULTS FOR TOMORROW'S ENGINEERING

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

ATTERBERG LIMITS TEST REPORT

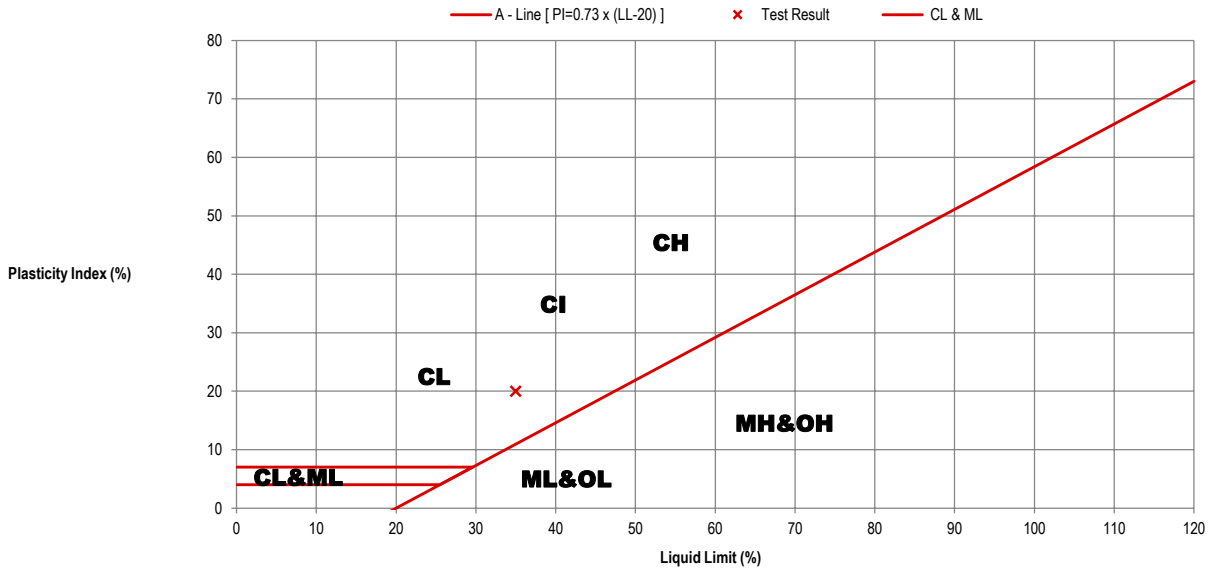
Test Method: AS 1289 2.1.1, 3.1.2, 3.2.1, 3.3.1, 3.4.1

Client	Golder Associates Pty Limited	**Report No.**	GA101501-AL
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR1
		Test Date	27/11/2018
Project	Inland Rail Package 13	**Report Date**	30/11/2018
Project No.	1893802	**Client Sample No.**	330-01-BH2227-U01400
Bore Hole	330-01-BH2227	**Depth From (m)**	14
		Depth To (m)	14.45
Description	U		

RESULTS OF TESTING

Liquid Limit (%)	**35**	
Plastic Limit (%)	**15**	
Plasticity Index (%)	**20**	
Linear Shrinkage (%)	**11.0**	**Curling Ocurred**
Moisture Content (%)	**22.6**	
Preparation Method	**Dry Sieved and Oven Dried**	

Plasticity Chart



Remarks:

Sample/s supplied by client

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory

C. Park

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

ATTERBERG LIMITS TEST REPORT

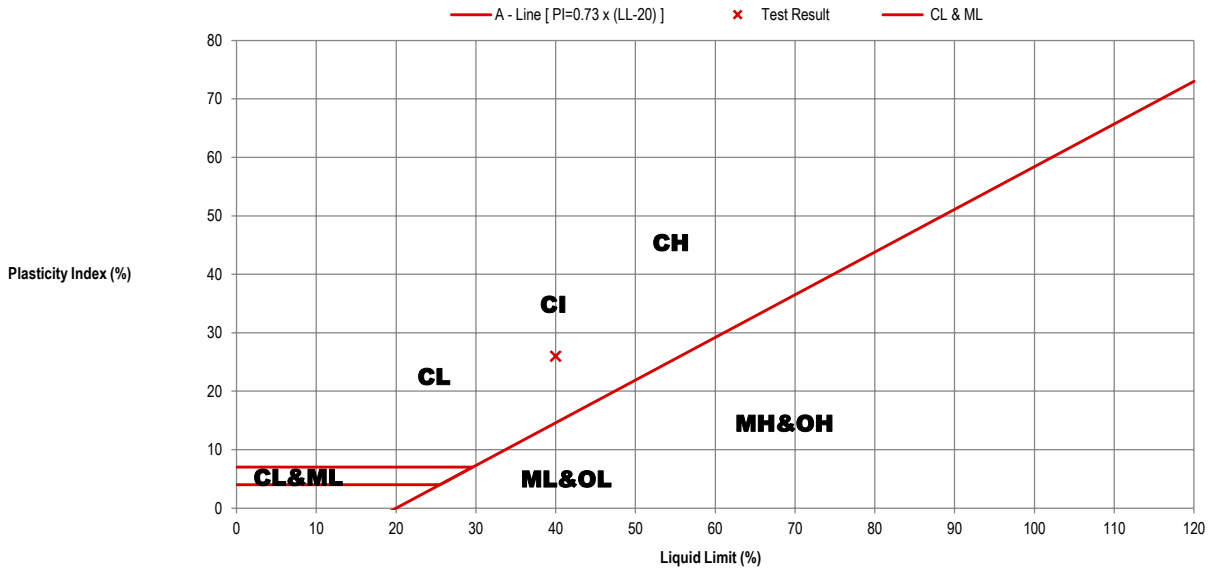
Test Method: AS 1289 2.1.1, 3.1.2, 3.2.1, 3.3.1, 3.4.1

Client	Golder Associates Pty Limited	**Report No.**	GA101503-AL
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR1
		Test Date	28/11/2018
Project	Inland Rail Package 13	**Report Date**	30/11/2018
Project No.	1893802	**Client Sample No.**	330-01-BH2227-S01700
Bore Hole	330-01-BH2227	**Depth From (m)**	17
		Depth To (m)	17.27
Description	SPT		

RESULTS OF TESTING

Liquid Limit (%)	**40**	
Plastic Limit (%)	**14**	
Plasticity Index (%)	**26**	
Linear Shrinkage (%)	**11.0**	**Curling Ocurred**
Moisture Content (%)	**13.8**	
Preparation Method	**Dry Sieved and Oven Dried**	

Plasticity Chart



Remarks:

Sample/s supplied by client

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory

C. Park

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

ACCURATE QUALITY RESULTS FOR TOMORROW'S ENGINEERING

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

ATTERBERG LIMITS TEST REPORT

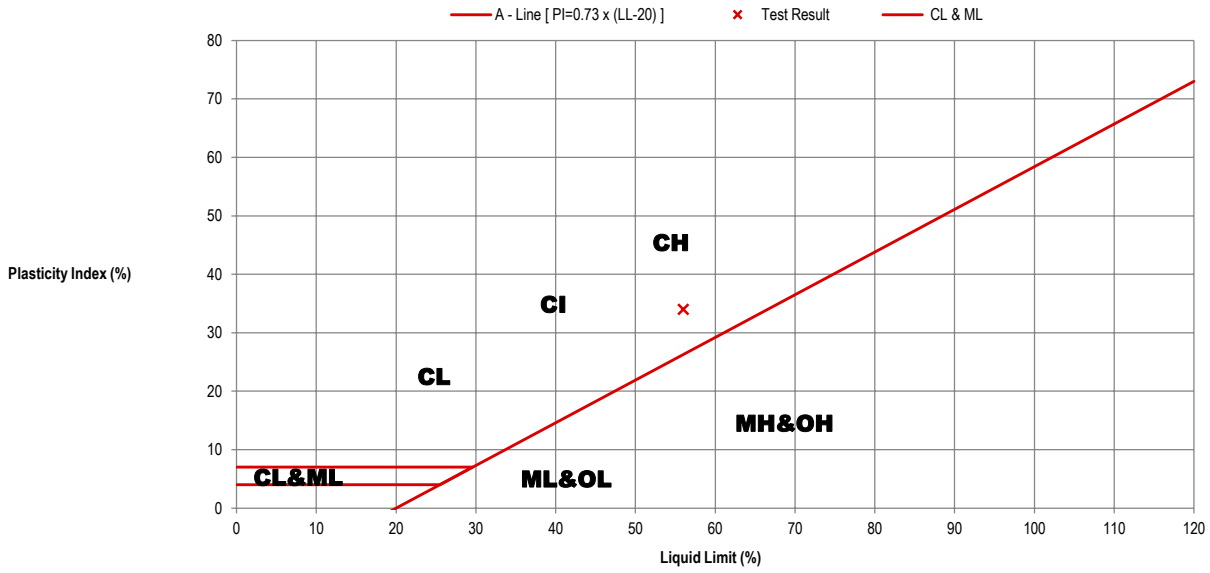
Test Method: AS 1289 2.1.1, 3.1.2, 3.2.1, 3.3.1, 3.4.1

Client	Golder Associates Pty Limited	**Report No.**	GA101568-AL
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR1
		Test Date	28/11/2018
Project	Inland Rail Package 13	**Report Date**	30/11/2018
Project No.	1893802	**Client Sample No.**	330-01-DH2503-S00050
Bore Hole	330-01-DH2503	**Depth From (m)**	0.5
		Depth To (m)	0.95
Description	SPT		

RESULTS OF TESTING

Liquid Limit (%)	**56**	
Plastic Limit (%)	**22**	
Plasticity Index (%)	**34**	
Linear Shrinkage (%)	**16.0**	**Cracking & Curling Ocurred**
Moisture Content (%)	**23.5**	
Preparation Method	**Dry Sieved and Oven Dried**	

Plasticity Chart



Remarks:

Sample/s supplied by client

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory

C. Park

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

ATTERBERG LIMITS TEST REPORT

Test Method: AS 1289 2.1.1, 3.1.2, 3.2.1, 3.3.1, 3.4.1

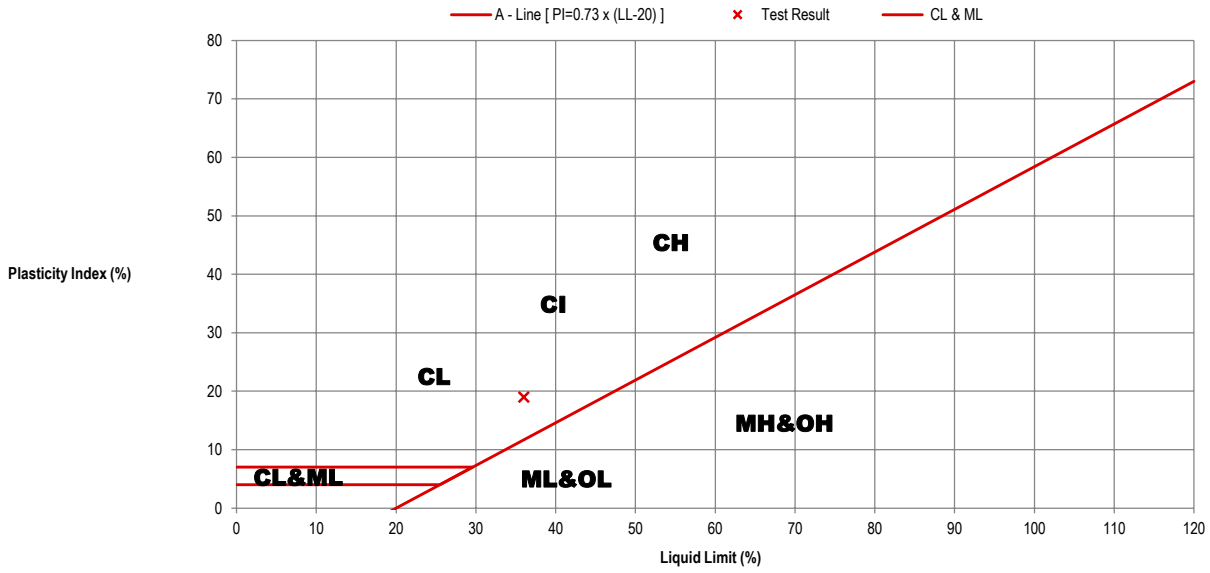
Client	Golder Associates Pty Limited	**Report No.**	GA101569-AL
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR1
		Test Date	29/11/2018
Project	Inland Rail Package 13	**Report Date**	30/11/2018

Project No.	1893802	**Client Sample No.**	330-01-DH2503-S00200		
Bore Hole	330-01-DH2503	**Depth From (m)**	2	**Depth To (m)**	2.45
Description	SPT				

RESULTS OF TESTING

Liquid Limit (%)	**36**	
Plastic Limit (%)	**17**	
Plasticity Index (%)	**19**	
Linear Shrinkage (%)	**8.0**	**Cracking & Curling Ocurred**
Moisture Content (%)	**15.6**	
Preparation Method	**Dry Sieved and Oven Dried**	

Plasticity Chart



Remarks:

Sample/s supplied by client

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory

C. Park

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

ACCURATE QUALITY RESULTS FOR TOMORROW'S ENGINEERING

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

ATTERBERG LIMITS TEST REPORT

Test Method: AS 1289 2.1.1, 3.1.2, 3.2.1, 3.3.1, 3.4.1

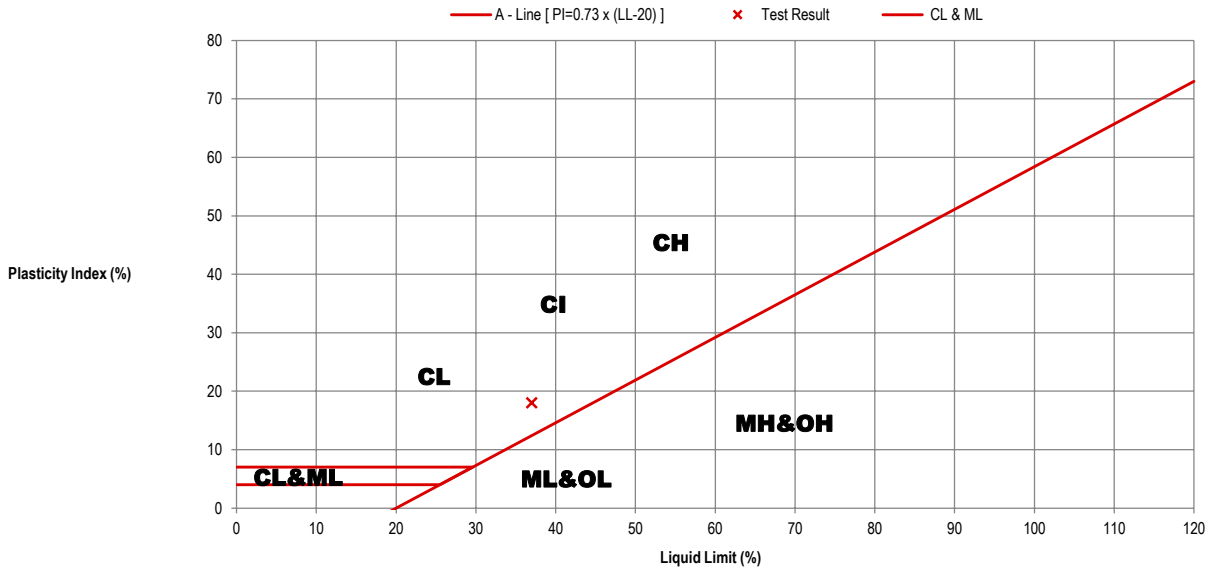
Client	Golder Associates Pty Limited	**Report No.**	GA101570-AL
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR1
		Test Date	28/11/2018
Project	Inland Rail Package 13	**Report Date**	30/11/2018

Project No.	1893802	**Client Sample No.**	330-01-DH2503-S00350		
Bore Hole	330-01-DH2503	**Depth From (m)**	3.5	**Depth To (m)**	3.95
Description	SPT				

RESULTS OF TESTING

Liquid Limit (%)	**37**	
Plastic Limit (%)	**19**	
Plasticity Index (%)	**18**	
Linear Shrinkage (%)	**8.5**	**Cracking & Curling Ocurred**
Moisture Content (%)	**22.9**	
Preparation Method	**Dry Sieved and Oven Dried**	

Plasticity Chart



Remarks:

Sample/s supplied by client

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory

C. Park

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

ATTERBERG LIMITS TEST REPORT

Test Method: AS 1289 2.1.1, 3.1.2, 3.2.1, 3.3.1, 3.4.1

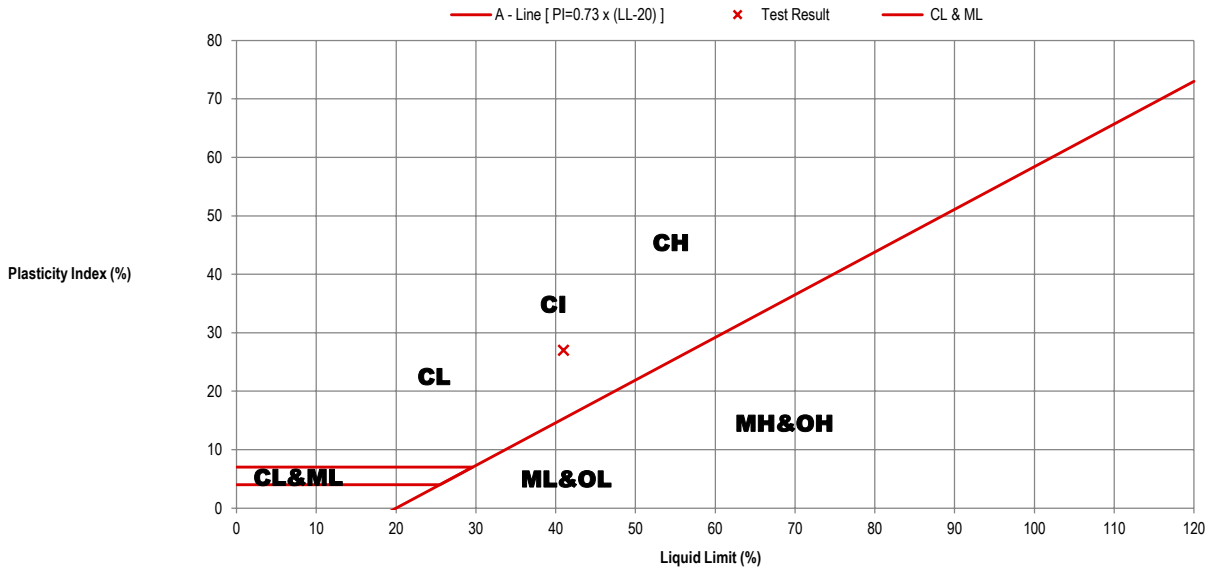
Client	Golder Associates Pty Limited	**Report No.**	GA101572-AL
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR1
		Test Date	29/11/2018
Project	Inland Rail Package 13	**Report Date**	30/11/2018

Project No.	1893802	**Client Sample No.**	330-01-DH2503-U00650		
Bore Hole	330-01-DH2503	**Depth From (m)**	6.5	**Depth To (m)**	6.89
Description	U				

RESULTS OF TESTING

Liquid Limit (%)	**41**	
Plastic Limit (%)	**14**	
Plasticity Index (%)	**27**	
Linear Shrinkage (%)	**13.5**	**Cracking & Curling Ocurred**
Moisture Content (%)	**15.2**	
Preparation Method	**Dry Sieved and Oven Dried**	

Plasticity Chart



Remarks:

Sample/s supplied by client

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory

C. Park

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

ATTERBERG LIMITS TEST REPORT

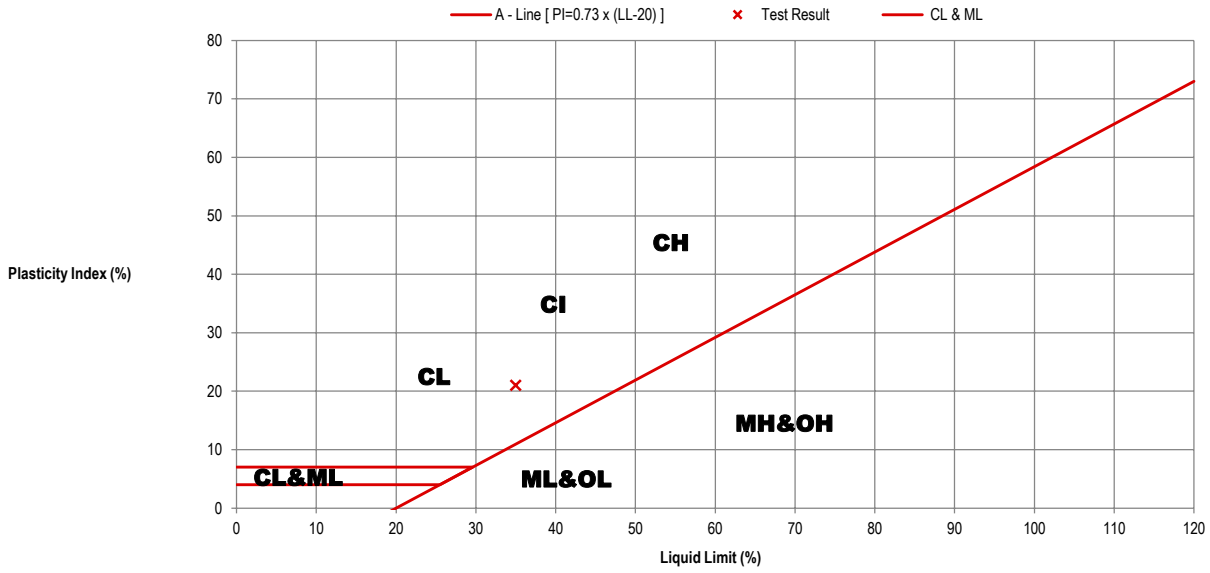
Test Method: AS 1289 2.1.1, 3.1.2, 3.2.1, 3.3.1, 3.4.1

Client	Golder Associates Pty Limited	**Report No.**	GA101713-AL
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR2
		Test Date	5/12/2018
Project	Inland Rail Package 13	**Report Date**	10/12/2018
Project No.	1893802	**Client Sample No.**	330-01-BH2103-S00050
Bore Hole	330-01-BH2103	**Depth From (m)**	0.5
		Depth To (m)	0.95
Description	SPT		

RESULTS OF TESTING

Liquid Limit (%)	**35**	
Plastic Limit (%)	**14**	
Plasticity Index (%)	**21**	
Linear Shrinkage (%)	**11.5**	**Curling Ocurred**
Moisture Content (%)	**7.3**	
Preparation Method	**Dry Sieved and Oven Dried**	

Plasticity Chart



Remarks:

Sample/s supplied by client

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory

C. Park

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

ATTERBERG LIMITS TEST REPORT

Test Method: AS 1289 2.1.1, 3.1.2, 3.2.1, 3.3.1, 3.4.1

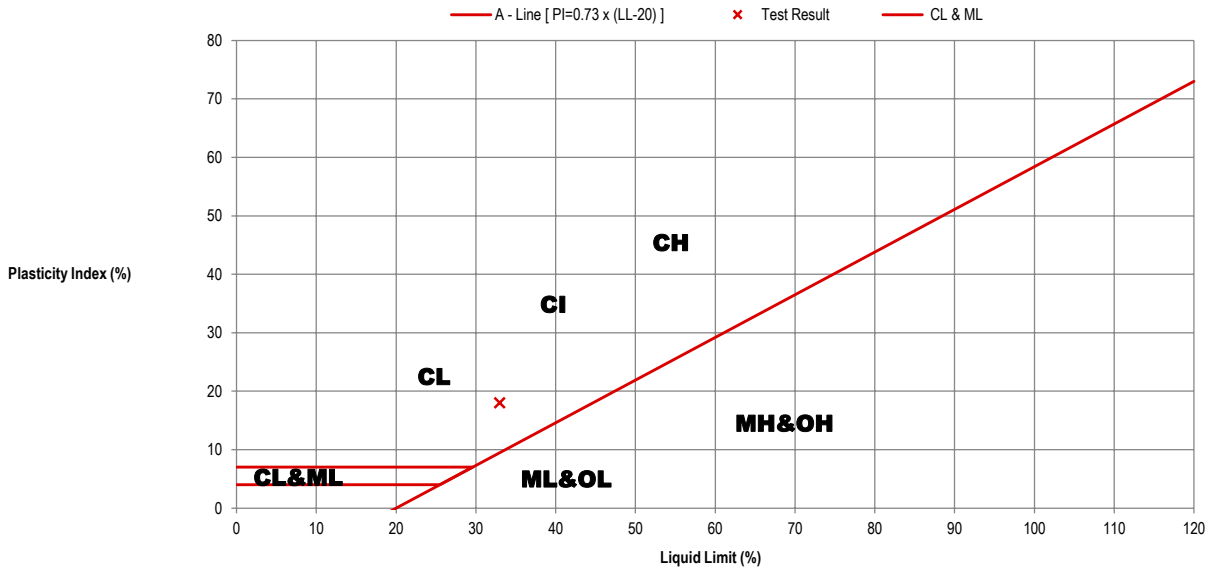
Client	Golder Associates Pty Limited	**Report No.**	GA101715-AL
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR2
		Test Date	5/12/2018
Project	Inland Rail Package 13	**Report Date**	10/12/2018

Project No.	1893802	**Client Sample No.**	330-01-BH2103-S00350		
Bore Hole	330-01-BH2103	**Depth From (m)**	3.5	**Depth To (m)**	3.95
Description	SPT				

RESULTS OF TESTING

Liquid Limit (%)	**33**	
Plastic Limit (%)	**15**	
Plasticity Index (%)	**18**	
Linear Shrinkage (%)	**9.5**	**Curling Ocurred**
Moisture Content (%)	**13.8**	
Preparation Method	**Dry Sieved and Oven Dried**	

Plasticity Chart



Remarks:

Sample/s supplied by client

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory

C. Park

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

ACCURATE QUALITY RESULTS FOR TOMORROW'S ENGINEERING

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

ATTERBERG LIMITS TEST REPORT

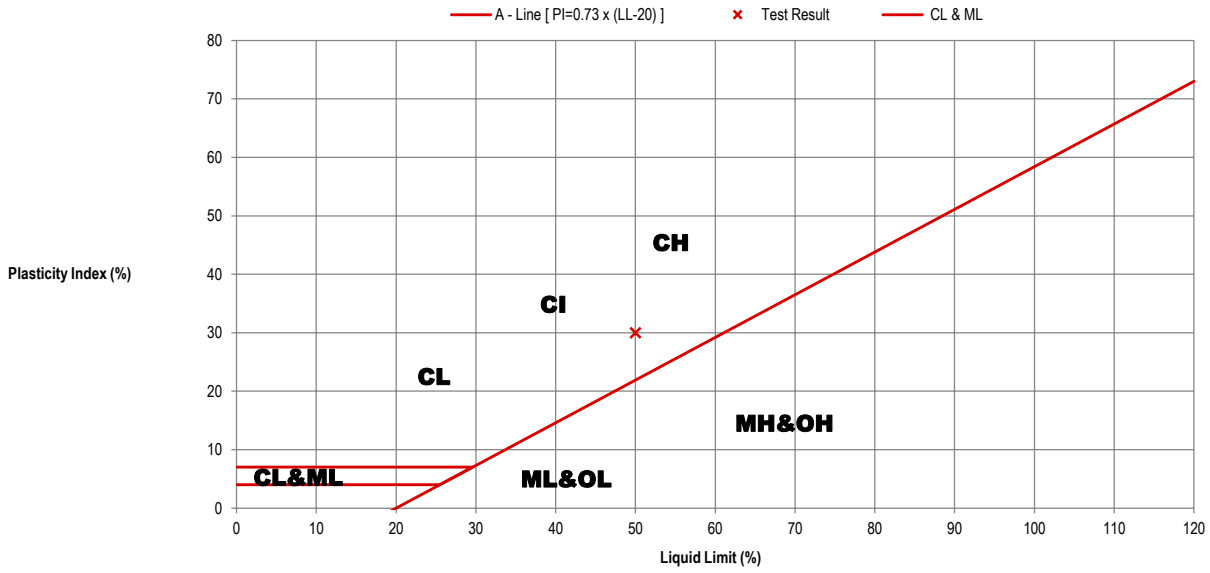
Test Method: AS 1289 2.1.1, 3.1.2, 3.2.1, 3.3.1, 3.4.1

Client	Golder Associates Pty Limited	**Report No.**	GA101717-AL
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR2
		Test Date	5/12/2018
Project	Inland Rail Package 13	**Report Date**	10/12/2018
Project No.	1893802	**Client Sample No.**	330-01-BH2103-U00600
Bore Hole	330-01-BH2103	**Depth From (m)** 6	**Depth To (m)** 6.29
Description	U		

RESULTS OF TESTING

Liquid Limit (%)	**50**	
Plastic Limit (%)	**20**	
Plasticity Index (%)	**30**	
Linear Shrinkage (%)	**13.0**	**Curling Ocurred**
Moisture Content (%)	**23.8**	
Preparation Method	**Dry Sieved and Oven Dried**	

Plasticity Chart



Remarks:

Sample/s supplied by client

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory

C. Park

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

ATTERBERG LIMITS TEST REPORT

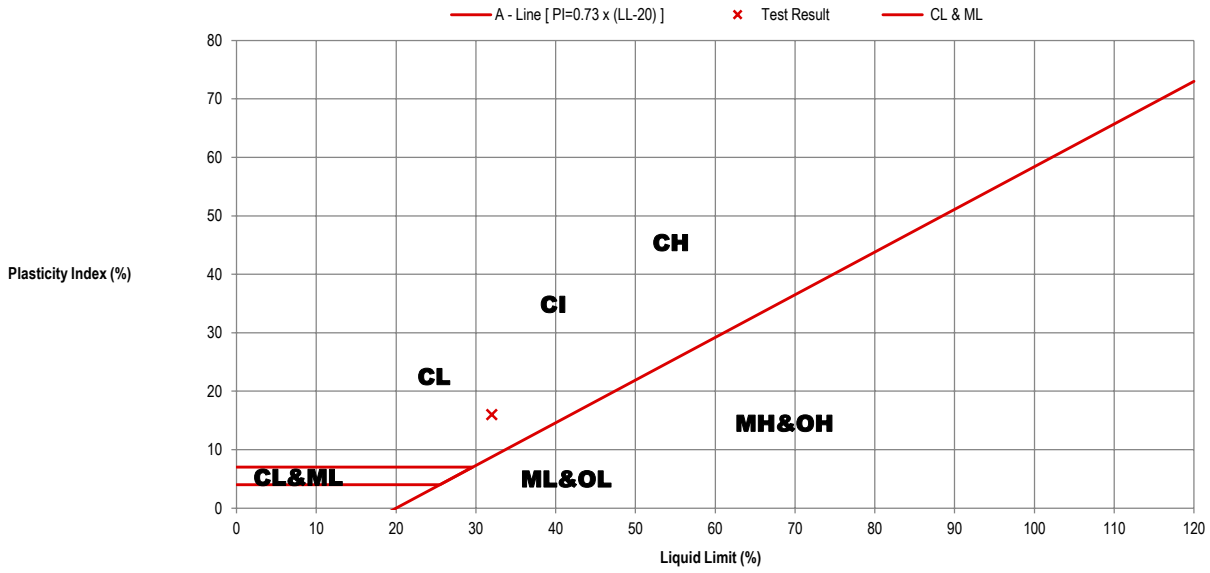
Test Method: AS 1289 2.1.1, 3.1.2, 3.2.1, 3.3.1, 3.4.1

Client	Golder Associates Pty Limited	**Report No.**	GA101740-AL
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR2
		Test Date	5/12/2018
Project	Inland Rail Package 13	**Report Date**	10/12/2018
Project No.	1893802	**Client Sample No.**	330-01-BH2104-S00050
Bore Hole	330-01-BH2104	**Depth From (m)**	0.5
		Depth To (m)	0.95
Description	SPT		

RESULTS OF TESTING

Liquid Limit (%)	**32**	
Plastic Limit (%)	**16**	
Plasticity Index (%)	**16**	
Linear Shrinkage (%)	**6.5**	**Curling Ocurred**
Moisture Content (%)	**9.3**	
Preparation Method	**Dry Sieved and Oven Dried**	

Plasticity Chart



Remarks:

Sample/s supplied by client

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory

C. Park

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

ATTERBERG LIMITS TEST REPORT

Test Method: AS 1289 2.1.1, 3.1.2, 3.2.1, 3.3.1, 3.4.1

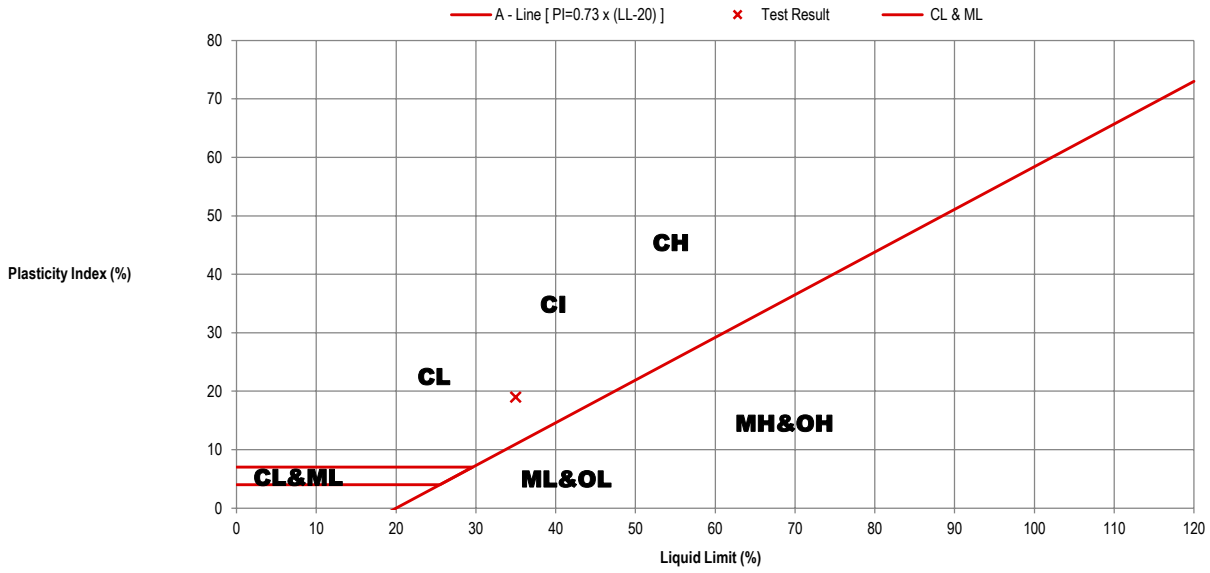
Client	Golder Associates Pty Limited	**Report No.**	GA101742-AL
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR2
		Test Date	5/12/2018
Project	Inland Rail Package 13	**Report Date**	10/12/2018

Project No.	1893802	**Client Sample No.**	330-01-BH2104-S00350		
Bore Hole	330-01-BH2104	**Depth From (m)**	3.5	**Depth To (m)**	3.94
Description	SPT				

RESULTS OF TESTING

Liquid Limit (%)	**35**	
Plastic Limit (%)	**16**	
Plasticity Index (%)	**19**	
Linear Shrinkage (%)	**10.5**	**Curling Ocurred**
Moisture Content (%)	**11.6**	
Preparation Method	**Dry Sieved and Oven Dried**	

Plasticity Chart



Remarks:

Sample/s supplied by client

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory

C. Park

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

ATTERBERG LIMITS TEST REPORT

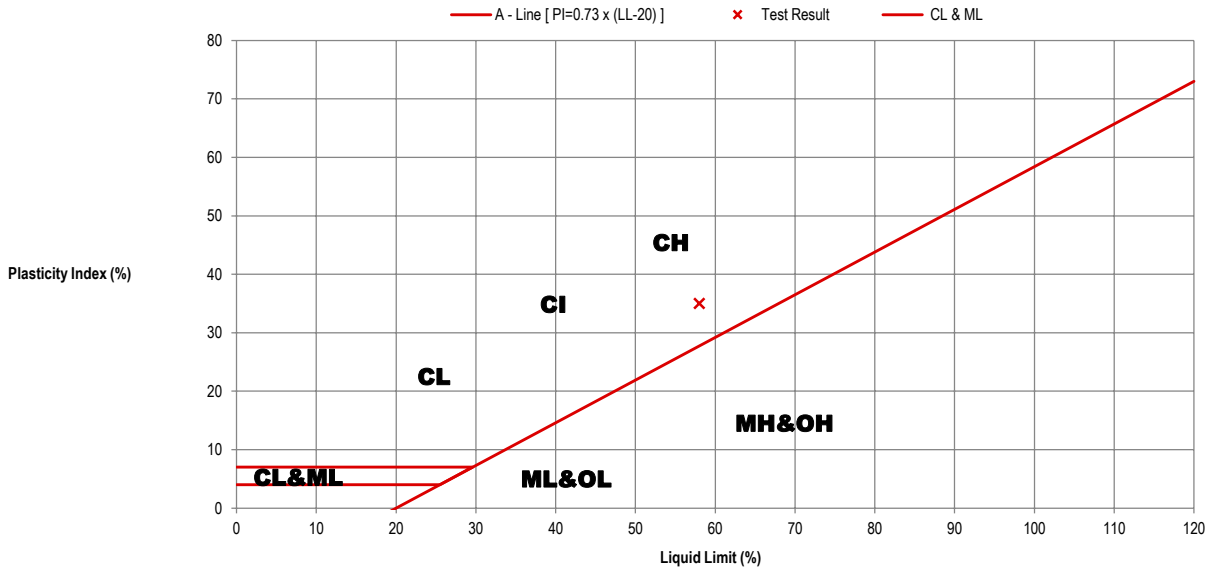
Test Method: AS 1289 2.1.1, 3.1.2, 3.2.1, 3.3.1, 3.4.1

Client	Golder Associates Pty Limited	**Report No.**	GA101745-AL
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR2
		Test Date	5/12/2018
Project	Inland Rail Package 13	**Report Date**	10/12/2018
Project No.	1893802	**Client Sample No.**	330-01-BH2104-S00800
Bore Hole	330-01-BH2104	**Depth From (m)** 8	**Depth To (m)** 8.45
Description	SPT		

RESULTS OF TESTING

Liquid Limit (%)	**58**	
Plastic Limit (%)	**23**	
Plasticity Index (%)	**35**	
Linear Shrinkage (%)	**16.5**	**Curling Ocurred**
Moisture Content (%)	**20.1**	
Preparation Method	**Dry Sieved and Oven Dried**	

Plasticity Chart



Remarks:

Sample/s supplied by client

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory

C. Park

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

ATTERBERG LIMITS TEST REPORT

Test Method: AS 1289 2.1.1, 3.1.2, 3.2.1, 3.3.1, 3.4.1

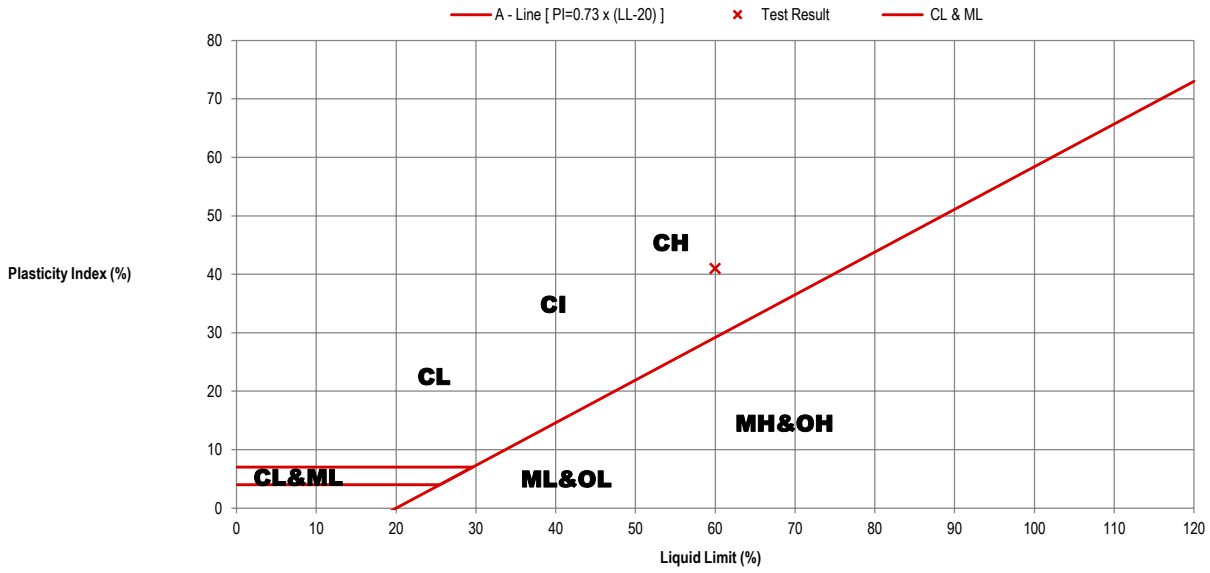
Client	Golder Associates Pty Limited	**Report No.**	GA101836-AL
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR3
		Test Date	21/01/2019
Project	Inland Rail Package 13	**Report Date**	23/01/2019

Project No.	1893802	**Client Sample No.**	330-01-BH2306-S00050-ATT : 330-01-BH2306-S00050-MOI		
Bore Hole	330-01-BH2306	**Depth From (m)**	0.5	**Depth To (m)**	0.95
Description	SPT				

RESULTS OF TESTING

Liquid Limit (%)	**60**	
Plastic Limit (%)	**19**	
Plasticity Index (%)	**41**	
Linear Shrinkage (%)	**16.5**	**Curling Ocurred**
Moisture Content (%)	**15.0**	
Preparation Method	**Dry Sieved and Oven Dried**	

Plasticity Chart



Remarks:

Sample/s supplied by client

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory

C. Channon

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

ACCURATE QUALITY RESULTS FOR TOMORROW'S ENGINEERING

Emerson Class

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

EMERSON CLASS NUMBER TEST REPORT

Test Method: AS 1289 3.8.1

Client	Golder Associates Pty Limited	**Report No.**	GA101836 - 101836-EM
		Request No	1893802_H2C_TR3
Address	PO Box 1734 MILTON BC QLD 4064	**Test Date**	15/01/2019
		Report Date	17/01/2019
Project	Inland Rail Package 13	**Project No**	1893802

RESULTS OF TESTING

Sample No	Client Sample No	Bore Hole	Depth From (m)	Depth To (m)	Description	Emerson Class Number
GA101836-EM	330-01-BH2306-S00050	330-01-BH2306	0.5	0.95	SILTY CLAY - brown / yellow	2

NOTES/REMARKS:

Sample/s supplied by the client

Tested with Distilled water at 22°C

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

EMERSON CLASS NUMBER TEST REPORT

Test Method: AS 1289 3.8.1

Client	Golder Associates Pty Limited	**Report No.**	GA101713 - 101740-EM
		Request No	1893802_H2C_TR2
Address	PO Box 1734 MILTON BC QLD 4064	**Test Date**	03/12/2018
		Report Date	05/12/2018
Project	Inland Rail Package 13	**Project No**	1893802

RESULTS OF TESTING

Sample No	Bore Hole	Depth From (m)	Depth To (m)	Description	Emerson Class Number
GA101713-EM	330-01-BH2103	0.5	0.95	Sandy CLAY - brown	6
GA101715-EM	330-01-BH2103	3.5	3.95	Gravelly Clayey SAND - brown	3
GA101717-EM	330-01-BH2103	6	6.29	Sandy CLAY - grey / brown	4
GA101740-EM	330-01-BH2104	0.5	0.95	Clayey SAND - brown	6

NOTES/REMARKS:

Sample/s supplied by the client

Tested with Distilled water at 21.5°C

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

EMERSON CLASS NUMBER TEST REPORT

Test Method: AS 1289 3.8.1

Client	Golder Associates Pty Limited	**Report No.**	GA101568 - 101570-EM
		Request No	1893802_H2C_TR1
Address	PO Box 1734 MILTON BC QLD 4064	**Test Date**	21/11/18-30/11/18
		Report Date	03/12/2018
Project	Inland Rail Package 13	**Project No**	1893802

RESULTS OF TESTING

Sample No	Bore Hole	Depth From (m)	Depth To (m)	Description	Emerson Class Number
GA101568-EM	330-01-DH2503	0.5	0.95	Sandy CLAY - dark brown	5
GA101569-EM	330-01-DH2503	2	2.45	Sandy CLAY - brown	3
GA101570-EM	330-01-DH2503	3.5	3.95	Sandy CLAY - dark brown	5

NOTES/REMARKS:

Sample/s supplied by the client

Tested with Distilled water at 21.4°C

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Shrink Swell Index

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

SHRINK SWELL INDEX TEST REPORT

Test Method AS 1289 7.1.1

Client	Golder Associates Pty Limited			**Report No.**	GA101457-ISS
				Request No.	1893802_H2C_TR1
Address	PO Box 1734 MILTON BC	QLD	4064	**Test Date**	27/11/2018
				Report Date	4/12/2018
Project	Inland Rail Package 13				
Description	U				

Sample No.	330-01-BH2216-U00350
Client ID	330-01-BH2216
Depth (m)	3.5-3.96

RESULTS OF TESTING

SWELL SPECIMEN

Swell Pressure (kPa) *	25
Wet Density (t/m^3)	1.82
Initial Moisture Content (%)	31.1
Final Moisture Content (%)	36.7
Swell (%)	**0.1**

SHRINKAGE SPECIMEN

Estimated Inert Inclusions (%)	10-20
Extent of Crumbling	Nil
Extent of Cracking	High
Moisture (%)	27.6
Shrinkage (%)	**2.6**

SHRINK SWELL INDEX (Iss) (%)	**1.5**

Notes/Remarks:

* Swell pressure determination in accordance with test method AS4133.3.3

Sample/s supplied by client Tested as received

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory

Authorised Signatory
Authorised Signatory
C. Park
J. Russell

NATA
ACCREDITED FOR TECHNICAL COMPETENCE
Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

SHRINK SWELL INDEX TEST REPORT

Test Method AS 1289 7.1.1

Client	Golder Associates Pty Limited			**Report No.**	GA101572-ISS
				Request No.	1893802_H2C_TR1
Address	PO Box 1734 MILTON BC	QLD	4064	**Test Date**	27/11/2018
				Report Date	4/12/2018
Project	Inland Rail Package 13				
Description	U				

Sample No.	330-01-DH2503-U00650
Client ID	330-01-DH2503
Depth (m)	6.5-6.89

RESULTS OF TESTING

SWELL SPECIMEN

Swell Pressure (kPa) *	75
Wet Density (t/m^3)	2.03
Initial Moisture Content (%)	15.2
Final Moisture Content (%)	19.9
Swell (%)	**1.7**

SHRINKAGE SPECIMEN

Estimated Inert Inclusions (%)	5-10
Extent of Crumbling	Nil
Extent of Cracking	Slight
Moisture (%)	14.6
Shrinkage (%)	**3.1**

SHRINK SWELL INDEX (Iss) (%)	**2.2**

Notes/Remarks:

* Swell pressure determination in accordance with test method AS4133.3.3

Sample/s supplied by client Tested as received

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory

Authorised Signatory
Authorised Signatory
C. Park
J. Russell

NATA
ACCREDITED FOR TECHNICAL COMPETENCE
Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

SHRINK SWELL INDEX TEST REPORT

Test Method AS 1289 7.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101836-ISS
		Request No.	1893802_H2C_TR3
Address	PO Box 1734 MILTON BC QLD 4064	**Test Date**	15/01/2019
		Report Date	22/01/2019
Project	Inland Rail Package 13		
Description	SILTY CLAY-brown/yellow		

Sample No.	330-01-BH2306-S00050
Client ID	330-01-BH2306
Depth (m)	0.5-0.95

RESULTS OF TESTING

SWELL SPECIMEN

Swell Pressure (kPa) *	-
Wet Density (t/m^3)	1.86
Initial Moisture Content (%)	15.0
Final Moisture Content (%)	26.3
Swell (%)	**8.9**

SHRINKAGE SPECIMEN

Estimated Inert Inclusions (%)	5-10
Extent of Crumbling	Nil
Extent of Cracking	Nil
Moisture (%)	14.0
Shrinkage (%)	**1.6**

SHRINK SWELL INDEX (Iss) (%)	**3.3**

Notes/Remarks: Single Individual Specimen remoulded to a target density of Field Wet Density at Field Moisture Content (-2.36mm material tested)

Sample/s supplied by client

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory

Authorised Signatory

C. Channon

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Triaxial Test Reports UU

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

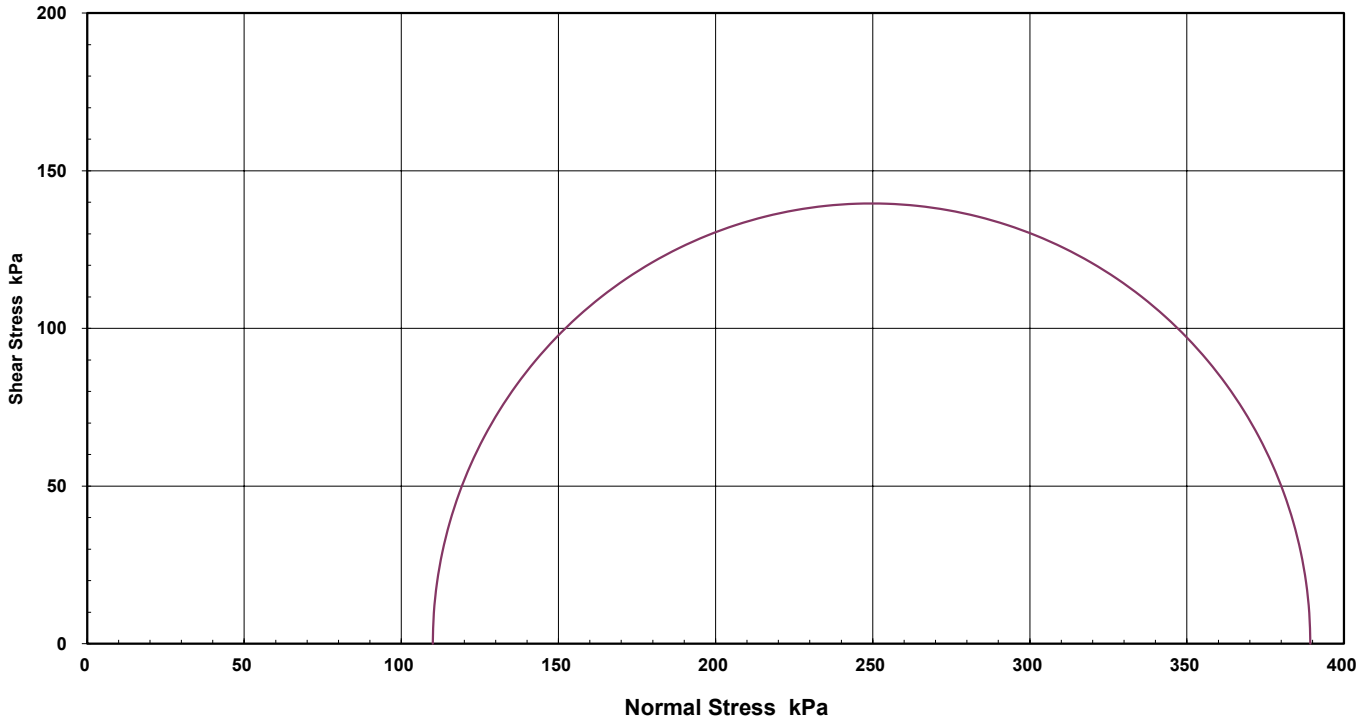
TRIAXIAL TEST REPORT

Test Method: AS1289.6.4.1

Client	Golder Associates Pty Limited	**Report No.**	GA101459- UU
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR1
		Test Date	26/11/2018
Project	Inland Rail Package 13	**Report Date**	3/12/2018

Project No.	1893802	**Client Sample No.**	330-01-BH2216-U00650
BoreHole	330-01-BH2216	**Depth From (m)** 6.5	**Depth To (m)** 6.99
Description	U	**Sample Type**	Single Individual Undisturbed Specimen

Mohr Circle Diagram



Interpretation between stages

Cohesion C (kPa)

Angle of Shear Resistance Φ (^{0})

MOISTURE CONTENTS	**Initial** 32.3 %	**Final** 32.3 %	**Failure Criteria** Maximum Deviator Stress

SAMPLE & TEST DETAILS

Sample Details		
Initial Height	99.0	mm
Initial Diameter	47.7	mm
Wet Density	1.91	t/m^3
Dry Density	1.44	t/m^3
Rate of Strain	0.505	% / min

FAILURE DETAILS

Confining Pressure	Principal Stresses S_1	Principal Stresses S_3	Deviator Stress	Strain
110 kPa	389 kPa	110 kPa	279 kPa	2.53 %

Notes/Remarks:

Graph not to scale

Tested as received

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory

T. Lockhart

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

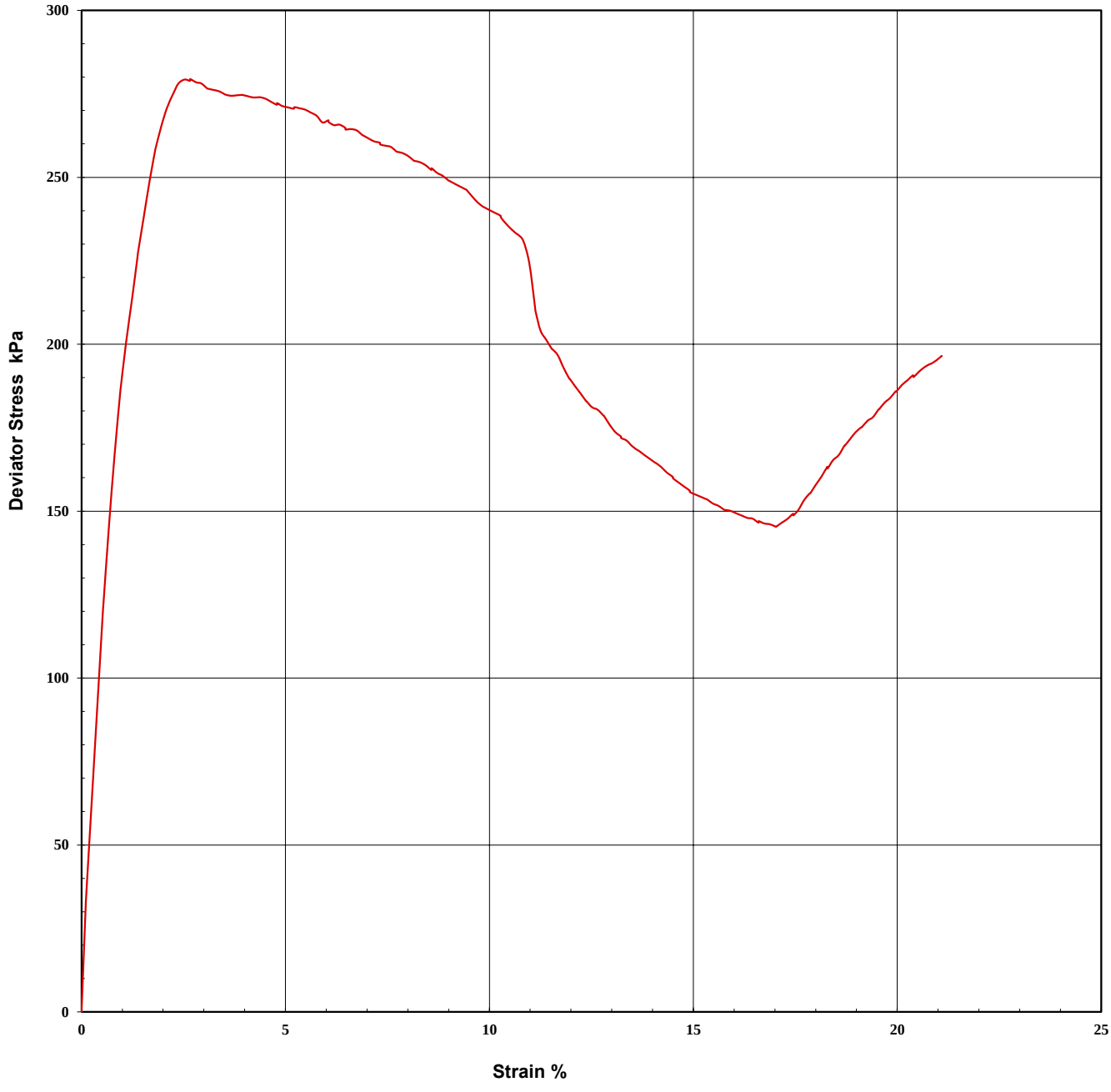
Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

TRIAXIAL TEST REPORT

Test Method: AS1289.6.4.1

Client	Golder Associates Pty Limited	**Report No.**	GA101459- UU

Stress/Strain Diagram



Notes/Remarks:

Graph not to scale

Tested as received

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory

T. Lockhart

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

TRIAXIAL TEST REPORT

Test Method: AS1289.6.4.1

Client	Golder Associates Pty Limited	**Report No.**	GA101459- UU

CLIENT:	Golder Associates Pty Limited	
PROJECT:	Inland Rail Package 13	BEFORE TEST
LAB SAMPLE No.	101459	DATE: 22/11/18
BOREHOLE:	330-01-BH2216	DEPTH: 6.5

CLIENT:	Golder Associates Pty Limited	
PROJECT:	Inland Rail Package 13	AFTER TEST
LAB SAMPLE No.	101459	DATE: 26/11/18
BOREHOLE:	330-01-BH2216	DEPTH: 6.5

Notes/Remarks:
Graph not to scale
Photo not to scale
Tested as received

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory

T. Lockhart

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

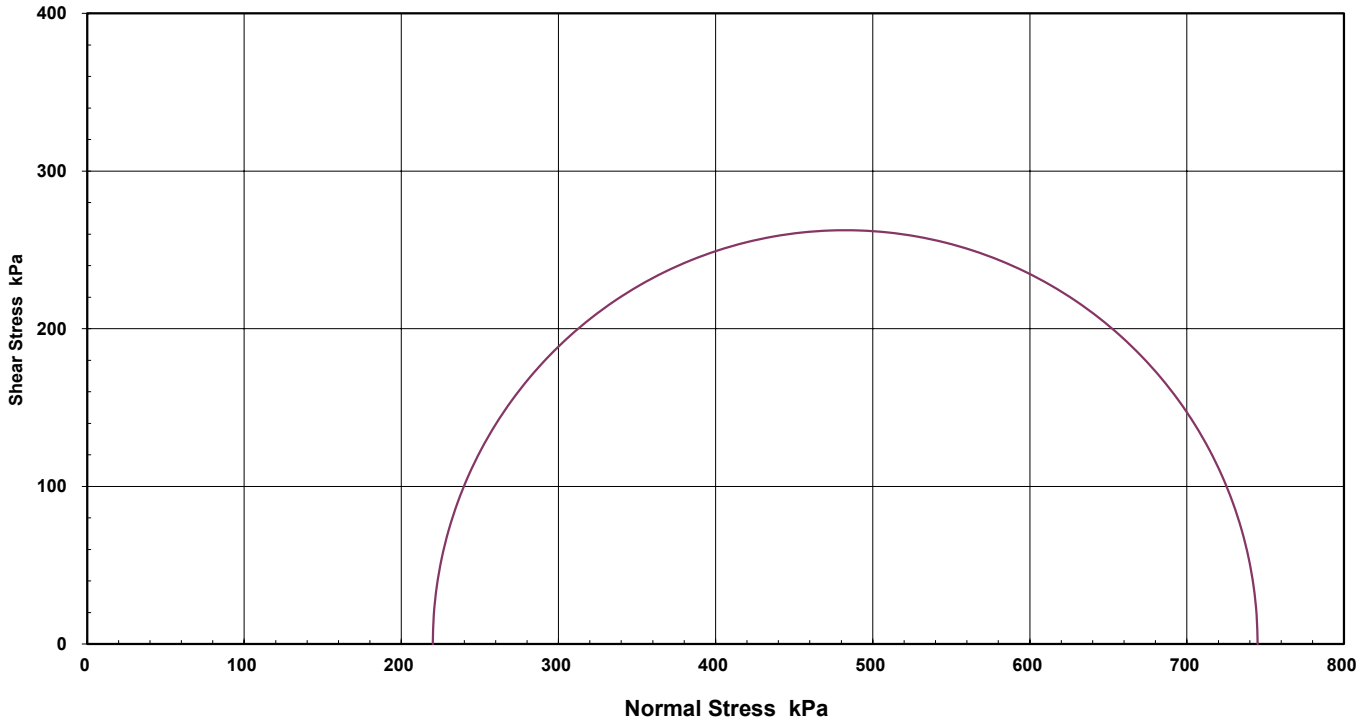
TRIAXIAL TEST REPORT

Test Method: AS1289.6.4.1

Client	Golder Associates Pty Limited	**Report No.**	GA101463- UU
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR1
		Test Date	26/11/2018
Project	Inland Rail Package 13	**Report Date**	3/12/2018

Project No.	1893802	**Client Sample No.**	330-01-BH2216-U01250
BoreHole	330-01-BH2216	**Depth From (m)** 12.5	**Depth To (m)** 12.99
Description	U	**Sample Type**	Single Individual Undisturbed Specimen

Mohr Circle Diagram



Interpretation between stages

Cohesion C (kPa)

Angle of Shear Resistance Φ (^{0})

MOISTURE CONTENTS	**Initial** 14.3 % **Final** 14.3 %	**Failure Criteria**	Maximum Deviator Stress

SAMPLE & TEST DETAILS

Sample Details			Confining Pressure
Initial Height	99.0	mm	
Initial Diameter	47.6	mm	220 kPa
Wet Density	2.08	t/m^3	
Dry Density	1.82	t/m^3	
Rate of Strain	0.505	% / min	

FAILURE DETAILS

Principal Stresses S_1	Principal Stresses S_3	Deviator Stress	Strain
745 kPa	220 kPa	525 kPa	11.70 %

Notes/Remarks:
Graph not to scale

Tested as received

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory

T. Lockhart

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

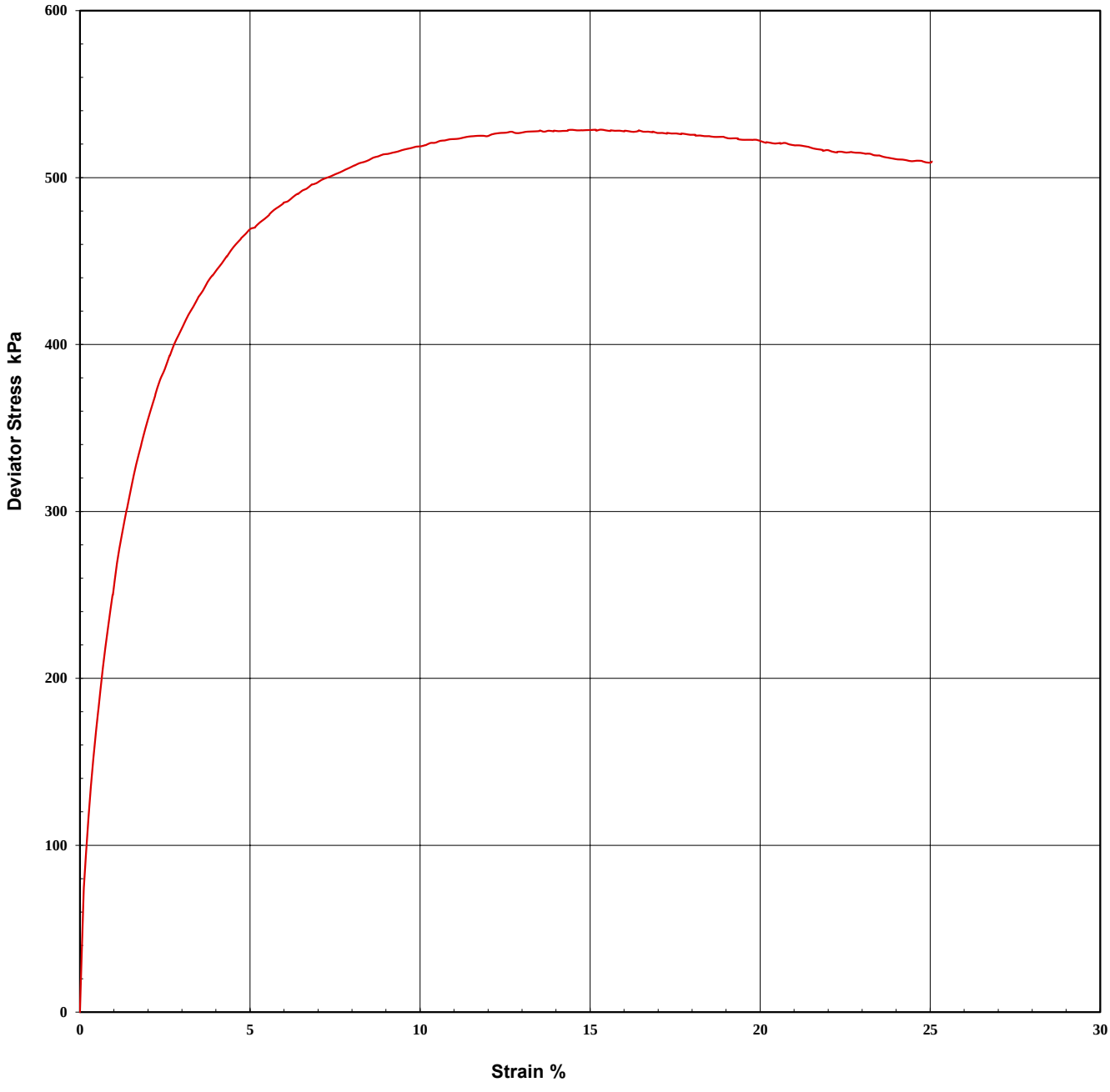
Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

TRIAXIAL TEST REPORT

Test Method: AS1289.6.4.1

Client	Golder Associates Pty Limited	**Report No.**	GA101463- UU

Stress/Strain Diagram



Notes/Remarks:
Graph not to scale

Tested as received

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory

T. Lockhart

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

TRIAXIAL TEST REPORT

Test Method: AS1289.6.4.1

Client	Golder Associates Pty Limited	**Report No.**	GA101463- UU

Notes/Remarks:
Graph not to scale
Photo not to scale
Tested as received

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory

T. Lockhart

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Triaxial Compression Rock

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

STRENGTH OF ROCK MATERIAL IN TRIAXIAL COMPRESSION

ASTM D7012

Standard Test Methods for Compressive Strength and Elastic Moduli of Intact Rock Core Specimens under Varying States of Stress and Temperatures

Method B : Elastic Moduli of Undrained Rock Core Specimens in Triaxial Compression Without Pore Pressure Measurements

Client	Golder Associates Pty Limited	**Report No.**	GA101598-RTX
		Request No.	330-01-BH2101
Address	PO Box 1734 MILTON BC QLD 4064	**Test Date**	24/01/2019
		Report Date	25/01/2019
Project	Inland Rail Package 13	**Depth From (m)**	81
Bore Hole	330-01-BH2101	**Depth To (m)**	82
Sample No:	330-01-BH2101-C08100		
Description	C		
Sample Type	Single Individual Rock Core Specimen		

Sample Details

Average Sample Diameter (mm)	60.9	Moisture Content (%)	5.9
Sample Height (mm)	152.64	Wet Density (t/m^3)	2.13
Duration of Test (min)	20:52:00	Dry Density (t/m^3)	2.01
Rate of Strain (%/min)	0.05	Bedding (^{o})	10
Mode of Failure	Shear	Test Apparatus	RTR2500 Triaxial Machine
Rupture Angle (°)	50		

Intact Test Results

	Value at Plastic Deformation	Value at Plastic Deformation	Value at Plastic Deformation	Value at Plastic Deformation	Value at Plastic Deformation	Peak Value
Confining Pressure (MPa)	2.00	5.00	8.01	12.01	15.00	15.00
Calc'd Deviator Stress (MPa)	16.0	22.1	27.7	32.8	-	-
Deviator Stress (MPa)	12.4	16.8	20.6	24.0	29.2	40.1
Axial Strain (με)	1894	2180	2499	2768	3389	8116
Diametral Strain (με)	-223	-282	-381	-446	-656	-2214
Tangent Modulus (GPa)	6.24	7.63	8.61	9.13	9.56	-
Poisson's Ratio	0.161	0.189	0.186	0.176	0.191	-

Residual Test Results

Confining Pressure (MPa)	14.99	13.15	7.94	4.92	1.94
Residual Deviator Stress (MPa)	35.8	32.0	26.0	19.6	11.4
Axial Strain (με)	13658	14903	16674	18530	20323
Diametral Strain (με)	-3640	-4593	-6378	-9306	-15553

Notes/Remarks:

Sample/s supplied by client Tested as received

Accredited for compliance with ISO/IES 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory

Authorised Signatory
C. Purvis

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

STRENGTH OF ROCK MATERIAL IN TRIAXIAL COMPRESSION

ASTM D7012

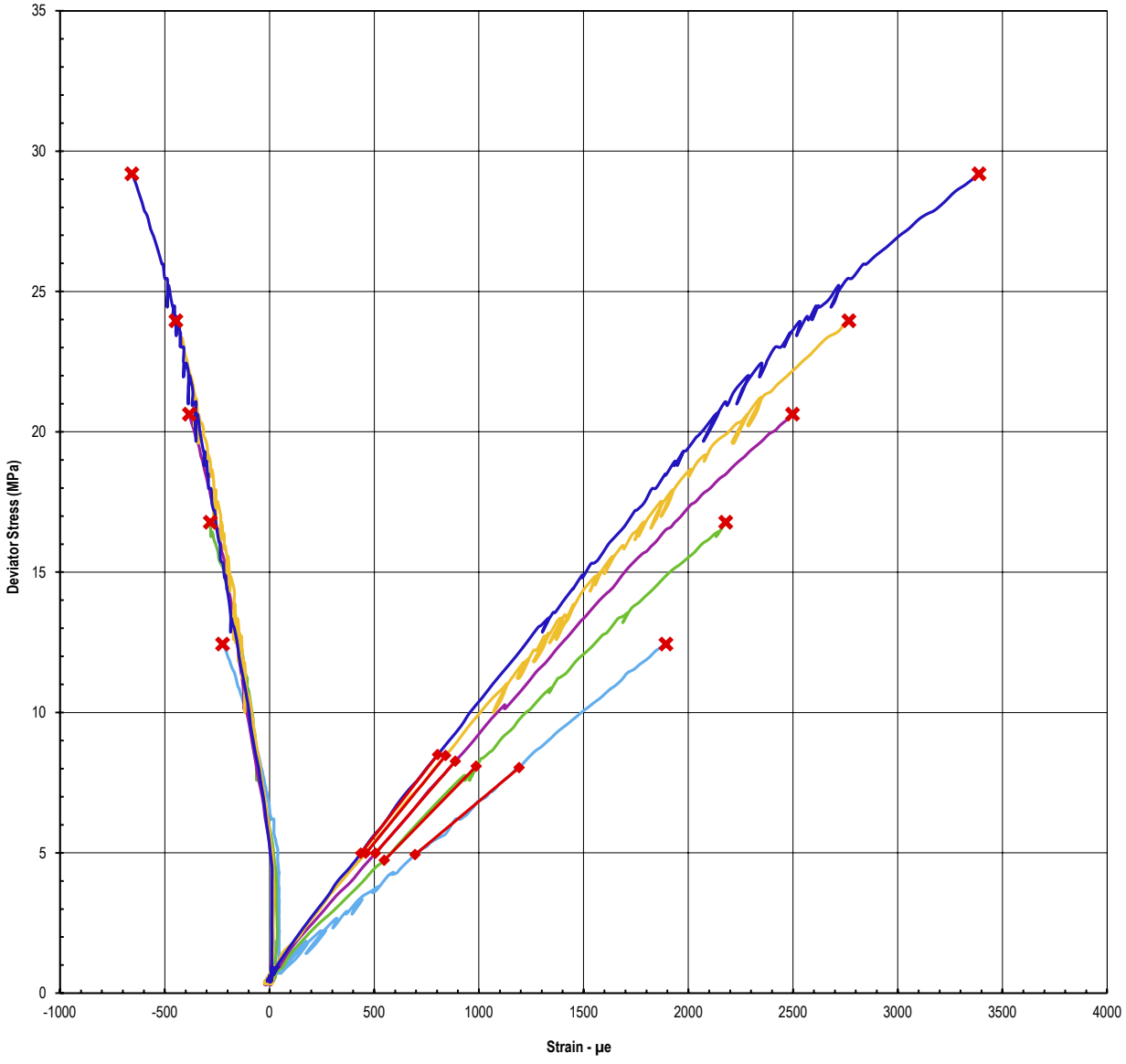
Standard Test Methods for Compressive Strength and Elastic Moduli of Intact Rock Core Specimens under Varying States of Stress and Temperatures

Method B : Elastic Moduli of Undrained Rock Core Specimens in Triaxial Compression Without Pore Pressure Measurements

Client Golder Associates Pty Limited

Report No. GA101598-RTX

Deviator Stress vs Axial Strain Plots



Notes/Remarks:

Graph not to scale

Sample/s supplied by client

Tested as received

Accredited for compliance with ISO/IES 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory

Authorised Signatory

C. Purvis

NATA
ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

STRENGTH OF ROCK MATERIAL IN TRIAXIAL COMPRESSION

ASTM D7012

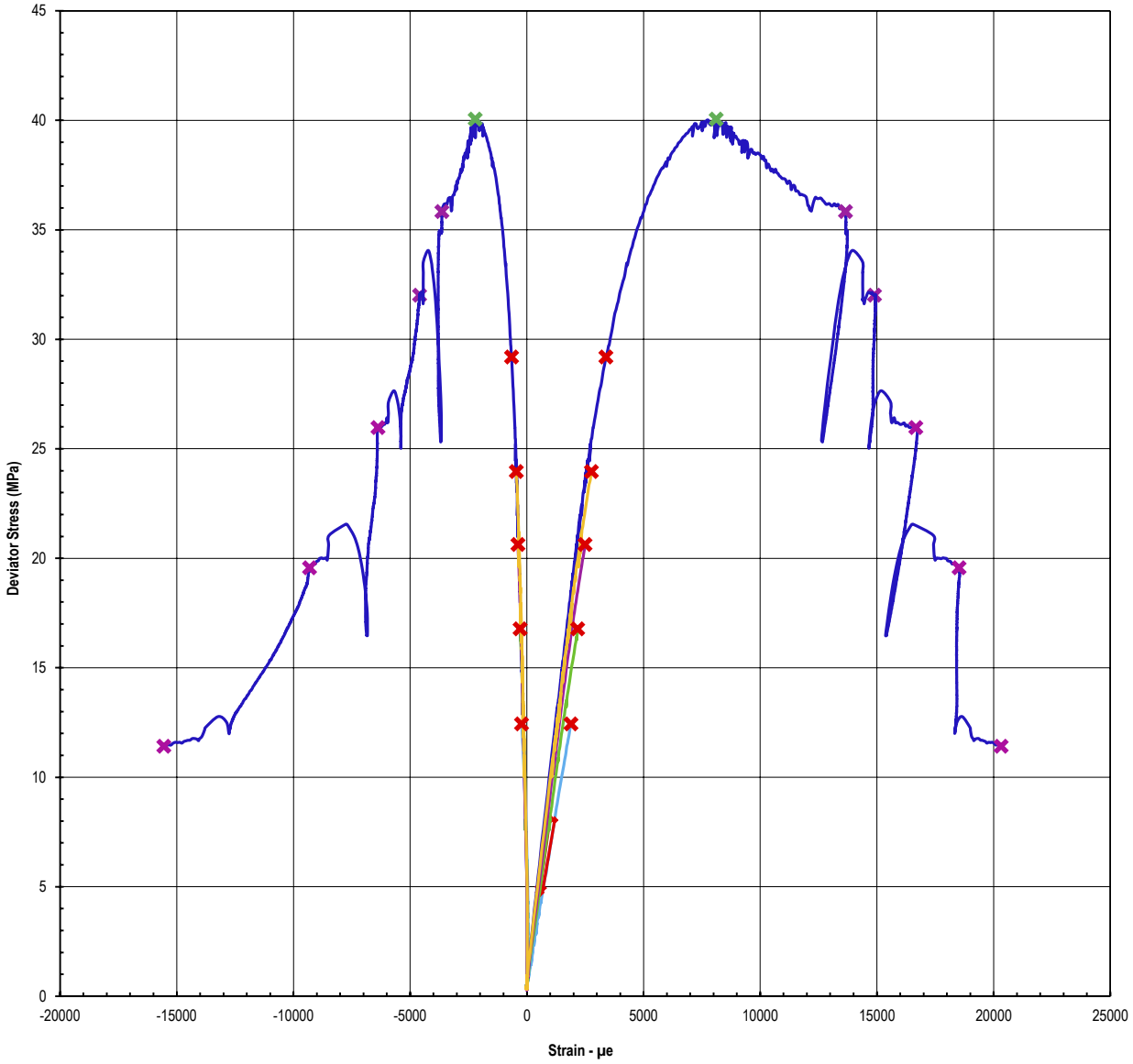
Standard Test Methods for Compressive Strength and Elastic Moduli of Intact Rock Core Specimens under Varying States of Stress and Temperatures

Method B : Elastic Moduli of Undrained Rock Core Specimens in Triaxial Compression Without Pore Pressure Measurements

Client Golder Associates Pty Limited

Report No. GA101598-RTX

Deviator Stress vs Axial Strain Plots



Notes/Remarks:

Graph not to scale

Sample/s supplied by client

Tested as received

Accredited for compliance with ISO/IES 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

STRENGTH OF ROCK MATERIAL IN TRIAXIAL COMPRESSION

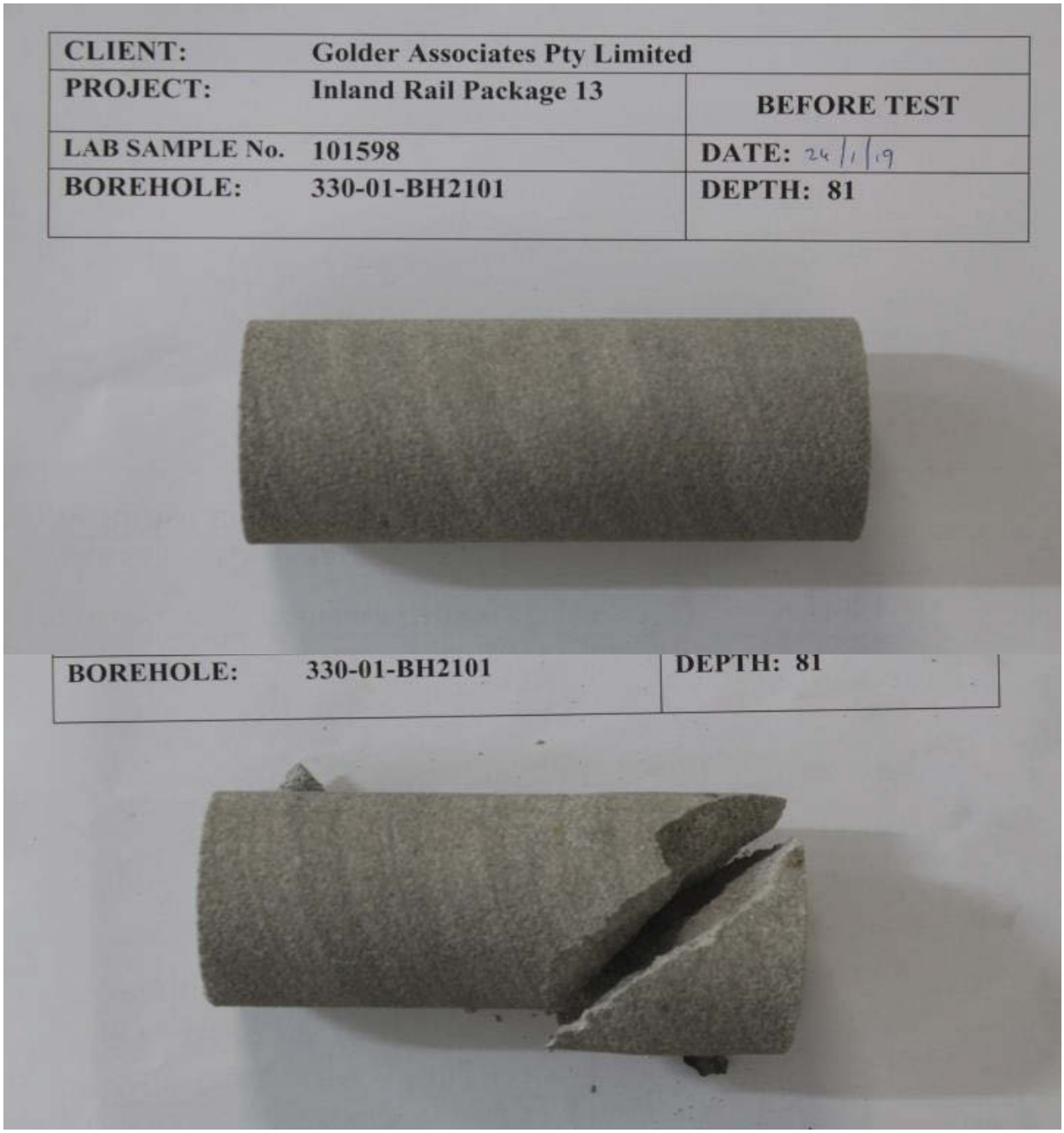
ASTM D7012

Standard Test Methods for Compressive Strength and Elastic Moduli of Intact Rock Core Specimens under Varying States of Stress and Temperatures

Method B : Elastic Moduli of Undrained Rock Core Specimens in Triaxial Compression Without Pore Pressure Measurements

Client	Golder Associates Pty Limited	**Report No.**	GA101598-RTX

Before and After Test Photos



Notes/Remarks:

Photo not to scale

Sample/s supplied by client

Tested as received

Accredited for compliance with ISO/IES 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory

Authorised Signatory

C. Purvis

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

STRENGTH OF ROCK MATERIAL IN TRIAXIAL COMPRESSION

ASTM D7012

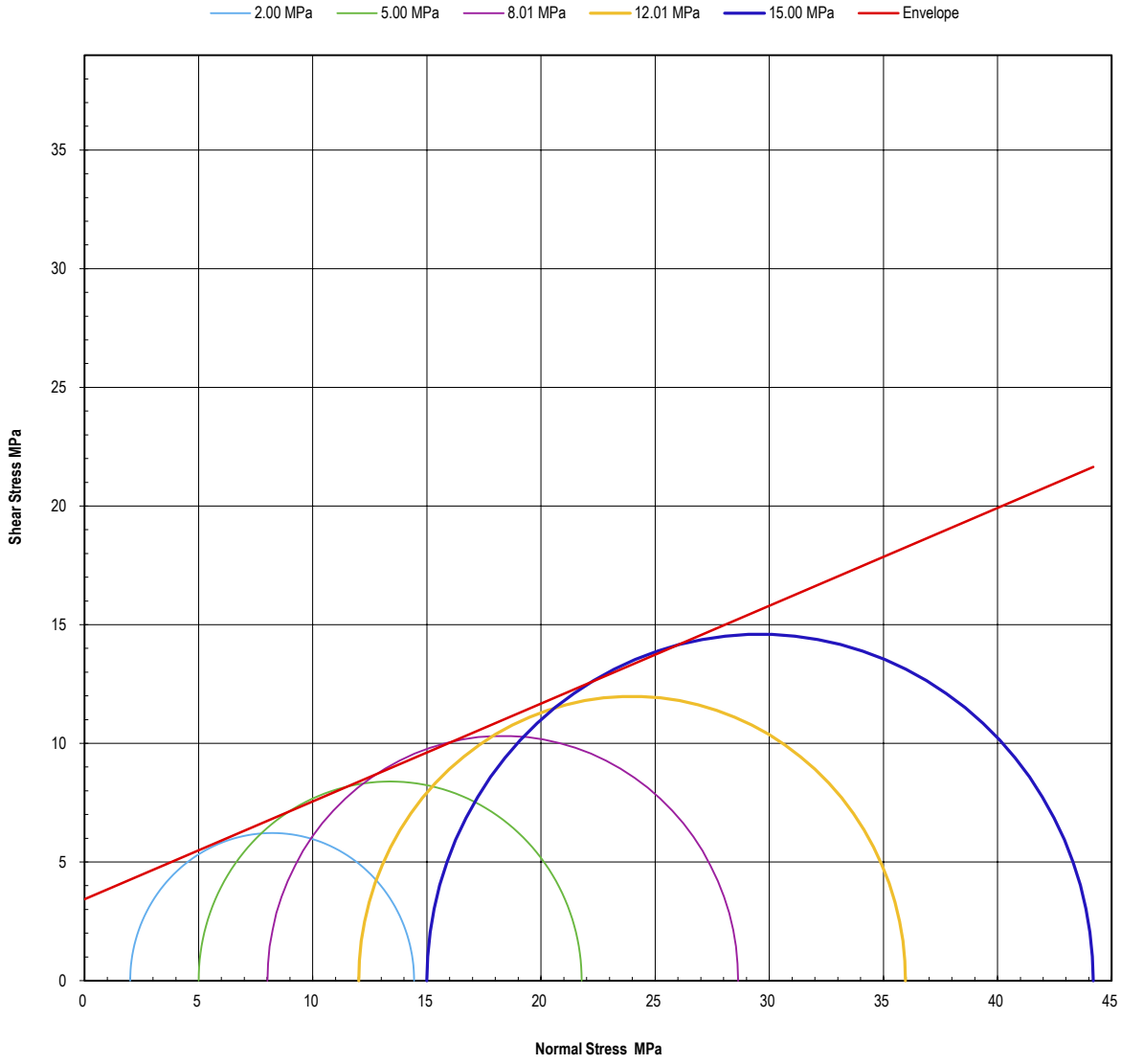
Standard Test Methods for Compressive Strength and Elastic Moduli of Intact Rock Core Specimens under Varying States of Stress and Temperatures

Method B : Elastic Moduli of Undrained Rock Core Specimens in Triaxial Compression Without Pore Pressure Measurements

Client Golder Associates Pty Limited

Report No. GA101598-RTX

Plastic Deformation - Mohr Circle Plot



Estimated Envelope - **(Calculated at Plastic Deformation on each Stage)**

Angle	22.4	°
Cohesion	3.43	MPa
Correlation	0.9978	

Notes/Remarks:

Graph not to scale

Sample/s supplied by client

Tested as received

Accredited for compliance with ISO/IES 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory

Authorised Signatory

C. Purvis

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

STRENGTH OF ROCK MATERIAL IN TRIAXIAL COMPRESSION

ASTM D7012

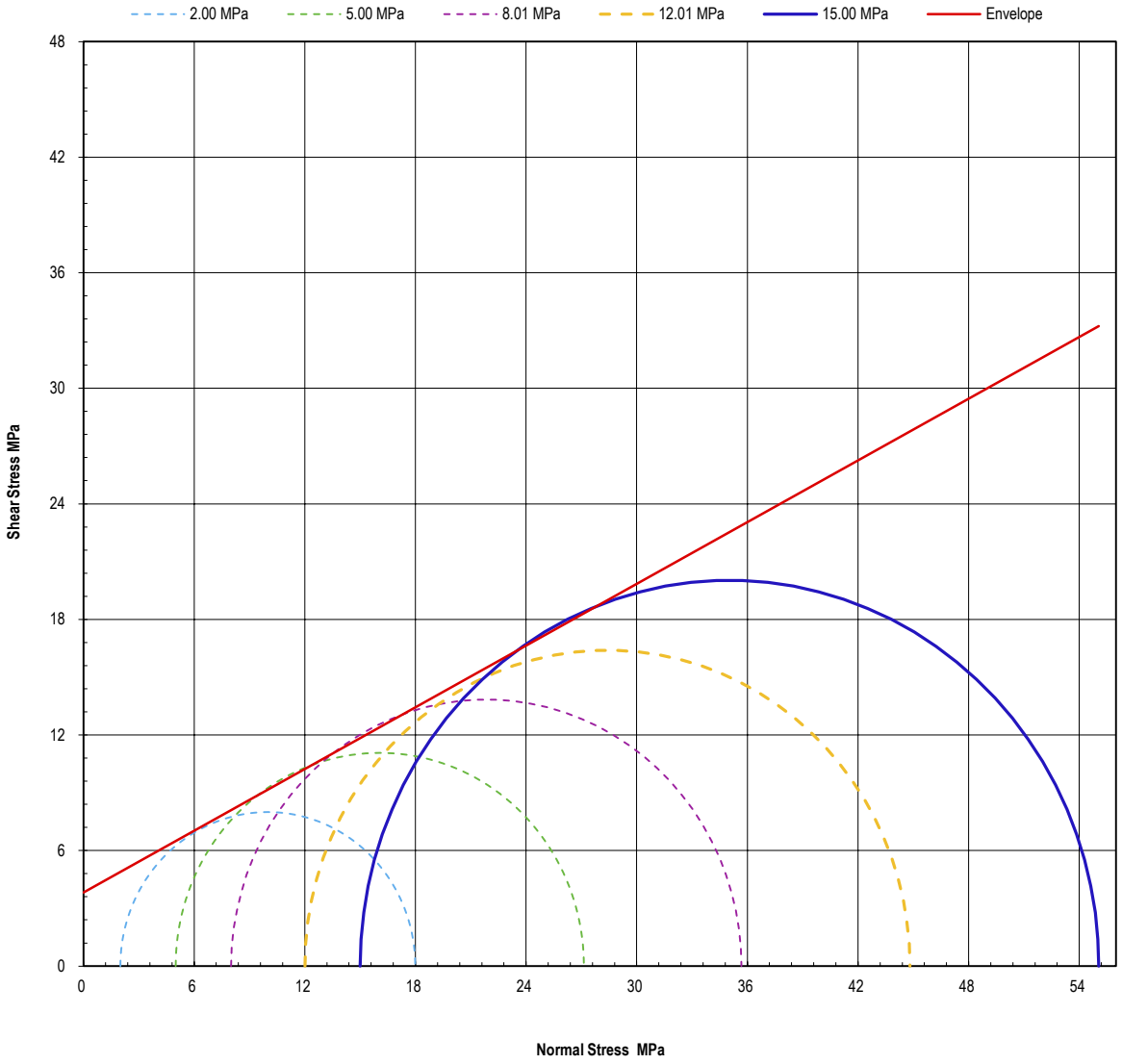
Standard Test Methods for Compressive Strength and Elastic Moduli of Intact Rock Core Specimens under Varying States of Stress and Temperatures

Method B : Elastic Moduli of Undrained Rock Core Specimens in Triaxial Compression Without Pore Pressure Measurements

Client Golder Associates Pty Limited

Report No. GA101598-RTX

Calculated Peak Stress Mohr Circle Plot



Calculated Peak Envelope		
Angle	28.1	°
Cohesion	3.83	MPa
Correlation	0.9982	

Notes/Remarks:

Graph not to scale

Sample/s supplied by client

Tested as received

Accredited for compliance with ISO/IES 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

STRENGTH OF ROCK MATERIAL IN TRIAXIAL COMPRESSION

ASTM D7012

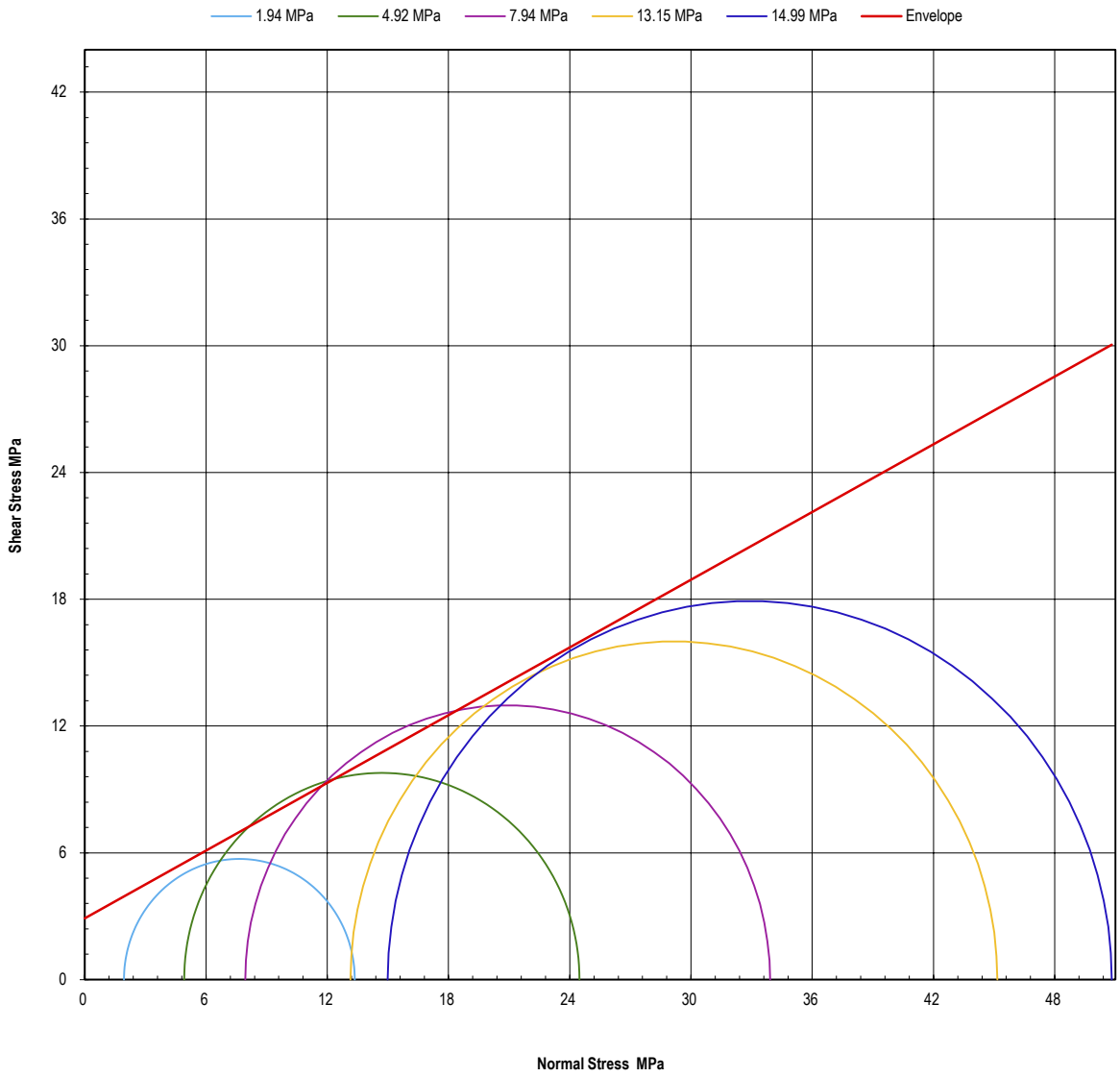
Standard Test Methods for Compressive Strength and Elastic Moduli of Intact Rock Core Specimens under Varying States of Stress and Temperatures

Method B : Elastic Moduli of Undrained Rock Core Specimens in Triaxial Compression Without Pore Pressure Measurements

Client Golder Associates Pty Limited

Report No. GA101598-RTX

Residual Stress Mohr Circle Plot



Estimated Residual Envelope

Angle	28.1	°
Cohesion	2.89	MPa
Correlation	0.9962	

Notes/Remarks:

Graph not to scale

Sample/s supplied by client

Tested as received

Accredited for compliance with ISO/IES 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory

Authorised Signatory

C. Purvis

NATA
ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

STRENGTH OF ROCK MATERIAL IN TRIAXIAL COMPRESSION

ASTM D7012

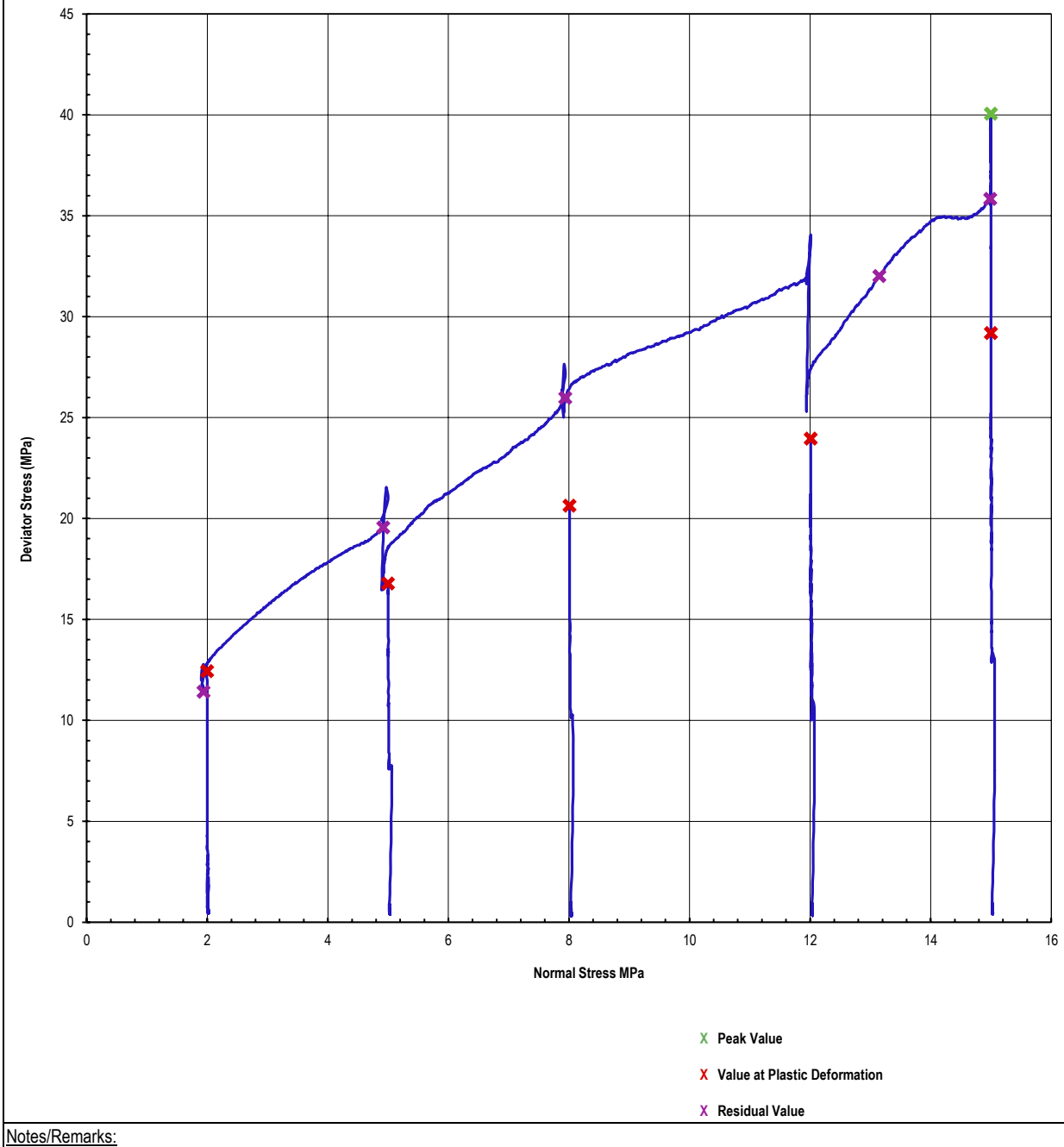
Standard Test Methods for Compressive Strength and Elastic Moduli of Intact Rock Core Specimens under Varying States of Stress and Temperatures

Method B : Elastic Moduli of Undrained Rock Core Specimens in Triaxial Compression Without Pore Pressure Measurements

Client Golder Associates Pty Limited

Report No. GA101598-RTX

Deviator Stress vs Normal Stress Plot



Notes/Remarks:

Graph not to scale

Sample/s supplied by client

Tested as received

Accredited for compliance with ISO/IES 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory

Authorised Signatory

C. Purvis

NATA
ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

STRENGTH OF ROCK MATERIAL IN TRIAXIAL COMPRESSION

ASTM D7012

Standard Test Methods for Compressive Strength and Elastic Moduli of Intact Rock Core Specimens under Varying States of Stress and Temperatures

Method B : Elastic Moduli of Undrained Rock Core Specimens in Triaxial Compression Without Pore Pressure Measurements

Client	Golder Associates Pty Limited	**Report No.**	GA101632-RTX
		Request No.	330-01-BH2101
Address	PO Box 1734 MILTON BC QLD 4064	**Test Date**	24/01/2019
		Report Date	25/01/2019
Project	Inland Rail Package 13	**Depth From (m)**	95
Bore Hole	330-01-BH2101	**Depth To (m)**	95.7
Sample No:	330-01-BH2101-C09500-TWR : 330-01-BH2101-C09500-MOI		
Description	C		
Sample Type	Single Individual Rock Core Specimen		

Sample Details

Average Sample Diameter (mm)	60.8	Moisture Content (%)	3.8
Sample Height (mm)	152.46	Wet Density (t/m^3)	2.18
Duration of Test (min)	16:59:00	Dry Density (t/m^3)	2.10
Rate of Strain (%/min)	0.05	Bedding (^{o})	10
Mode of Failure	Shear	Test Apparatus	RTR2500 Triaxial Machine
Rupture Angle (°)	60		

Intact Test Results

	Value at Plastic Deformation	Value at Plastic Deformation	Value at Plastic Deformation	Value at Plastic Deformation	Value at Plastic Deformation	Peak Value
Confining Pressure (MPa)	1.99	5.01	8.01	12.00	15.01	15.01
Calc'd Deviator Stress (MPa)	16.7	25.0	33.0	43.0	-	-
Deviator Stress (MPa)	11.9	17.2	22.4	28.8	36.4	54.4
Axial Strain (με)	1688	1980	2274	2747	3382	8256
Diametral Strain (με)	-176	-249	-358	-478	-696	-2891
Tangent Modulus (GPa)	6.80	8.21	9.81	10.6	11.1	-
Poisson's Ratio	0.168	0.137	0.183	0.184	0.189	-

Residual Test Results

Confining Pressure (MPa)	15.01	11.98	7.94	4.97	1.96
Residual Deviator Stress (MPa)	39.5	32.7	24.4	17.4	9.09
Axial Strain (με)	13768	15047	16129	16541	16704
Diametral Strain (με)	-7377	-11021	-16197	-20410	-25195

Notes/Remarks:

Sample/s supplied by client Tested as received

Accredited for compliance with ISO/IES 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory

Authorised Signatory
C. Purvis

NATA ACCREDITED FOR TECHNICAL COMPETENCE
Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

STRENGTH OF ROCK MATERIAL IN TRIAXIAL COMPRESSION

ASTM D7012

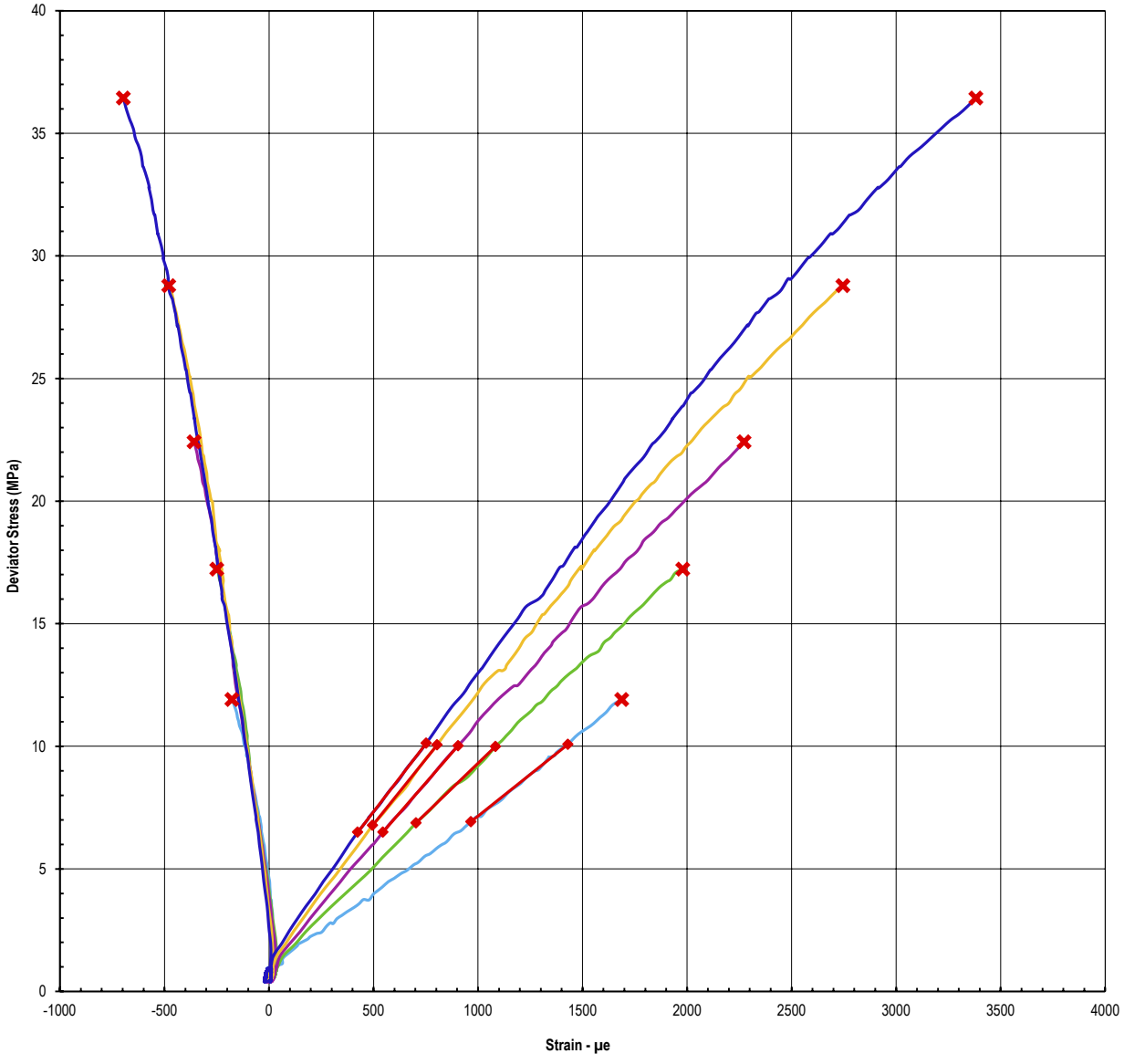
Standard Test Methods for Compressive Strength and Elastic Moduli of Intact Rock Core Specimens under Varying States of Stress and Temperatures

Method B : Elastic Moduli of Undrained Rock Core Specimens in Triaxial Compression Without Pore Pressure Measurements

Client Golder Associates Pty Limited

Report No. GA101632-RTX

Deviator Stress vs Axial Strain Plots



Notes/Remarks:

Graph not to scale

Sample/s supplied by client

Tested as received

Accredited for compliance with ISO/IES 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory

Authorised Signatory

C. Purvis

NATA
ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

STRENGTH OF ROCK MATERIAL IN TRIAXIAL COMPRESSION

ASTM D7012

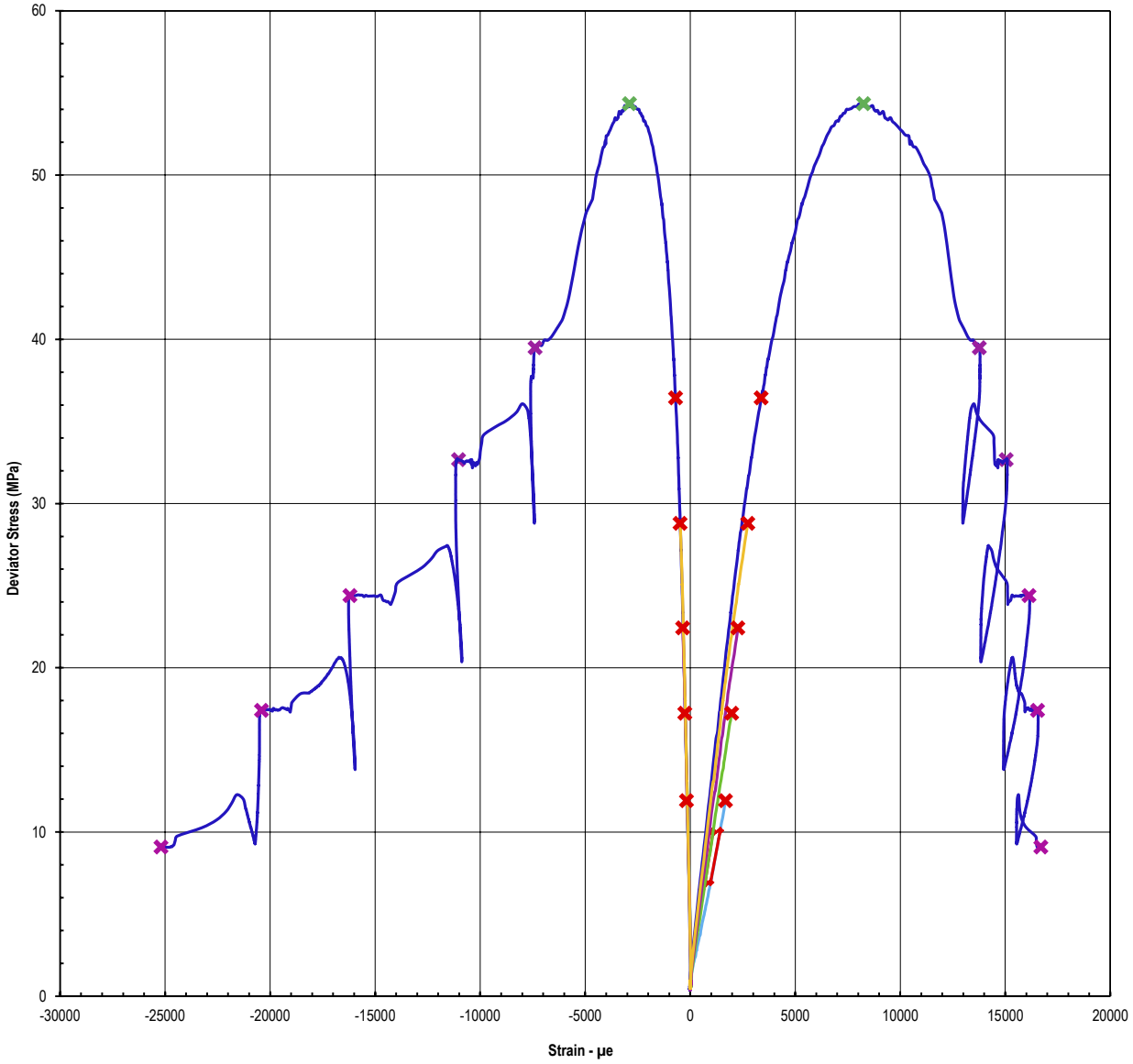
Standard Test Methods for Compressive Strength and Elastic Moduli of Intact Rock Core Specimens under Varying States of Stress and Temperatures

Method B : Elastic Moduli of Undrained Rock Core Specimens in Triaxial Compression Without Pore Pressure Measurements

Client Golder Associates Pty Limited

Report No. GA101632-RTX

Deviator Stress vs Axial Strain Plots



Notes/Remarks:

Graph not to scale

Sample/s supplied by client

Tested as received

Accredited for compliance with ISO/IES 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

STRENGTH OF ROCK MATERIAL IN TRIAXIAL COMPRESSION

ASTM D7012

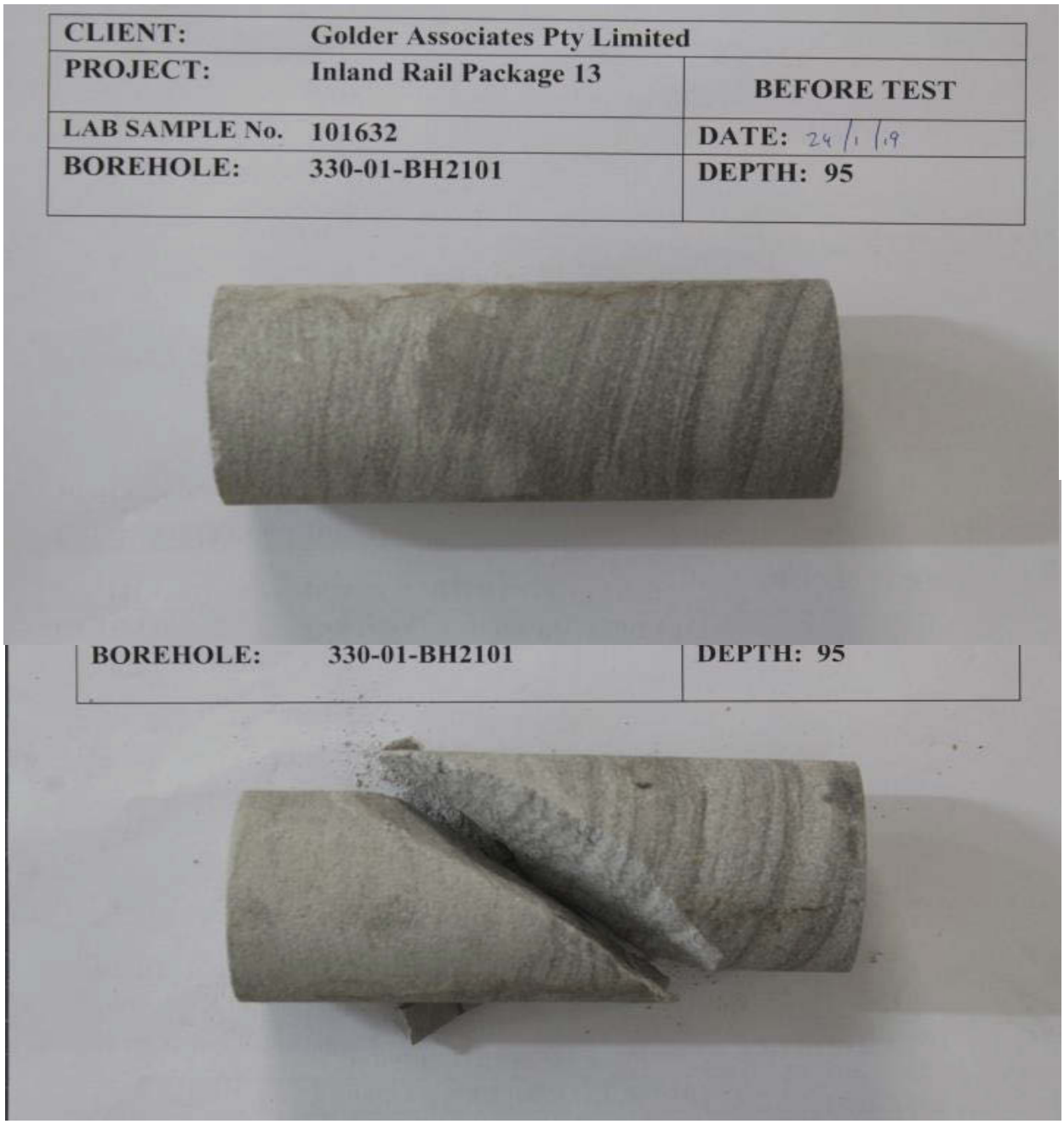
Standard Test Methods for Compressive Strength and Elastic Moduli of Intact Rock Core Specimens under Varying States of Stress and Temperatures

Method B : Elastic Moduli of Undrained Rock Core Specimens in Triaxial Compression Without Pore Pressure Measurements

Client Golder Associates Pty Limited

Report No. GA101632-RTX

Before and After Test Photos



Notes/Remarks:

Photo not to scale

Sample/s supplied by client

Tested as received

Accredited for compliance with ISO/IES 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory

Authorised Signatory

C. Purvis

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

STRENGTH OF ROCK MATERIAL IN TRIAXIAL COMPRESSION

ASTM D7012

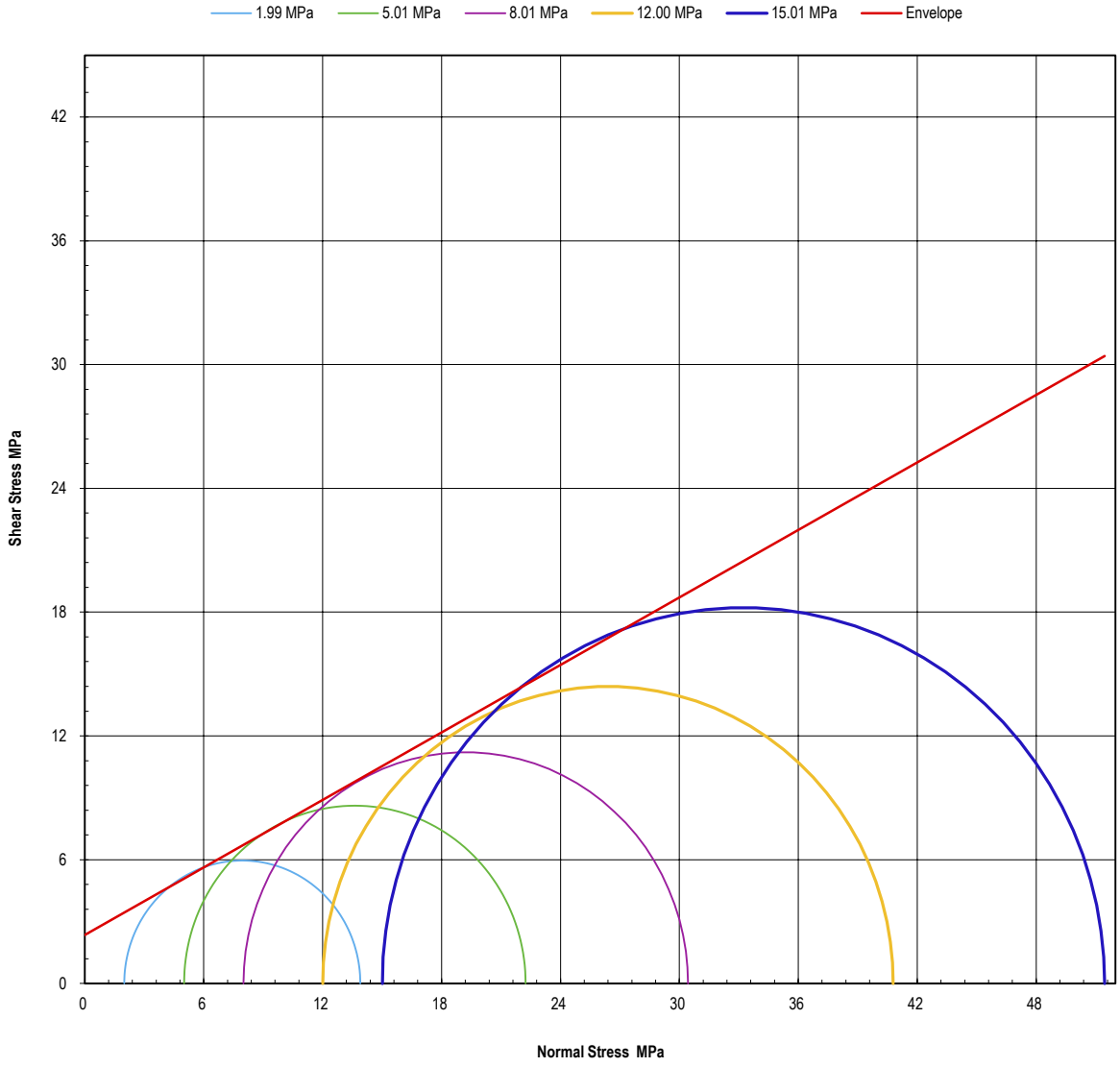
Standard Test Methods for Compressive Strength and Elastic Moduli of Intact Rock Core Specimens under Varying States of Stress and Temperatures

Method B : Elastic Moduli of Undrained Rock Core Specimens in Triaxial Compression Without Pore Pressure Measurements

Client Golder Associates Pty Limited

Report No. GA101632-RTX

Plastic Deformation - Mohr Circle Plot



Estimated Envelope - **(Calculated at Plastic Deformation on each Stage)**

Angle	28.6	°
Cohesion	2.34	MPa
Correlation	0.9991	

Notes/Remarks:

Graph not to scale

Sample/s supplied by client

Tested as received

Accredited for compliance with ISO/IES 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory

Authorised Signatory

C. Purvis

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

STRENGTH OF ROCK MATERIAL IN TRIAXIAL COMPRESSION

ASTM D7012

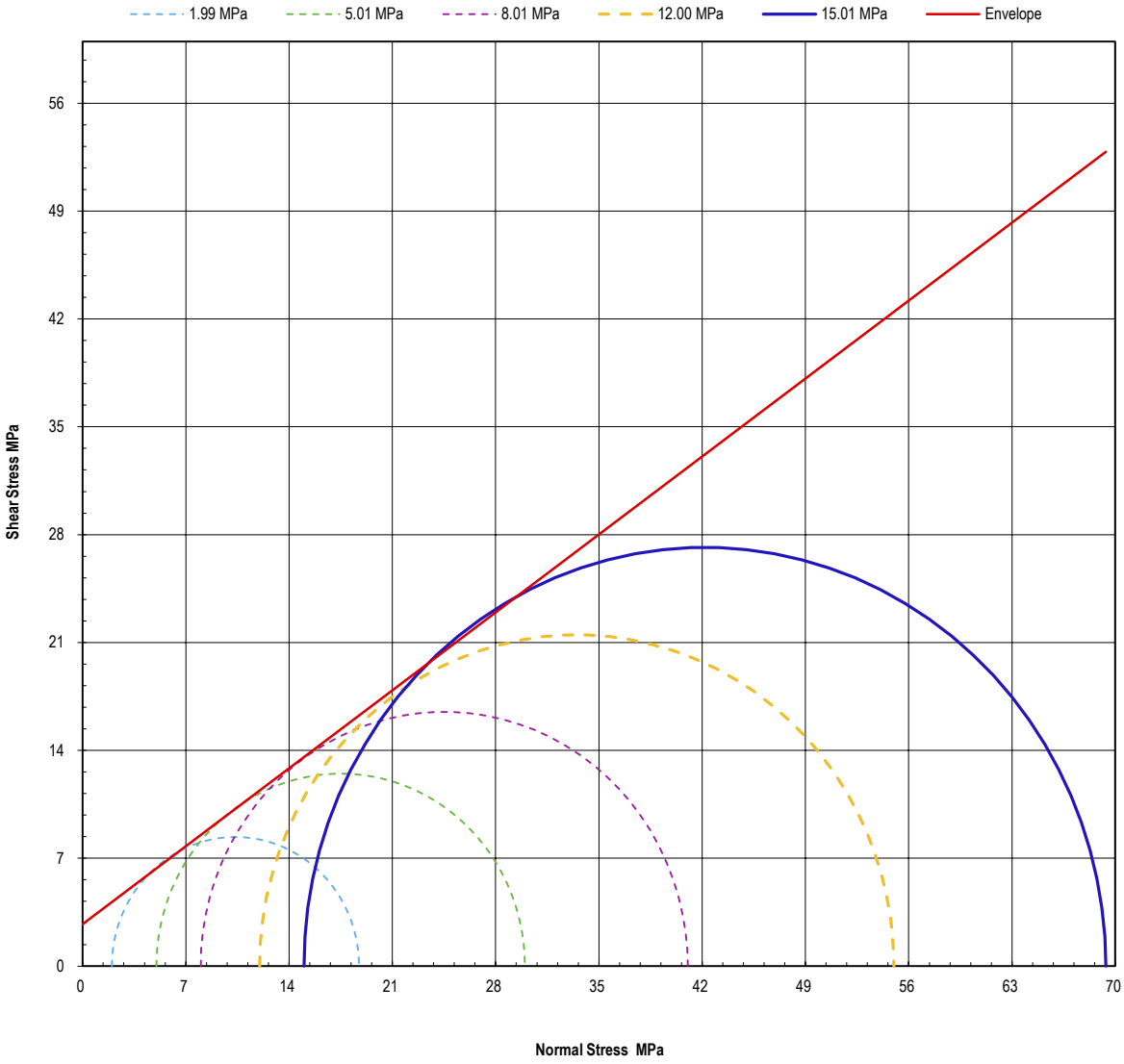
Standard Test Methods for Compressive Strength and Elastic Moduli of Intact Rock Core Specimens under Varying States of Stress and Temperatures

Method B : Elastic Moduli of Undrained Rock Core Specimens in Triaxial Compression Without Pore Pressure Measurements

Client Golder Associates Pty Limited

Report No. GA101632-RTX

Calculated Peak Stress Mohr Circle Plot



Calculated Peak Envelope		
Angle	35.9	°
Cohesion	2.72	MPa
Correlation	1.0000	

Notes/Remarks:

Graph not to scale

Sample/s supplied by client

Tested as received

Accredited for compliance with ISO/IES 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

STRENGTH OF ROCK MATERIAL IN TRIAXIAL COMPRESSION

ASTM D7012

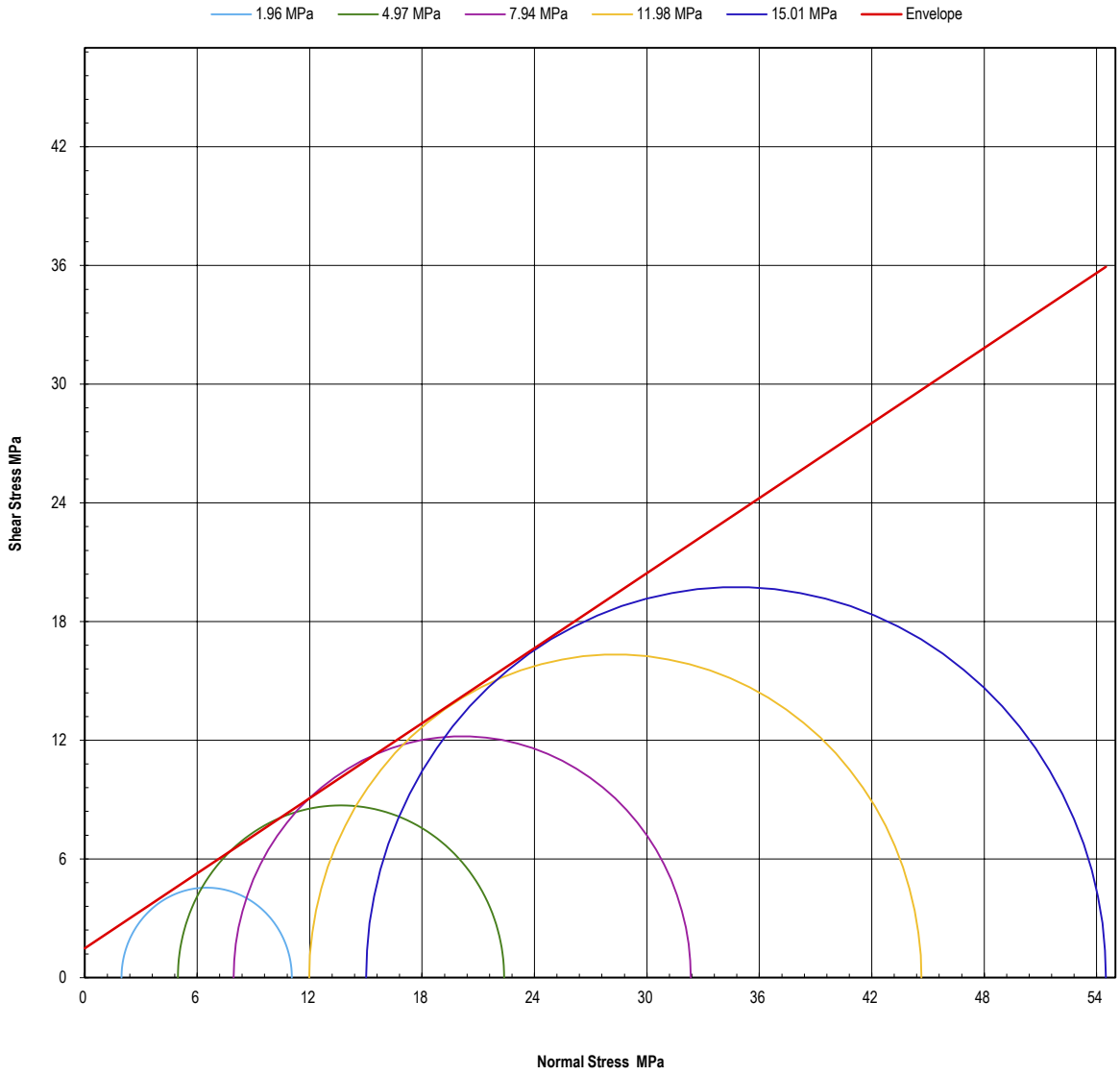
Standard Test Methods for Compressive Strength and Elastic Moduli of Intact Rock Core Specimens under Varying States of Stress and Temperatures

Method B : Elastic Moduli of Undrained Rock Core Specimens in Triaxial Compression Without Pore Pressure Measurements

Client Golder Associates Pty Limited

Report No. GA101632-RTX

Residual Stress Mohr Circle Plot



Estimated Residual Envelope

Angle	32.3	°
Cohesion	1.49	MPa
Correlation	0.9997	

Notes/Remarks:

Graph not to scale

Sample/s supplied by client

Tested as received

Accredited for compliance with ISO/IES 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory

Authorised Signatory

C. Purvis

NATA
ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

STRENGTH OF ROCK MATERIAL IN TRIAXIAL COMPRESSION

ASTM D7012

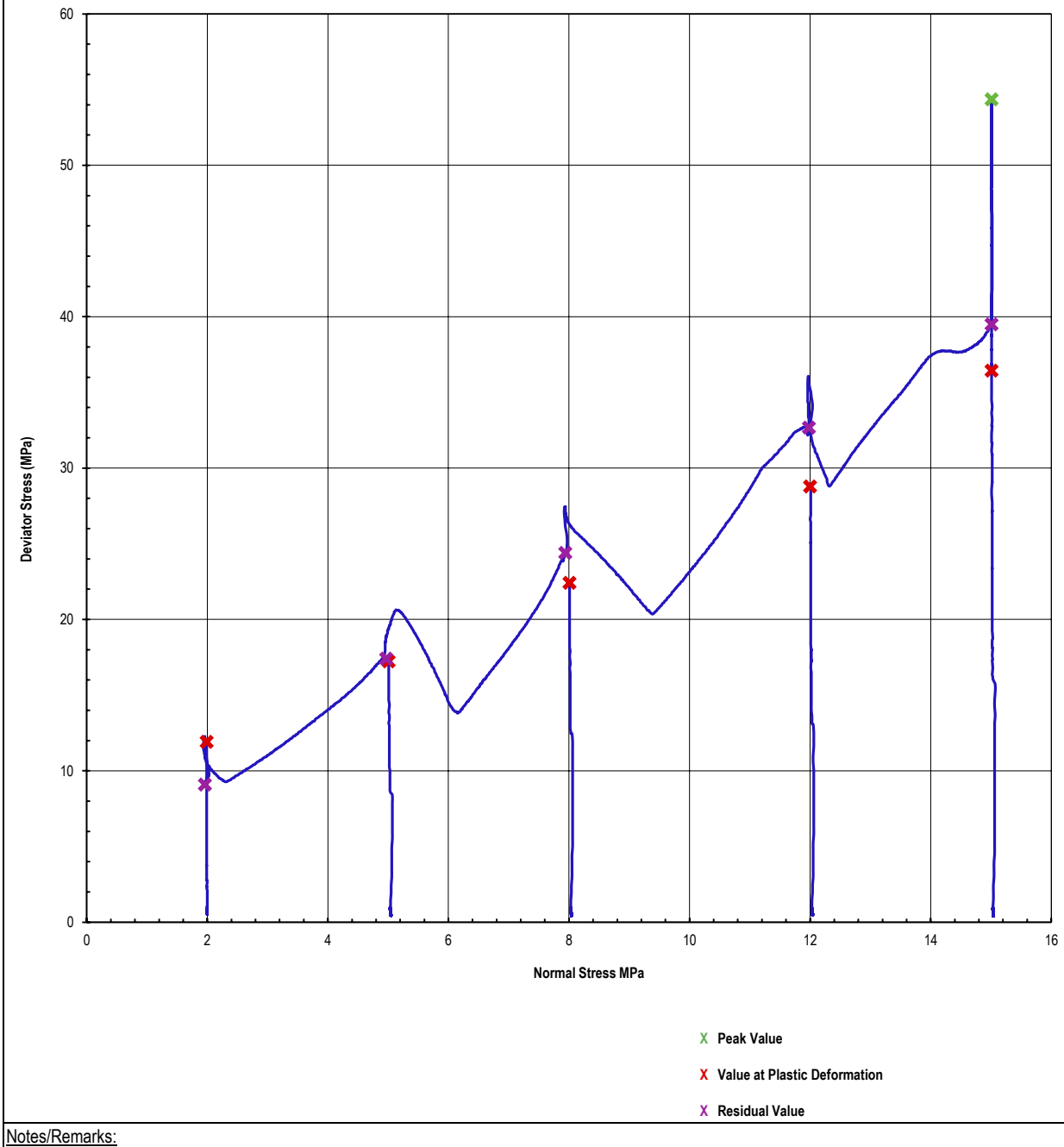
Standard Test Methods for Compressive Strength and Elastic Moduli of Intact Rock Core Specimens under Varying States of Stress and Temperatures

Method B : Elastic Moduli of Undrained Rock Core Specimens in Triaxial Compression Without Pore Pressure Measurements

Client Golder Associates Pty Limited

Report No. GA101632-RTX

Deviator Stress vs Normal Stress Plot



Notes/Remarks:

Graph not to scale

Sample/s supplied by client

Tested as received

Accredited for compliance with ISO/IES 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory

Authorised Signatory

C. Purvis

NATA
ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

STRENGTH OF ROCK MATERIAL IN TRIAXIAL COMPRESSION

ASTM D7012

Standard Test Methods for Compressive Strength and Elastic Moduli of Intact Rock Core Specimens under Varying States of Stress and Temperatures

Method B : Elastic Moduli of Undrained Rock Core Specimens in Triaxial Compression Without Pore Pressure Measurements

Client	Golder Associates Pty Limited	**Report No.**	GA101671-RTX
		Request No.	330-01-BH2101
Address	PO Box 1734 MILTON BC QLD 4064	**Test Date**	24/01/2019
		Report Date	25/01/2019
Project	Inland Rail Package 13	**Depth From (m)**	117
Bore Hole	330-01-BH2101	**Depth To (m)**	117.9
Sample No:	330-01-BH2101-C11700-TWR : 330-01-BH2101-C11700-MOI		
Description	C		
Sample Type	Single Individual Rock Core Specimen		

Sample Details

Average Sample Diameter (mm)	60.9	Moisture Content (%)	2.1
Sample Height (mm)	151.47	Wet Density (t/m^3)	2.15
Duration of Test (min)	17:08:00	Dry Density (t/m^3)	2.10
Rate of Strain (%/min)	0.05	Bedding (^{o})	Nil
Mode of Failure	Shear	Test Apparatus	RTR2500 Triaxial Machine
Rupture Angle (°)	50		

Intact Test Results

	Value at Plastic Deformation	Value at Plastic Deformation	Value at Plastic Deformation	Value at Plastic Deformation	Value at Plastic Deformation	Peak Value
Confining Pressure (MPa)	1.97	5.00	8.01	12.01	15.00	15.01
Calc'd Deviator Stress (MPa)	27.4	34.2	42.6	49.8	-	-
Deviator Stress (MPa)	24.1	29.7	36.9	42.8	50.7	59.1
Axial Strain (με)	1799	1842	2169	2492	3047	4552
Diametral Strain (με)	-192	-224	-287	-368	-598	-1298
Tangent Modulus (GPa)	14.1	15.6	17.5	17.8	18.3	-
Poisson's Ratio	0.119	0.158	0.174	0.180	0.174	-

Residual Test Results

Confining Pressure (MPa)	15.00	11.95	7.91	4.92	1.92
Residual Deviator Stress (MPa)	53.1	47.4	38.4	29.9	19.7
Axial Strain (με)	8192	8877	10246	10738	11401
Diametral Strain (με)	-1980	-2676	-5488	-8756	-14957

Notes/Remarks:

Sample/s supplied by client Tested as received

Accredited for compliance with ISO/IES 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory

Authorised Signatory
C. Purvis

NATA ACCREDITED FOR TECHNICAL COMPETENCE
Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

STRENGTH OF ROCK MATERIAL IN TRIAXIAL COMPRESSION

ASTM D7012

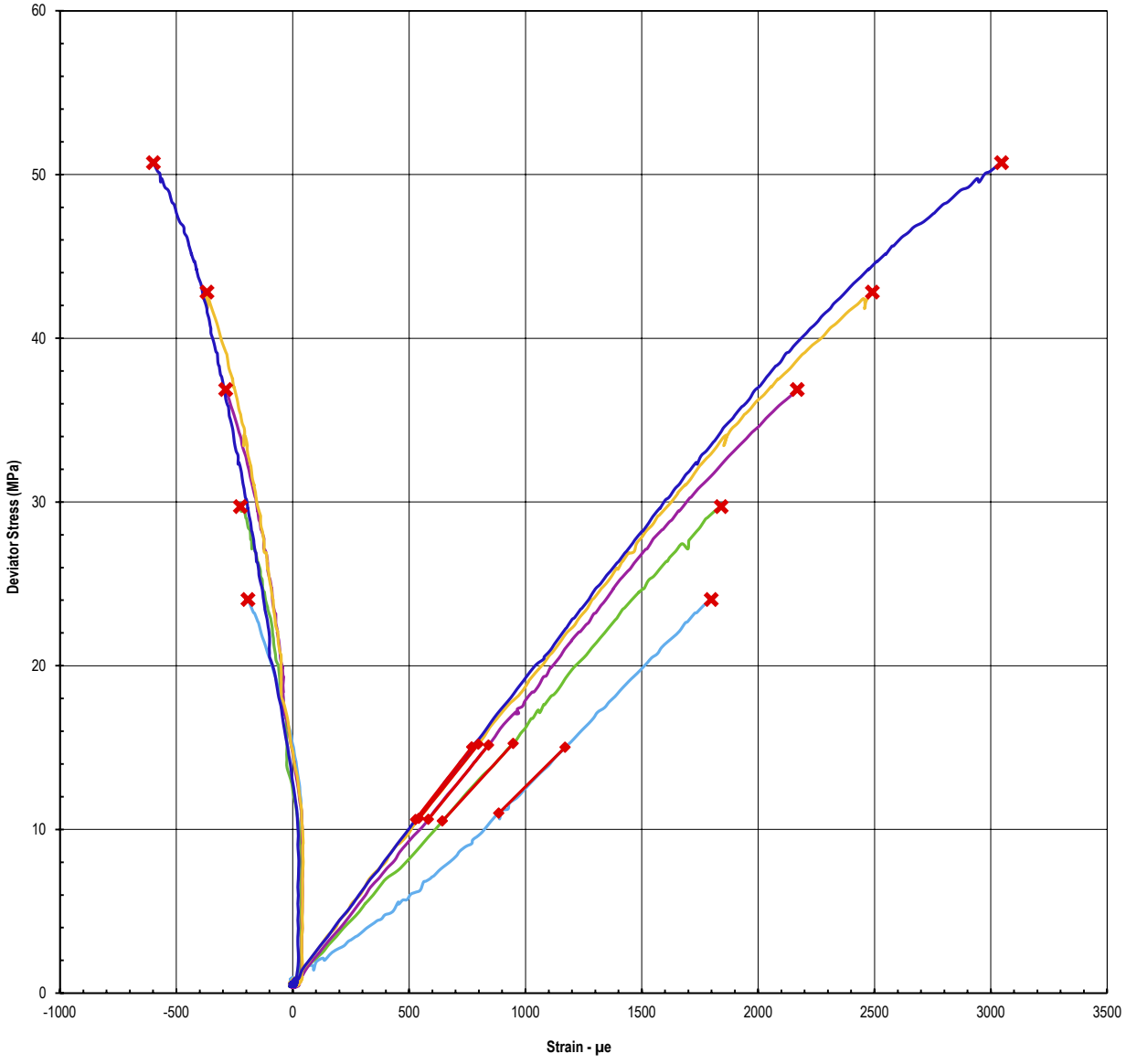
Standard Test Methods for Compressive Strength and Elastic Moduli of Intact Rock Core Specimens under Varying States of Stress and Temperatures

Method B : Elastic Moduli of Undrained Rock Core Specimens in Triaxial Compression Without Pore Pressure Measurements

Client Golder Associates Pty Limited

Report No. GA101671-RTX

Deviator Stress vs Axial Strain Plots



Notes/Remarks:

Graph not to scale

Sample/s supplied by client

Tested as received

Accredited for compliance with ISO/IES 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory

Authorised Signatory

C. Purvis

NATA
ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

STRENGTH OF ROCK MATERIAL IN TRIAXIAL COMPRESSION

ASTM D7012

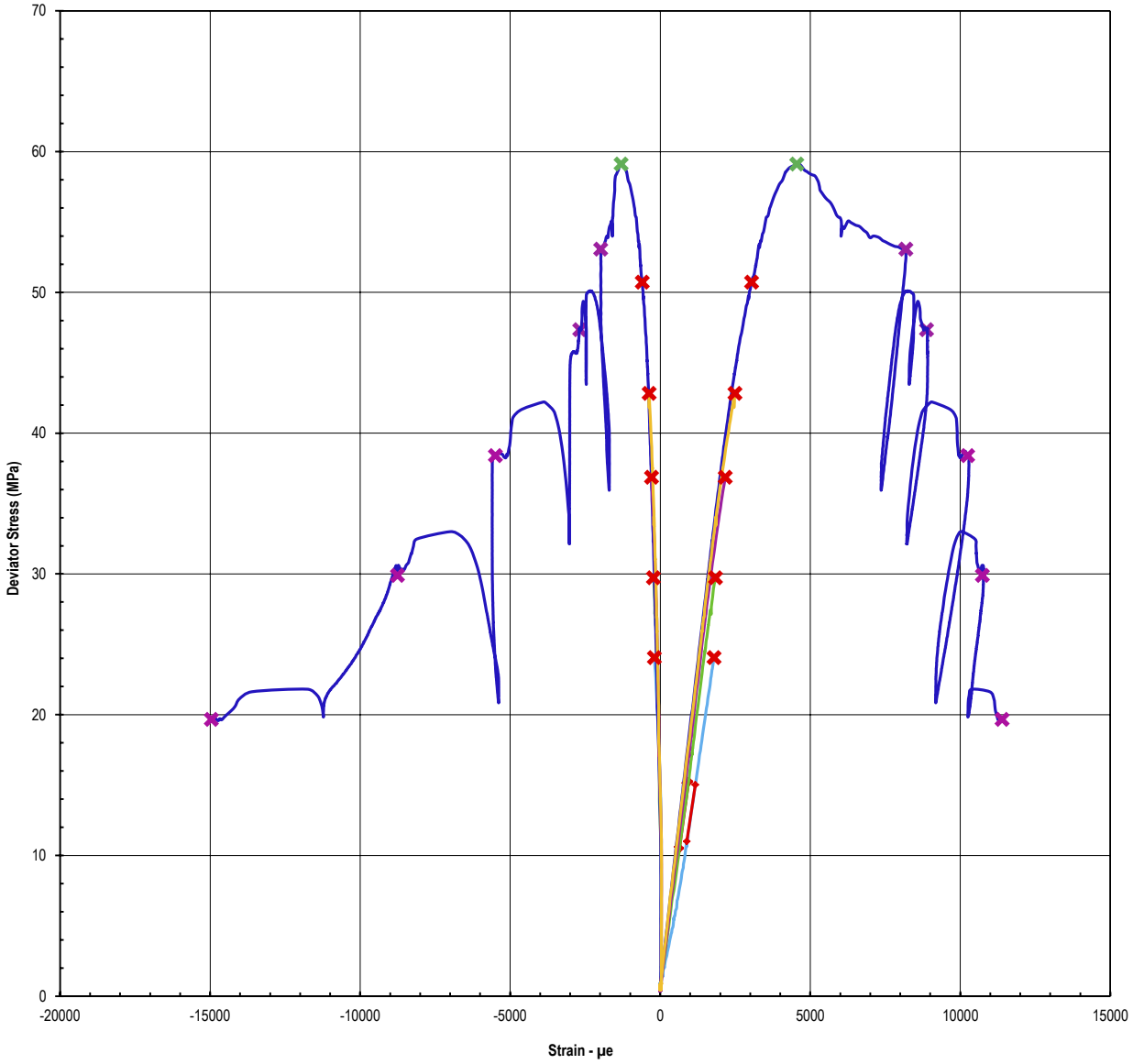
Standard Test Methods for Compressive Strength and Elastic Moduli of Intact Rock Core Specimens under Varying States of Stress and Temperatures

Method B : Elastic Moduli of Undrained Rock Core Specimens in Triaxial Compression Without Pore Pressure Measurements

Client Golder Associates Pty Limited

Report No. GA101671-RTX

Deviator Stress vs Axial Strain Plots



Notes/Remarks:

Graph not to scale

Sample/s supplied by client

Tested as received

Accredited for compliance with ISO/IES 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

STRENGTH OF ROCK MATERIAL IN TRIAXIAL COMPRESSION

ASTM D7012

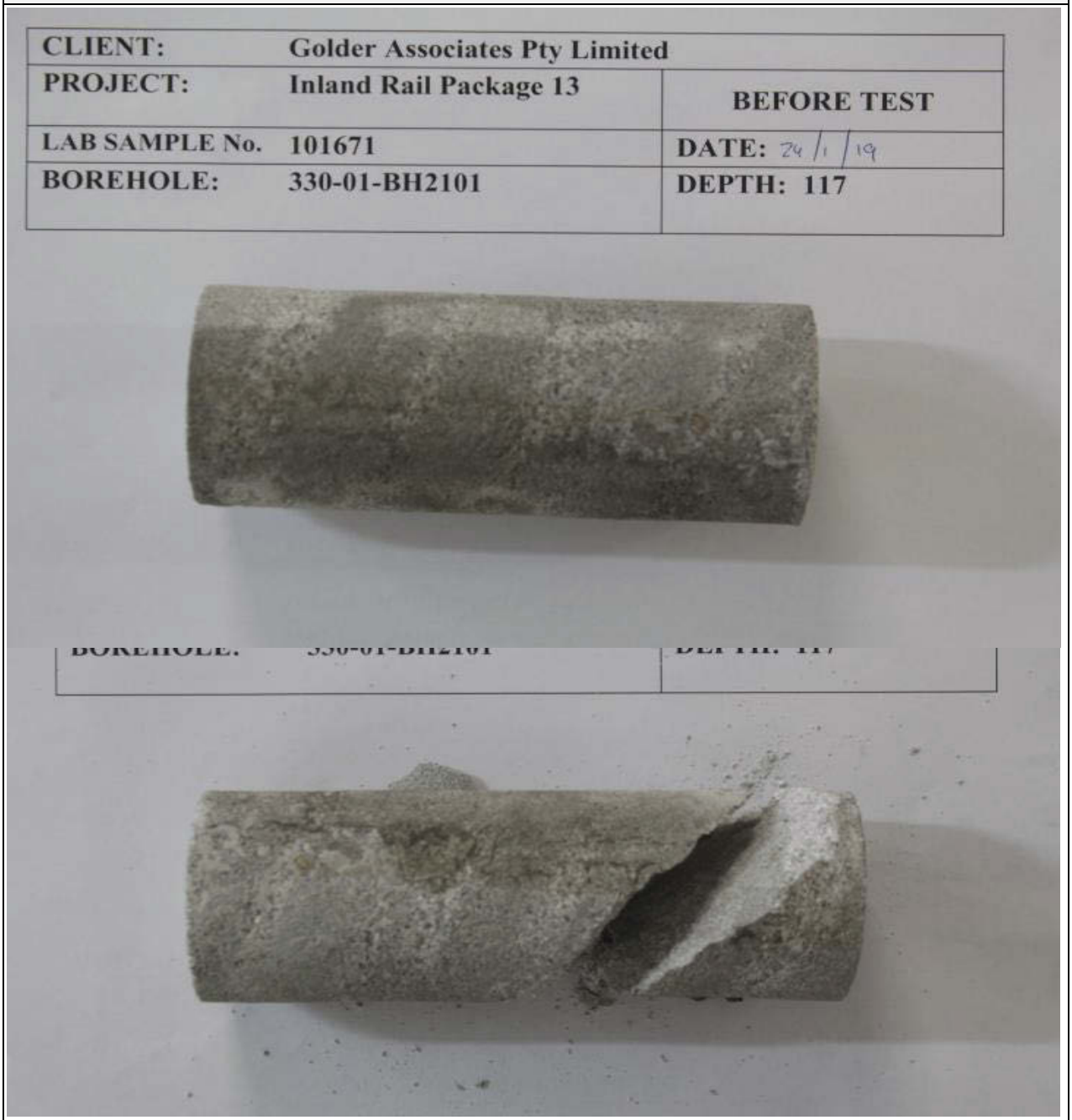
Standard Test Methods for Compressive Strength and Elastic Moduli of Intact Rock Core Specimens under Varying States of Stress and Temperatures

Method B : Elastic Moduli of Undrained Rock Core Specimens in Triaxial Compression Without Pore Pressure Measurements

Client Golder Associates Pty Limited

Report No. GA101671-RTX

Before and After Test Photos



Notes/Remarks:

Photo not to scale

Sample/s supplied by client

Tested as received

Accredited for compliance with ISO/IES 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory

Authorised Signatory

C. Purvis

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

STRENGTH OF ROCK MATERIAL IN TRIAXIAL COMPRESSION

ASTM D7012

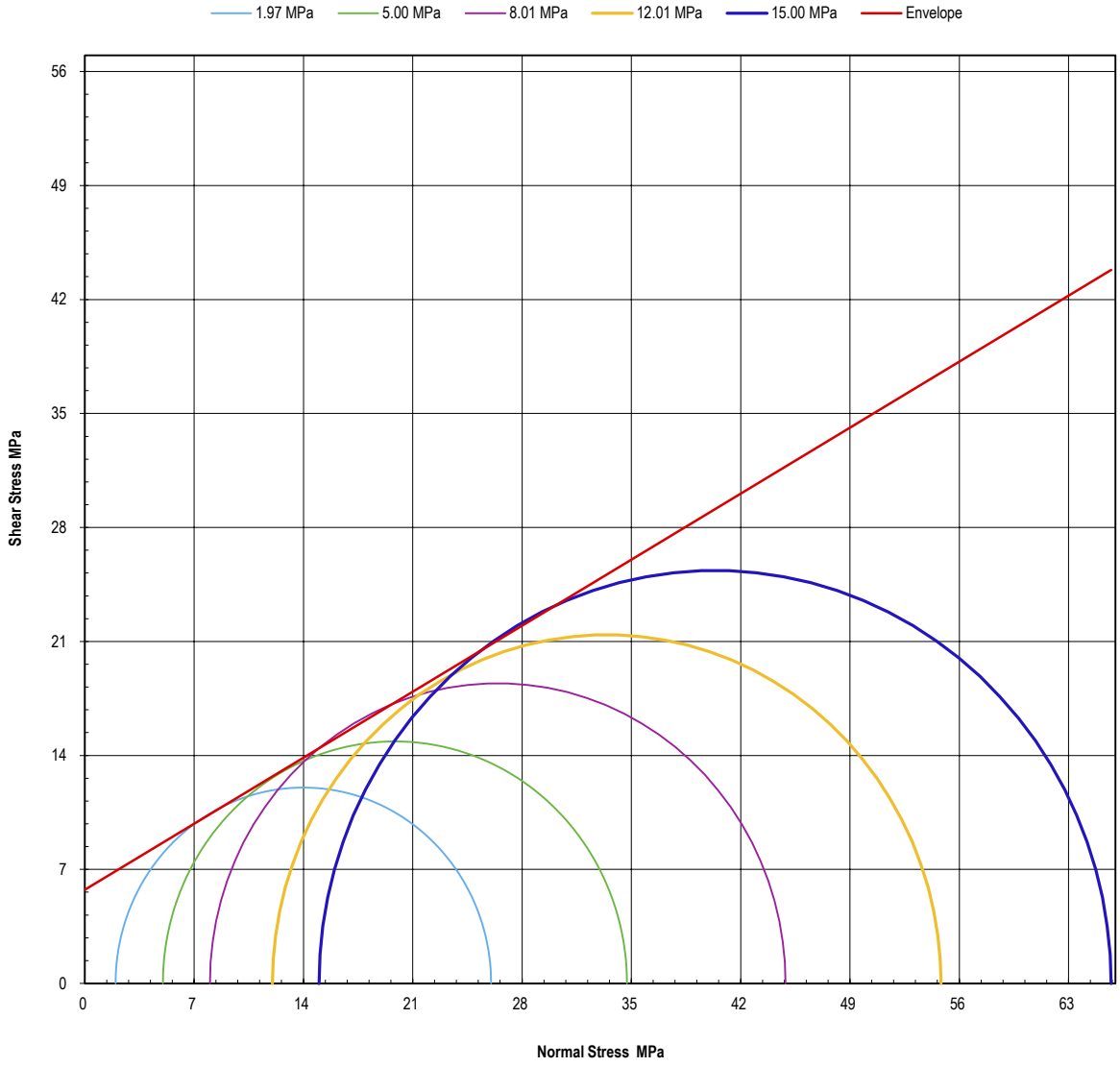
Standard Test Methods for Compressive Strength and Elastic Moduli of Intact Rock Core Specimens under Varying States of Stress and Temperatures

Method B : Elastic Moduli of Undrained Rock Core Specimens in Triaxial Compression Without Pore Pressure Measurements

Client Golder Associates Pty Limited

Report No. GA101671-RTX

Plastic Deformation - Mohr Circle Plot



Estimated Envelope - **(Calculated at Plastic Deformation on each Stage)**

Angle	30.1	°
Cohesion	5.75	MPa
Correlation	0.9992	

Notes/Remarks:

Graph not to scale

Sample/s supplied by client

Tested as received

Accredited for compliance with ISO/IES 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory

Authorised Signatory

C. Purvis

NATA
ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

STRENGTH OF ROCK MATERIAL IN TRIAXIAL COMPRESSION

ASTM D7012

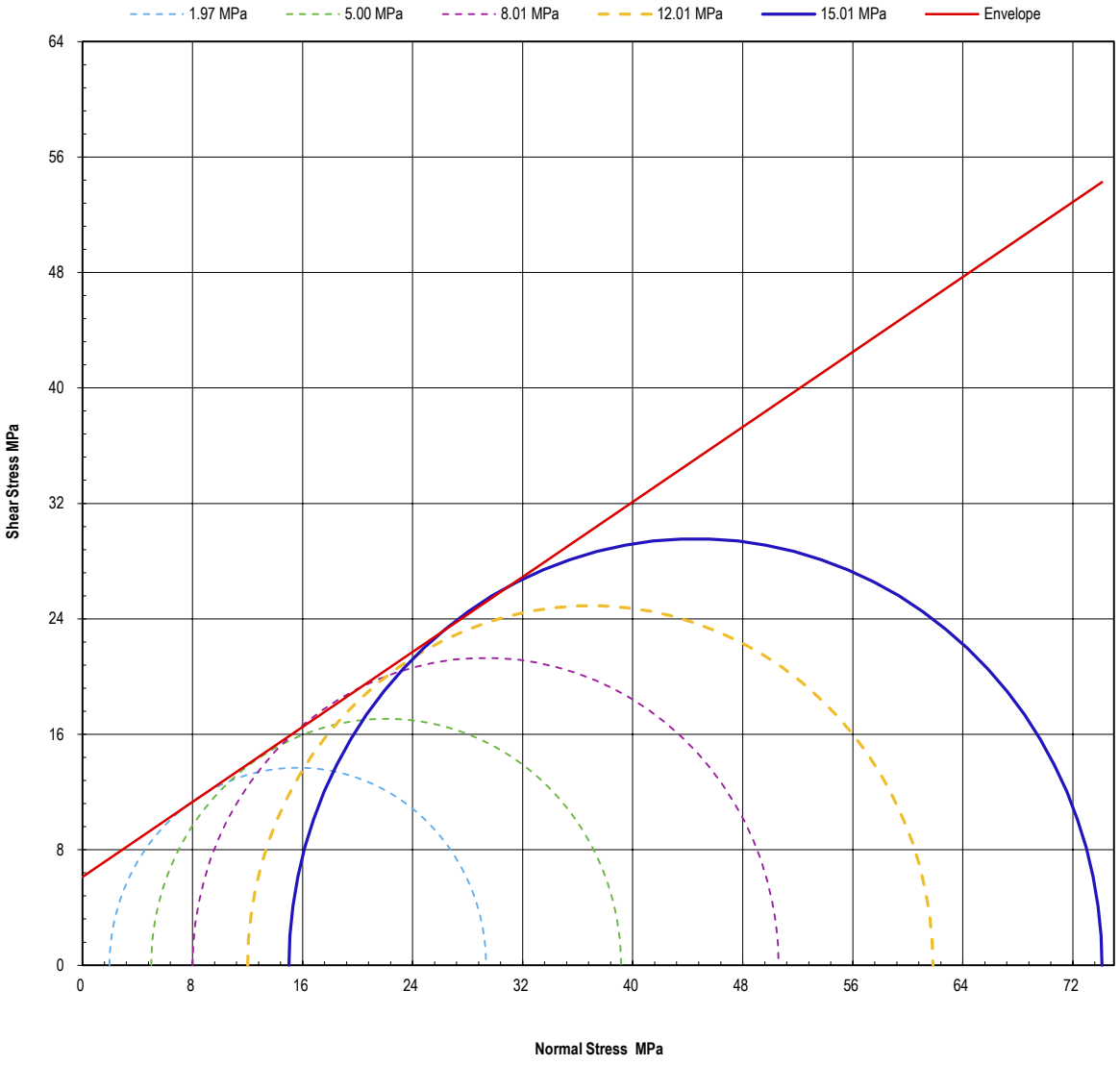
Standard Test Methods for Compressive Strength and Elastic Moduli of Intact Rock Core Specimens under Varying States of Stress and Temperatures

Method B : Elastic Moduli of Undrained Rock Core Specimens in Triaxial Compression Without Pore Pressure Measurements

Client Golder Associates Pty Limited

Report No. GA101671-RTX

Calculated Peak Stress Mohr Circle Plot



Calculated Peak Envelope		
Angle	33.0	°
Cohesion	6.11	MPa
Correlation	0.9992	

Notes/Remarks:

Graph not to scale

Sample/s supplied by client

Tested as received

Accredited for compliance with ISO/IES 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

STRENGTH OF ROCK MATERIAL IN TRIAXIAL COMPRESSION

ASTM D7012

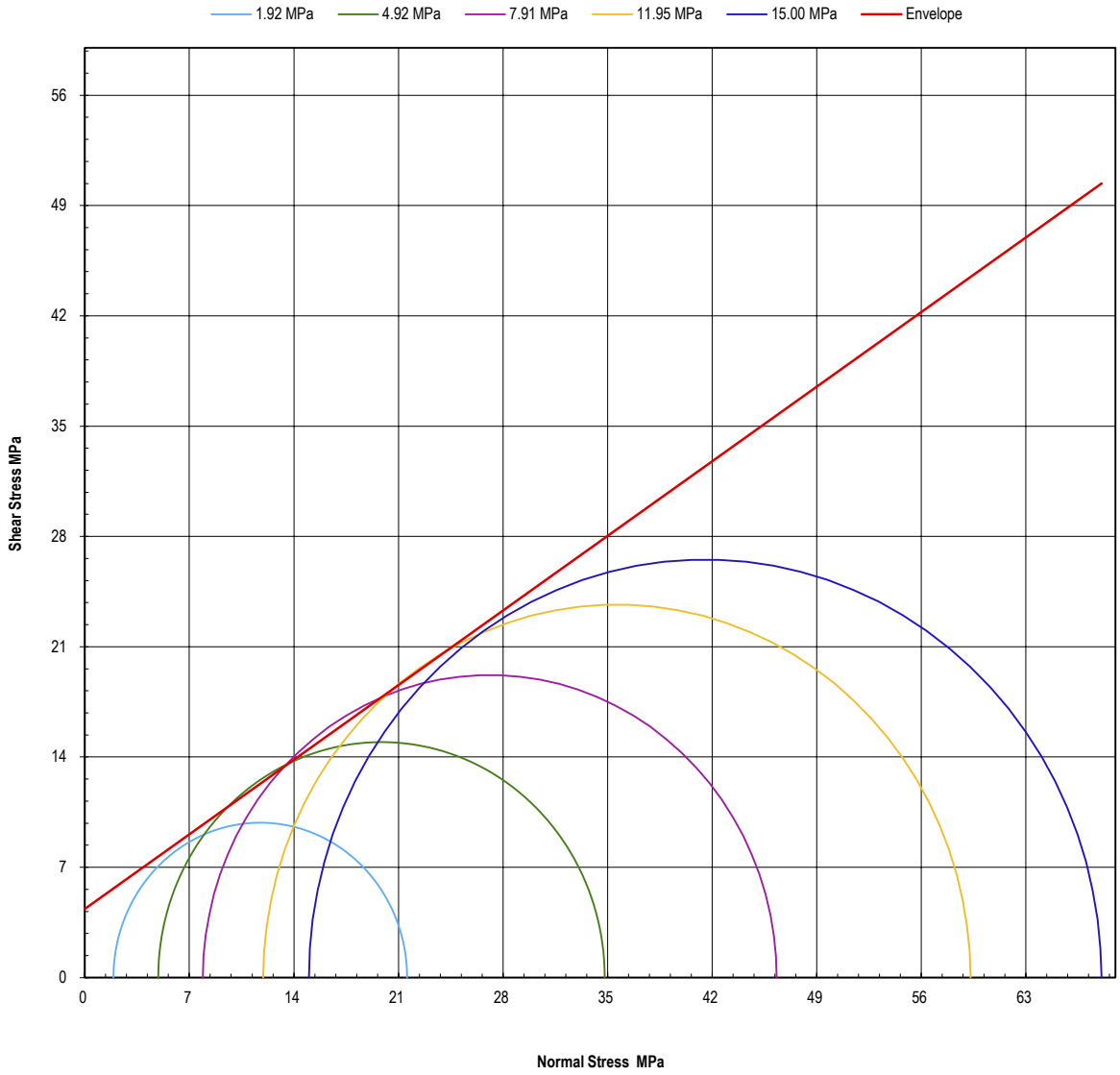
Standard Test Methods for Compressive Strength and Elastic Moduli of Intact Rock Core Specimens under Varying States of Stress and Temperatures

Method B : Elastic Moduli of Undrained Rock Core Specimens in Triaxial Compression Without Pore Pressure Measurements

Client Golder Associates Pty Limited

Report No. GA101671-RTX

Residual Stress Mohr Circle Plot



Estimated Residual Envelope

Angle	34.1	°
Cohesion	4.36	MPa
Correlation	0.9987	

Notes/Remarks:

Graph not to scale

Sample/s supplied by client

Tested as received

Accredited for compliance with ISO/IES 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory

Authorised Signatory

C. Purvis

NATA
ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

STRENGTH OF ROCK MATERIAL IN TRIAXIAL COMPRESSION

ASTM D7012

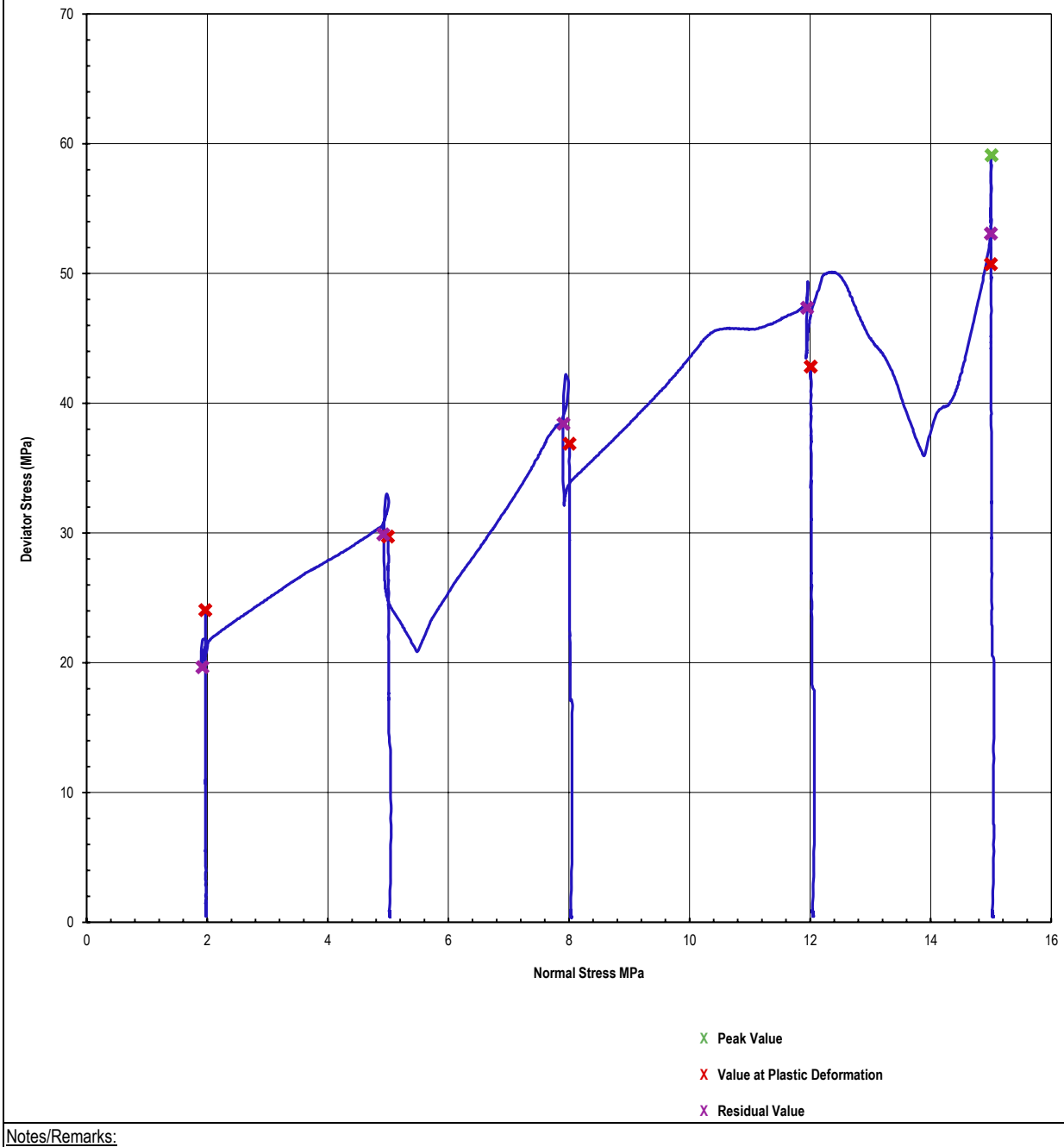
Standard Test Methods for Compressive Strength and Elastic Moduli of Intact Rock Core Specimens under Varying States of Stress and Temperatures

Method B : Elastic Moduli of Undrained Rock Core Specimens in Triaxial Compression Without Pore Pressure Measurements

Client Golder Associates Pty Limited

Report No. GA101671-RTX

Deviator Stress vs Normal Stress Plot



Notes/Remarks:

Graph not to scale

Sample/s supplied by client

Tested as received

Accredited for compliance with ISO/IES 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory

Authorised Signatory

C. Purvis

NATA
ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

STRENGTH OF ROCK MATERIAL IN TRIAXIAL COMPRESSION

ASTM D7012

Standard Test Methods for Compressive Strength and Elastic Moduli of Intact Rock Core Specimens under Varying States of Stress and Temperatures

Method B : Elastic Moduli of Undrained Rock Core Specimens in Triaxial Compression Without Pore Pressure Measurements

Client	Golder Associates Pty Limited	**Report No.**	GA101681-RTX
		Request No.	330-01-BH2101
Address	PO Box 1734 MILTON BC QLD 4064	**Test Date**	24/01/2019
		Report Date	25/01/2019
Project	Inland Rail Package 13	**Depth From (m)**	120.3
Bore Hole	330-01-BH2101	**Depth To (m)**	120.9
Sample No:	330-01-BH2101-C12030-TWR : 330-01-BH2101-C12030-MOI		
Description	C		
Sample Type	Single Individual Rock Core Specimen		

Sample Details

Average Sample Diameter (mm)	60.9	Moisture Content (%)	2.2
Sample Height (mm)	150.45	Wet Density (t/m^3)	2.46
Duration of Test (min)	12:21:00	Dry Density (t/m^3)	2.41
Rate of Strain (%/min)	0.05	Bedding (^{o})	Nil
Mode of Failure	Shear	Test Apparatus	RTR2500 Triaxial Machine
Rupture Angle (°)	40		

Intact Test Results

	Value at Plastic Deformation	Value at Plastic Deformation	Value at Plastic Deformation	Value at Plastic Deformation	Value at Plastic Deformation	Peak Value
Confining Pressure (MPa)	2.00	5.04	8.01	12.02	15.03	15.03
Calc'd Deviator Stress (MPa)	26.2	32.8	37.4	43.5	-	-
Deviator Stress (MPa)	26.1	32.7	37.3	43.4	48.2	48.4
Axial Strain (με)	1059	1200	1339	1538	1770	1814
Diametral Strain (με)	-125	-131	-182	-230	-280	-285
Tangent Modulus (GPa)	23.5	27.6	27.1	28.8	28.7	-
Poisson's Ratio	0.173	0.176	0.197	0.216	0.207	-

Residual Test Results

Confining Pressure (MPa)	15.02	11.96	7.90	4.91	1.93
Residual Deviator Stress (MPa)	36.7	30.4	23.9	18.0	10.6
Axial Strain (με)	5702	7122	8582	9806	10824
Diametral Strain (με)	-693	-801	-1066	-1460	-2062

Notes/Remarks:

Sample/s supplied by client Tested as received

Accredited for compliance with ISO/IES 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory

Authorised Signatory
C. Purvis

NATA ACCREDITED FOR TECHNICAL COMPETENCE
Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

STRENGTH OF ROCK MATERIAL IN TRIAXIAL COMPRESSION

ASTM D7012

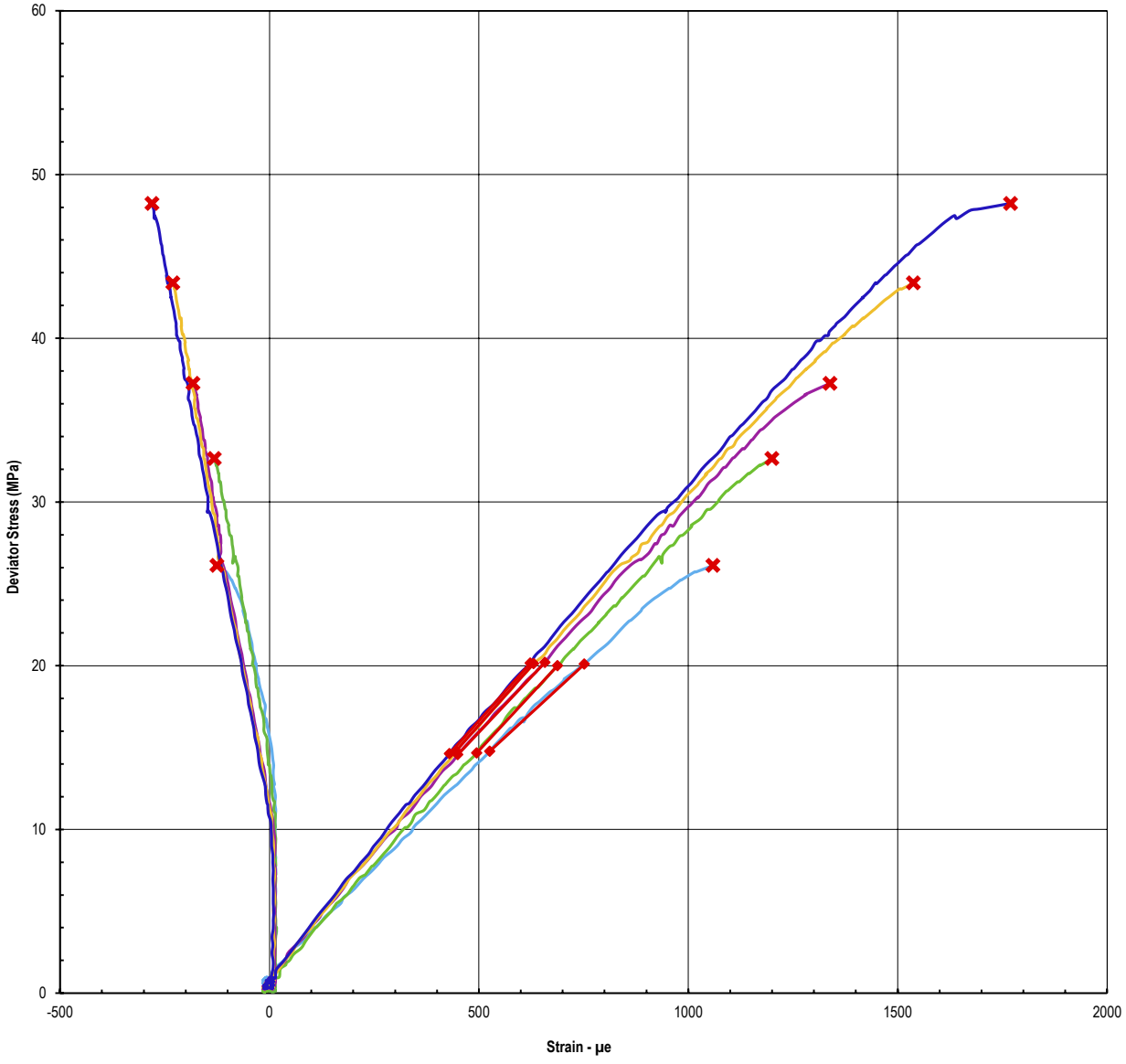
Standard Test Methods for Compressive Strength and Elastic Moduli of Intact Rock Core Specimens under Varying States of Stress and Temperatures

Method B : Elastic Moduli of Undrained Rock Core Specimens in Triaxial Compression Without Pore Pressure Measurements

Client Golder Associates Pty Limited

Report No. GA101681-RTX

Deviator Stress vs Axial Strain Plots



Notes/Remarks:

Graph not to scale

Sample/s supplied by client

Tested as received

Accredited for compliance with ISO/IES 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory

Authorised Signatory

C. Purvis

NATA
ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

STRENGTH OF ROCK MATERIAL IN TRIAXIAL COMPRESSION

ASTM D7012

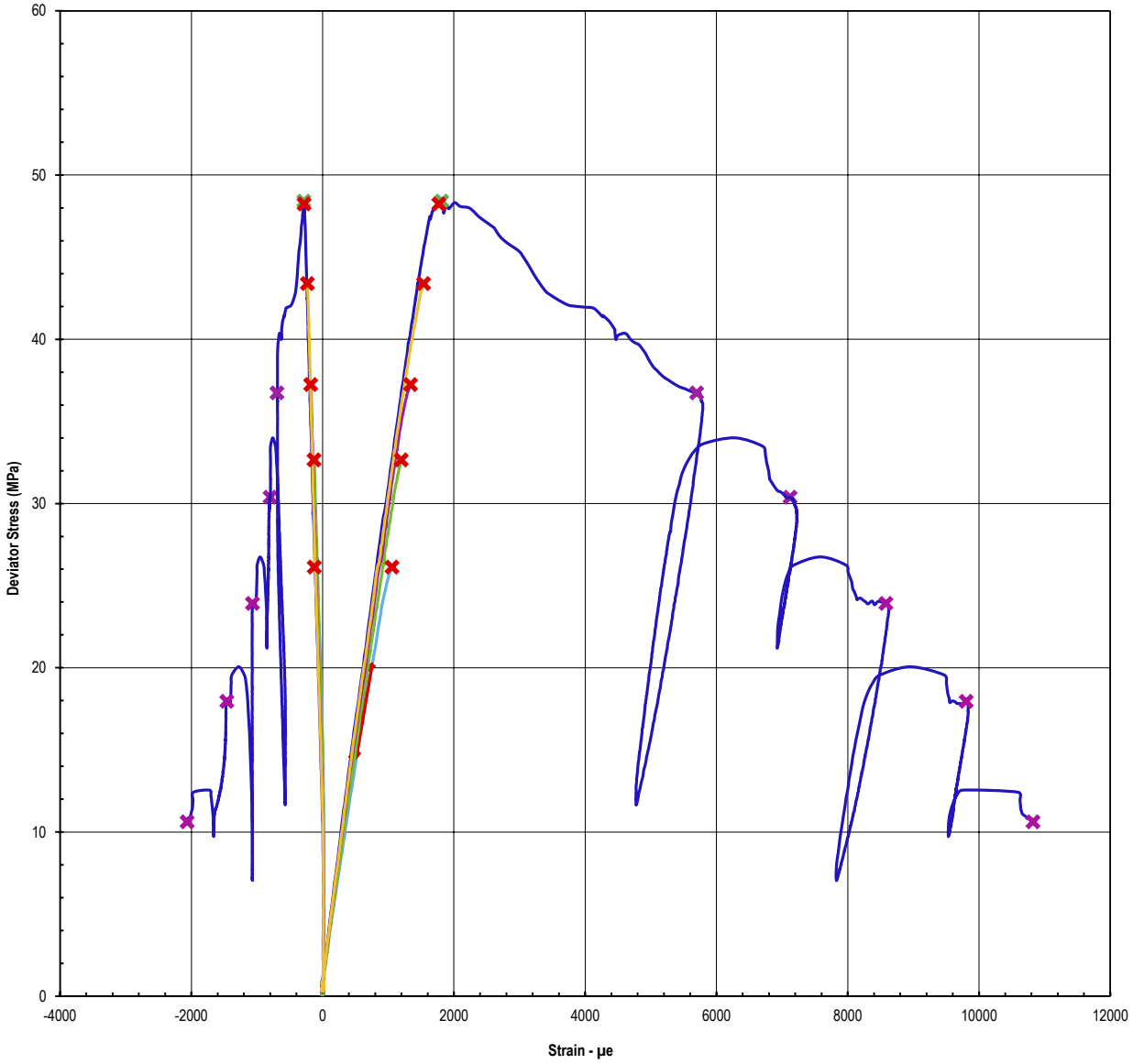
Standard Test Methods for Compressive Strength and Elastic Moduli of Intact Rock Core Specimens under Varying States of Stress and Temperatures

Method B : Elastic Moduli of Undrained Rock Core Specimens in Triaxial Compression Without Pore Pressure Measurements

Client Golder Associates Pty Limited

Report No. GA101681-RTX

Deviator Stress vs Axial Strain Plots



Notes/Remarks:

Graph not to scale

Sample/s supplied by client

Tested as received

Accredited for compliance with ISO/IES 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

STRENGTH OF ROCK MATERIAL IN TRIAXIAL COMPRESSION

ASTM D7012

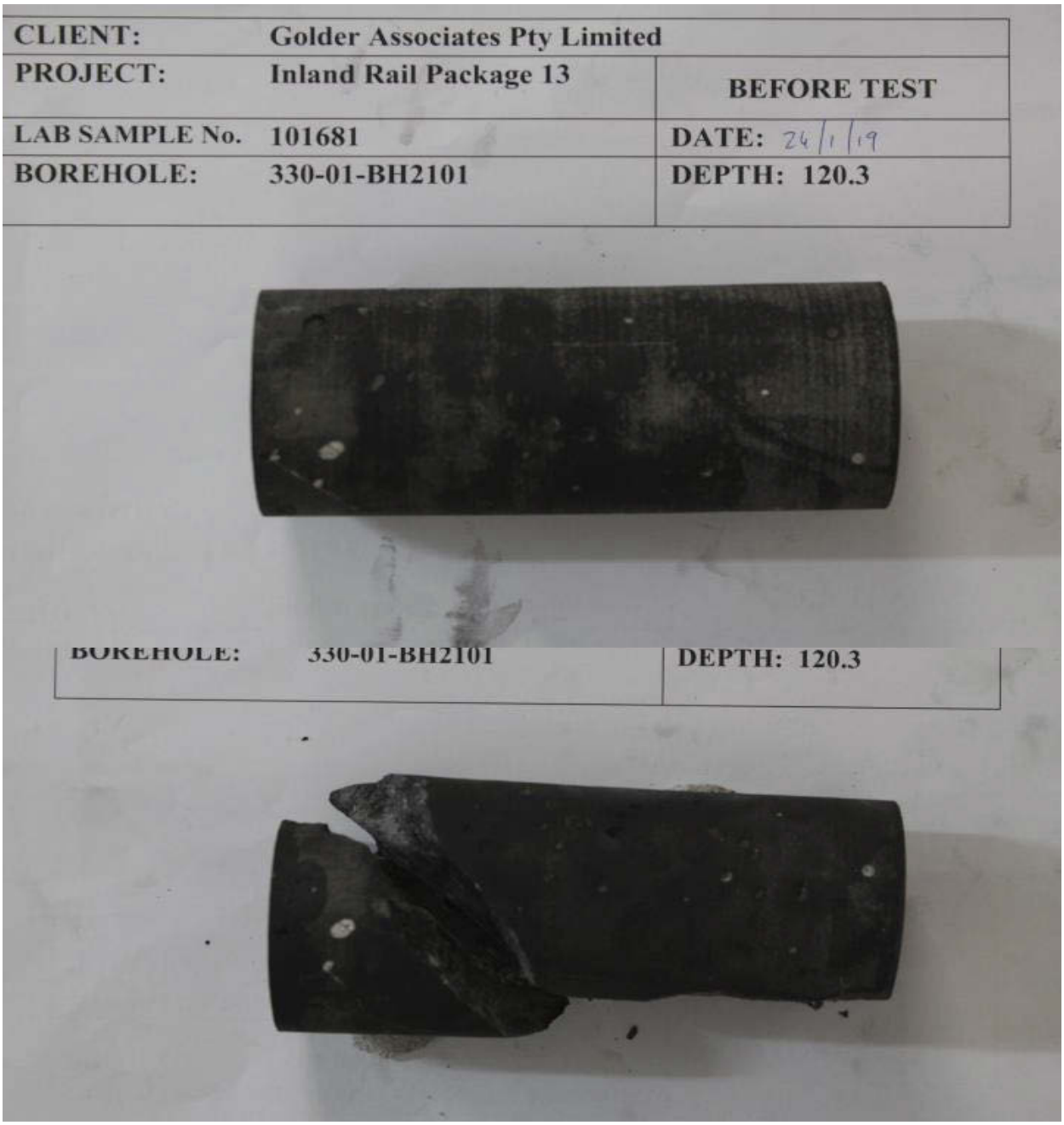
Standard Test Methods for Compressive Strength and Elastic Moduli of Intact Rock Core Specimens under Varying States of Stress and Temperatures

Method B : Elastic Moduli of Undrained Rock Core Specimens in Triaxial Compression Without Pore Pressure Measurements

Client Golder Associates Pty Limited

Report No. GA101681-RTX

Before and After Test Photos



Notes/Remarks:

Photo not to scale

Sample/s supplied by client

Tested as received

Accredited for compliance with ISO/IES 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory

Authorised Signatory

C. Purvis

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

STRENGTH OF ROCK MATERIAL IN TRIAXIAL COMPRESSION

ASTM D7012

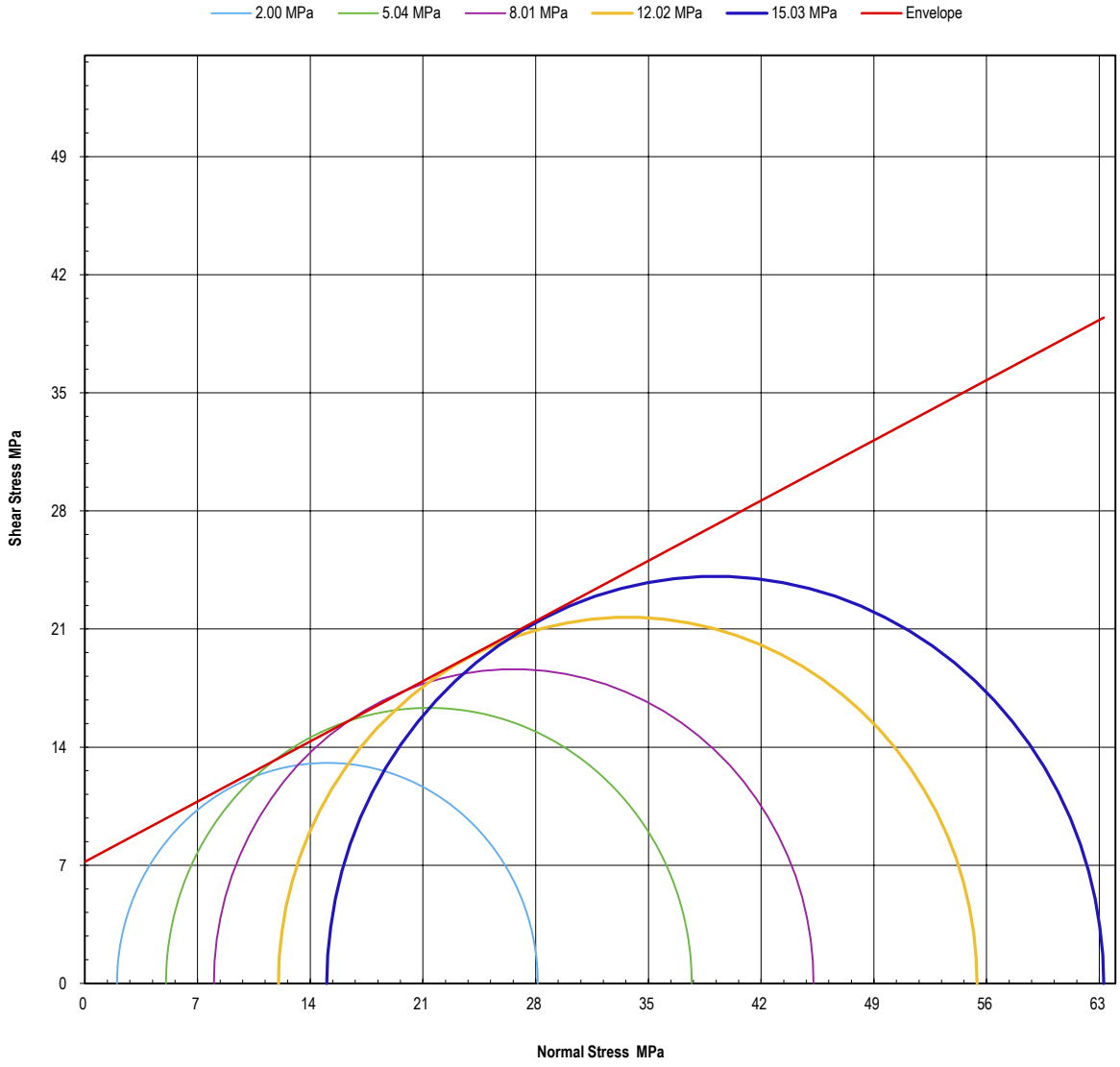
Standard Test Methods for Compressive Strength and Elastic Moduli of Intact Rock Core Specimens under Varying States of Stress and Temperatures

Method B : Elastic Moduli of Undrained Rock Core Specimens in Triaxial Compression Without Pore Pressure Measurements

Client Golder Associates Pty Limited

Report No. GA101681-RTX

Plastic Deformation - Mohr Circle Plot



Estimated Envelope - **(Calculated at Plastic Deformation on each Stage)**

Angle	27.0	°
Cohesion	7.21	MPa
Correlation	0.9993	

Notes/Remarks:

Graph not to scale

Sample/s supplied by client

Tested as received

Accredited for compliance with ISO/IES 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory

Authorised Signatory

C. Purvis

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

STRENGTH OF ROCK MATERIAL IN TRIAXIAL COMPRESSION

ASTM D7012

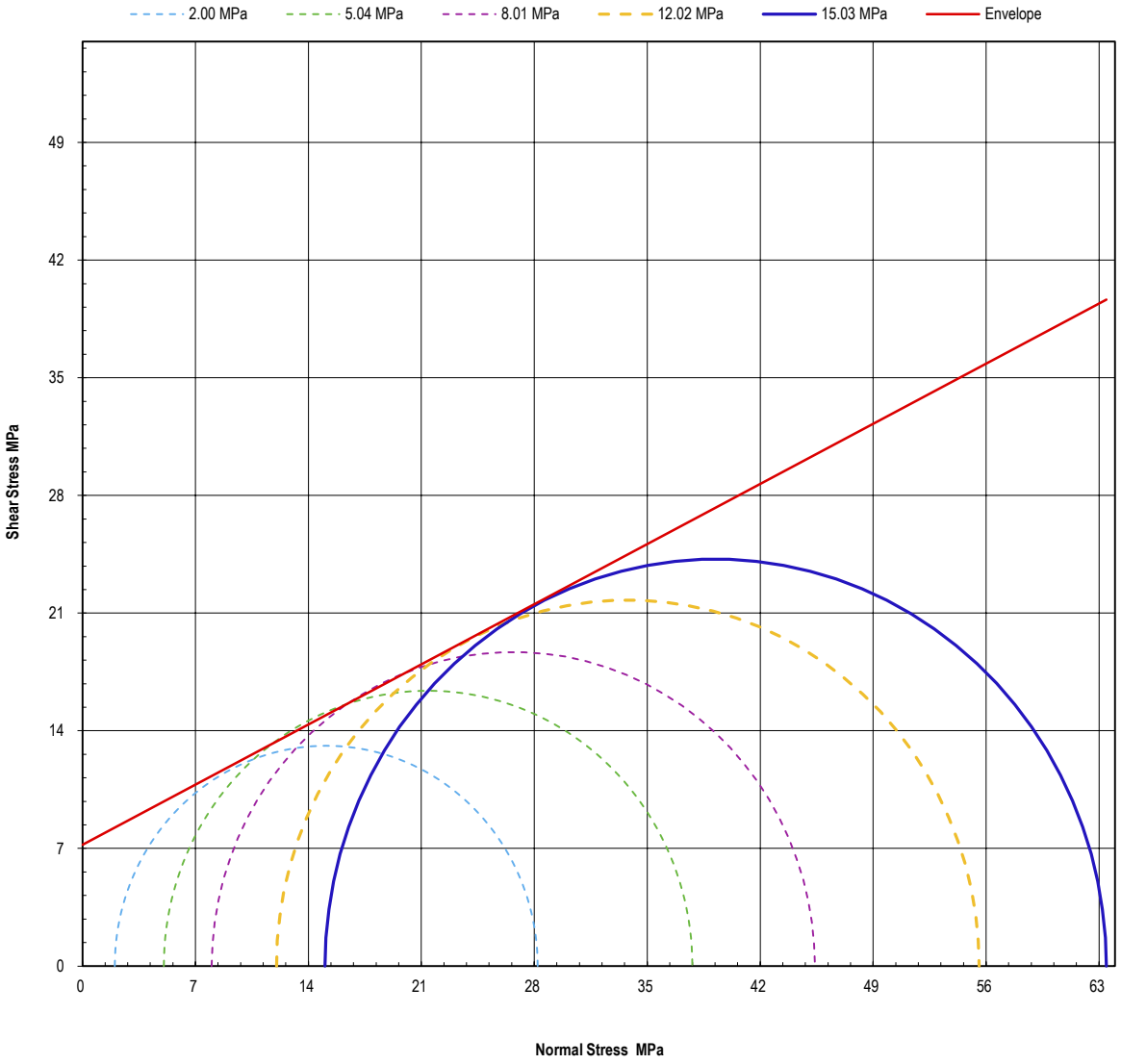
Standard Test Methods for Compressive Strength and Elastic Moduli of Intact Rock Core Specimens under Varying States of Stress and Temperatures

Method B : Elastic Moduli of Undrained Rock Core Specimens in Triaxial Compression Without Pore Pressure Measurements

Client Golder Associates Pty Limited

Report No. GA101681-RTX

Calculated Peak Stress Mohr Circle Plot



Calculated Peak Envelope		
Angle	27.1	°
Cohesion	7.22	MPa
Correlation	0.9990	

Notes/Remarks:

Graph not to scale

Sample/s supplied by client

Tested as received

Accredited for compliance with ISO/IES 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

STRENGTH OF ROCK MATERIAL IN TRIAXIAL COMPRESSION

ASTM D7012

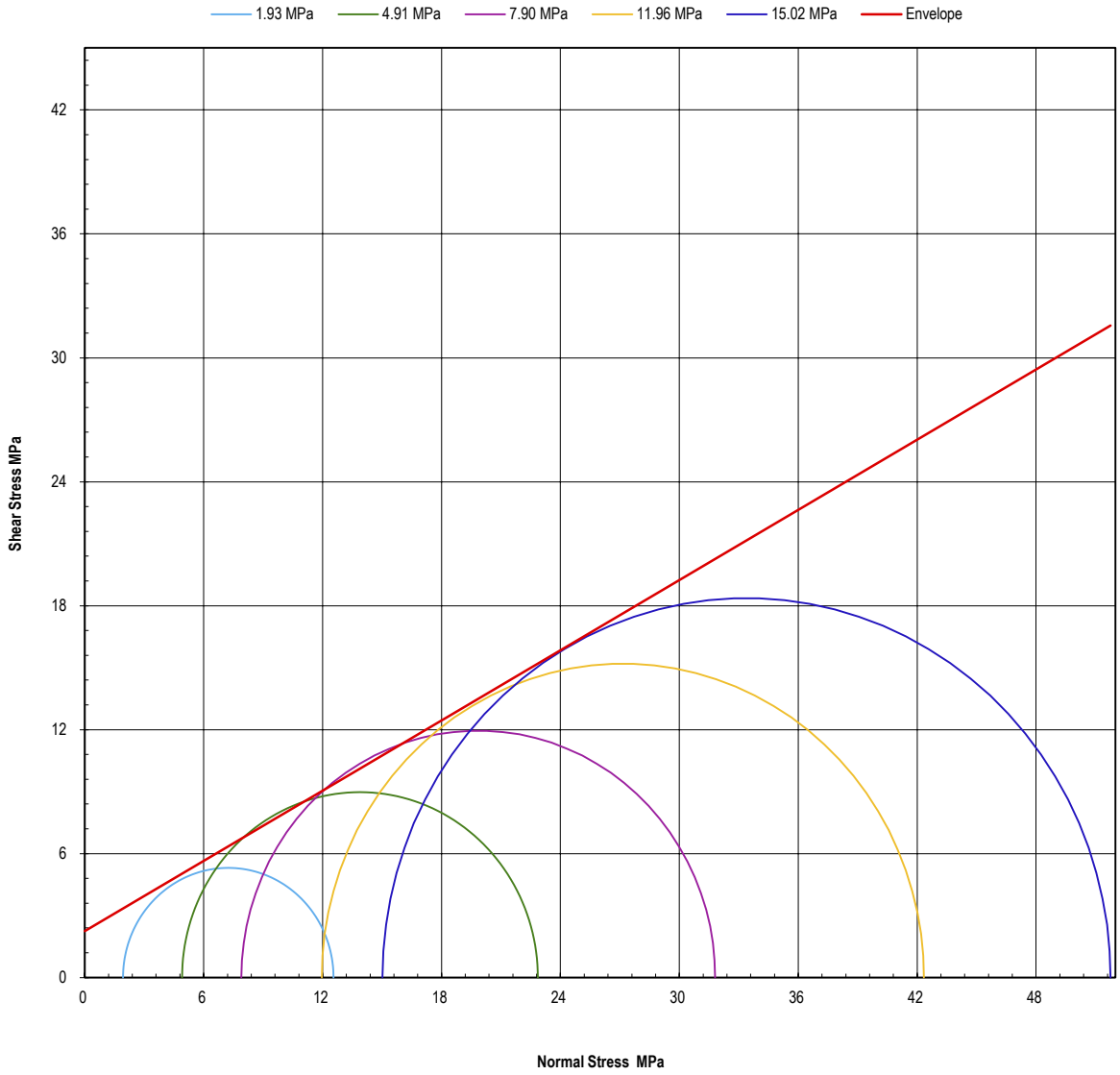
Standard Test Methods for Compressive Strength and Elastic Moduli of Intact Rock Core Specimens under Varying States of Stress and Temperatures

Method B : Elastic Moduli of Undrained Rock Core Specimens in Triaxial Compression Without Pore Pressure Measurements

Client Golder Associates Pty Limited

Report No. GA101681-RTX

Residual Stress Mohr Circle Plot



Estimated Residual Envelope

Angle	29.5	°
Cohesion	2.24	MPa
Correlation	0.9993	

Notes/Remarks:

Graph not to scale

Sample/s supplied by client

Tested as received

Accredited for compliance with ISO/IES 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory

Authorised Signatory

C. Purvis

NATA
ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

STRENGTH OF ROCK MATERIAL IN TRIAXIAL COMPRESSION

ASTM D7012

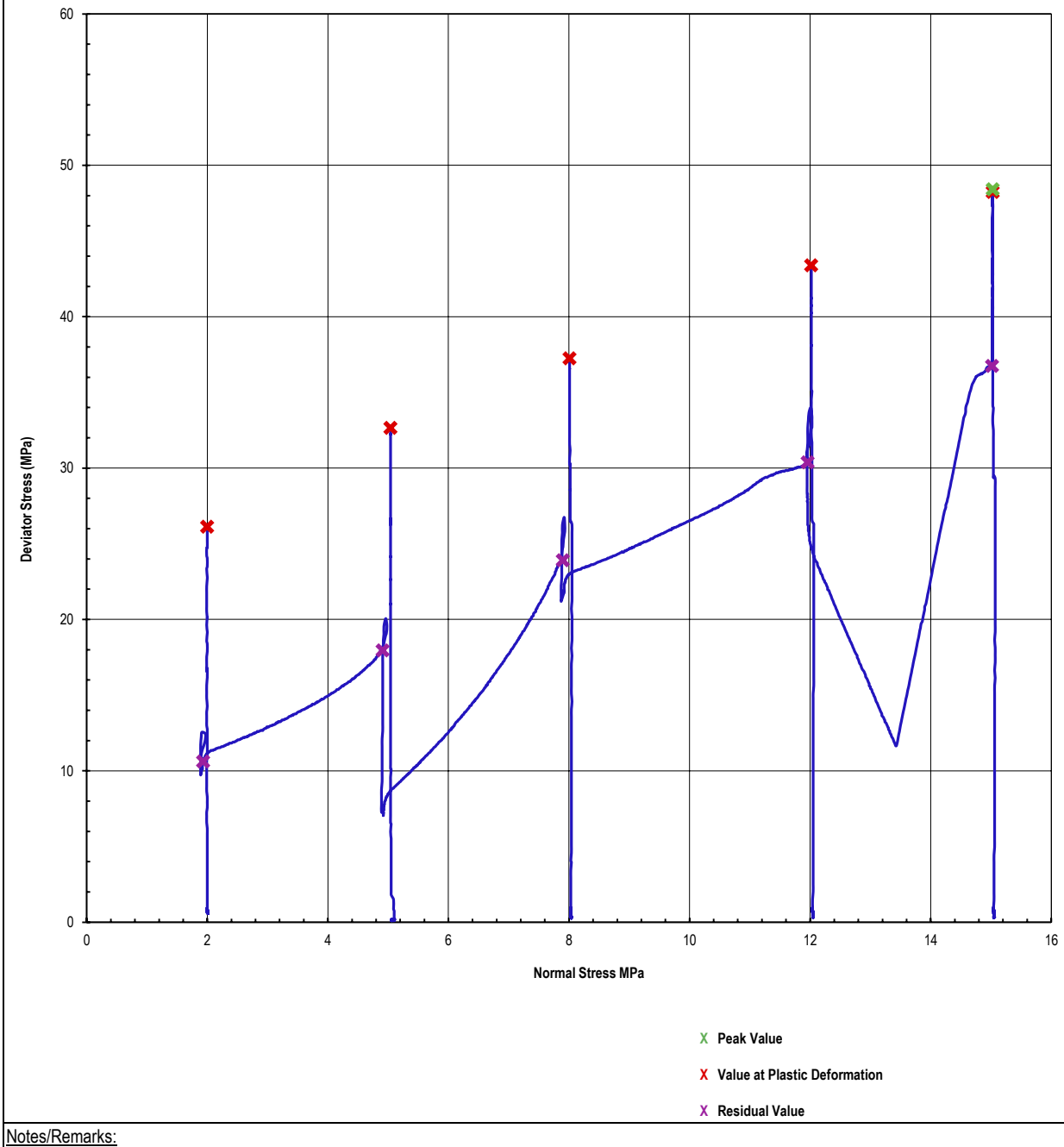
Standard Test Methods for Compressive Strength and Elastic Moduli of Intact Rock Core Specimens under Varying States of Stress and Temperatures

Method B : Elastic Moduli of Undrained Rock Core Specimens in Triaxial Compression Without Pore Pressure Measurements

Client Golder Associates Pty Limited

Report No. GA101681-RTX

Deviator Stress vs Normal Stress Plot



Notes/Remarks:

Graph not to scale

Sample/s supplied by client

Tested as received

Accredited for compliance with ISO/IES 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory

Authorised Signatory

C. Purvis

NATA
ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Point Load Testing

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

POINT LOAD TEST REPORT

Test Method: AS 4133.4.1

Client	Golder Associates Pty Limited	**Report No.**	GA101410-101565-PL
		Request No	1893802_H2C_TR1
Address	PO Box 1734 MILTON BC QLD 4064	**Test Date**	30/11/2018
		Report Date	4/12/2018
Project	Inland Rail Package 13		
Project No	1893802		

Trilab Sample No.	101410	101412	101414	101416
Client Sample No	330-01-BH2203-C01500	330-01-BH2203-C01650	330-01-BH2203-C01850	330-01-BH2203-C02000
Bore Hole	330-01-BH2203	330-01-BH2203	330-01-BH2203	330-01-BH2203
Depth From/To (m)	15.00-16.00	16.50-17.50	18.50-19.00	20.00-20.50
Description	C	C	C	C
I_s (MPa)	0.18	0.05	0.13	2.25
$I_{s(50)}$ (MPa)	0.18	0.05	0.13	2.24
Load Direction	Diametral	Diametral	Diametral	Diametral

Trilab Sample No.	101417	101427	101429	101431
Client Sample No	330-01-BH2203-C02200	330-01-BH2207-C01150	330-01-BH2207-C01350	330-01-BH2207-C01550
Bore Hole	330-01-BH2203	330-01-BH2207	330-01-BH2207	330-01-BH2207
Depth From/To (m)	22.00-23.00	11.50-12.00	13.50-14.00	15.50-16.00
Description	C	C	C	C
I_s (MPa)	0.19	0.43	0.06	1.37
$I_{s(50)}$ (MPa)	0.19	0.43	0.06	1.36
Load Direction	Diametral	Diametral	Diametral	Diametral

NOTES/REMARKS: Tested as received

Sample/s supplied by the client

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

POINT LOAD TEST REPORT

Test Method: AS 4133.4.1

Client	Golder Associates Pty Limited	**Report No.**	GA101410-101565-PL
		Request No	1893802_H2C_TR1
Address	PO Box 1734 MILTON BC QLD 4064	**Test Date**	30/11/2018
		Report Date	4/12/2018
Project	Inland Rail Package 13		
Project No	1893802		

Trilab Sample No.	101432	101434	101453	101455
Client Sample No	330-01-BH2207-C01650	330-01-BH2207-C01950	330-01-BH2212-C02460	330-01-BH2212-C02520
Bore Hole	330-01-BH2207	330-01-BH2207	330-01-BH2212	330-01-BH2212
Depth From/To (m)	16.50-17.00	19.50-20.00	24.60-24.70	25.20-25.30
Description	C	C	C	C
I_s (MPa)	0.23	0.73	0.75	0.10
$I_{s(50)}$ (MPa)	0.23	0.73	0.74	0.10
Load Direction	Diametral	Diametral	Diametral	Diametral

Trilab Sample No.	101485	101487	101489	101507
Client Sample No	330-01-BH2224-C02150	330-01-BH2224-C02350	330-01-BH2224-C02550	330-01-BH2301-C00260
Bore Hole	330-01-BH2224	330-01-BH2224	330-01-BH2224	330-01-BH2301
Depth From/To (m)	21.50-22.00	23.50-24.00	25.50-26.00	2.60-2.70
Description	C	C	C	C
I_s (MPa)	0.31	4.39	0.11	0.23
$I_{s(50)}$ (MPa)	0.31	4.27	0.11	0.23
Load Direction	Diametral	Diametral	Diametral	Diametral

NOTES/REMARKS: Tested as received

Sample/s supplied by the client

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

POINT LOAD TEST REPORT

Test Method: AS 4133.4.1

Client	Golder Associates Pty Limited	**Report No.**	GA101410-101565-PL
		Request No	1893802_H2C_TR1
Address	PO Box 1734 MILTON BC QLD 4064	**Test Date**	30/11/2018
		Report Date	4/12/2018
Project	Inland Rail Package 13		
Project No	1893802		

Trilab Sample No.	101508	101510	101512	101514
Client Sample No	330-01-BH2301-C00330	330-01-BH2301-C00440	330-01-BH2301-C00560	330-01-BH2301-C00760
Bore Hole	330-01-BH2301	330-01-BH2301	330-01-BH2301	330-01-BH2301
Depth From/To (m)	3.30-3.40	4.40-4.50	5.60-5.70	7.60-7.70
Description	C	C	C	C
I_s (MPa)	0.03	0.08	0.79	0.90
$I_{s(50)}$ (MPa)	0.03	0.08	0.78	0.89
Load Direction	Diametral	Diametral	Diametral	Diametral

Trilab Sample No.	101517	101524	101530	101532
Client Sample No	330-01-BH2301-C01130	330-01-BH2301-C01450	330-01-BH2301-C01600	330-01-BH2301-C01780
Bore Hole	330-01-BH2301	330-01-BH2301	330-01-BH2301	330-01-BH2301
Depth From/To (m)	11.30-11.40	14.50-14.60	16.00-16.10	17.80-17.90
Description	C	C	C	C
I_s (MPa)	1.09	1.11	1.36	2.35
$I_{s(50)}$ (MPa)	1.08	1.07	1.35	2.25
Load Direction	Diametral	Diametral	Diametral	Diametral

NOTES/REMARKS: Tested as received

Sample/s supplied by the client

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

POINT LOAD TEST REPORT

Test Method: AS 4133.4.1

Client	Golder Associates Pty Limited	**Report No.**	GA101410-101565-PL
		Request No	1893802_H2C_TR1
Address	PO Box 1734 MILTON BC QLD 4064	**Test Date**	30/11/2018
		Report Date	4/12/2018
Project	Inland Rail Package 13		
Project No	1893802		

Trilab Sample No.	101533	101534	101536	101537
Client Sample No	330-01-BH2301-C01900	330-01-BH2301-C02130	330-01-BH2301-C02550	330-01-BH2301-C02930
Bore Hole	330-01-BH2301	330-01-BH2301	330-01-BH2301	330-01-BH2301
Depth From/To (m)	19.00-19.10	21.30-21.40	25.50-25.60	29.30-29.40
Description	C	C	C	C
I_s (MPa)	1.55	5.72	7.13	0.21
$I_{s(50)}$ (MPa)	1.55	5.67	7.05	0.21
Load Direction	Diametral	Diametral	Diametral	Diametral

Trilab Sample No.	101538	101540	101553	101554
Client Sample No	330-01-BH2301-C03030	330-01-BH2303-C00240	330-01-BH2303-C00570	330-01-BH2303-C00710
Bore Hole	330-01-BH2301	330-01-BH2303	330-01-BH2303	330-01-BH2303
Depth From/To (m)	30.30-30.40	2.40-2.50	5.70-5.80	7.10-7.20
Description	C	C	C	C
I_s (MPa)	0.68	4.05	0.23	3.18
$I_{s(50)}$ (MPa)	0.68	4.00	0.22	3.15
Load Direction	Diametral	Diametral	Diametral	Diametral

NOTES/REMARKS: Tested as received

Sample/s supplied by the client

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

POINT LOAD TEST REPORT

Test Method: AS 4133.4.1

Client	Golder Associates Pty Limited	**Report No.**	GA101410-101565-PL
		Request No	1893802_H2C_TR1
Address	PO Box 1734 MILTON BC QLD 4064	**Test Date**	30/11/2018
		Report Date	4/12/2018
Project	Inland Rail Package 13		
Project No	1893802		

Trilab Sample No.	101556	101559	101560	101562
Client Sample No	330-01-BH2303-C01040	330-01-BH2303-C01340	330-01-BH2303-C01470	330-01-BH2303-C01750
Bore Hole	330-01-BH2303	330-01-BH2303	330-01-BH2303	330-01-BH2303
Depth From/To (m)	10.40-10.50	13.40-13.50	14.70-14.80	17.50-17.60
Description	C	C	C	C
I_s (MPa)	1.83	0.71	1.19	0.36
$I_{s(50)}$ (MPa)	1.83	0.71	1.18	0.36
Load Direction	Diametral	Diametral	Diametral	Diametral

Trilab Sample No.	101564	101565	101410	101412
Client Sample No	330-01-BH2303-C01870	330-01-BH2303-C02220	330-01-BH2203-C01500	330-01-BH2203-C01650
Bore Hole	330-01-BH2303	330-01-BH2303	330-01-BH2203	330-01-BH2203
Depth From/To (m)	18.70-18.80	22.20-22.30	15.00-16.00	16.50-17.50
Description	C	C	C	C
I_s (MPa)	1.72	0.11	0.28	0.45
$I_{s(50)}$ (MPa)	1.66	0.11	0.28	0.43
Load Direction	Diametral	Diametral	Axial	Axial

NOTES/REMARKS: Tested as received

Sample/s supplied by the client

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

POINT LOAD TEST REPORT

Test Method: AS 4133.4.1

Client	Golder Associates Pty Limited	**Report No.**	GA101410-101565-PL
		Request No	1893802_H2C_TR1
Address	PO Box 1734 MILTON BC QLD 4064	**Test Date**	30/11/2018
		Report Date	4/12/2018
Project	Inland Rail Package 13		
Project No	1893802		

Trilab Sample No.	101414	101416	101417	101427
Client Sample No	330-01-BH2203-C01850	330-01-BH2203-C02000	330-01-BH2203-C02200	330-01-BH2207-C01150
Bore Hole	330-01-BH2203	330-01-BH2203	330-01-BH2203	330-01-BH2207
Depth From/To (m)	18.50-19.00	20.00-20.50	22.00-23.00	11.50-12.00
Description	C	C	C	C
I_s (MPa)	0.23	1.98	0.28	0.29
$I_{s(50)}$ (MPa)	0.23	2.00	0.29	0.30
Load Direction	Axial	Axial	Axial	Axial

Trilab Sample No.	101429	101431	101432	101434
Client Sample No	330-01-BH2207-C01350	330-01-BH2207-C01550	330-01-BH2207-C01650	330-01-BH2207-C01950
Bore Hole	330-01-BH2207	330-01-BH2207	330-01-BH2207	330-01-BH2207
Depth From/To (m)	13.50-14.00	15.50-16.00	16.50-17.00	19.50-20.00
Description	C	C	C	C
I_s (MPa)	0.15	1.74	0.45	1.56
$I_{s(50)}$ (MPa)	0.15	1.76	0.45	1.56
Load Direction	Axial	Axial	Axial	Axial

NOTES/REMARKS: Tested as received

Sample/s supplied by the client

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

POINT LOAD TEST REPORT

Test Method: AS 4133.4.1

Client	Golder Associates Pty Limited	**Report No.**	GA101410-101565-PL
		Request No	1893802_H2C_TR1
Address	PO Box 1734 MILTON BC QLD 4064	**Test Date**	30/11/2018
		Report Date	4/12/2018
Project	Inland Rail Package 13		
Project No	1893802		

Trilab Sample No.	101453	101455	101485	101487
Client Sample No	330-01-BH2212-C02460	330-01-BH2212-C02520	330-01-BH2224-C02150	330-01-BH2224-C02350
Bore Hole	330-01-BH2212	330-01-BH2212	330-01-BH2224	330-01-BH2224
Depth From/To (m)	24.60-24.70	25.20-25.30	21.50-22.00	23.50-24.00
Description	C	C	C	C
I_S (MPa)	0.73	0.11	0.43	6.40
$I_{S(50)}$ (MPa)	0.72	0.11	0.44	6.41
Load Direction	Axial	Axial	Axial	Axial

Trilab Sample No.	101489	101507	101508	101510
Client Sample No	330-01-BH2224-C02550	330-01-BH2301-C00260	330-01-BH2301-C00330	330-01-BH2301-C00440
Bore Hole	330-01-BH2224	330-01-BH2301	330-01-BH2301	330-01-BH2301
Depth From/To (m)	25.50-26.00	2.60-2.70	3.30-3.40	4.40-4.50
Description	C	C	C	C
I_S (MPa)	0.36	0.24	0.14	0.54
$I_{S(50)}$ (MPa)	0.36	0.24	0.13	0.54
Load Direction	Axial	Axial	Axial	Axial

NOTES/REMARKS: Tested as received

Sample/s supplied by the client

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

POINT LOAD TEST REPORT

Test Method: AS 4133.4.1

Client	Golder Associates Pty Limited	**Report No.**	GA101410-101565-PL
		Request No	1893802_H2C_TR1
Address	PO Box 1734 MILTON BC QLD 4064	**Test Date**	30/11/2018
		Report Date	4/12/2018
Project	Inland Rail Package 13		
Project No	1893802		

Trilab Sample No.	101512	101514	101517	101524
Client Sample No	330-01-BH2301-C00560	330-01-BH2301-C00760	330-01-BH2301-C01130	330-01-BH2301-C01450
Bore Hole	330-01-BH2301	330-01-BH2301	330-01-BH2301	330-01-BH2301
Depth From/To (m)	5.60-5.70	7.60-7.70	11.30-11.40	14.50-14.60
Description	C	C	C	C
I_s (MPa)	1.00	1.13	0.96	1.05
$I_{s(50)}$ (MPa)	1.01	1.11	1.01	1.05
Load Direction	Axial	Axial	Axial	Axial

Trilab Sample No.	101530	101532	101533	101534
Client Sample No	330-01-BH2301-C01600	330-01-BH2301-C01780	330-01-BH2301-C01900	330-01-BH2301-C02130
Bore Hole	330-01-BH2301	330-01-BH2301	330-01-BH2301	330-01-BH2301
Depth From/To (m)	16.00-16.10	17.80-17.90	19.00-19.10	21.30-21.40
Description	C	C	C	C
I_s (MPa)	0.83	1.91	3.01	5.77
$I_{s(50)}$ (MPa)	0.83	1.98	3.01	5.87
Load Direction	Axial	Axial	Axial	Axial

NOTES/REMARKS: Tested as received

Sample/s supplied by the client

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

POINT LOAD TEST REPORT

Test Method: AS 4133.4.1

Client	Golder Associates Pty Limited	**Report No.**	GA101410-101565-PL
		Request No	1893802_H2C_TR1
Address	PO Box 1734 MILTON BC QLD 4064	**Test Date**	30/11/2018
		Report Date	4/12/2018
Project	Inland Rail Package 13		
Project No	1893802		

Trilab Sample No.	101536	101537	101538	101540
Client Sample No	330-01-BH2301-C02550	330-01-BH2301-C02930	330-01-BH2301-C03030	330-01-BH2303-C00240
Bore Hole	330-01-BH2301	330-01-BH2301	330-01-BH2301	330-01-BH2303
Depth From/To (m)	25.50-25.60	29.30-29.40	30.30-30.40	2.40-2.50
Description	C	C	C	C
I_s (MPa)	1.11	0.29	0.89	6.46
$I_{s(50)}$ (MPa)	1.17	0.28	0.89	6.05
Load Direction	Axial	Axial	Axial	Axial

Trilab Sample No.	101553	101554	101556	101559
Client Sample No	330-01-BH2303-C00570	330-01-BH2303-C00710	330-01-BH2303-C01040	330-01-BH2303-C01340
Bore Hole	330-01-BH2303	330-01-BH2303	330-01-BH2303	330-01-BH2303
Depth From/To (m)	5.70-5.80	7.10-7.20	10.40-10.50	13.40-13.50
Description	C	C	C	C
I_s (MPa)	0.25	3.53	2.60	0.88
$I_{s(50)}$ (MPa)	0.25	3.52	2.38	0.93
Load Direction	Axial	Axial	Axial	Axial

NOTES/REMARKS: Tested as received

Sample/s supplied by the client

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

POINT LOAD TEST REPORT

Test Method: AS 4133.4.1

Client	Golder Associates Pty Limited	**Report No.**	GA101410-101565-PL
		Request No	1893802_H2C_TR1
Address	PO Box 1734 MILTON BC QLD 4064	**Test Date**	30/11/2018
		Report Date	4/12/2018
Project	Inland Rail Package 13		
Project No	1893802		

Trilab Sample No.	101560	101562	101564	101565
Client Sample No	330-01-BH2303-C01470	330-01-BH2303-C01750	330-01-BH2303-C01870	330-01-BH2303-C02220
Bore Hole	330-01-BH2303	330-01-BH2303	330-01-BH2303	330-01-BH2303
Depth From/To (m)	14.70-14.80	17.50-17.60	18.70-18.80	22.20-22.30
Description	C	C	C	C
I_S (MPa)	2.52	0.38	1.30	0.31
$I_{S(50)}$ (MPa)	2.54	0.39	1.34	0.31
Load Direction	Axial	Axial	Axial	Axial

Trilab Sample No.				
Client Sample No				
Bore Hole				
Depth From/To (m)				
Description				
I_S (MPa)				
$I_{S(50)}$ (MPa)				
Load Direction				

NOTES/REMARKS: Tested as received

Sample/s supplied by the client

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

POINT LOAD TEST REPORT

Test Method: AS 4133.4.1

Client	Golder Associates Pty Limited	**Report No.**	GA101582-101767-PL
		Request No	1893802_H2C_TR2
Address	PO Box 1734 MILTON BC QLD 4064	**Test Date**	29/11/2018
		Report Date	4/12/2018
Project	Inland Rail Package 13		
Project No	1893802		

Trilab Sample No.	101582	101583	101584	101585
Client Sample No	330-01-BH2101-C07000	330-01-BH2101-C07000	330-01-BH2101-C07000	330-01-BH2101-C07000
Bore Hole	330-01-BH2101	330-01-BH2101	330-01-BH2101	330-01-BH2101
Depth From/To (m)	70.20-70.33	70.33-70.47	70.47-70.60	70.60-70.73
Description	C	C	C	C
I_s (MPa)	1.07	1.11	0.89	1.29
$I_{s(50)}$ (MPa)	1.15	1.16	0.94	1.34
Load Direction	Axial	Axial	Axial	Axial

Trilab Sample No.	101586	101590	101591	101592
Client Sample No	330-01-BH2101-C07000	330-01-BH2101-C07200	330-01-BH2101-C07200	330-01-BH2101-C07200
Bore Hole	330-01-BH2101	330-01-BH2101	330-01-BH2101	330-01-BH2101
Depth From/To (m)	70.73-70.86	72.36-72.49	72.03-72.15	72.49-72.61
Description	C	C	C	C
I_s (MPa)	0.70	0.43	0.34	0.29
$I_{s(50)}$ (MPa)	0.76	0.46	0.36	0.30
Load Direction	Axial	Axial	Axial	Axial

NOTES/REMARKS: Tested as received

Sample/s supplied by the client

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

POINT LOAD TEST REPORT

Test Method: AS 4133.4.1

Client	Golder Associates Pty Limited	**Report No.**	GA101582-101767-PL
		Request No	1893802_H2C_TR2
Address	PO Box 1734 MILTON BC QLD 4064	**Test Date**	29/11/2018
		Report Date	4/12/2018
Project	Inland Rail Package 13		
Project No	1893802		

Trilab Sample No.	101593	101594	101602	101603
Client Sample No	330-01-BH2101-C07200	330-01-BH2101-C07200	330-01-BH2101-C08100	330-01-BH2101-C08100
Bore Hole	330-01-BH2101	330-01-BH2101	330-01-BH2101	330-01-BH2101
Depth From/To (m)	72.61-72.74	72.74-72.81	81.43-81.53	81.53-81.63
Description	C	C	C	C
I_s (MPa)	0.34	0.38	0.73	0.63
$I_{s(50)}$ (MPa)	0.36	0.39	0.79	0.70
Load Direction	Axial	Axial	Axial	Axial

Trilab Sample No.	101604	101605	101606	101609
Client Sample No	330-01-BH2101-C08100	330-01-BH2101-C08100	330-01-BH2101-C08100	330-01-BH2101-C08610
Bore Hole	330-01-BH2101	330-01-BH2101	330-01-BH2101	330-01-BH2101
Depth From/To (m)	81.63-81.74	81.74-81.84	81.84-81.93	86.10-86.18
Description	C	C	C	C
I_s (MPa)	0.77	1.03	1.13	0.35
$I_{s(50)}$ (MPa)	0.83	1.12	1.23	0.36
Load Direction	Axial	Axial	Axial	Axial

NOTES/REMARKS: Tested as received

Sample/s supplied by the client

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

POINT LOAD TEST REPORT

Test Method: AS 4133.4.1

Client	Golder Associates Pty Limited	**Report No.**	GA101582-101767-PL
		Request No	1893802_H2C_TR2
Address	PO Box 1734 MILTON BC QLD 4064	**Test Date**	29/11/2018
		Report Date	4/12/2018
Project	Inland Rail Package 13		
Project No	1893802		

Trilab Sample No.	101610	101611	101612	101613
Client Sample No	330-01-BH2101-C08610	330-01-BH2101-C08610	330-01-BH2101-C08610	330-01-BH2101-C08610
Bore Hole	330-01-BH2101	330-01-BH2101	330-01-BH2101	330-01-BH2101
Depth From/To (m)	86.34-86.42	86.42-86.49	86.49-86.57	86.57-86.66
Description	C	C	C	C
I_s (MPa)	0.16	0.34	0.34	0.08
$I_{s(50)}$ (MPa)	0.17	0.36	0.36	0.08
Load Direction	Axial	Axial	Axial	Axial

Trilab Sample No.	101616	101617	101618	101619
Client Sample No	330-01-BH2101-C08700	330-01-BH2101-C08700	330-01-BH2101-C08700	330-01-BH2101-C08700
Bore Hole	330-01-BH2101	330-01-BH2101	330-01-BH2101	330-01-BH2101
Depth From/To (m)	87.21-87.28	87.28-87.35	87.35-87.42	87.42-87.50
Description	C	C	C	C
I_s (MPa)	0.92	0.70	0.53	0.98
$I_{s(50)}$ (MPa)	0.93	0.72	0.54	1.00
Load Direction	Axial	Axial	Axial	Axial

NOTES/REMARKS: Tested as received

Sample/s supplied by the client

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

POINT LOAD TEST REPORT

Test Method: AS 4133.4.1

Client	Golder Associates Pty Limited	**Report No.**	GA101582-101767-PL
		Request No	1893802_H2C_TR2
Address	PO Box 1734 MILTON BC QLD 4064	**Test Date**	29/11/2018
		Report Date	4/12/2018
Project	Inland Rail Package 13		
Project No	1893802		

Trilab Sample No.	101625	101626	101627	101628
Client Sample No	330-01-BH2101-C09100	330-01-BH2101-C09100	330-01-BH2101-C09100	330-01-BH2101-C09100
Bore Hole	330-01-BH2101	330-01-BH2101	330-01-BH2101	330-01-BH2101
Depth From/To (m)	91.05-91.15	91.21-91.27	91.32-91.42	91.59-91.70
Description	C	C	C	C
I_S (MPa)	0.34	0.09	0.18	0.36
$I_{S(50)}$ (MPa)	0.29	0.09	0.18	0.35
Load Direction	Axial	Axial	Axial	Axial

Trilab Sample No.	101629	101635	101636	101637
Client Sample No	330-01-BH2101-C09100	330-01-BH2101-C09600	330-01-BH2101-C09600	330-01-BH2101-C09600
Bore Hole	330-01-BH2101	330-01-BH2101	330-01-BH2101	330-01-BH2101
Depth From/To (m)	91.47-91.51	96.21-96.31	96.31-96.41	96.42-96.52
Description	C	C	C	C
I_S (MPa)	0.08	1.04	0.74	1.35
$I_{S(50)}$ (MPa)	0.07	1.10	0.77	1.45
Load Direction	Axial	Axial	Axial	Axial

NOTES/REMARKS: Tested as received

Sample/s supplied by the client

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

POINT LOAD TEST REPORT

Test Method: AS 4133.4.1

Client	Golder Associates Pty Limited	**Report No.**	GA101582-101767-PL
		Request No	1893802_H2C_TR2
Address	PO Box 1734 MILTON BC QLD 4064	**Test Date**	29/11/2018
		Report Date	4/12/2018
Project	Inland Rail Package 13		
Project No	1893802		

Trilab Sample No.	101638	101639	101647	101648
Client Sample No	330-01-BH2101-C09600	330-01-BH2101-C09600	330-01-BH2101-C10460	330-01-BH2101-C10460
Bore Hole	330-01-BH2101	330-01-BH2101	330-01-BH2101	330-01-BH2101
Depth From/To (m)	96.52-96.63	96.63-96.73	104.69-104.80	104.80-104.90
Description	C	C	C	C
I_s (MPa)	1.07	1.16	1.07	0.82
$I_{s(50)}$ (MPa)	1.14	1.21	1.03	0.79
Load Direction	Axial	Axial	Axial	Axial

Trilab Sample No.	101651	101652	101653	101654
Client Sample No	330-01-BH2101-C10820	330-01-BH2101-C10820	330-01-BH2101-C10820	330-01-BH2101-C10820
Bore Hole	330-01-BH2101	330-01-BH2101	330-01-BH2101	330-01-BH2101
Depth From/To (m)	108.90-109.0	108.86-108.90	108.82-108.86	108.58-108.63
Description	C	C	C	C
I_s (MPa)	1.00	0.34	0.50	0.10
$I_{s(50)}$ (MPa)	0.98	0.36	0.48	0.10
Load Direction	Axial	Axial	Axial	Axial

NOTES/REMARKS: Tested as received

Sample/s supplied by the client

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

POINT LOAD TEST REPORT

Test Method: AS 4133.4.1

Client	Golder Associates Pty Limited	**Report No.**	GA101582-101767-PL
		Request No	1893802_H2C_TR2
Address	PO Box 1734 MILTON BC QLD 4064	**Test Date**	29/11/2018
		Report Date	4/12/2018
Project	Inland Rail Package 13		
Project No	1893802		

Trilab Sample No.	101655	101661	101662	101663
Client Sample No	330-01-BH2101-C10820	330-01-BH2101-C11400	330-01-BH2101-C11400	330-01-BH2101-C11400
Bore Hole	330-01-BH2101	330-01-BH2101	330-01-BH2101	330-01-BH2101
Depth From/To (m)	108.41-108.45	114.16-114.25	114.25-114.37	114.37-114.50
Description	C	C	C	C
I_s (MPa)	0.63	1.81	1.48	2.52
$I_{s(50)}$ (MPa)	0.63	1.80	1.54	2.62
Load Direction	Axial	Axial	Axial	Axial

Trilab Sample No.	101664	101665	101674	101675
Client Sample No	330-01-BH2101-C11400	330-01-BH2101-C11400	330-01-BH2101-C12030	330-01-BH2101-C12030
Bore Hole	330-01-BH2101	330-01-BH2101	330-01-BH2101	330-01-BH2101
Depth From/To (m)	114.50-114.62	114.62-114.75	120.33-120.42	120.53-120.63
Description	C	C	C	C
I_s (MPa)	2.15	1.97	0.96	1.03
$I_{s(50)}$ (MPa)	2.13	2.08	1.01	1.04
Load Direction	Axial	Axial	Axial	Axial

NOTES/REMARKS: Tested as received

Sample/s supplied by the client

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

POINT LOAD TEST REPORT

Test Method: AS 4133.4.1

Client	Golder Associates Pty Limited	**Report No.**	GA101582-101767-PL
		Request No	1893802_H2C_TR2
Address	PO Box 1734 MILTON BC QLD 4064	**Test Date**	29/11/2018
		Report Date	4/12/2018
Project	Inland Rail Package 13		
Project No	1893802		

Trilab Sample No.	101676	101677	101678	101687
Client Sample No	330-01-BH2101-C12030	330-01-BH2101-C12030	330-01-BH2101-C12030	330-01-BH2102-C00365
Bore Hole	330-01-BH2101	330-01-BH2101	330-01-BH2101	330-01-BH2102
Depth From/To (m)	120.63-120.71	120.71-120.77	120.81-120.90	3.80-3.88
Description	C	C	C	C
I_s (MPa)	0.88	0.96	0.64	0.18
$I_{s(50)}$ (MPa)	0.92	0.98	0.67	0.18
Load Direction	Axial	Axial	Axial	Axial

Trilab Sample No.	101688	101689	101690	101691
Client Sample No	330-01-BH2102-C00365	330-01-BH2102-C00365	330-01-BH2102-C00365	330-01-BH2102-C00365
Bore Hole	330-01-BH2102	330-01-BH2102	330-01-BH2102	330-01-BH2102
Depth From/To (m)	3.88-3.94	3.94-4.0	4.0-4.08	4.08-4.14
Description	C	C	C	C
I_s (MPa)	0.56	0.44	0.87	0.01
$I_{s(50)}$ (MPa)	0.53	0.43	0.85	0.01
Load Direction	Axial	Axial	Axial	Axial

NOTES/REMARKS: Tested as received

Sample/s supplied by the client

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

POINT LOAD TEST REPORT

Test Method: AS 4133.4.1

Client	Golder Associates Pty Limited	**Report No.**	GA101582-101767-PL
		Request No	1893802_H2C_TR2
Address	PO Box 1734 MILTON BC QLD 4064	**Test Date**	29/11/2018
		Report Date	4/12/2018
Project	Inland Rail Package 13		
Project No	1893802		

Trilab Sample No.	101696	101697	101698	101699
Client Sample No	330-01-BH2102-C01020	330-01-BH2102-C01020	330-01-BH2102-C01020	330-01-BH2102-C01020
Bore Hole	330-01-BH2102	330-01-BH2102	330-01-BH2102	330-01-BH2102
Depth From/To (m)	10.38-10.45	10.45-10.52	10.52-10.60	10.60-10.69
Description	C	C	C	C
I_s (MPa)	1.73	1.45	1.38	1.34
$I_{s(50)}$ (MPa)	1.76	1.37	1.37	1.41
Load Direction	Axial	Axial	Axial	Axial

Trilab Sample No.	101700	101704	101705	101706
Client Sample No	330-01-BH2102-C01020	330-01-BH2102-C02046	330-01-BH2102-C02046	330-01-BH2102-C02046
Bore Hole	330-01-BH2102	330-01-BH2102	330-01-BH2102	330-01-BH2102
Depth From/To (m)	10.69-10.78	20.50-20.60	20.60-20.68	20.68-20.76
Description	C	C	C	C
I_s (MPa)	1.12	0.57	0.55	0.22
$I_{s(50)}$ (MPa)	1.14	0.54	0.50	0.21
Load Direction	Axial	Axial	Axial	Axial

NOTES/REMARKS: Tested as received

Sample/s supplied by the client

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

POINT LOAD TEST REPORT

Test Method: AS 4133.4.1

Client	Golder Associates Pty Limited	**Report No.**	GA101582-101767-PL
		Request No	1893802_H2C_TR2
Address	PO Box 1734 MILTON BC QLD 4064	**Test Date**	29/11/2018
		Report Date	4/12/2018
Project	Inland Rail Package 13		
Project No	1893802		

Trilab Sample No.	101707	101708	101726	101728
Client Sample No	330-01-BH2102-C02046	330-01-BH2102-C02046	330-01-BH2103-C01700	330-01-BH2103-C01800
Bore Hole	330-01-BH2102	330-01-BH2102	330-01-BH2103	330-01-BH2103
Depth From/To (m)	20.76-20.85	20.85-20.95	17.15-17.38	18.0-18.13
Description	C	C	C	C
I_s (MPa)	0.43	0.47	0.35	0.29
$I_{s(50)}$ (MPa)	0.40	0.45	0.35	0.30
Load Direction	Axial	Axial	Axial	Axial

Trilab Sample No.	101730	101732	101734	101736
Client Sample No	330-01-BH2103-C01920	330-01-BH2103-C02175	330-01-BH2103-C02285	330-01-BH2103-C02555
Bore Hole	330-01-BH2103	330-01-BH2103	330-01-BH2103	330-01-BH2103
Depth From/To (m)	19.42-19.55	21.75-21.85	22.90-23.0	27.30-27.40
Description	C	C	C	C
I_s (MPa)	0.17	0.21	0.46	1.28
$I_{s(50)}$ (MPa)	0.17	0.20	0.44	1.24
Load Direction	Axial	Axial	Axial	Axial

NOTES/REMARKS: Tested as received

Sample/s supplied by the client

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

POINT LOAD TEST REPORT

Test Method: AS 4133.4.1

Client	Golder Associates Pty Limited	**Report No.**	GA101582-101767-PL
		Request No	1893802_H2C_TR2
Address	PO Box 1734 MILTON BC QLD 4064	**Test Date**	29/11/2018
		Report Date	4/12/2018
Project	Inland Rail Package 13		
Project No	1893802		

Trilab Sample No.	101737	101753	101755	101758
Client Sample No	330-01-BH2103-C02800	330-01-BH2104-C01600	330-01-BH2104-C01965	330-01-BH2104-C02152
Bore Hole	330-01-BH2103	330-01-BH2104	330-01-BH2104	330-01-BH2104
Depth From/To (m)	28.0-28.1	16.0-16.11	19.74-19.86	21.86-21.96
Description	C	C	C	C
I_s (MPa)	0.40	0.26	0.34	0.23
$I_{s(50)}$ (MPa)	0.40	0.26	0.34	0.22
Load Direction	Axial	Axial	Axial	Axial

Trilab Sample No.	101759	101761	101765	101767
Client Sample No	330-01-BH2104-C02346	330-01-BH2104-C02520	330-01-BH2104-C02700	330-01-BH2104-C03000
Bore Hole	330-01-BH2104	330-01-BH2104	330-01-BH2104	330-01-BH2104
Depth From/To (m)	23.46-23.59	25.22-25.34	27.15-27.29	30.15-30.25
Description	C	C	C	#N/A
I_s (MPa)	0.25	0.33	1.48	0.81
$I_{s(50)}$ (MPa)	0.24	0.33	1.42	0.77
Load Direction	Axial	Axial	Axial	Axial

NOTES/REMARKS: Tested as received

Sample/s supplied by the client

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

POINT LOAD TEST REPORT

Test Method: AS 4133.4.1

Client	Golder Associates Pty Limited	**Report No.**	GA101582-101767-PL
		Request No	1893802_H2C_TR2
Address	PO Box 1734 MILTON BC QLD 4064	**Test Date**	29/11/2018
		Report Date	4/12/2018
Project	Inland Rail Package 13		
Project No	1893802		

Trilab Sample No.	101582	101583	101584	101585
Client Sample No	330-01-BH2101-C07000	330-01-BH2101-C07000	330-01-BH2101-C07000	330-01-BH2101-C07000
Bore Hole	330-01-BH2101	330-01-BH2101	330-01-BH2101	330-01-BH2101
Depth From/To (m)	70.20-70.33	70.33-70.47	70.47-70.60	70.60-70.73
Description	C	C	C	C
I_s (MPa)	0.98	1.14	0.89	0.78
$I_{s(50)}$ (MPa)	1.04	1.20	0.95	0.84
Load Direction	Diametral	Diametral	Diametral	Diametral

Trilab Sample No.	101586	101590	101586	101590
Client Sample No	330-01-BH2101-C07000	330-01-BH2101-C07200	330-01-BH2101-C07200	330-01-BH2101-C07200
Bore Hole	330-01-BH2101	330-01-BH2101	330-01-BH2101	330-01-BH2101
Depth From/To (m)	70.73-70.86	72.36-72.49	72.03-72.15	72.49-72.61
Description	C	C	C	C
I_s (MPa)	0.94	0.34	0.42	0.47
$I_{s(50)}$ (MPa)	1.00	0.36	0.45	0.50
Load Direction	Diametral	Diametral	Diametral	Diametral

NOTES/REMARKS: Tested as received

Sample/s supplied by the client

This document is issued in accordance with NATA's accreditation requirements. Accredited for compliance with ISO/IEC 17025 - Testing. The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

POINT LOAD TEST REPORT

Test Method: AS 4133.4.1

Client	Golder Associates Pty Limited	**Report No.**	GA101582-101767-PL
		Request No	1893802_H2C_TR2
Address	PO Box 1734 MILTON BC QLD 4064	**Test Date**	29/11/2018
		Report Date	4/12/2018
Project	Inland Rail Package 13		
Project No	1893802		

Trilab Sample No.	101593	101594	101602	101603
Client Sample No	330-01-BH2101-C07200	330-01-BH2101-C07200	330-01-BH2101-C08100	330-01-BH2101-C08100
Bore Hole	330-01-BH2101	330-01-BH2101	330-01-BH2101	330-01-BH2101
Depth From/To (m)	72.61-72.74	72.74-72.81	81.43-81.53	81.53-81.63
Description	C	C	C	C
I_S (MPa)	0.21	0.34	0.75	0.79
$I_{S(50)}$ (MPa)	0.23	0.36	0.80	0.84
Load Direction	Diametral	Diametral	Diametral	Diametral

Trilab Sample No.	101604	101605	101606	101609
Client Sample No	330-01-BH2101-C08100	330-01-BH2101-C08100	330-01-BH2101-C08100	330-01-BH2101-C08610
Bore Hole	330-01-BH2101	330-01-BH2101	330-01-BH2101	330-01-BH2101
Depth From/To (m)	81.63-81.74	81.74-81.84	81.84-81.93	86.10-86.18
Description	C	C	C	C
I_S (MPa)	0.76	0.95	1.03	0.42
$I_{S(50)}$ (MPa)	0.80	1.02	1.10	0.45
Load Direction	Diametral	Diametral	Diametral	Diametral

NOTES/REMARKS: Tested as received

Sample/s supplied by the client

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

POINT LOAD TEST REPORT

Test Method: AS 4133.4.1

Client	Golder Associates Pty Limited	**Report No.**	GA101582-101767-PL
		Request No	1893802_H2C_TR2
Address	PO Box 1734 MILTON BC QLD 4064	**Test Date**	29/11/2018
		Report Date	4/12/2018
Project	Inland Rail Package 13		
Project No	1893802		

Trilab Sample No.	101610	101611	101612	101613
Client Sample No	330-01-BH2101-C08610	330-01-BH2101-C08610	330-01-BH2101-C08610	330-01-BH2101-C08610
Bore Hole	330-01-BH2101	330-01-BH2101	330-01-BH2101	330-01-BH2101
Depth From/To (m)	86.34-86.42	86.42-86.49	86.49-86.57	86.57-86.66
Description	C	C	C	C
I_s (MPa)	0.16	0.31	0.34	0.11
$I_{s(50)}$ (MPa)	0.17	0.33	0.36	0.11
Load Direction	Diametral	Diametral	Diametral	Diametral

Trilab Sample No.	101616	101617	101618	101619
Client Sample No	330-01-BH2101-C08700	330-01-BH2101-C08700	330-01-BH2101-C08700	330-01-BH2101-C08700
Bore Hole	330-01-BH2101	330-01-BH2101	330-01-BH2101	330-01-BH2101
Depth From/To (m)	87.21-87.28	87.28-87.35	87.35-87.42	87.42-87.50
Description	C	C	C	C
I_s (MPa)	0.59	0.53	0.20	0.48
$I_{s(50)}$ (MPa)	0.64	0.57	0.21	0.51
Load Direction	Diametral	Diametral	Diametral	Diametral

NOTES/REMARKS: Tested as received

Sample/s supplied by the client

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

POINT LOAD TEST REPORT

Test Method: AS 4133.4.1

Client	Golder Associates Pty Limited	**Report No.**	GA101582-101767-PL
		Request No	1893802_H2C_TR2
Address	PO Box 1734 MILTON BC QLD 4064	**Test Date**	29/11/2018
		Report Date	4/12/2018
Project	Inland Rail Package 13		
Project No	1893802		

Trilab Sample No.	101625	101627	101628	101635
Client Sample No	330-01-BH2101-C09100	330-01-BH2101-C09100	330-01-BH2101-C09100	330-01-BH2101-C09600
Bore Hole	330-01-BH2101	330-01-BH2101	330-01-BH2101	330-01-BH2101
Depth From/To (m)	91.05-91.15	91.32-91.42	91.59-91.70	96.21-96.31
Description	C	C	C	C
I_s (MPa)	0.01	0.02	0.09	0.65
$I_{s(50)}$ (MPa)	0.01	0.03	0.09	0.69
Load Direction	Diametral	Diametral	Diametral	Diametral

Trilab Sample No.	101636	101637	101638	101639
Client Sample No	330-01-BH2101-C09600	330-01-BH2101-C09600	330-01-BH2101-C09600	330-01-BH2101-C09600
Bore Hole	330-01-BH2101	330-01-BH2101	330-01-BH2101	330-01-BH2101
Depth From/To (m)	96.31-96.41	96.42-96.52	96.52-96.63	96.63-96.73
Description	C	C	C	C
I_s (MPa)	0.74	1.43	1.01	0.78
$I_{s(50)}$ (MPa)	0.80	1.48	1.06	0.84
Load Direction	Diametral	Diametral	Diametral	Diametral

NOTES/REMARKS: Tested as received

Sample/s supplied by the client

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

POINT LOAD TEST REPORT

Test Method: AS 4133.4.1

Client	Golder Associates Pty Limited	**Report No.**	GA101582-101767-PL
		Request No	1893802_H2C_TR2
Address	PO Box 1734 MILTON BC QLD 4064	**Test Date**	29/11/2018
		Report Date	4/12/2018
Project	Inland Rail Package 13		
Project No	1893802		

Trilab Sample No.	101647	101648	101651	101661
Client Sample No	330-01-BH2101-C10460	330-01-BH2101-C10460	330-01-BH2101-C10820	330-01-BH2101-C11400
Bore Hole	330-01-BH2101	330-01-BH2101	330-01-BH2101	330-01-BH2101
Depth From/To (m)	104.69-104.80	104.80-104.90	108.90-109	114.16-114.25
Description	C	C	C	C
I_s (MPa)	0.16	0.07	0.05	1.89
$I_{s(50)}$ (MPa)	0.17	0.08	0.05	1.99
Load Direction	Diametral	Diametral	Diametral	Diametral

Trilab Sample No.	101662	101663	101664	101665
Client Sample No	330-01-BH2101-C11400	330-01-BH2101-C11400	330-01-BH2101-C11400	330-01-BH2101-C11400
Bore Hole	330-01-BH2101	330-01-BH2101	330-01-BH2101	330-01-BH2101
Depth From/To (m)	114.25-114.37	114.37-114.50	114.50-114.62	114.62-114.75
Description	C	C	C	C
I_s (MPa)	1.12	1.33	1.05	1.76
$I_{s(50)}$ (MPa)	1.20	1.39	1.13	1.88
Load Direction	Diametral	Diametral	Diametral	Diametral

NOTES/REMARKS: Tested as received

Sample/s supplied by the client

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

POINT LOAD TEST REPORT

Test Method: AS 4133.4.1

Client	Golder Associates Pty Limited	**Report No.**	GA101582-101767-PL
		Request No	1893802_H2C_TR2
Address	PO Box 1734 MILTON BC QLD 4064	**Test Date**	29/11/2018
		Report Date	4/12/2018
Project	Inland Rail Package 13		
Project No	1893802		

Trilab Sample No.	101674	101675	101676	101677
Client Sample No	330-01-BH2101-C12030	330-01-BH2101-C12030	330-01-BH2101-C12030	330-01-BH2101-C12030
Bore Hole	330-01-BH2101	330-01-BH2101	330-01-BH2101	330-01-BH2101
Depth From/To (m)	120.33-120.42	120.53-120.63	120.63-120.71	120.71-120.77
Description	C	C	C	C
I_S (MPa)	0.51	0.52	0.23	0.52
$I_{S(50)}$ (MPa)	0.55	0.56	0.25	0.56
Load Direction	Diametral	Diametral	Diametral	Diametral

Trilab Sample No.	101678	101687	101688	101689
Client Sample No	330-01-BH2101-C12030	330-01-BH2102-C00365	330-01-BH2102-C00365	330-01-BH2102-C00365
Bore Hole	330-01-BH2101	330-01-BH2102	330-01-BH2102	330-01-BH2102
Depth From/To (m)	120.81-120.90	3.80-3.88	3.88-3.94	3.94-4.00
Description	C	C	C	C
I_S (MPa)	0.17	0.28	0.31	0.38
$I_{S(50)}$ (MPa)	0.18	0.28	0.31	0.38
Load Direction	Diametral	Diametral	Diametral	Diametral

NOTES/REMARKS: Tested as received

Sample/s supplied by the client

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

POINT LOAD TEST REPORT

Test Method: AS 4133.4.1

Client	Golder Associates Pty Limited	**Report No.**	GA101582-101767-PL
		Request No	1893802_H2C_TR2
Address	PO Box 1734 MILTON BC QLD 4064	**Test Date**	29/11/2018
		Report Date	4/12/2018
Project	Inland Rail Package 13		
Project No	1893802		

Trilab Sample No.	101690	101691	101696	101697
Client Sample No	330-01-BH2102-C00365	330-01-BH2102-C00365	330-01-BH2102-C01020	330-01-BH2102-C01020
Bore Hole	330-01-BH2102	330-01-BH2102	330-01-BH2102	330-01-BH2102
Depth From/To (m)	4.00-4.08	4.08-4.14	10.38-10.45	10.45-10.52
Description	C	C	C	C
I_s (MPa)	0.28	0.00	0.73	1.95
$I_{s(50)}$ (MPa)	0.27	0.00	0.73	1.90
Load Direction	Diametral	Diametral	Diametral	Diametral

Trilab Sample No.	101698	101699	101700	101704
Client Sample No	330-01-BH2102-C01020	330-01-BH2102-C01020	330-01-BH2102-C01020	330-01-BH2102-C02046
Bore Hole	330-01-BH2102	330-01-BH2102	330-01-BH2102	330-01-BH2102
Depth From/To (m)	10.52-10.60	10.60-10.69	10.69-10.78	20.50-20.60
Description	C	C	C	C
I_s (MPa)	0.69	1.37	1.32	0.17
$I_{s(50)}$ (MPa)	0.69	1.36	1.31	0.17
Load Direction	Diametral	Diametral	Diametral	Diametral

NOTES/REMARKS: Tested as received

Sample/s supplied by the client

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

POINT LOAD TEST REPORT

Test Method: AS 4133.4.1

Client	Golder Associates Pty Limited	**Report No.**	GA101582-101767-PL
		Request No	1893802_H2C_TR2
Address	PO Box 1734 MILTON BC QLD 4064	**Test Date**	29/11/2018
		Report Date	4/12/2018
Project	Inland Rail Package 13		
Project No	1893802		

Trilab Sample No.	101705	101706	101707	101708
Client Sample No	330-01-BH2102-C02046	330-01-BH2102-C02046	330-01-BH2102-C02046	330-01-BH2102-C02046
Bore Hole	330-01-BH2102	330-01-BH2102	330-01-BH2102	330-01-BH2102
Depth From/To (m)	20.60-20.68	20.68-20.76	20.76-20.85	20.85-20.95
Description	C	C	C	C
I_s (MPa)	0.03	0.15	0.05	0.18
$I_{s(50)}$ (MPa)	0.03	0.15	0.05	0.18
Load Direction	Diametral	Diametral	Diametral	Diametral

Trilab Sample No.	101726	101728	101730	101732
Client Sample No	330-01-BH2103-C01700	330-01-BH2103-C01800	330-01-BH2103-C01920	330-01-BH2103-C02175
Bore Hole	330-01-BH2103	330-01-BH2103	330-01-BH2103	330-01-BH2103
Depth From/To (m)	17.15-17.38	18.00-18.13	19.42-19.55	21.75-21.85
Description	C	C	C	C
I_s (MPa)	0.12	0.22	0.17	0.16
$I_{s(50)}$ (MPa)	0.12	0.21	0.16	0.16
Load Direction	Diametral	Diametral	Diametral	Diametral

NOTES/REMARKS: Tested as received

Sample/s supplied by the client

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

POINT LOAD TEST REPORT

Test Method: AS 4133.4.1

Client	Golder Associates Pty Limited	**Report No.**	GA101582-101767-PL
		Request No	1893802_H2C_TR2
Address	PO Box 1734 MILTON BC QLD 4064	**Test Date**	29/11/2018
		Report Date	4/12/2018
Project	Inland Rail Package 13		
Project No	1893802		

Trilab Sample No.	101734	101736	101737	101753
Client Sample No	330-01-BH2103-C02285	330-01-BH2103-C02555	330-01-BH2103-C02800	330-01-BH2104-C01600
Bore Hole	330-01-BH2103	330-01-BH2103	330-01-BH2103	330-01-BH2104
Depth From/To (m)	22.90-23.00	27.30-27.40	28.00-28.10	16.00-16.11
Description	C	C	C	C
I_s (MPa)	0.15	0.67	0.44	0.20
$I_{s(50)}$ (MPa)	0.15	0.66	0.44	0.20
Load Direction	Diametral	Diametral	Diametral	Diametral

Trilab Sample No.	101755	101758	101759	101761
Client Sample No	330-01-BH2104-C01965	330-01-BH2104-C02152	330-01-BH2104-C02346	330-01-BH2104-C02520
Bore Hole	330-01-BH2104	330-01-BH2104	330-01-BH2104	330-01-BH2104
Depth From/To (m)	19.74-19.86	21.86-21.96	23.46-23.59	25.22-25.34
Description	C	C	C	C
I_s (MPa)	0.31	0.11	0.28	1.44
$I_{s(50)}$ (MPa)	0.32	0.11	0.28	1.42
Load Direction	Diametral	Diametral	Diametral	Diametral

NOTES/REMARKS: Tested as received

Sample/s supplied by the client

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

POINT LOAD TEST REPORT

Test Method: AS 4133.4.1

Client	Golder Associates Pty Limited	**Report No.**	GA101582-101767-PL
		Request No	1893802_H2C_TR2
Address	PO Box 1734 MILTON BC QLD 4064	**Test Date**	29/11/2018
		Report Date	4/12/2018
Project	Inland Rail Package 13		
Project No	1893802		

Trilab Sample No.	101765	101767		
Client Sample No	330-01-BH2104-C02700	330-01-BH2104-C03000		
Bore Hole	330-01-BH2104	330-01-BH2104		
Depth From/To (m)	27.15-27.29	30.15-30.25		
Description	C	C		
I_S (MPa)	0.76	0.43		
$I_{S(50)}$ (MPa)	0.75	0.42		
Load Direction	Diametral	Diametral		

Trilab Sample No.				
Client Sample No				
Bore Hole				
Depth From/To (m)				
Description				
I_S (MPa)				
$I_{S(50)}$ (MPa)				
Load Direction				

NOTES/REMARKS: Tested as received

Sample/s supplied by the client

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

POINT LOAD TEST REPORT

Test Method: AS 4133.4.1

Client	Golder Associates Pty Limited	**Report No.**	GA101839-101848-PL
		Request No	1893802_H2C_TR3
Address	PO Box 1734 MILTON BC QLD 4064	**Test Date**	2/01/2019
		Report Date	7/01/2019
Project	Inland Rail Package 13		
Project No	1893802		

Trilab Sample No.	101839	101840	101841	101843
Client Sample No	330-01-BH2306-C00440	330-01-BH2306-C00650	330-01-BH2306-C01150	330-01-BH2306-C01500
Bore Hole	330-01-BH2306	330-01-BH2306	330-01-BH2306	330-01-BH2306
Depth From/To (m)	4.44-4.51	6.64-6.72	11.58-11.64	15.59-15.65
Description	C	C	C	C
I_s (MPa)	0.30	0.81	0.83	1.38
$I_{s(50)}$ (MPa)	0.29	0.82	0.83	1.28
Load Direction	Diametral	Diametral	Diametral	Diametral

Trilab Sample No.	101844	101845	101847	101848
Client Sample No	330-01-BH2306-C01850	330-01-BH2306-C01900	330-01-BH2306-C02150	330-01-BH2306-C02400
Bore Hole	330-01-BH2306	330-01-BH2306	330-01-BH2306	330-01-BH2306
Depth From/To (m)	18.89-18.97	19.14-19.23	21.71-21.81	24.43-24.51
Description	C	C	C	C
I_s (MPa)	0.38	0.27	0.48	0.52
$I_{s(50)}$ (MPa)	0.36	0.27	0.48	0.53
Load Direction	Diametral	Diametral	Diametral	Diametral

NOTES/REMARKS: Tested as received

Sample/s supplied by the client

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

POINT LOAD TEST REPORT

Test Method: AS 4133.4.1

Client	Golder Associates Pty Limited	**Report No.**	GA101839-101848-PL
		Request No	1893802_H2C_TR3
Address	PO Box 1734 MILTON BC QLD 4064	**Test Date**	2/01/2019
		Report Date	7/01/2019
Project	Inland Rail Package 13		
Project No	1893802		

Trilab Sample No.	101839	101840	101841	101843
Client Sample No	330-01-BH2306-C00440	330-01-BH2306-C00650	330-01-BH2306-C01150	330-01-BH2306-C01500
Bore Hole	330-01-BH2306	330-01-BH2306	330-01-BH2306	330-01-BH2306
Depth From/To (m)	4.40-4.44	6.59-6.64	11.54-11.58	15.55-15.59
Description	C	C	C	C
I_s (MPa)	0.35	0.15	1.51	0.89
$I_{s(50)}$ (MPa)	0.34	0.15	1.51	0.91
Load Direction	Axial	Axial	Axial	Axial

Trilab Sample No.	101844	101845	101847	101848
Client Sample No	330-01-BH2306-C01850	330-01-BH2306-C01900	330-01-BH2306-C02150	330-01-BH2306-C02400
Bore Hole	330-01-BH2306	330-01-BH2306	330-01-BH2306	330-01-BH2306
Depth From/To (m)	18.79-18.84	19.09-19.14	21.81-21.87	24.39-24.43
Description	C	C	C	C
I_s (MPa)	0.44	0.12	0.29	0.87
$I_{s(50)}$ (MPa)	0.47	0.13	0.30	0.90
Load Direction	Axial	Axial	Axial	Axial

NOTES/REMARKS: Tested as received

Sample/s supplied by the client

Uniaxial Compressive Strength

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

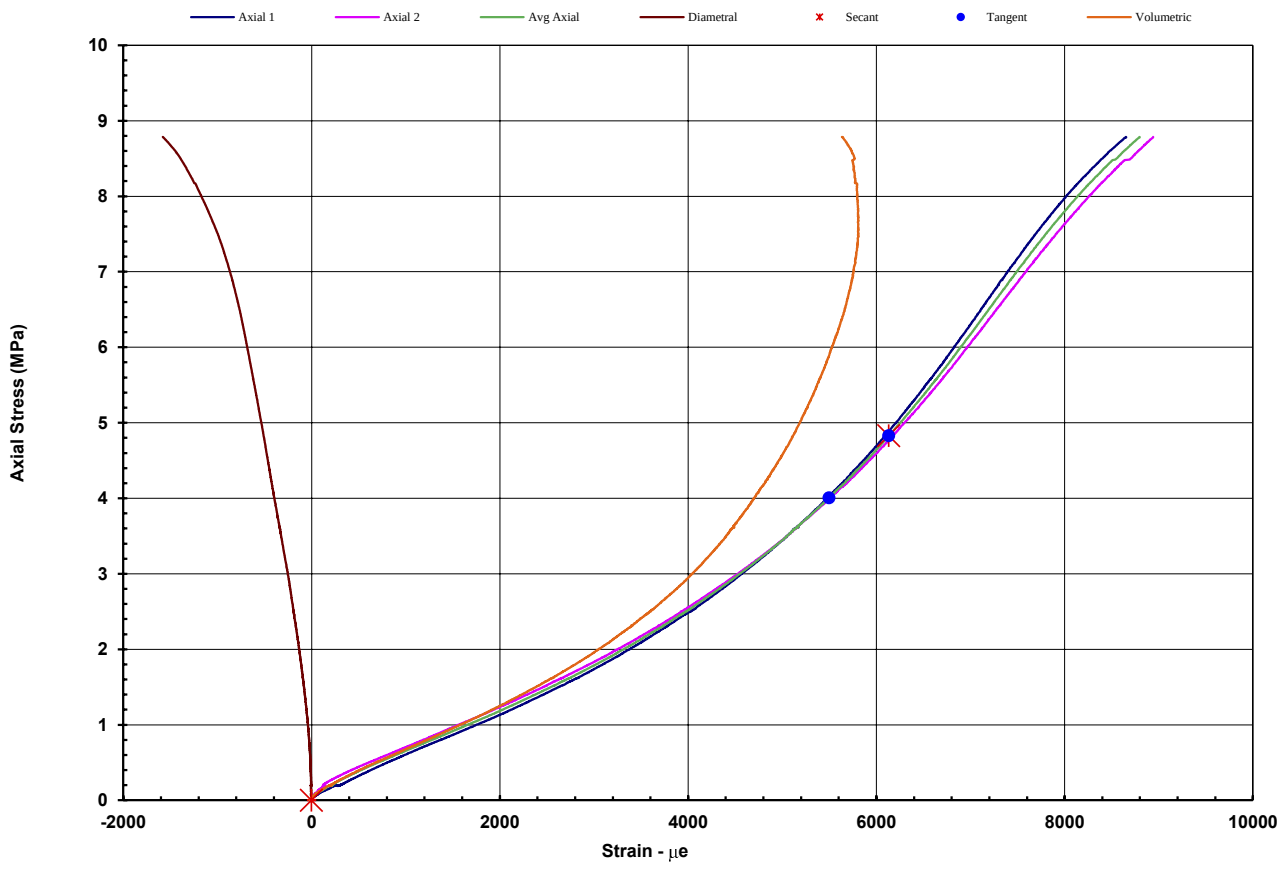
Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101411-MOD
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR1
		Test Date	7/12/2018
Project	Inland Rail Package 13	**Report Date**	10/12/2018
Project No.	1893802	**Client Sample No.**	330-01-BH2203-C01500
Bore Hole	330-01-BH2203	**Depth From (m)** 15	**Depth To (m)** 16
Description	C		
Sample Type	Single Individual Rock Core Specimen		

Uniaxial Compressive Strength 9.65 MPa

Young's Modulus		Poisson Ratio	
Tangent	1.30 GPa	0.083	from 41 % to 50 % of Max UCS
Secant	0.787 GPa	0.083	from 0 % to 50 % of Max UCS

Axial Stress vs Strain Plots



Notes/Remarks:

Sample/s supplied by client Graph not to scale Tested as received. **Page 1 of 2** EP13402

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory
C.N. Madison

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

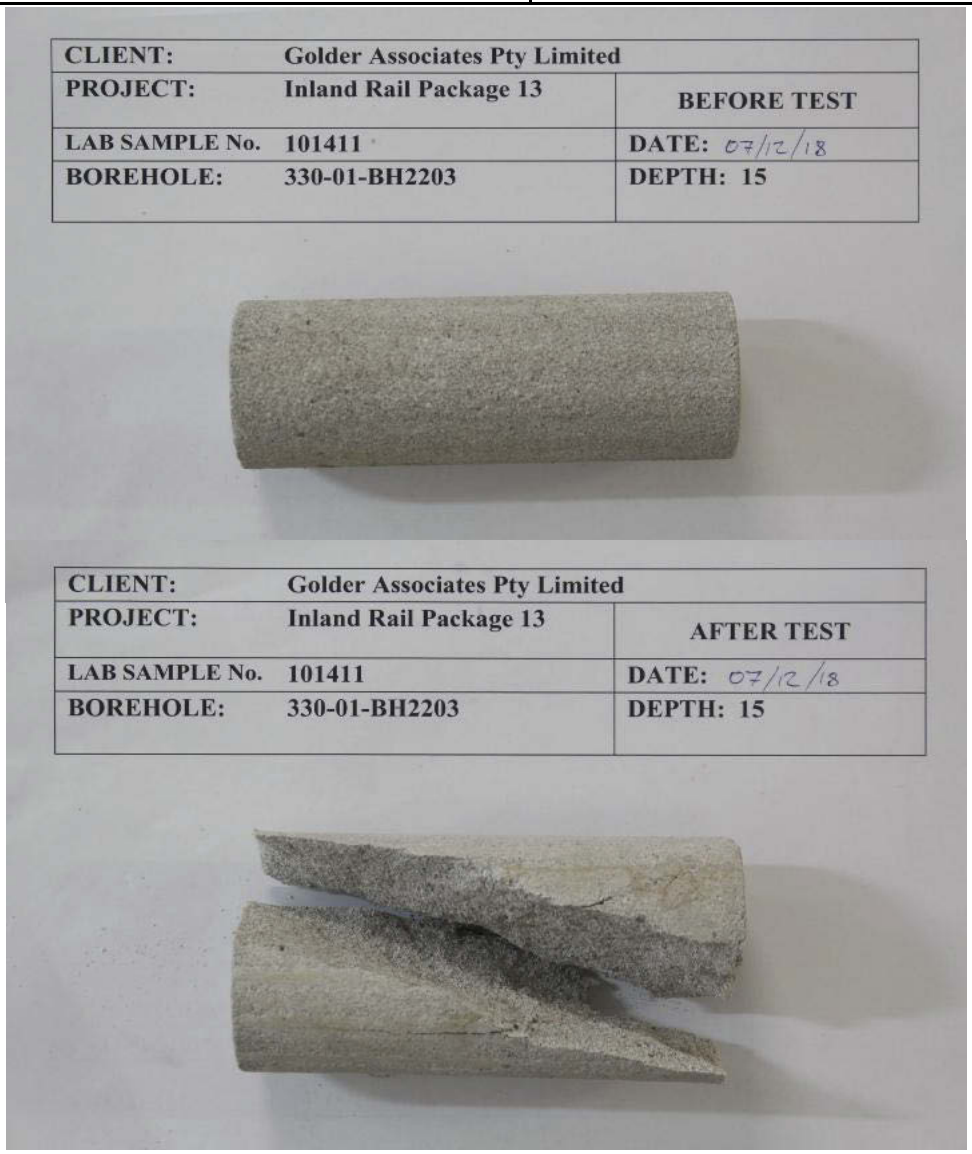
Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101411-MOD

Average Sample Diameter (mm)	51.7	Moisture Content (%)	4.2
Sample Height (mm)	141.7	Wet Density (t/m^3)	2.38
Duration of Test (min)	25.23	Dry Density (t/m^3)	2.28
Rate of Displacement (mm/min)	0.10	Bedding (°)	Nil
Mode of Failure	Shear	Test Apparatus	100kN Compression Machine



Notes/Remarks:

Sample/s supplied by client Photo not to scale Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

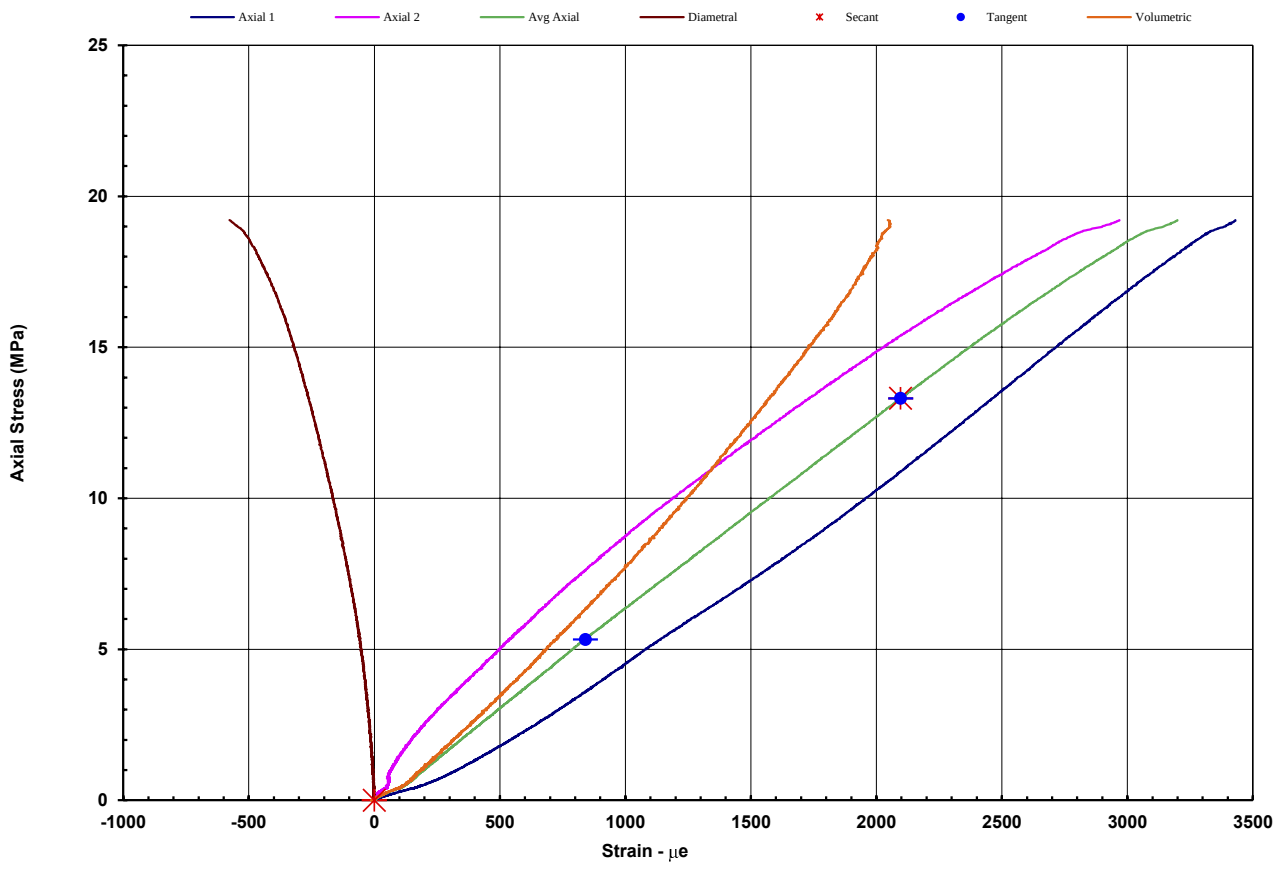
Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101413-MOD
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR1
		Test Date	6/12/2018
Project	Inland Rail Package 13	**Report Date**	10/12/2018
Project No.	1893802	**Client Sample No.**	330-01-BH2203-C01650
Bore Hole	330-01-BH2203	**Depth From (m)** 16.5	**Depth To (m)** 17.5
Description	C		
Sample Type	Single Individual Rock Core Specimen		

Uniaxial Compressive Strength 26.6 MPa

Young's Modulus		Poisson Ratio	
Tangent	6.35 GPa	0.125	from 20 % to 50 % of Max UCS
Secant	6.34 GPa	0.125	from 0 % to 50 % of Max UCS

Axial Stress vs Strain Plots



Notes/Remarks:

Sample/s supplied by client Graph not to scale Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory
C.N. Madison

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101413-MOD

Average Sample Diameter (mm)	51.8	Moisture Content (%)	2.8
Sample Height (mm)	141.7	Wet Density (t/m^3)	2.48
Duration of Test (min)	28.07	Dry Density (t/m^3)	2.41
Rate of Displacement (mm/min)	0.10	Bedding (°)	5
Mode of Failure	Conical	Test Apparatus	100kN Compression Machine

Notes/Remarks:

Sample/s supplied by client Photo not to scale Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

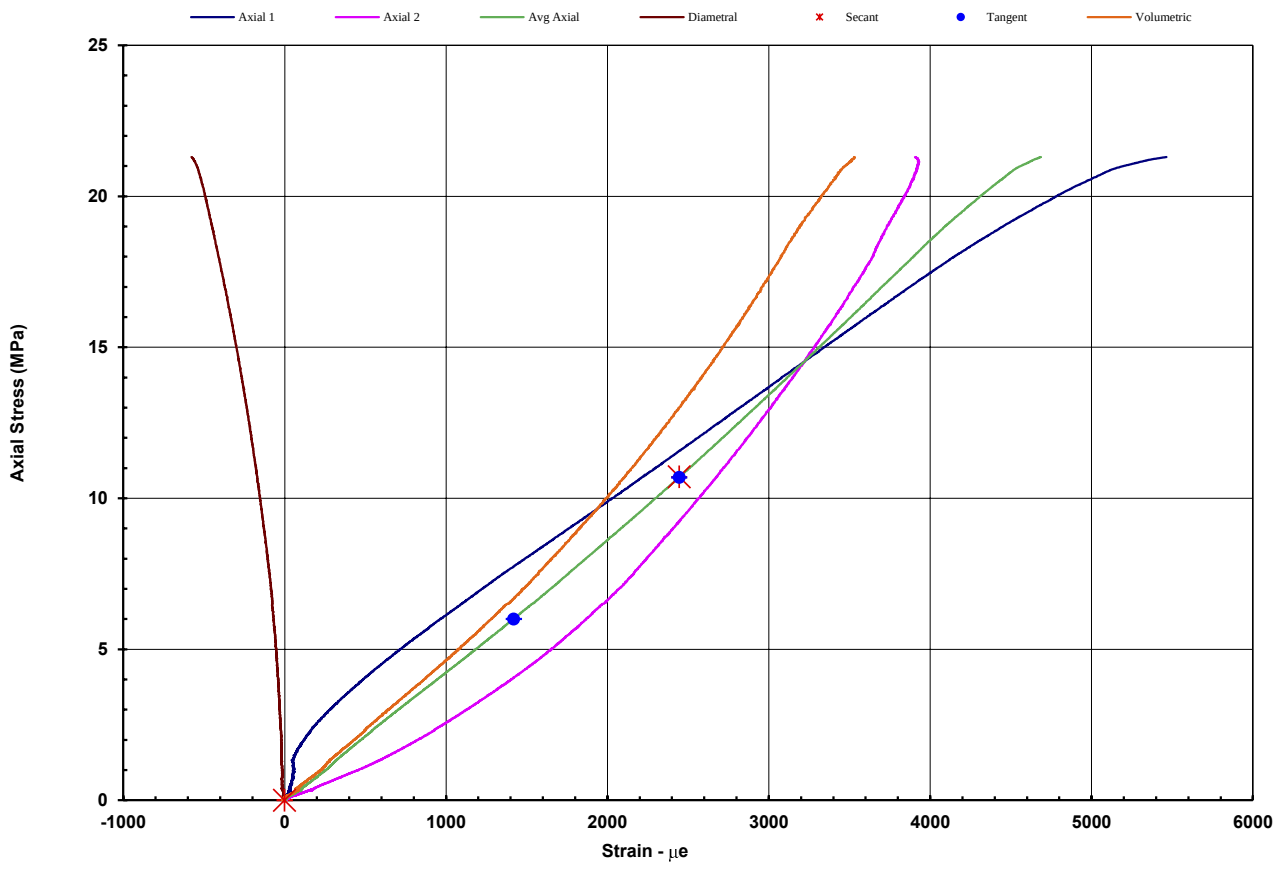
Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101415-MOD
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR1
		Test Date	6/12/2018
Project	Inland Rail Package 13	**Report Date**	7/12/2018
Project No.	1893802	**Client Sample No.**	330-01-BH2203-C01950
Bore Hole	330-01-BH2203	**Depth From (m)** 19.5	**Depth To (m)** 20
Description	C		
Sample Type	Single Individual Rock Core Specimen		

Uniaxial Compressive Strength 21.4 MPa

Young's Modulus		Poisson Ratio	
Tangent	4.57 GPa	0.069	from 28 % to 50 % of Max UCS
Secant	4.38 GPa	0.069	from 0 % to 50 % of Max UCS

Axial Stress vs Strain Plots



Notes/Remarks:

Sample/s supplied by client Graph not to scale Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory
C.N. Madison

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

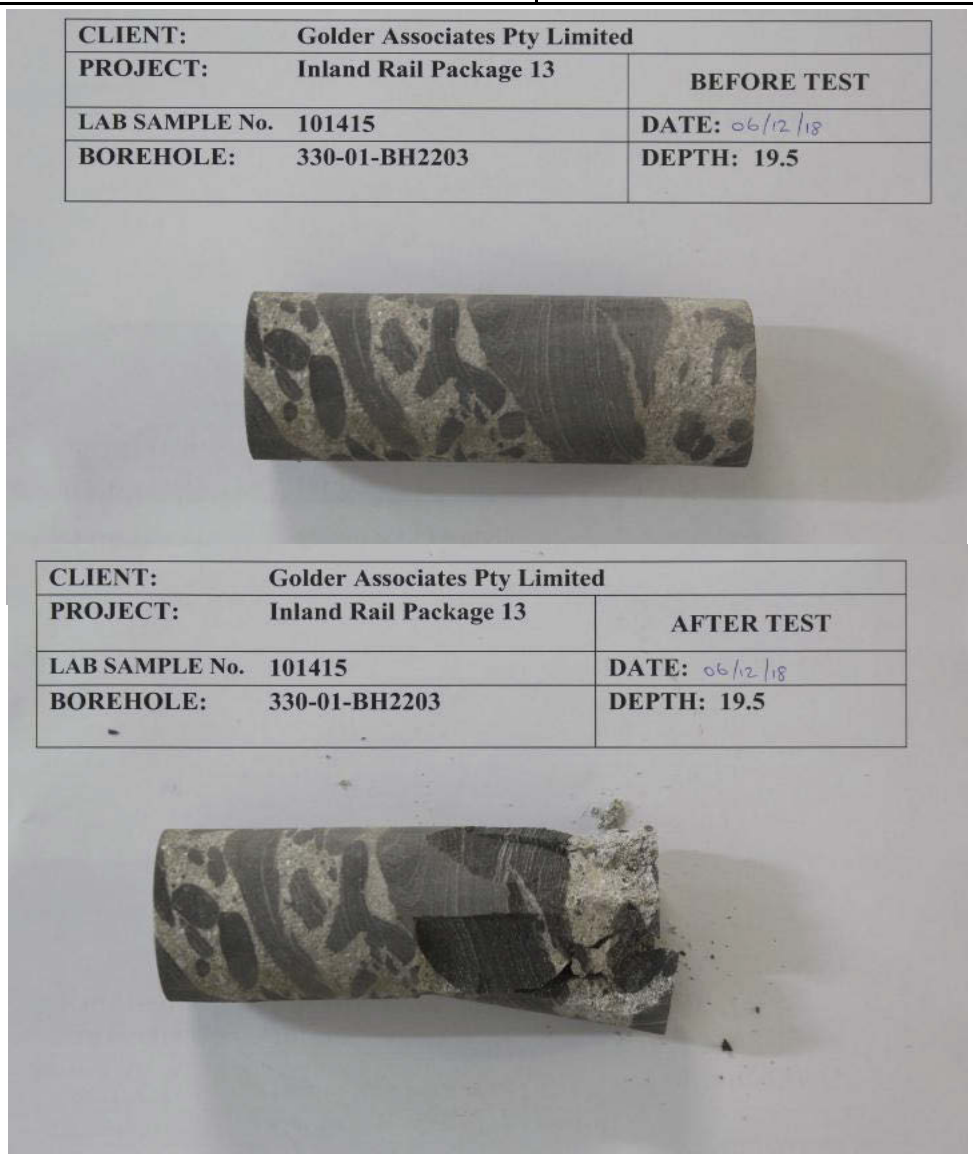
Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101415-MOD

Average Sample Diameter (mm)	51.8	Moisture Content (%)	2.3
Sample Height (mm)	141.2	Wet Density (t/m^3)	2.46
Duration of Test (min)	28.15	Dry Density (t/m^3)	2.40
Rate of Displacement (mm/min)	0.10	Bedding (°)	30
Mode of Failure	Conical	Test Apparatus	100kN Compression Machine



Notes/Remarks:

Sample/s supplied by client Photo not to scale Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

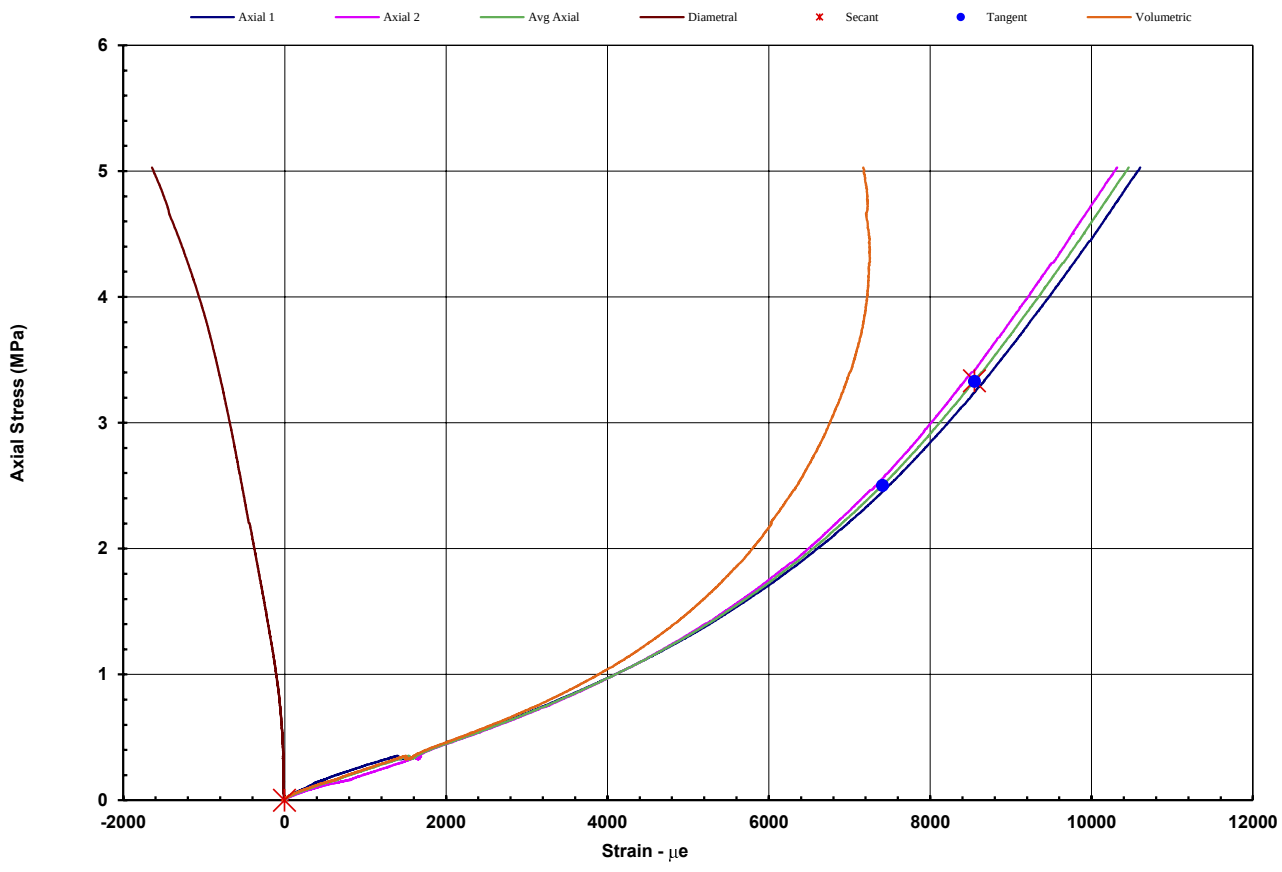
Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101418-MOD
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR1
		Test Date	6/12/2018
Project	Inland Rail Package 13	**Report Date**	7/12/2018
Project No.	1893802	**Client Sample No.**	330-01-BH2203-C02200
Bore Hole	330-01-BH2203	**Depth From (m)** 22	**Depth To (m)** 23
Description	C		
Sample Type	Single Individual Rock Core Specimen		

Uniaxial Compressive Strength 6.66 MPa

	Young's Modulus	Poisson Ratio	
Tangent	0.726 GPa	0.093	from 38 % to 50 % of Max UCS
Secant	0.390 GPa	0.093	from 0 % to 50 % of Max UCS

Axial Stress vs Strain Plots



Notes/Remarks:

Sample/s supplied by client Graph not to scale Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory
C.N. Madison

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101418-MOD

Average Sample Diameter (mm)	52.1	Moisture Content (%)	5.6
Sample Height (mm)	141.8	Wet Density (t/m^3)	2.34
Duration of Test (min)	30.72	Dry Density (t/m^3)	2.22
Rate of Displacement (mm/min)	0.10	Bedding (°)	Nil
Mode of Failure	Shear	Test Apparatus	100kN Compression Machine

Notes/Remarks:

Sample/s supplied by client Photo not to scale Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

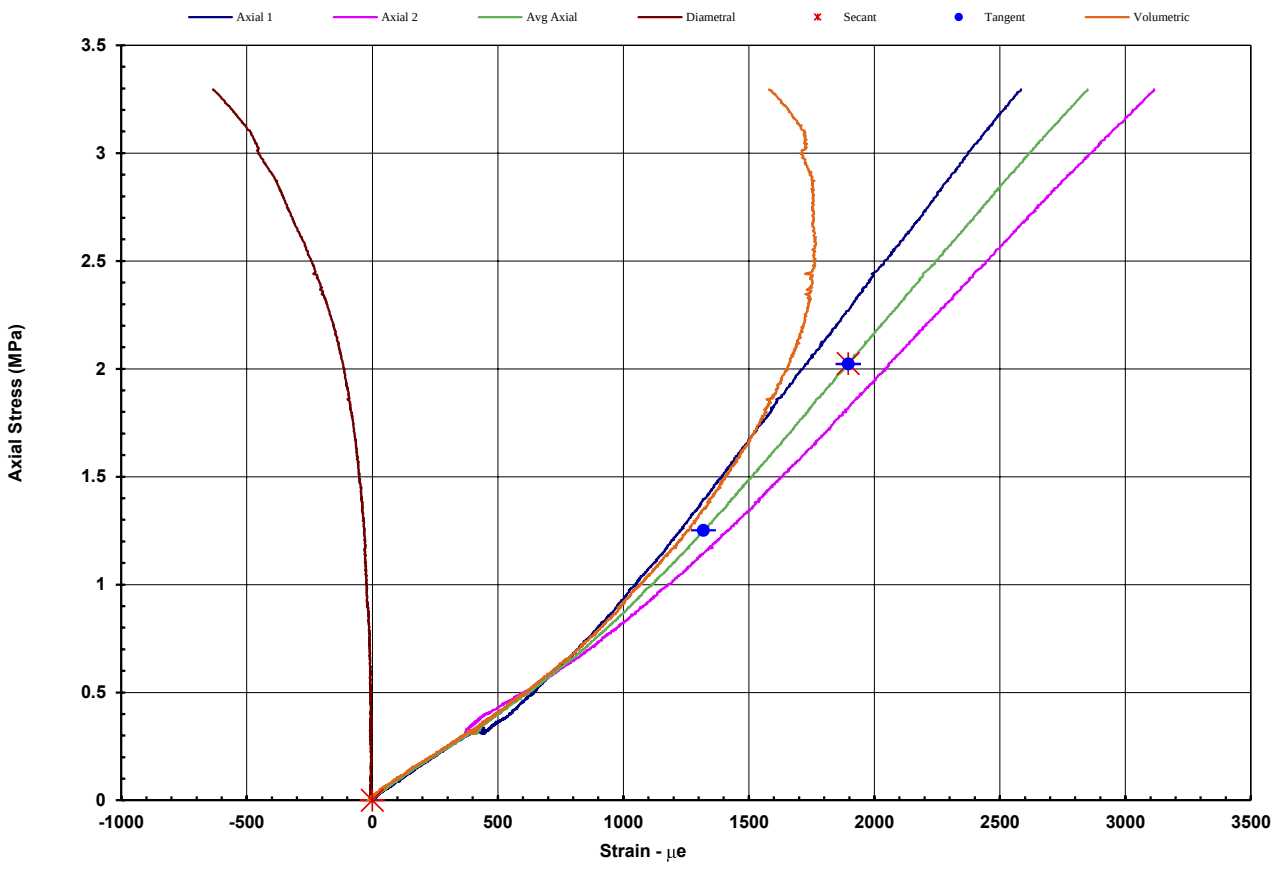
Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101428-MOD
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR1
		Test Date	4/12/2018
Project	Inland Rail Package 13	**Report Date**	6/12/2018
Project No.	1893802	**Client Sample No.**	330-01-BH2207-C01200
Bore Hole	330-01-BH2207	**Depth From (m)** 12	**Depth To (m)** 12.5
Description	C		
Sample Type	Single Individual Rock Core Specimen		

Uniaxial Compressive Strength 4.04 MPa

	Young's Modulus	Poisson Ratio	
Tangent	1.34 GPa	0.061	from 31 % to 50 % of Max UCS
Secant	1.07 GPa	0.062	from 0 % to 50 % of Max UCS

Axial Stress vs Strain Plots



Notes/Remarks:

Sample/s supplied by client Graph not to scale Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory
C.N. Madison

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

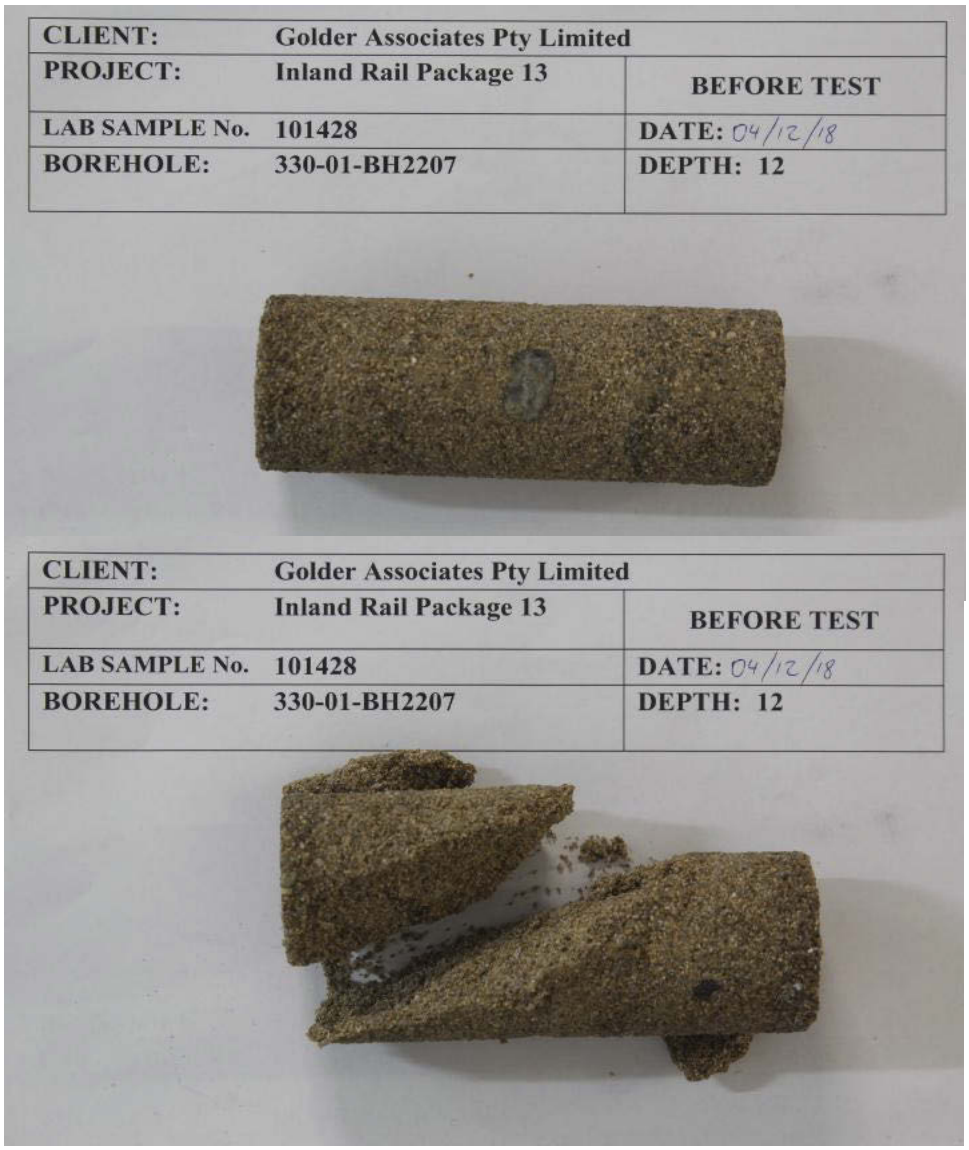
Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101428-MOD

Average Sample Diameter (mm)	51.6	Moisture Content (%)	9.4
Sample Height (mm)	138.0	Wet Density (t/m^3)	2.11
Duration of Test (min)	18.33	Dry Density (t/m^3)	1.93
Rate of Displacement (mm/min)	0.10	Bedding (°)	Nil
Mode of Failure	Shear	Test Apparatus	100kN Compression Machine



Notes/Remarks:

Sample/s supplied by client Photo not to scale Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

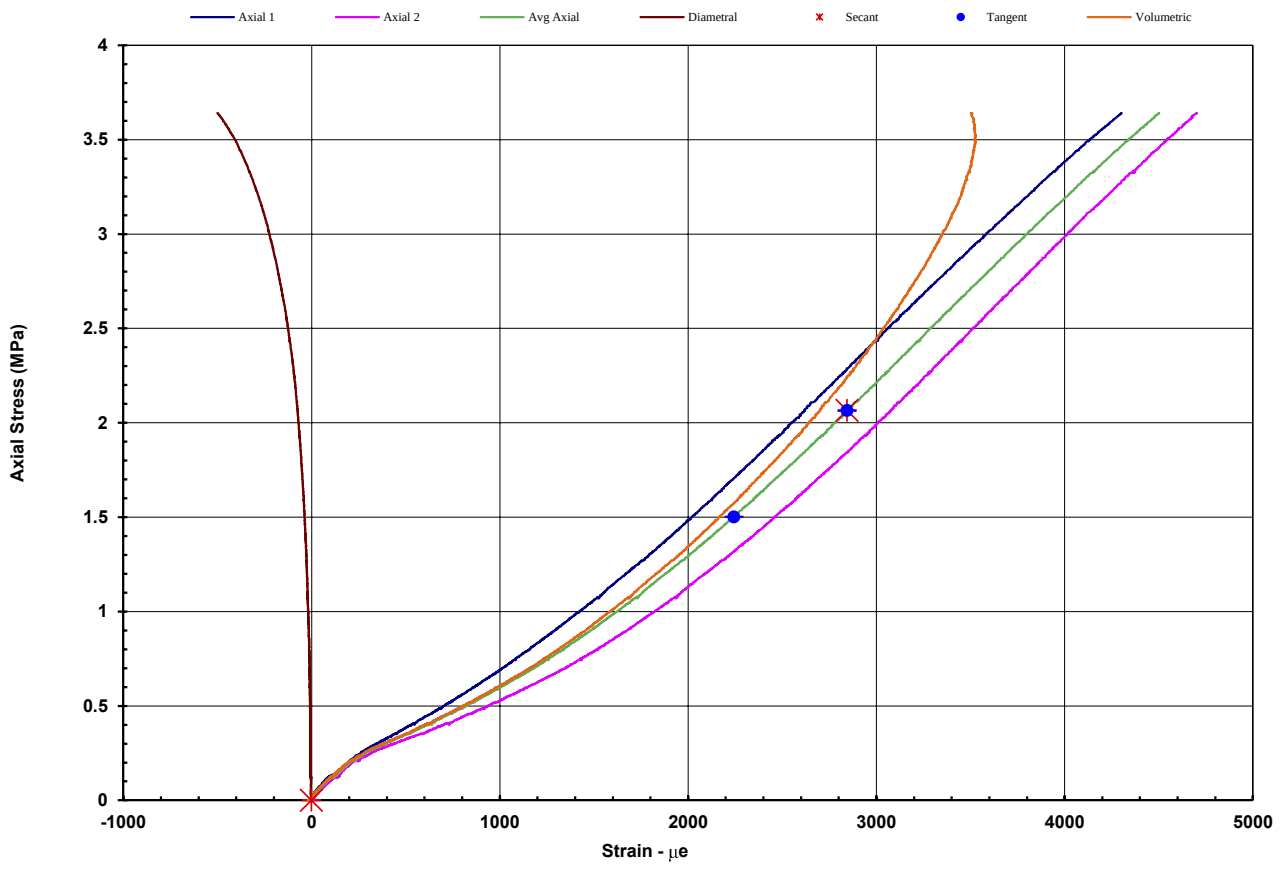
Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101430-MOD
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR1
		Test Date	4/12/2018
Project	Inland Rail Package 13	**Report Date**	7/12/2018
Project No.	1893802	**Client Sample No.**	330-01-BH2207-C01400
Bore Hole	330-01-BH2207	**Depth From (m)** 14	**Depth To (m)** 14.5
Description	C		
Sample Type	Single Individual Rock Core Specimen		

Uniaxial Compressive Strength 4.12 MPa

Young's Modulus		Poisson Ratio	
Tangent	0.937 GPa	0.026	from 36 % to 50 % of Max UCS
Secant	0.726 GPa	0.026	from 0 % to 50 % of Max UCS

Axial Stress vs Strain Plots



Notes/Remarks:

Sample/s supplied by client Graph not to scale Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory
C.N. Madison

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

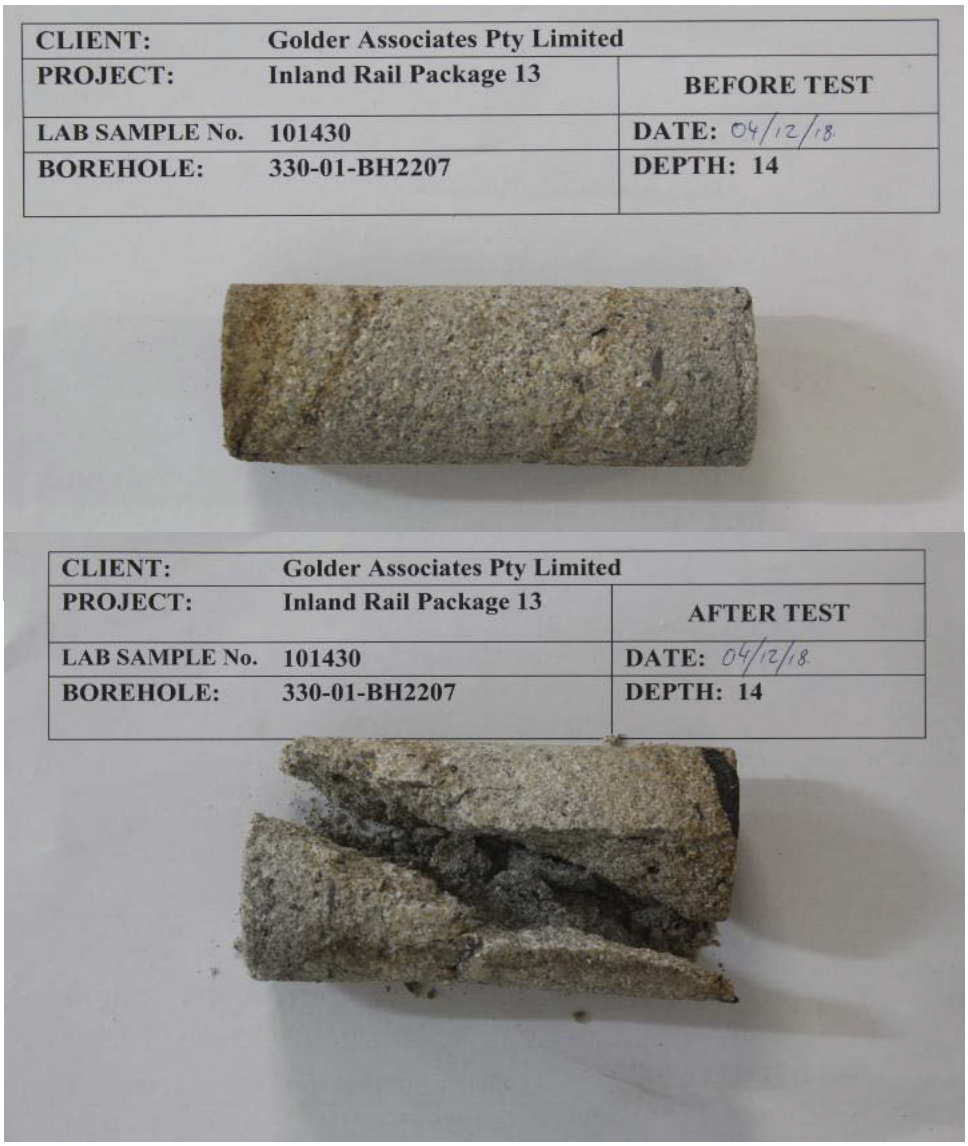
Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101430-MOD

Average Sample Diameter (mm)	52.1	Moisture Content (%)	5.8
Sample Height (mm)	140.6	Wet Density (t/m^3)	2.36
Duration of Test (min)	24.87	Dry Density (t/m^3)	2.23
Rate of Displacement (mm/min)	0.10	Bedding (°)	Nil
Mode of Failure	Shear	Test Apparatus	100kN Compression Machine



Notes/Remarks:

Sample/s supplied by client Photo not to scale Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

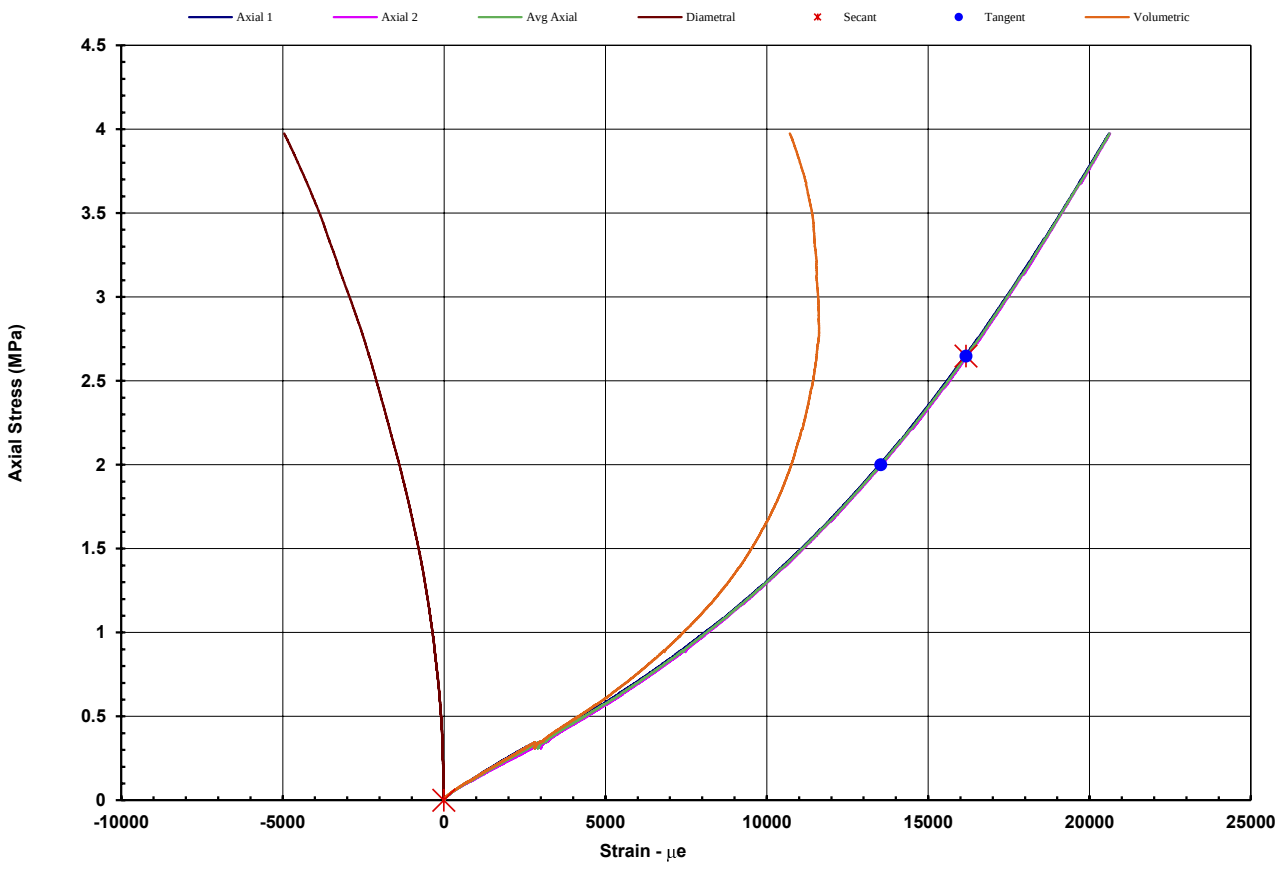
Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101433-MOD
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR1
		Test Date	5/12/2018
Project	Inland Rail Package 13	**Report Date**	7/12/2018
Project No.	1893802	**Client Sample No.**	330-01-BH2207-C01700
Bore Hole	330-01-BH2207	**Depth From (m)** 17	**Depth To (m)** 17.5
Description	C		
Sample Type	Single Individual Rock Core Specimen		

Uniaxial Compressive Strength 5.29 MPa

	Young's Modulus	Poisson Ratio	
Tangent	0.245 GPa	0.143	from 38 % to 50 % of Max UCS
Secant	0.164 GPa	0.143	from 0 % to 50 % of Max UCS

Axial Stress vs Strain Plots



Notes/Remarks:

Sample/s supplied by client Graph not to scale Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory
C Nicholson

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

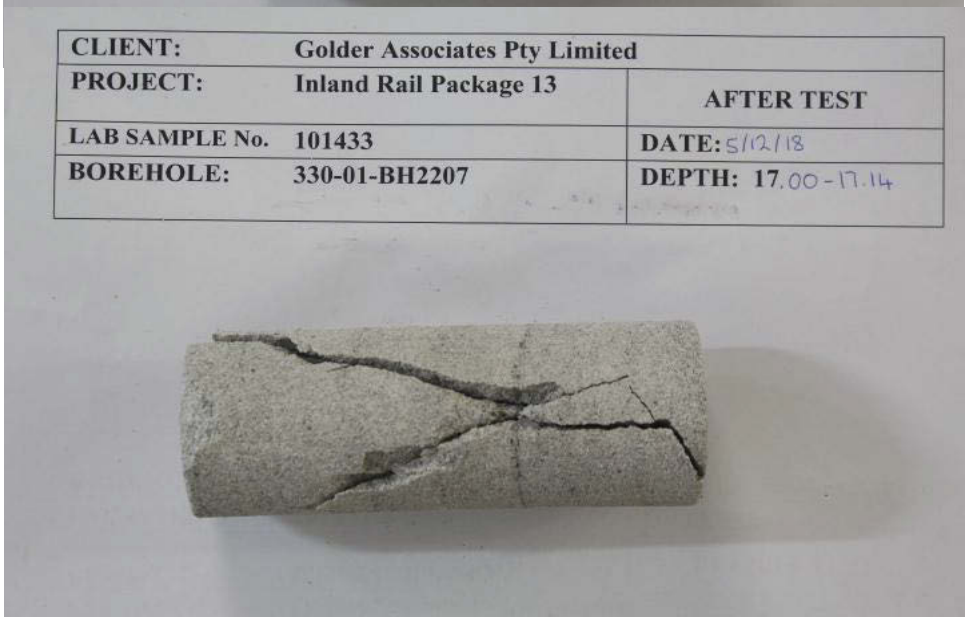
Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101433-MOD

Average Sample Diameter (mm)	52.2	Moisture Content (%)	6.0
Sample Height (mm)	139.8	Wet Density (t/m^3)	2.40
Duration of Test (min)	53.48	Dry Density (t/m^3)	2.27
Rate of Displacement (mm/min)	0.10	Bedding (°)	10
Mode of Failure	Conical	Test Apparatus	100kN Compression Machine



Notes/Remarks:

Sample/s supplied by client Photo not to scale Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

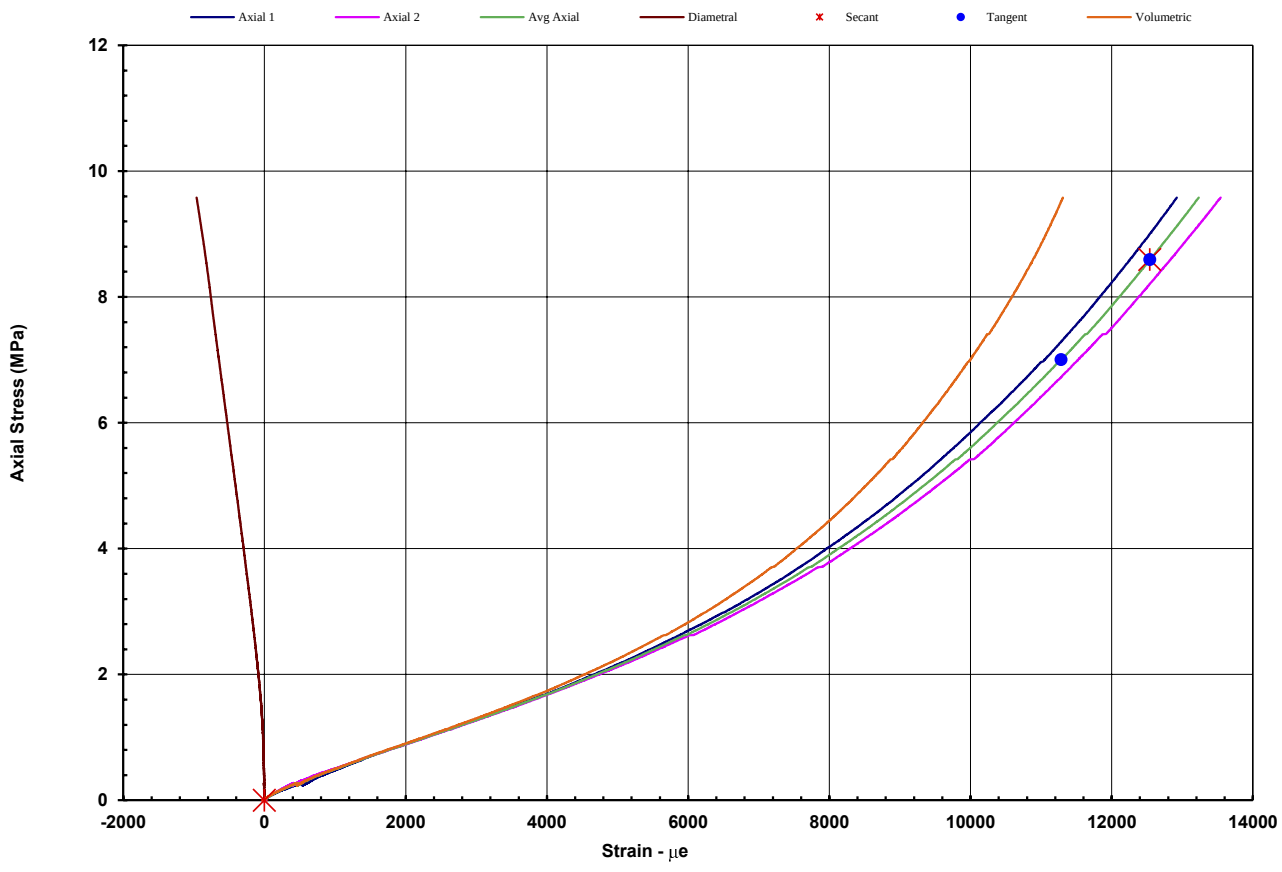
Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101435-MOD
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR1
		Test Date	4/12/2018
Project	Inland Rail Package 13	**Report Date**	7/12/2018
Project No.	1893802	**Client Sample No.**	330-01-BH2207-C02000
Bore Hole	330-01-BH2207	**Depth From (m)** 20	**Depth To (m)** 20.5
Description	C		
Sample Type	Single Individual Rock Core Specimen		

Uniaxial Compressive Strength 17.2 MPa

Young's Modulus		Poisson Ratio	
Tangent	1.26 GPa	0.066	from 41 % to 50 % of Max UCS
Secant	0.685 GPa	0.066	from 0 % to 50 % of Max UCS

Axial Stress vs Strain Plots



Notes/Remarks:

Sample/s supplied by client Graph not to scale Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory
C.N. Madison

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

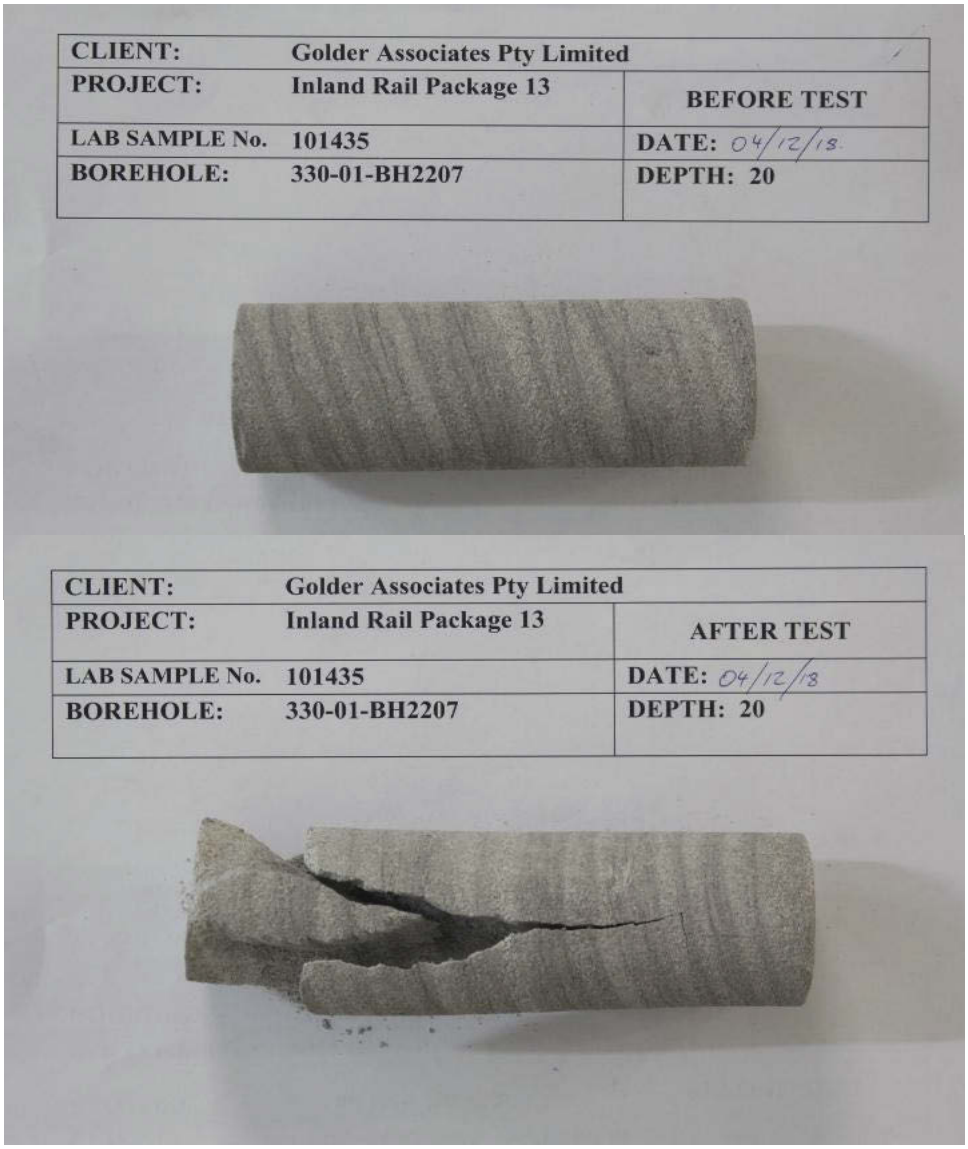
Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101435-MOD

Average Sample Diameter (mm)	51.7	Moisture Content (%)	3.6
Sample Height (mm)	143.8	Wet Density (t/m^3)	2.40
Duration of Test (min)	44.22	Dry Density (t/m^3)	2.32
Rate of Displacement (mm/min)	0.10	Bedding (°)	20
Mode of Failure	Conical	Test Apparatus	100kN Compression Machine



Notes/Remarks:

Sample/s supplied by client Photo not to scale Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

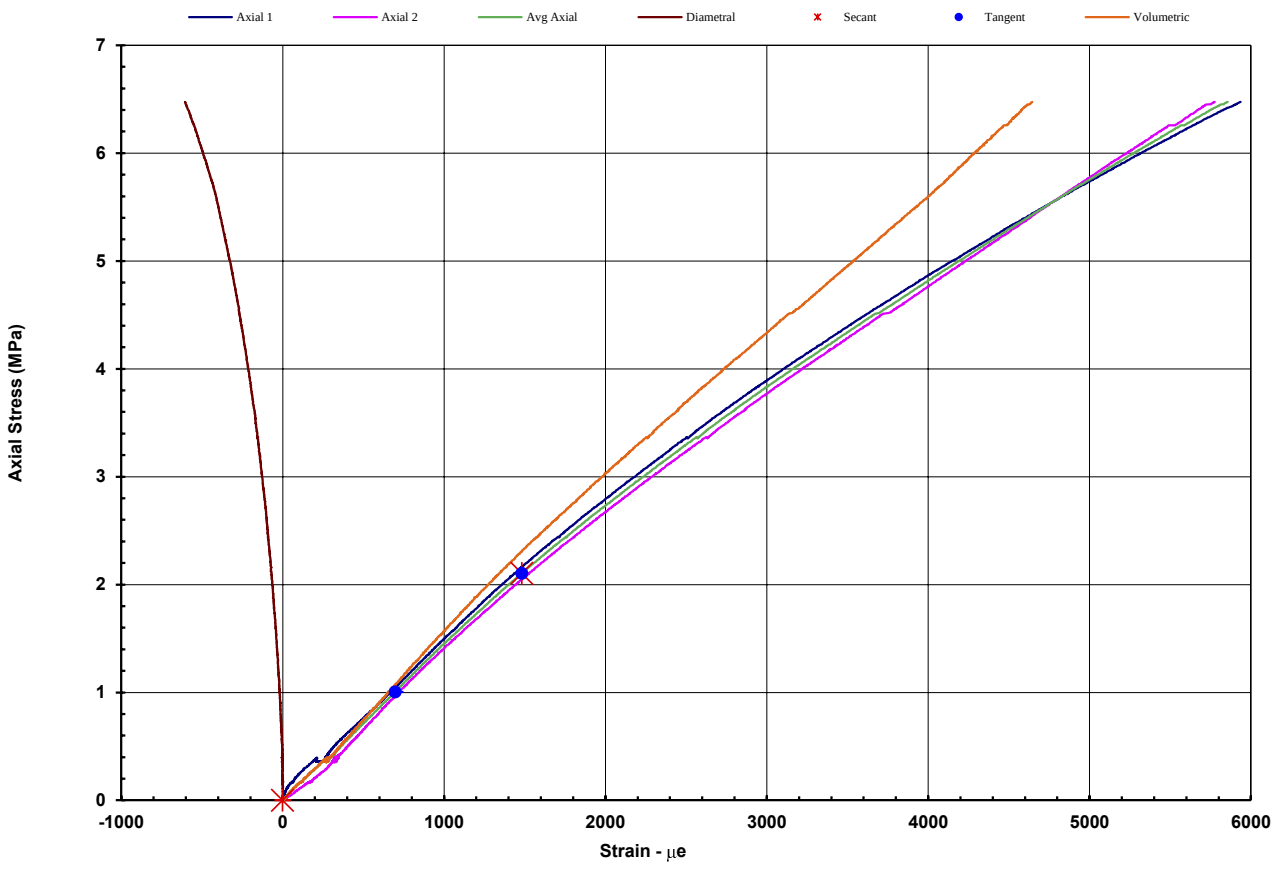
Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101454-MOD
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR1
		Test Date	6/12/2018
Project	Inland Rail Package 13	**Report Date**	7/12/2018
Project No.	1893802	**Client Sample No.**	330-01-BH2212-C02470
Bore Hole	330-01-BH2212	**Depth From (m)** 24.7	**Depth To (m)** 24.8
Description	C		
Sample Type	Single Individual Rock Core Specimen		

Uniaxial Compressive Strength 8.28 MPa

	Young's Modulus	Poisson Ratio	
Tangent	1.40 GPa	0.047	from 12 % to 25 % of Max UCS
Secant	1.42 GPa	0.047	from 0 % to 25 % of Max UCS

Axial Stress vs Strain Plots



Notes/Remarks:

Sample/s supplied by client Graph not to scale Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory
C.N. Madison

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101454-MOD

Average Sample Diameter (mm)	51.9	Moisture Content (%)	8.3
Sample Height (mm)	140.2	Wet Density (t/m^3)	2.28
Duration of Test (min)	27.85	Dry Density (t/m^3)	2.11
Rate of Displacement (mm/min)	0.10	Bedding (°)	10
Mode of Failure	Shear	Test Apparatus	100kN Compression Machine

Notes/Remarks:

Sample/s supplied by client Photo not to scale Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

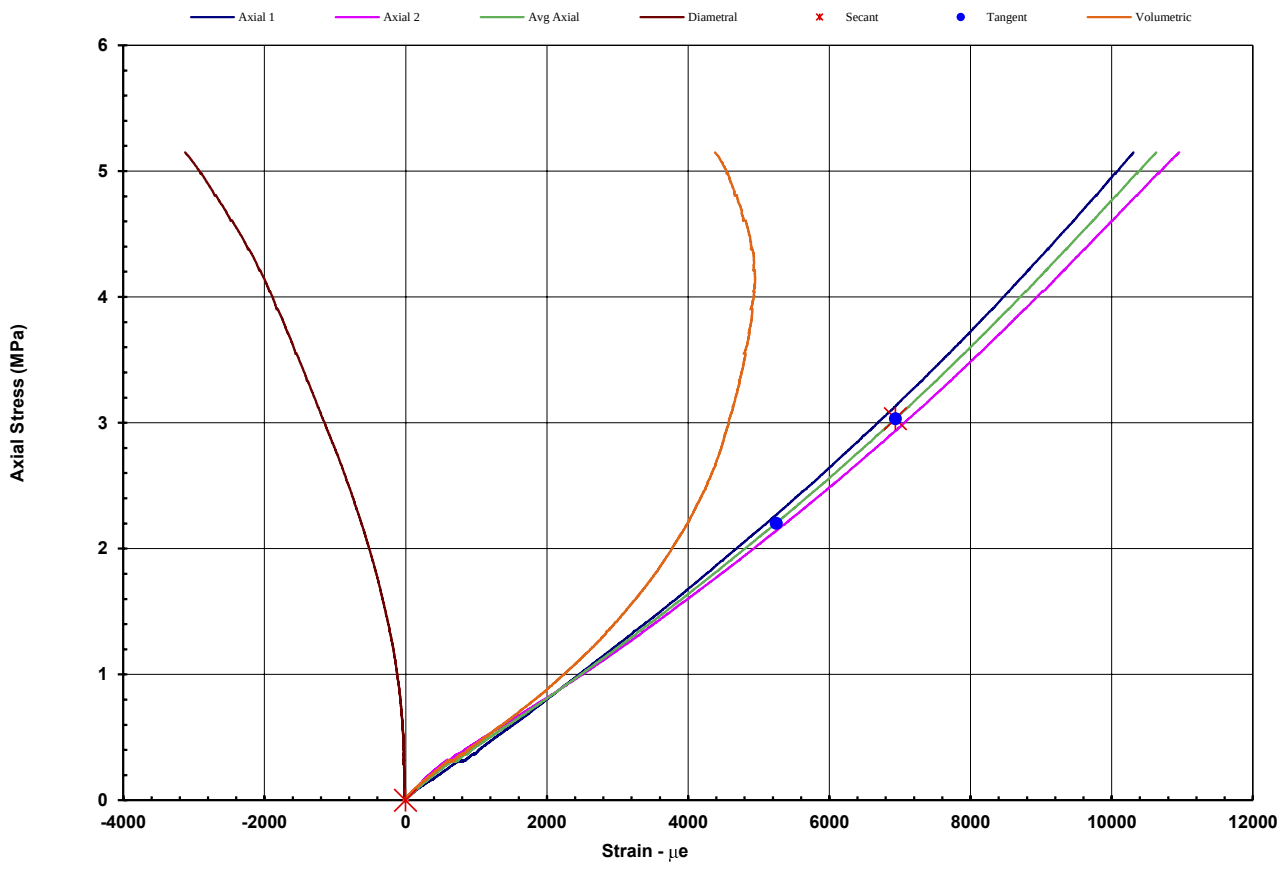
Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101486-MOD
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR1
		Test Date	4/12/2018
Project	Inland Rail Package 13	**Report Date**	7/12/2018
Project No.	1893802	**Client Sample No.**	330-01-BH2224-C02200
Bore Hole	330-01-BH2224	**Depth From (m)** 22	**Depth To (m)** 22.5
Description	C		
Sample Type	Single Individual Rock Core Specimen		

Uniaxial Compressive Strength 6.05 MPa

	Young's Modulus	Poisson Ratio	
Tangent	0.492 GPa	0.169	from 36 % to 50 % of Max UCS
Secant	0.437 GPa	0.170	from 0 % to 50 % of Max UCS

Axial Stress vs Strain Plots



Notes/Remarks:

Sample/s supplied by client Graph not to scale Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory
C.N. Madison

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

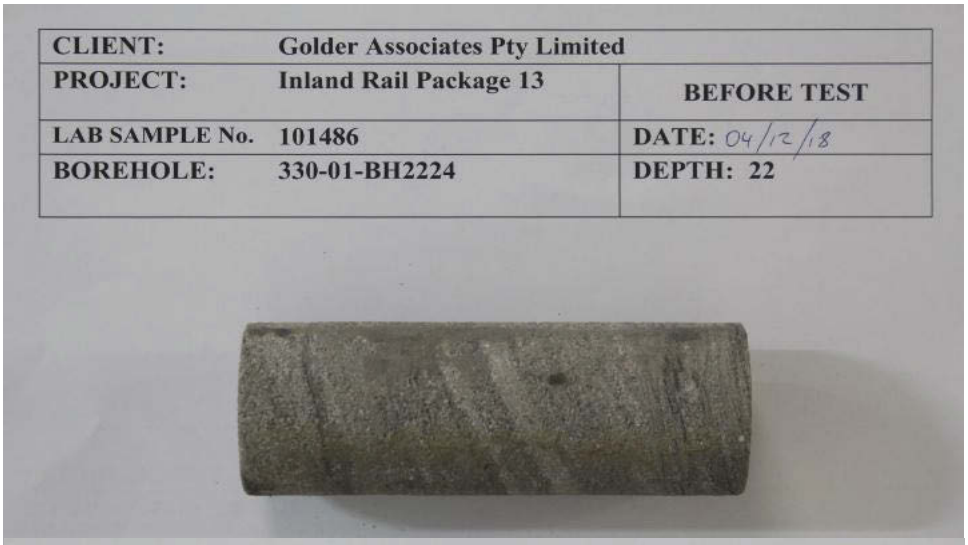
Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

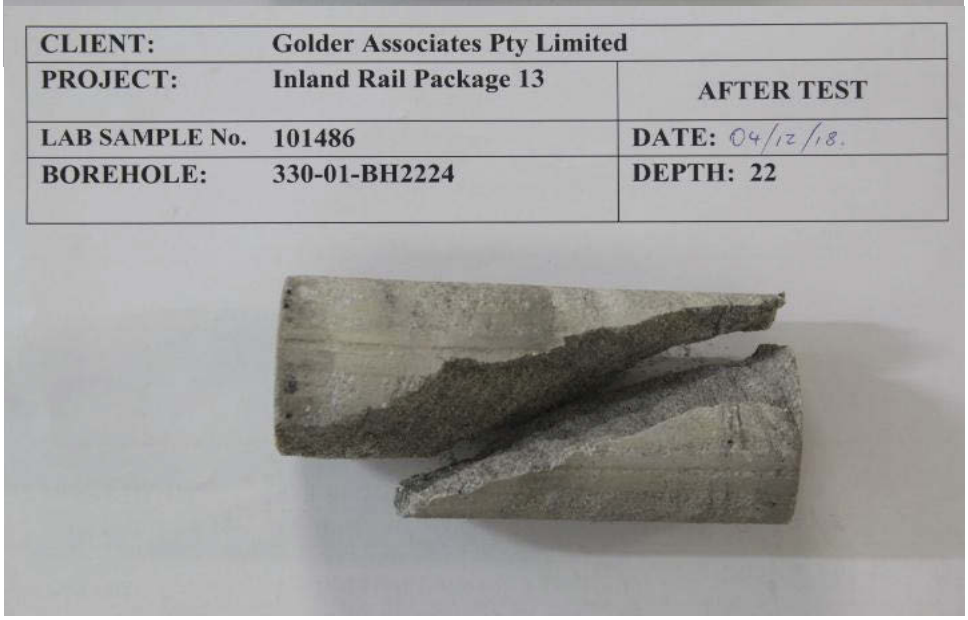
UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101486-MOD

Average Sample Diameter (mm)	51.7	Moisture Content (%)	6.6
Sample Height (mm)	138.1	Wet Density (t/m^3)	2.31
Duration of Test (min)	32.13	Dry Density (t/m^3)	2.17
Rate of Displacement (mm/min)	0.10	Bedding (°)	35
Mode of Failure	Shear	Test Apparatus	100kN Compression Machine





Notes/Remarks:

Sample/s supplied by client Photo not to scale Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

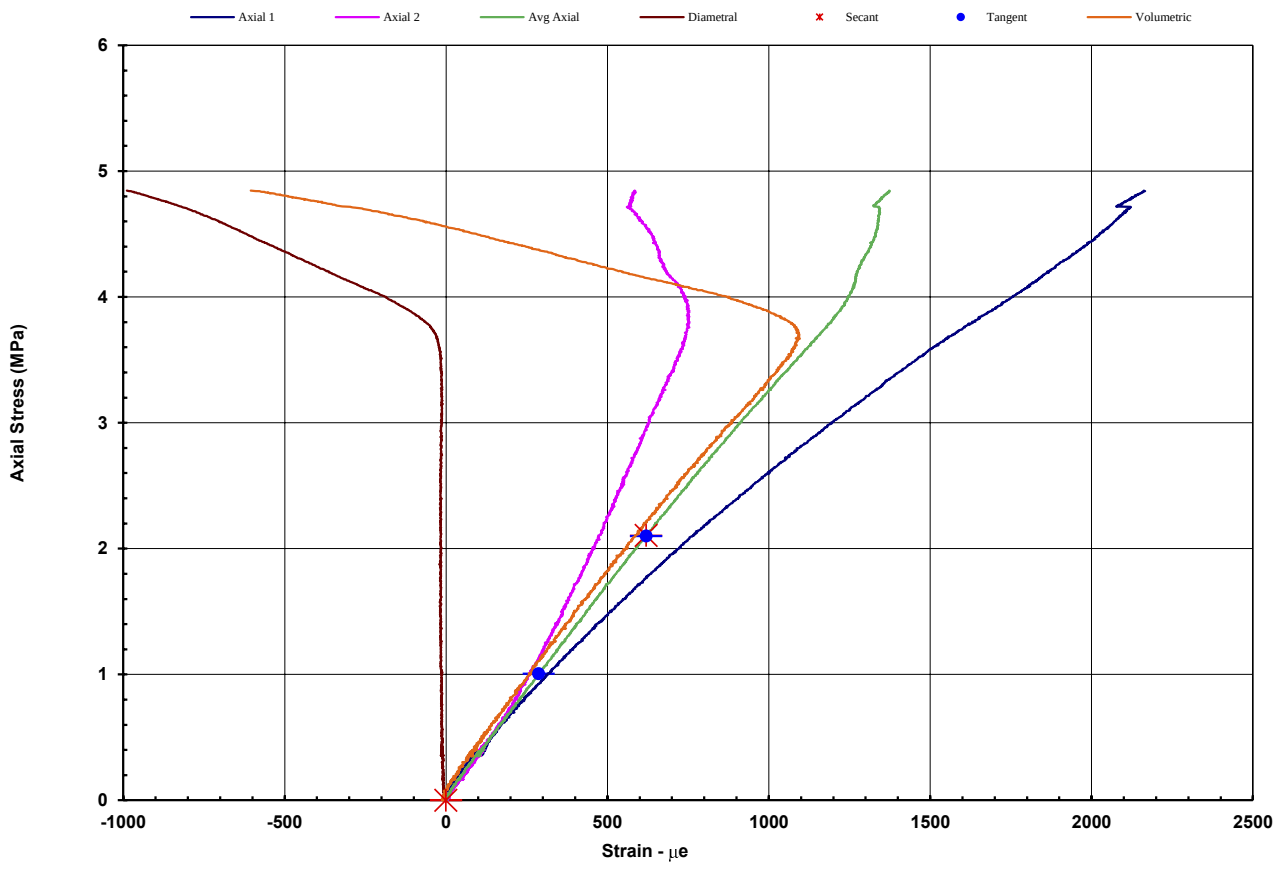
Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101488-MOD
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR1
		Test Date	6/12/2018
Project	Inland Rail Package 13	**Report Date**	7/12/2018
Project No.	1893802	**Client Sample No.**	330-01-BH2224-C02400
Bore Hole	330-01-BH2224	**Depth From (m)** 24	**Depth To (m)** 24.5
Description	C		
Sample Type	Single Individual Rock Core Specimen		

Uniaxial Compressive Strength 5.01 MPa

	Young's Modulus	Poisson Ratio	
Tangent	3.29 GPa	0.026	from 20 % to 42 % of Max UCS
Secant	3.39 GPa	0.026	from 0 % to 42 % of Max UCS

Axial Stress vs Strain Plots



Notes/Remarks:

Sample/s supplied by client Graph not to scale Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory
C.N. Madison

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

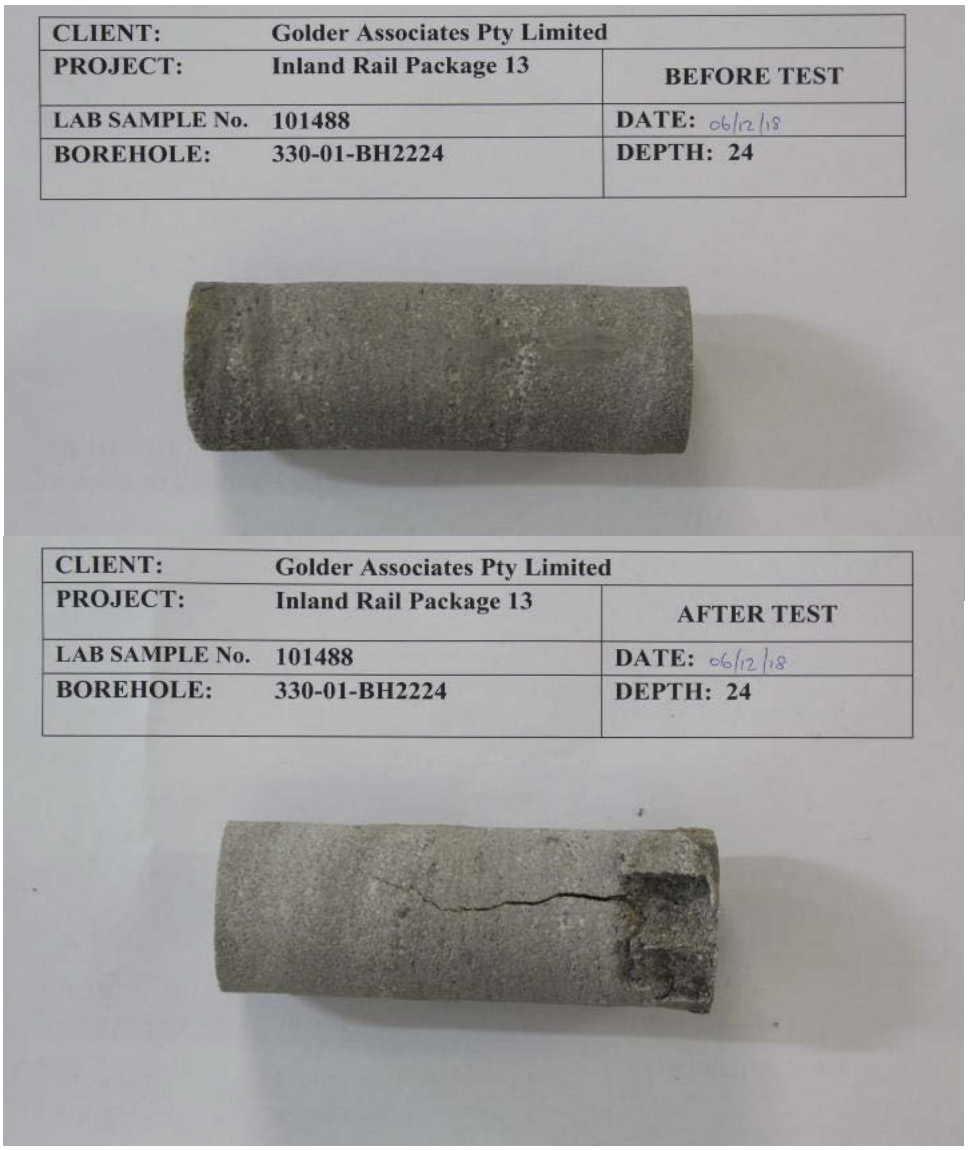
Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101488-MOD

Average Sample Diameter (mm)	51.7	Moisture Content (%)	5.9
Sample Height (mm)	140.2	Wet Density (t/m^3)	2.35
Duration of Test (min)	19.88	Dry Density (t/m^3)	2.22
Rate of Displacement (mm/min)	0.10	Bedding (°)	10
Mode of Failure	Axial Splitting	Test Apparatus	100kN Compression Machine



Notes/Remarks:

Sample/s supplied by client Photo not to scale Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

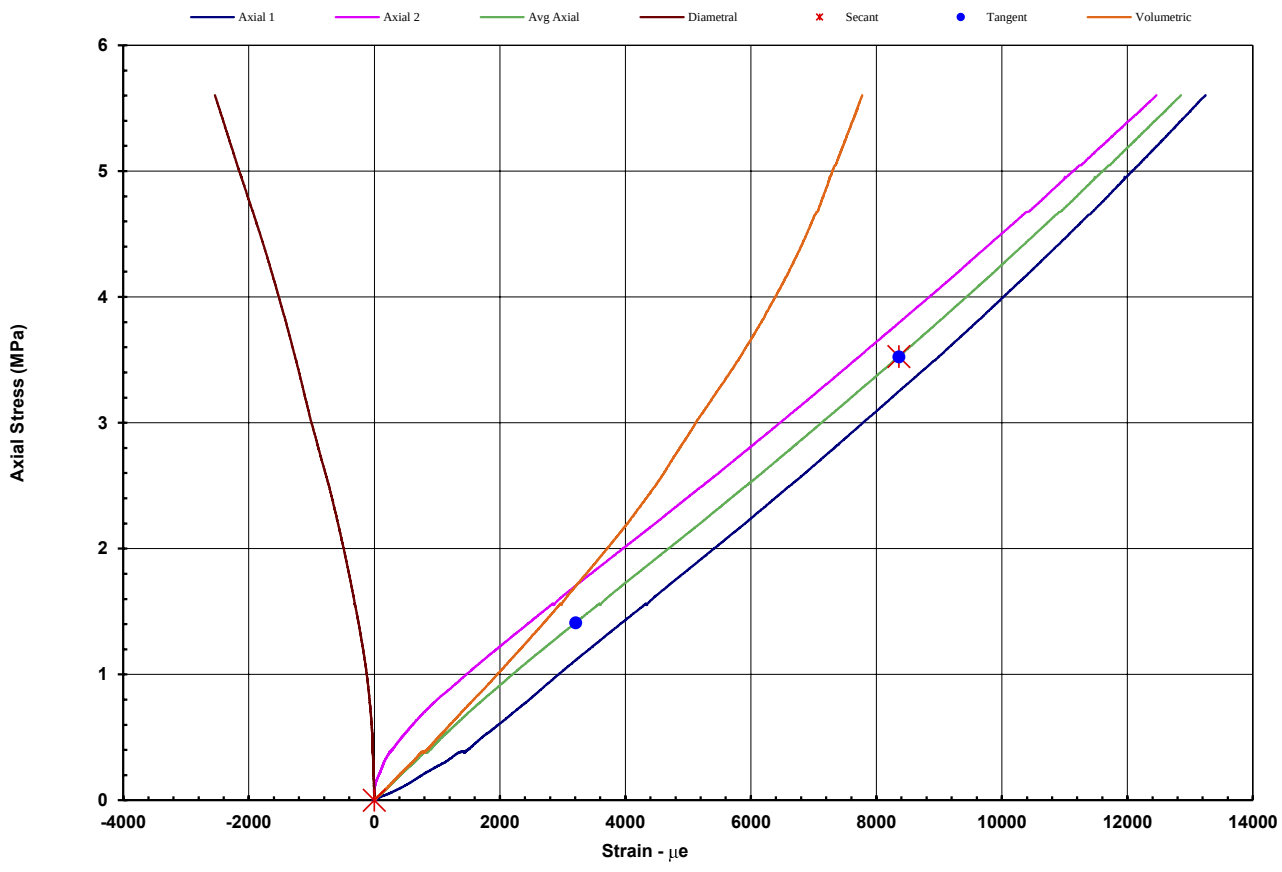
Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101490-MOD
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR1
		Test Date	7/12/2018
Project	Inland Rail Package 13	**Report Date**	10/12/2018
Project No.	1893802	**Client Sample No.**	330-01-BH2224-C02600
Bore Hole	330-01-BH2224	**Depth From (m)** 26	**Depth To (m)** 26.5
Description	C		
Sample Type	Single Individual Rock Core Specimen		

Uniaxial Compressive Strength 7.04 MPa

	Young's Modulus	Poisson Ratio	
Tangent	0.410 GPa	0.151	from 20 % to 50 % of Max UCS
Secant	0.422 GPa	0.151	from 0 % to 50 % of Max UCS

Axial Stress vs Strain Plots



Notes/Remarks:

The length to diameter ratio falls outside the test method limits of 2.5:1 to 3.0:1.

Sample/s supplied by client Graph not to scale Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory

C Nicholson

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

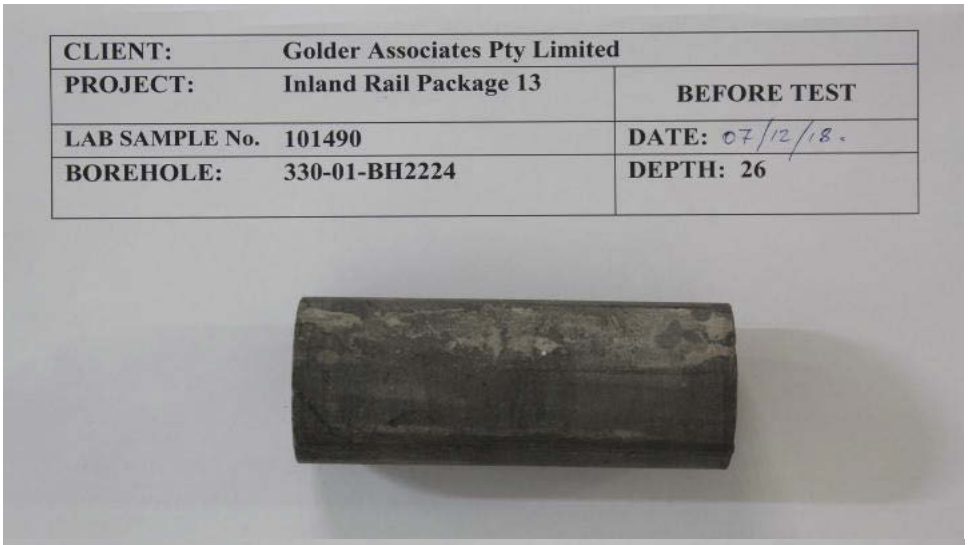
Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101490-MOD

Average Sample Diameter (mm)	51.5	Moisture Content (%)	7.9
Sample Height (mm)	123.4	Wet Density (t/m^3)	2.29
Duration of Test (min)	37.23	Dry Density (t/m^3)	2.12
Rate of Displacement (mm/min)	0.10	Bedding (°)	20
Mode of Failure	Conical	Test Apparatus	100kN Compression Machine



Notes/Remarks:

The length to diameter ratio falls outside the test method limits of 2.5:1 to 3.0:1.

Sample/s supplied by client Photo not to scale Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

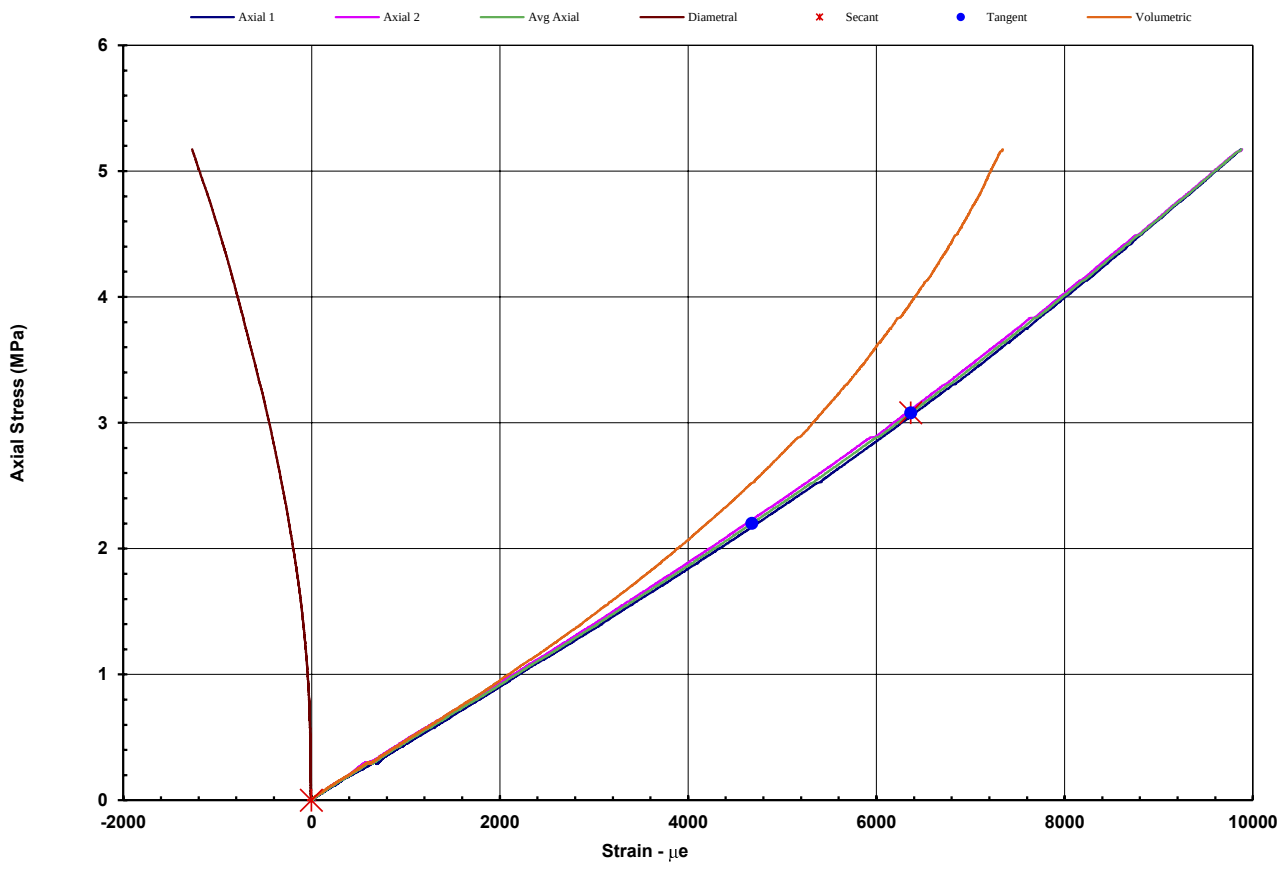
Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101509-MOD
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR1
		Test Date	4/12/2018
Project	Inland Rail Package 13	**Report Date**	7/12/2018
Project No.	1893802	**Client Sample No.**	330-01-BH2301-C00430
Bore Hole	330-01-BH2301	**Depth From (m)** 4.3	**Depth To (m)** 4.4
Description	C		
Sample Type	Single Individual Rock Core Specimen		

Uniaxial Compressive Strength 6.15 MPa

Young's Modulus		Poisson Ratio	
Tangent	0.520 GPa	0.074	from 36 % to 50 % of Max UCS
Secant	0.483 GPa	0.074	from 0 % to 50 % of Max UCS

Axial Stress vs Strain Plots



Notes/Remarks:

Sample/s supplied by client Graph not to scale Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory
C.N. Madison

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

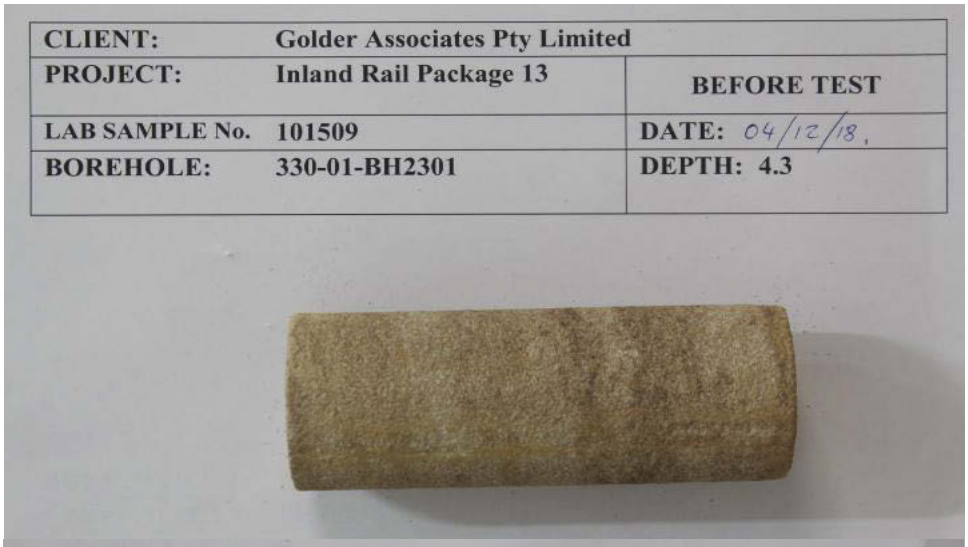
Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101509-MOD

Average Sample Diameter (mm)	51.8	Moisture Content (%)	3.5
Sample Height (mm)	133.1	Wet Density (t/m^3)	2.25
Duration of Test (min)	34.53	Dry Density (t/m^3)	2.18
Rate of Displacement (mm/min)	0.10	Bedding (°)	5
Mode of Failure	Conical	Test Apparatus	100kN Compression Machine



Notes/Remarks:

Sample/s supplied by client Photo not to scale Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

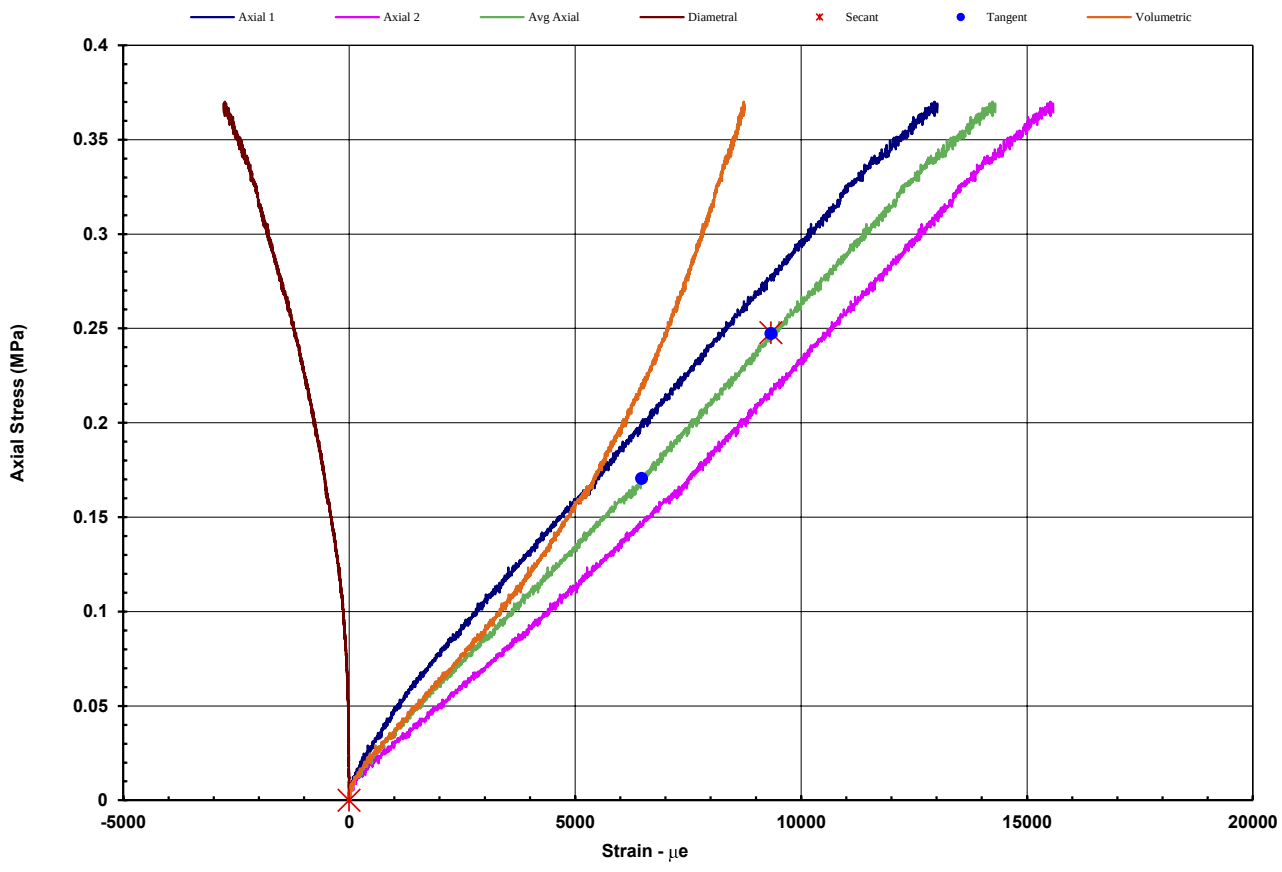
Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101513-MOD
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR1
		Test Date	5/12/2018
Project	Inland Rail Package 13	**Report Date**	7/12/2018
Project No.	1893802	**Client Sample No.**	330-01-BH2301-C00730
Bore Hole	330-01-BH2301	**Depth From (m)** 7.3	**Depth To (m)** 7.4
Description	C		
Sample Type	Single Individual Rock Core Specimen		

Uniaxial Compressive Strength 0.491 MPa

	Young's Modulus	Poisson Ratio	
Tangent	0.027 GPa	0.126	from 35 % to 50 % of Max UCS
Secant	0.027 GPa	0.126	from 0 % to 50 % of Max UCS

Axial Stress vs Strain Plots



Notes/Remarks:

The length to diameter ratio falls outside the test method limits of 2.5:1 to 3.0:1.

Sample/s supplied by client Graph not to scale Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory
C.N. Madison

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

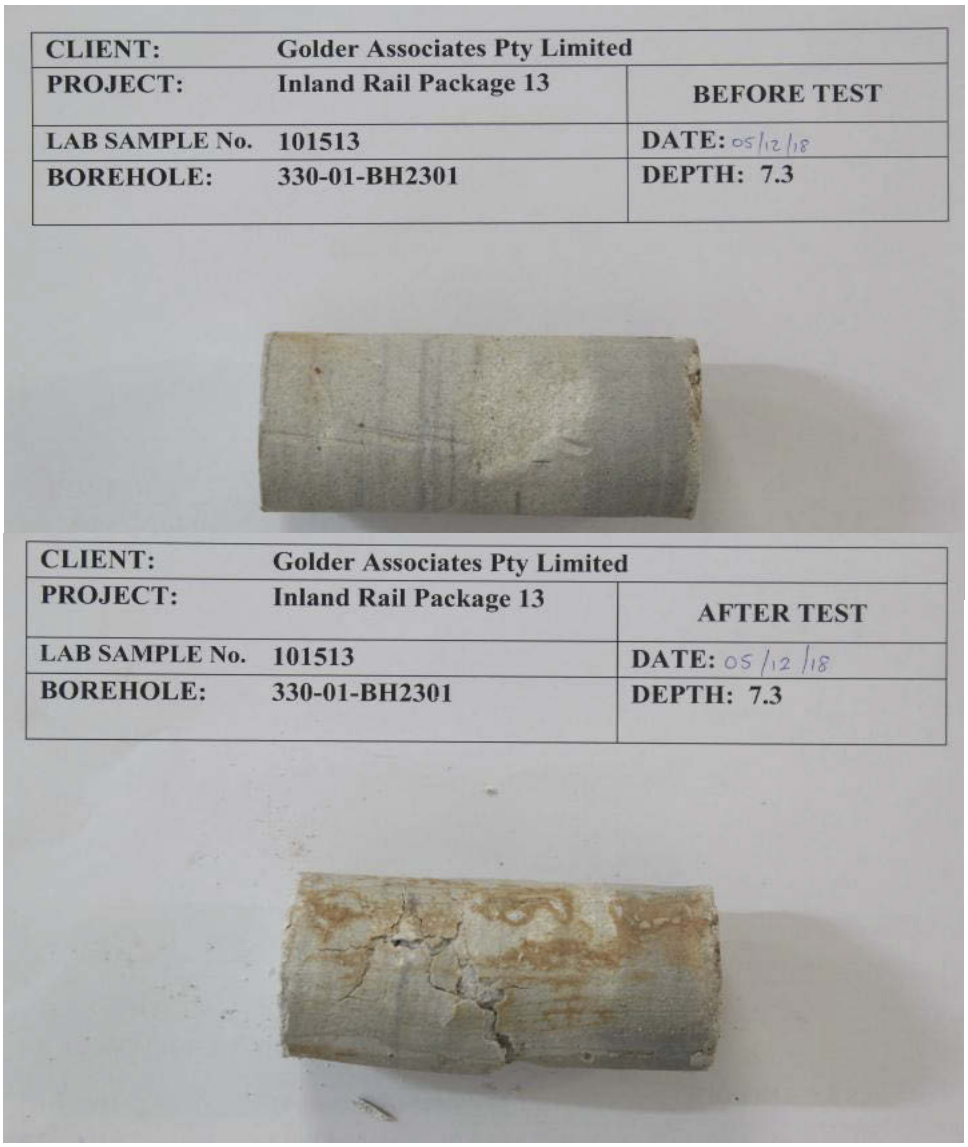
Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101513-MOD

Average Sample Diameter (mm)	51.7	Moisture Content (%)	8.3
Sample Height (mm)	116.2	Wet Density (t/m^3)	2.14
Duration of Test (min)	37.18	Dry Density (t/m^3)	1.97
Rate of Displacement (mm/min)	0.10	Bedding (°)	Nil
Mode of Failure	Shear	Test Apparatus	100kN Compression Machine



Notes/Remarks:

The length to diameter ratio falls outside the test method limits of 2.5:1 to 3.0:1.

Sample/s supplied by client Photo not to scale Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

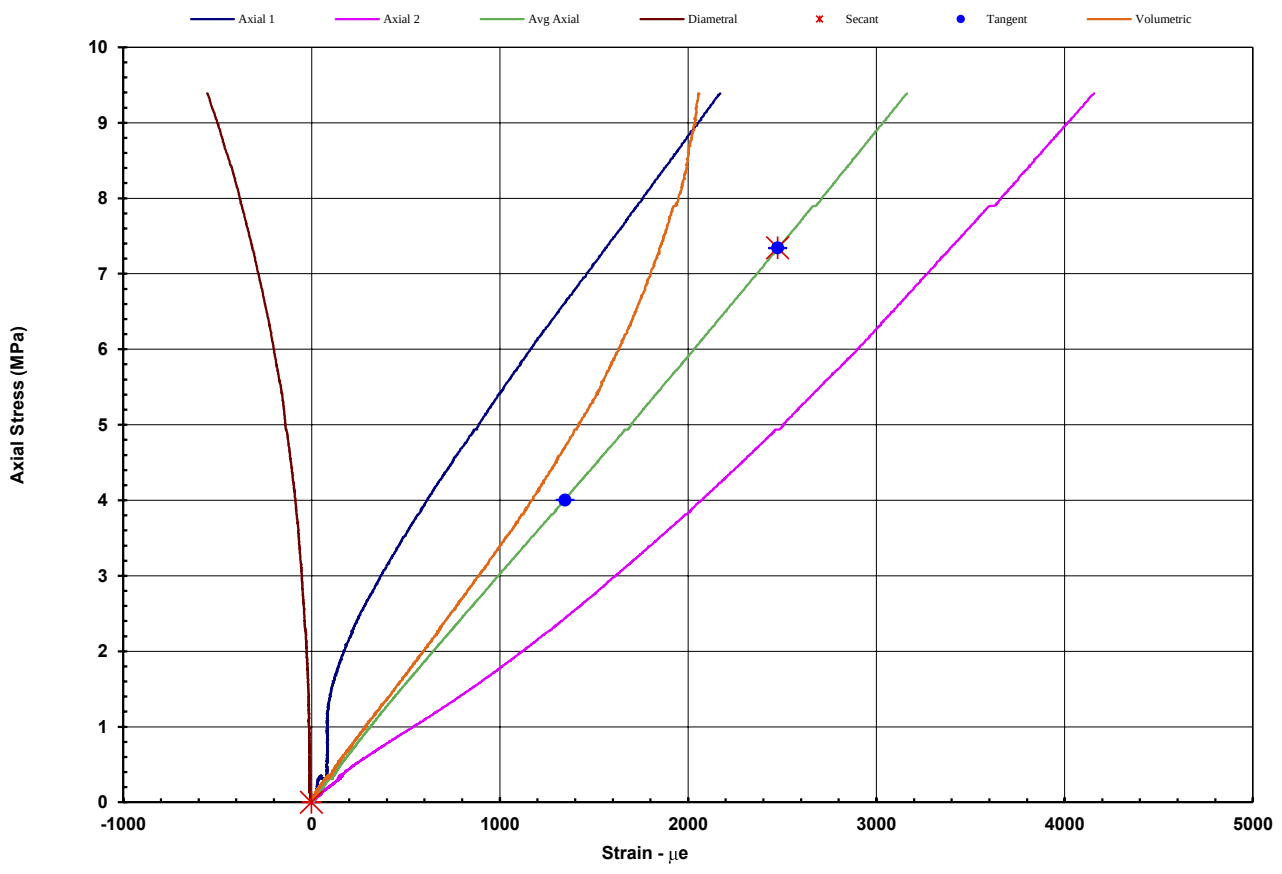
Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101515-MOD
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR1
		Test Date	5/12/2018
Project	Inland Rail Package 13	**Report Date**	7/12/2018
Project No.	1893802	**Client Sample No.**	330-01-BH2301-C00770
Bore Hole	330-01-BH2301	**Depth From (m)** 7.7	**Depth To (m)** 7.8
Description	C		
Sample Type	Single Individual Rock Core Specimen		

Uniaxial Compressive Strength 14.7 MPa

Young's Modulus		Poisson Ratio	
Tangent	2.95 GPa	0.127	from 27 % to 50 % of Max UCS
Secant	2.97 GPa	0.127	from 0 % to 50 % of Max UCS

Axial Stress vs Strain Plots



Notes/Remarks:

Sample/s supplied by client Graph not to scale Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory
C.N. Madison

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101515-MOD

Average Sample Diameter (mm)	50.7	Moisture Content (%)	2.9
Sample Height (mm)	131.6	Wet Density (t/m^3)	2.26
Duration of Test (min)	29.75	Dry Density (t/m^3)	2.19
Rate of Displacement (mm/min)	0.10	Bedding (°)	Nil
Mode of Failure	Shear	Test Apparatus	100kN Compression Machine

Notes/Remarks:

Sample/s supplied by client Photo not to scale Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

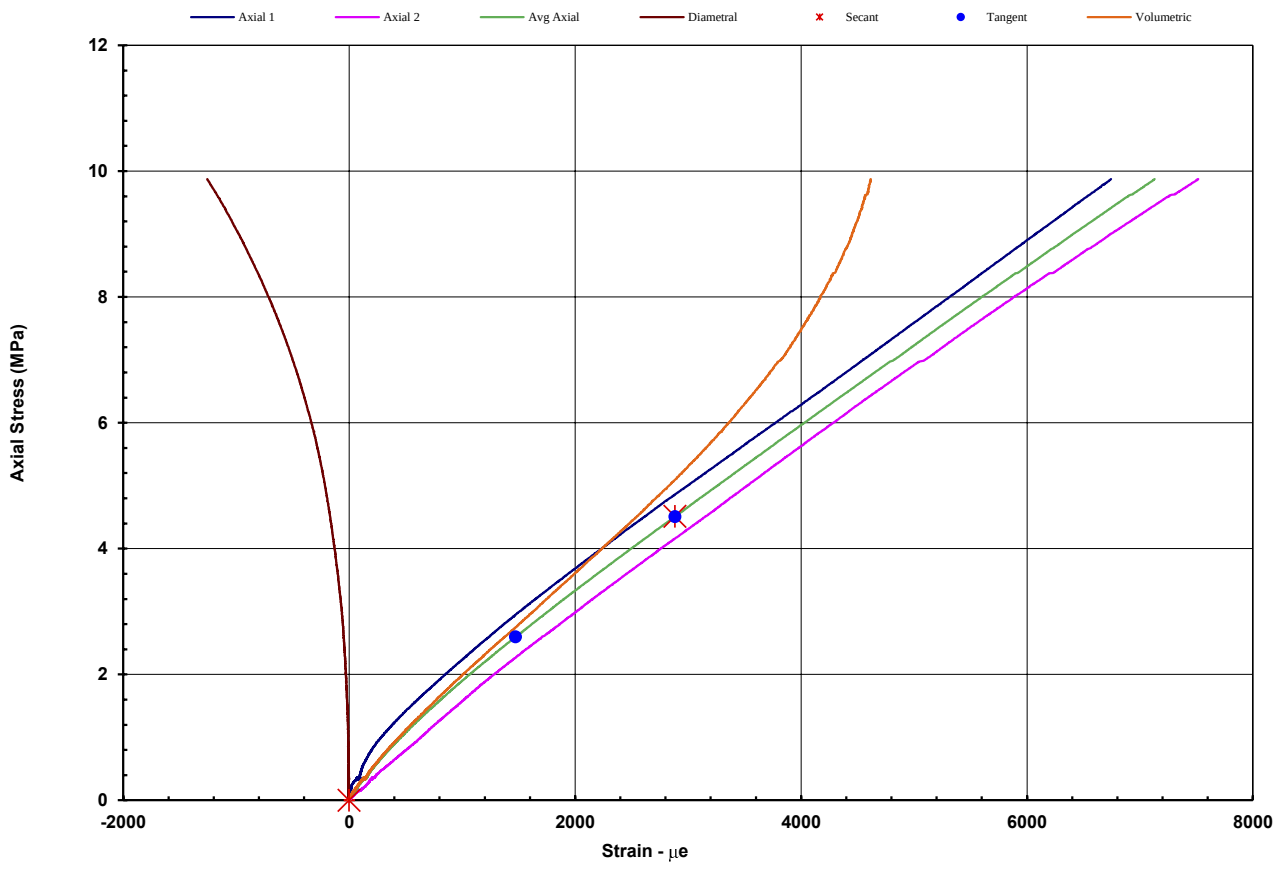
Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101518-MOD
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR1
		Test Date	6/12/2018
Project	Inland Rail Package 13	**Report Date**	7/12/2018
Project No.	1893802	**Client Sample No.**	330-01-BH2301-C01140
Bore Hole	330-01-BH2301	**Depth From (m)** 11.4	**Depth To (m)** 11.5
Description	C		
Sample Type	Single Individual Rock Core Specimen		

Uniaxial Compressive Strength 13.0 MPa

	Young's Modulus	Poisson Ratio	
Tangent	1.35 GPa	0.058	from 20 % to 35 % of Max UCS
Secant	1.56 GPa	0.059	from 0 % to 35 % of Max UCS

Axial Stress vs Strain Plots



Notes/Remarks:

Sample/s supplied by client Graph not to scale Tested as received. **Page 1 of 2** EP13402

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory
C.N. Madison

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101518-MOD

Average Sample Diameter (mm)	51.5	Moisture Content (%)	2.8
Sample Height (mm)	132.4	Wet Density (t/m^3)	2.35
Duration of Test (min)	31.80	Dry Density (t/m^3)	2.29
Rate of Displacement (mm/min)	0.10	Bedding (°)	30
Mode of Failure	Conical	Test Apparatus	100kN Compression Machine

Notes/Remarks:

Sample/s supplied by client Photo not to scale Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

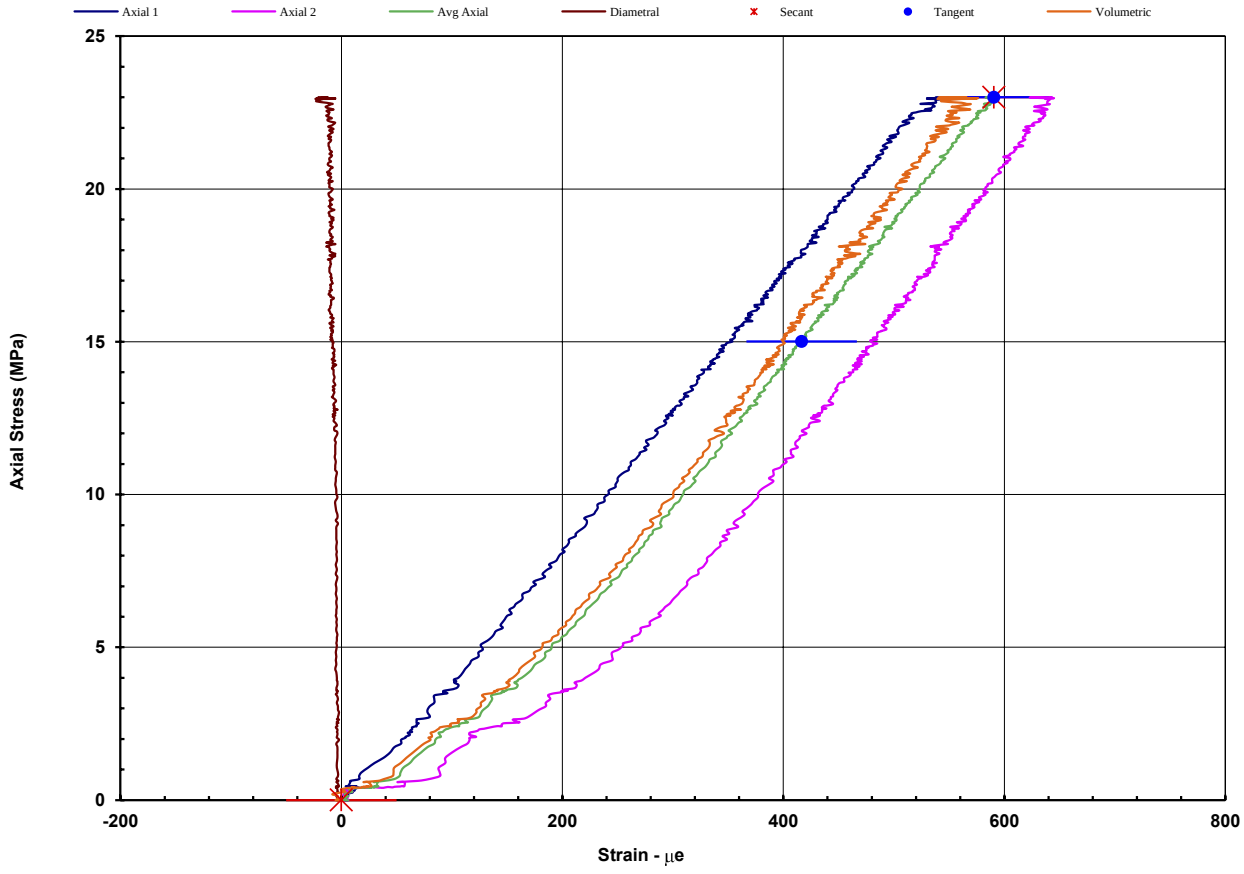
Test Method: AS 4133.4.3.1

Client	Golder Associates Pty Limited	**Report No.**	GA101535-MOD
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR1
		Test Date	11/12/2018
Project	Inland Rail Package 13	**Report Date**	12/12/2018
Project No.	1893802	**Client Sample No.**	330-01-BH2301-C02170
Bore Hole	330-01-BH2301	**Depth From (m)**	21.66
		Depth To (m)	21.81
Description	C		
Sample Type	Single Individual Rock Core Specimen		

Uniaxial Compressive Strength 105 MPa

	Young's Modulus	Poisson Ratio	
Tangent	45.9 GPa	0.021	from 14 % to 22 % of Max UCS
Secant	39.0 GPa	0.021	from 0 % to 22 % of Max UCS

Axial Stress vs Strain Plots



Notes/Remarks:

Sample/s supplied by client | Graph not to scale | Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory
C. Mardon

NATA ACCREDITED FOR TECHNICAL COMPETENCE
Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

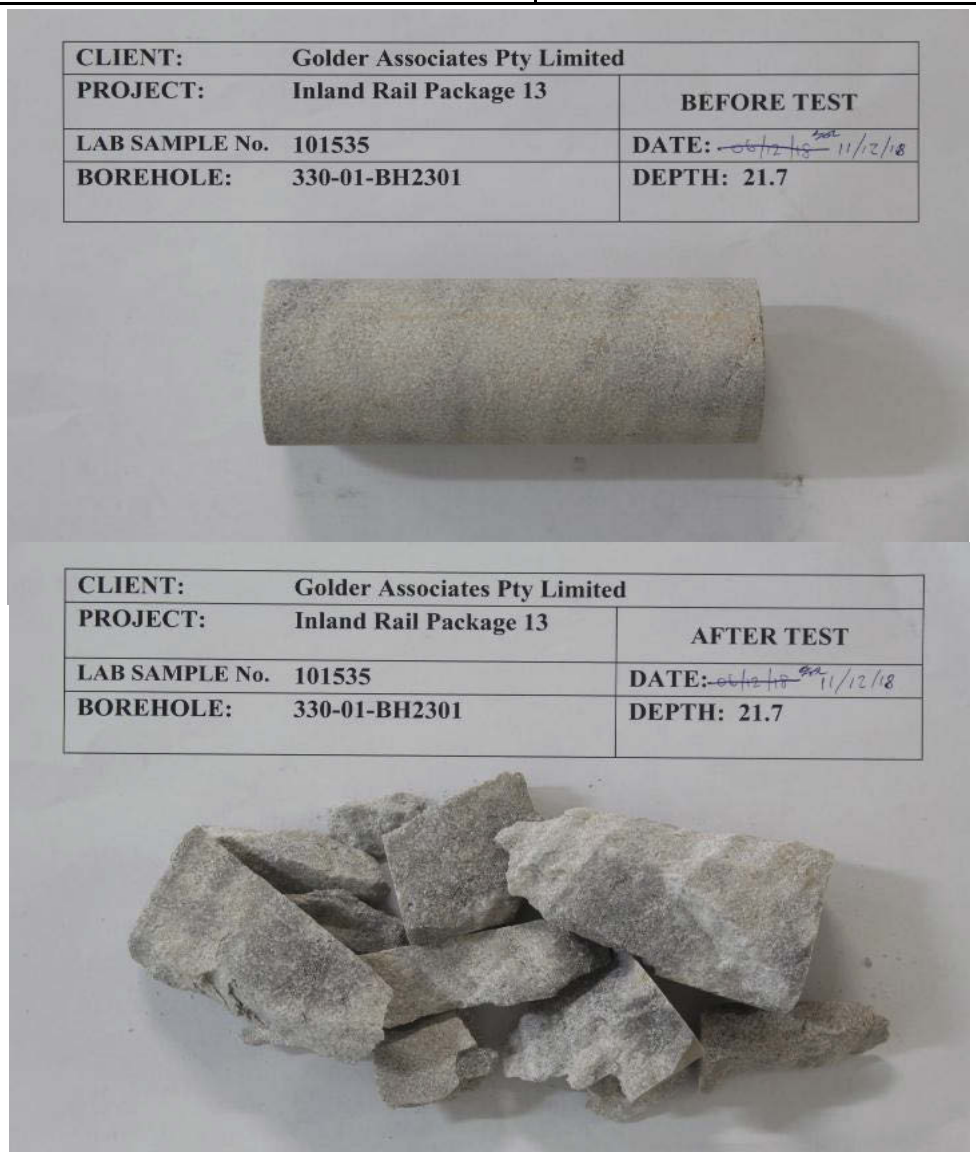
Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

Test Method: AS 4133.4.3.1

Client	Golder Associates Pty Limited	**Report No.**	GA101535-MOD

Average Sample Diameter (mm)	51.9	Moisture Content (%)	0.3
Sample Height (mm)	141.5	Wet Density (t/m^3)	2.34
Duration of Test (min)	9.17	Dry Density (t/m^3)	2.33
Rate of Loading (MPa/min)	11.51	Bedding (°)	35
Mode of Failure	Disintegration	Test Apparatus	Kelba 1000kN Load Cell



Notes/Remarks:

Sample/s supplied by client | Graph not to scale | Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory

N. Maddison

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

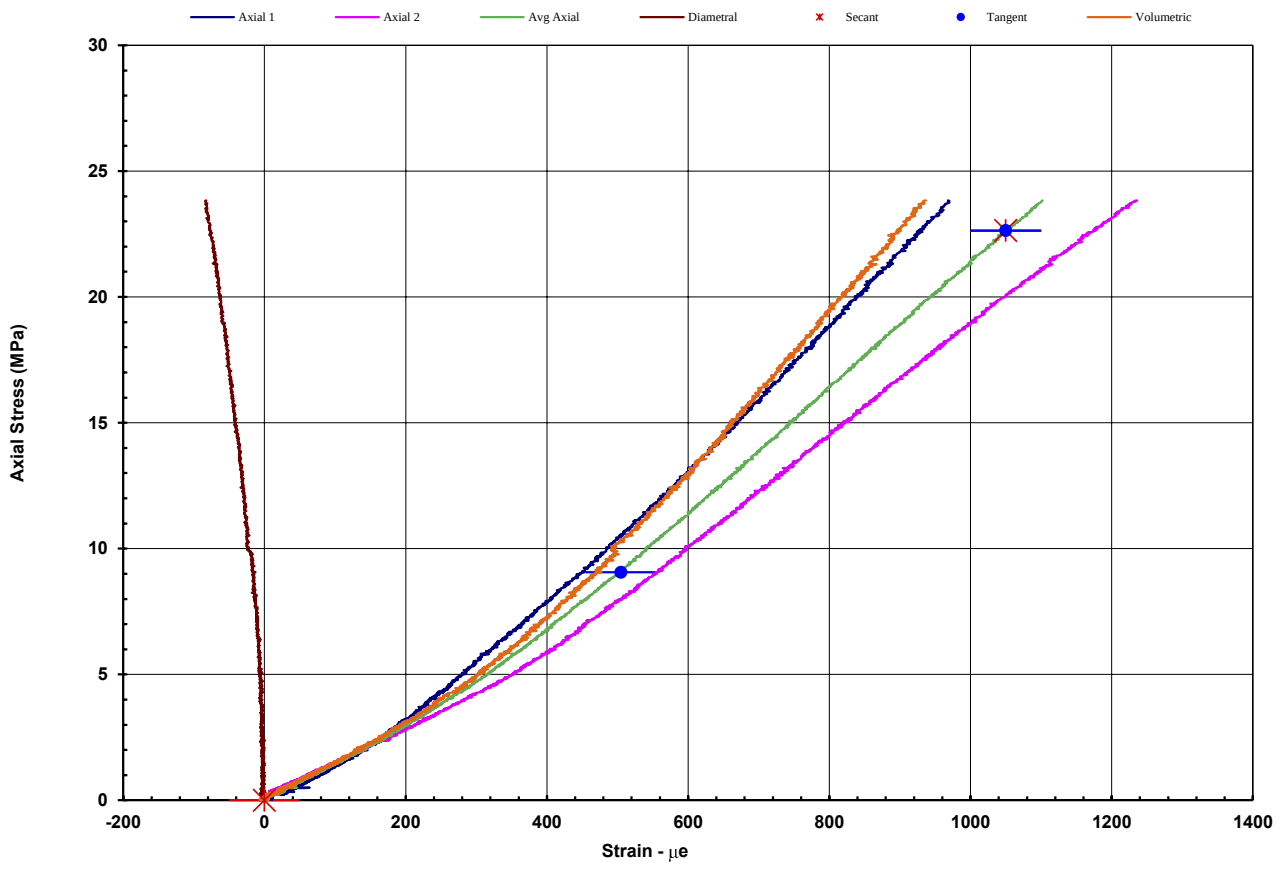
Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101541-MOD
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR1
		Test Date	4/12/2018
Project	Inland Rail Package 13	**Report Date**	7/12/2018
Project No.	1893802	**Client Sample No.**	330-01-BH2303-C00250
Bore Hole	330-01-BH2303 **Depth From (m)** 2.5	**Depth To (m)**	2.6
Description	C		
Sample Type	Single Individual Rock Core Specimen		

Uniaxial Compressive Strength 45.3 MPa

Young's Modulus		**Poisson Ratio**	
Tangent	24.9 GPa	0.073	from 20 % to 50 % of Max UCS
Secant	21.6 GPa	0.073	from 0 % to 50 % of Max UCS

Axial Stress vs Strain Plots



Notes/Remarks:

Sample/s supplied by client Graph not to scale Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory
C.N. Madison

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

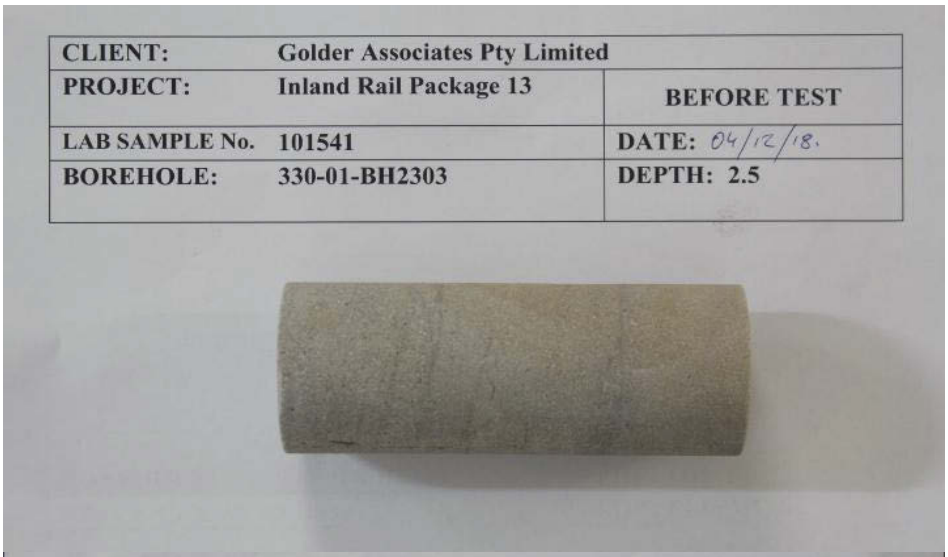
Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

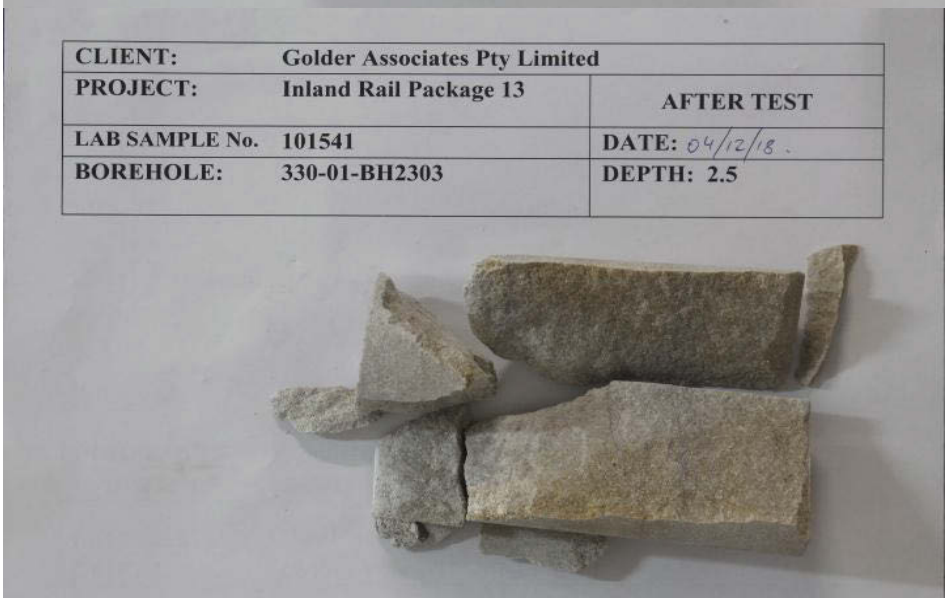
UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101541-MOD

Average Sample Diameter (mm)	51.6	Moisture Content (%)	2.2
Sample Height (mm)	132.1	Wet Density (t/m^3)	2.35
Duration of Test (min)	31.28	Dry Density (t/m^3)	2.30
Rate of Displacement (mm/min)	0.10	Bedding (°)	10
Mode of Failure	Conical	Test Apparatus	100kN Compression Machine





Notes/Remarks:

Sample/s supplied by client Photo not to scale Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

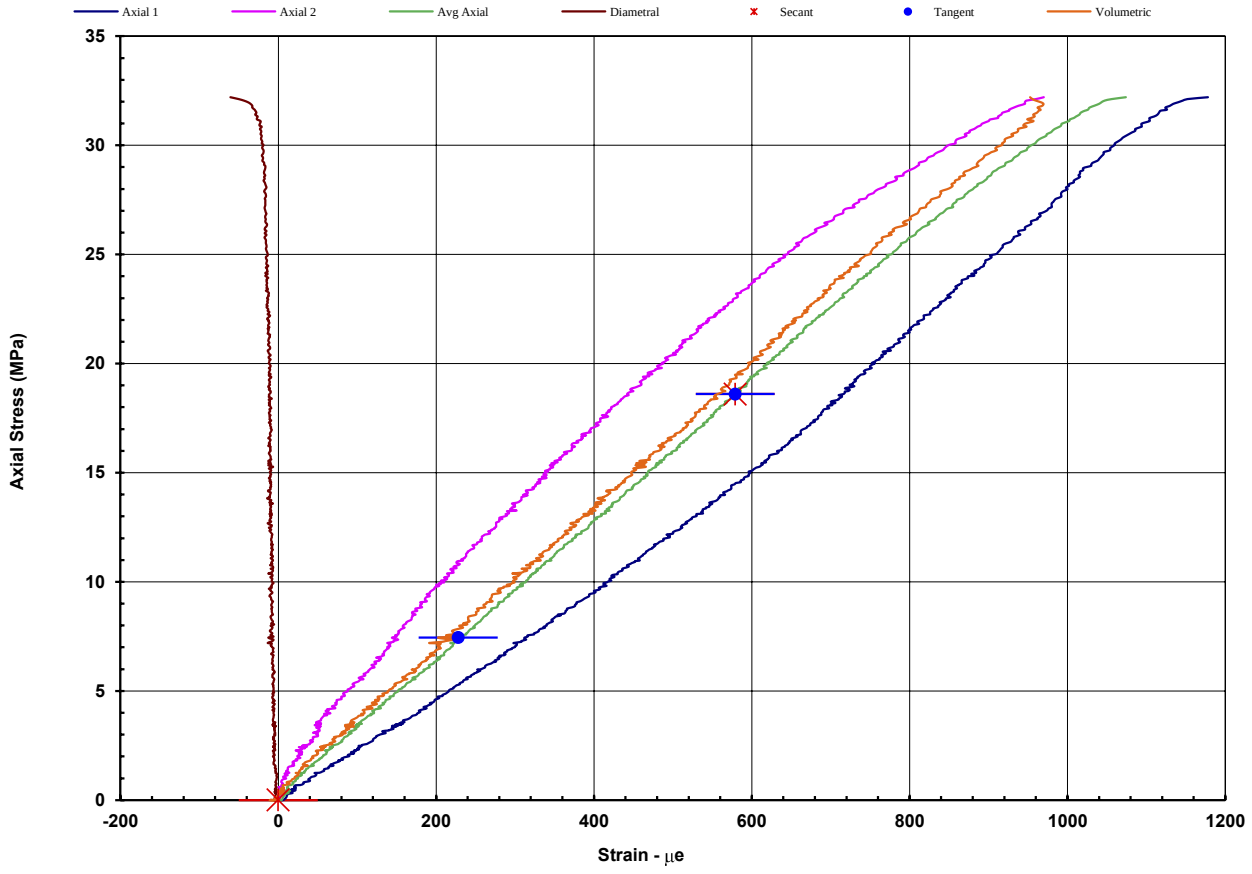
Test Method: AS 4133.4.3.1

Client	Golder Associates Pty Limited	**Report No.**	GA101555-MOD
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR1
		Test Date	4/12/2018
Project	Inland Rail Package 13	**Report Date**	7/12/2018
Project No.	1893802	**Client Sample No.**	330-01-BH2303-C00720
Bore Hole	330-01-BH2303	**Depth From (m)** 7.2	**Depth To (m)** 7.3
Description	C		
Sample Type	Single Individual Rock Core Specimen		

Uniaxial Compressive Strength 37.1 MPa

	Young's Modulus	Poisson Ratio	
Tangent	31.8 GPa	0.019	from 20 % to 50 % of Max UCS
Secant	32.1 GPa	0.019	from 0 % to 50 % of Max UCS

Axial Stress vs Strain Plots



Notes/Remarks:

Sample/s supplied by client | Graph not to scale | Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory

C. Mardon

NATA ACCREDITED FOR TECHNICAL COMPETENCE
Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

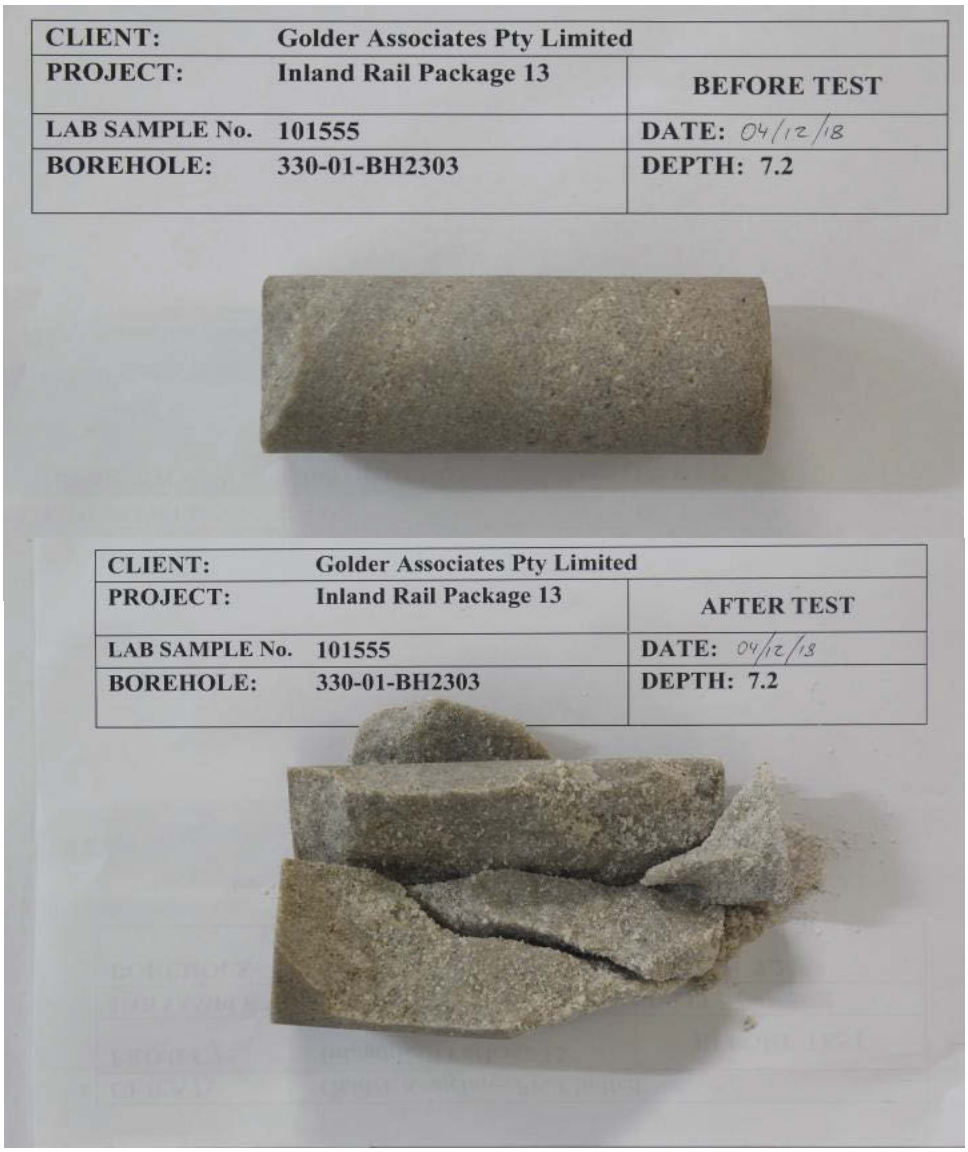
Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

Test Method: AS 4133.4.3.1

Client	Golder Associates Pty Limited	**Report No.**	GA101555-MOD

Average Sample Diameter (mm)	51.7	Moisture Content (%)	3.9
Sample Height (mm)	134.0	Wet Density (t/m^3)	2.26
Duration of Test (min)	7.37	Dry Density (t/m^3)	2.17
Rate of Loading (MPa/min)	5.04	Bedding (°)	30
Mode of Failure	Conical	Test Apparatus	Kelba 1000kN Load Cell



Notes/Remarks:

Sample/s supplied by client | Graph not to scale | Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory
N. Maddison

NATA ACCREDITED FOR TECHNICAL COMPETENCE
Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

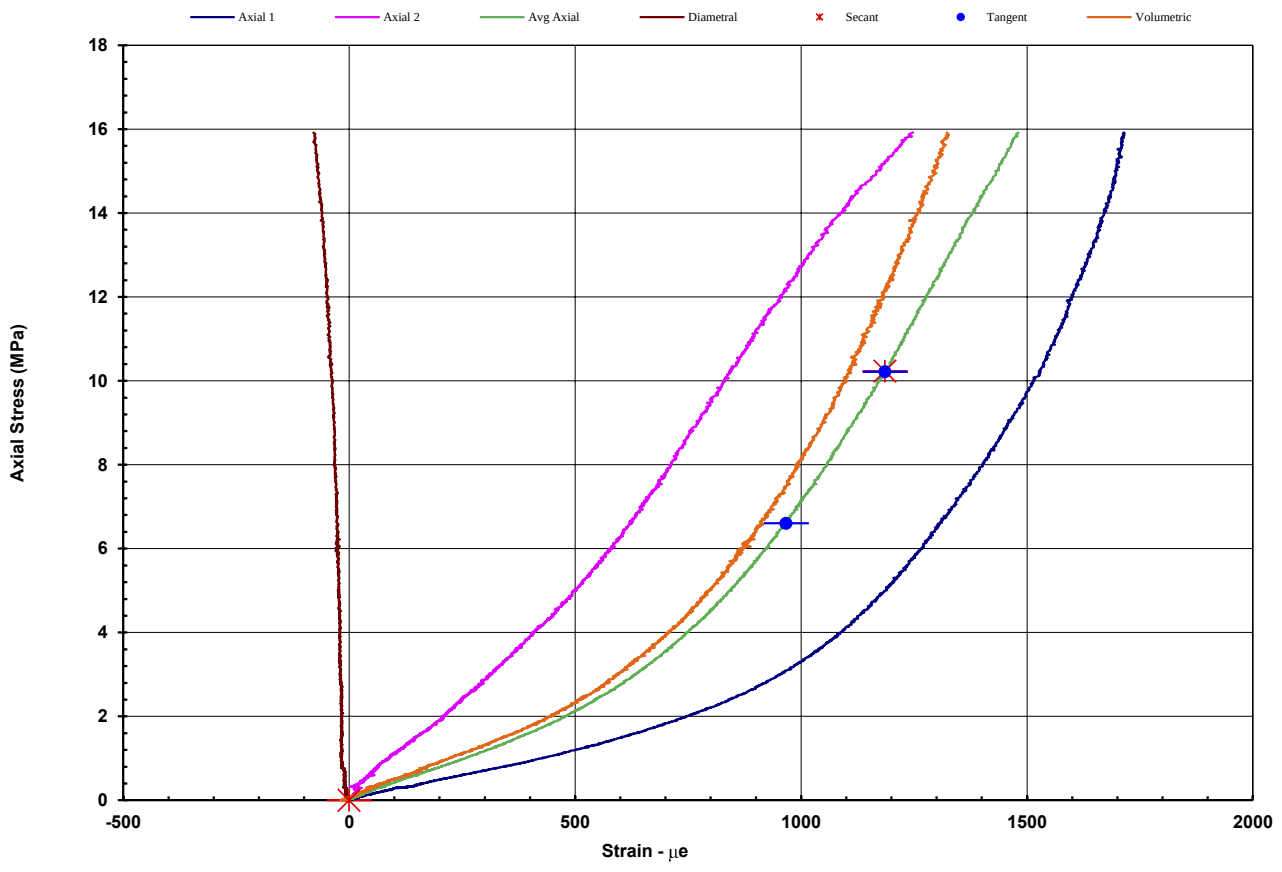
Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101557-MOD
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR1
		Test Date	4/12/2018
Project	Inland Rail Package 13	**Report Date**	7/12/2018
Project No.	1893802	**Client Sample No.**	330-01-BH2303-C01050
Bore Hole	330-01-BH2303	**Depth From (m)** 10.5	**Depth To (m)** 10.6
Description	C		
Sample Type	Single Individual Rock Core Specimen		

Uniaxial Compressive Strength 20.4 MPa

	Young's Modulus	Poisson Ratio	
Tangent	16.5 GPa	0.033	from 32 % to 50 % of Max UCS
Secant	8.63 GPa	0.033	from 0 % to 50 % of Max UCS

Axial Stress vs Strain Plots



Notes/Remarks:

The length to diameter ratio falls outside the test method limits of 2.5:1 to 3.0:1.

Sample/s supplied by client Graph not to scale Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory

C.N. Madison

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

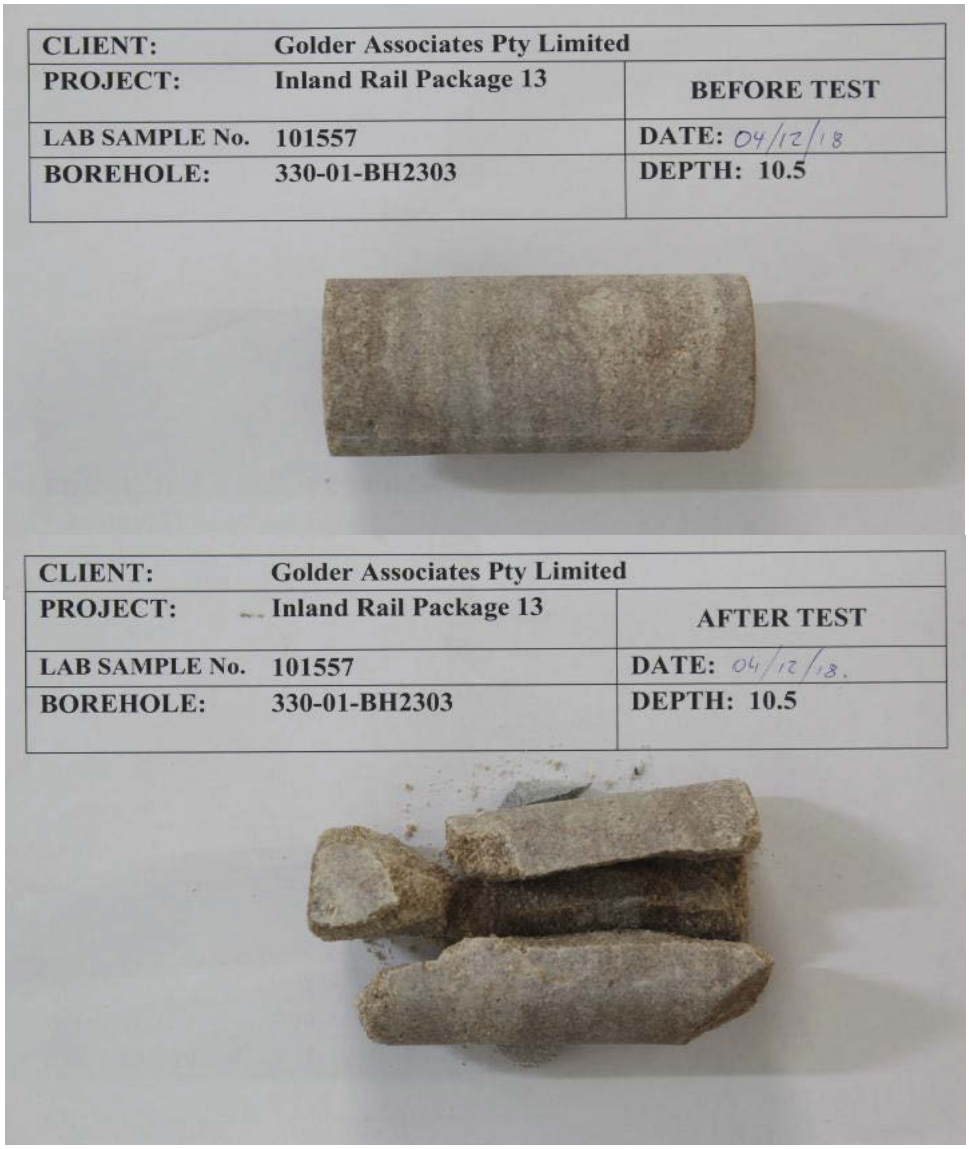
Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101557-MOD

Average Sample Diameter (mm)	52.0	Moisture Content (%)	3.6
Sample Height (mm)	113.1	Wet Density (t/m^3)	2.19
Duration of Test (min)	22.00	Dry Density (t/m^3)	2.11
Rate of Displacement (mm/min)	0.10	Bedding (°)	30
Mode of Failure	Conical	Test Apparatus	100kN Compression Machine



Notes/Remarks:

The length to diameter ratio falls outside the test method limits of 2.5:1 to 3.0:1.

Sample/s supplied by client Photo not to scale Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

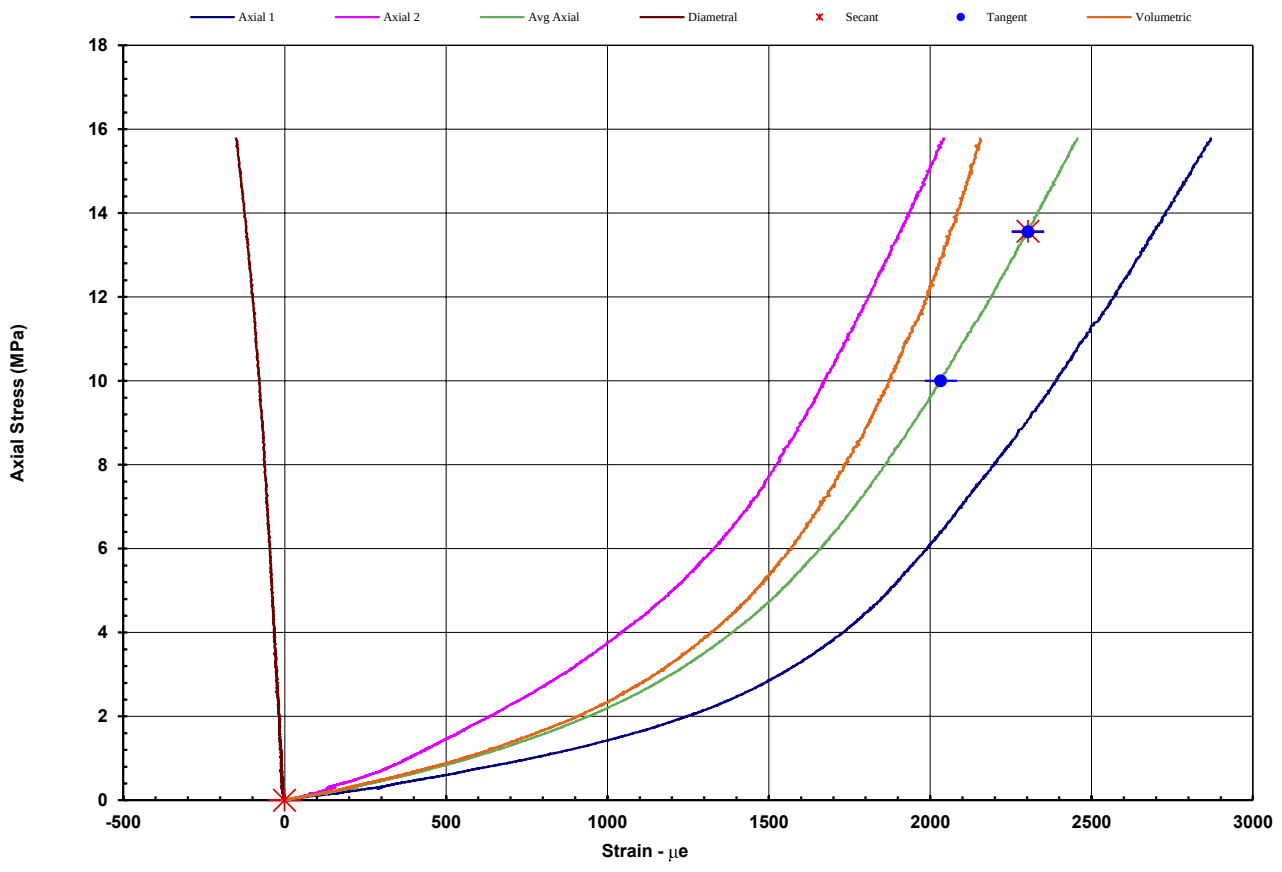
Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101561-MOD
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR1
		Test Date	4/12/2018
Project	Inland Rail Package 13	**Report Date**	7/12/2018
Project No.	1893802	**Client Sample No.**	330-01-BH2303-C01480
Bore Hole	330-01-BH2303	**Depth From (m)** 14.8	**Depth To (m)** 14.9
Description	C		
Sample Type	Single Individual Rock Core Specimen		

Uniaxial Compressive Strength 27.1 MPa

Young's Modulus		Poisson Ratio	
Tangent	13.2 GPa	0.052	from 37 % to 50 % of Max UCS
Secant	5.89 GPa	0.052	from 0 % to 50 % of Max UCS

Axial Stress vs Strain Plots



Notes/Remarks:

Sample/s supplied by client Graph not to scale Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory
C.N. Madison

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

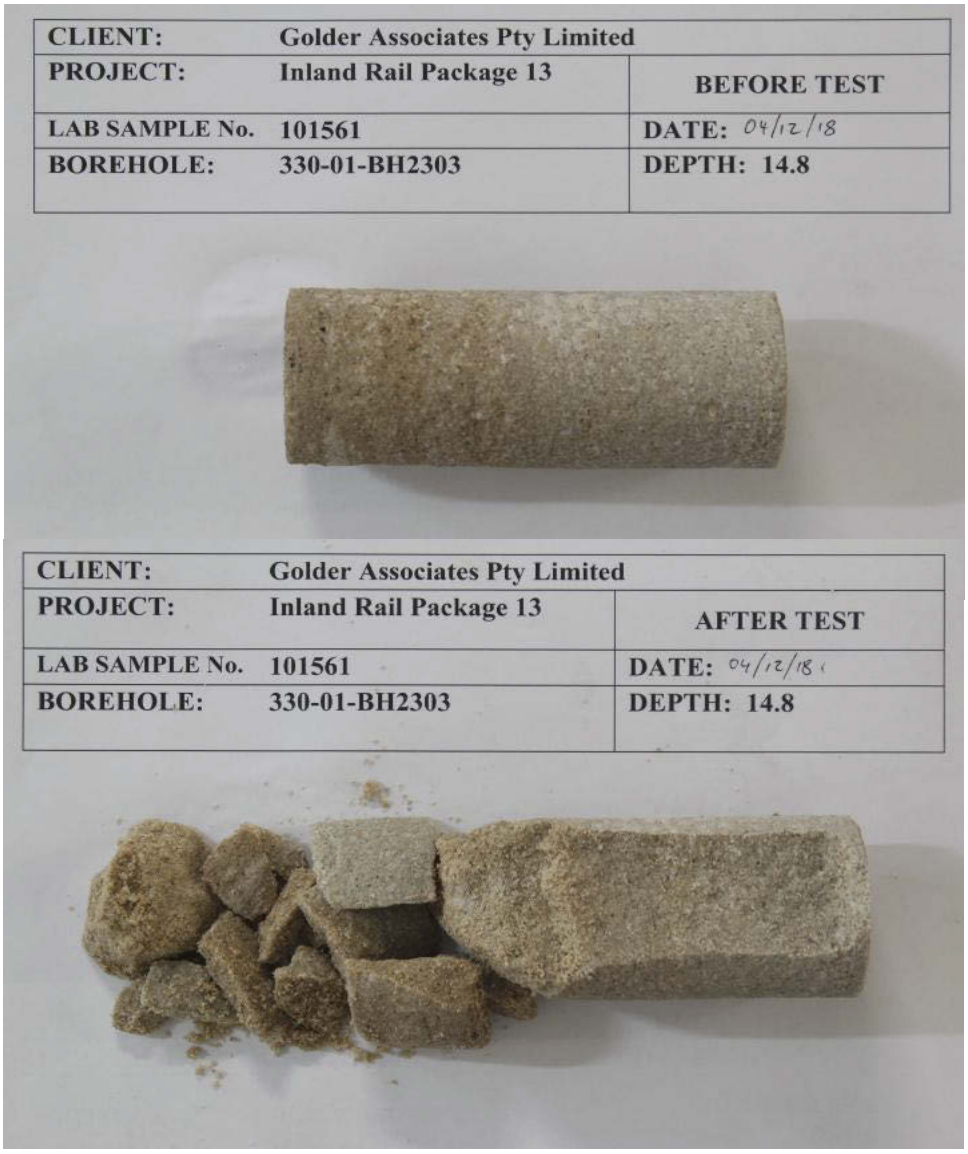
Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101561-MOD

Average Sample Diameter (mm)	51.7	Moisture Content (%)	6.6
Sample Height (mm)	132.0	Wet Density (t/m^3)	2.21
Duration of Test (min)	25.50	Dry Density (t/m^3)	2.07
Rate of Displacement (mm/min)	0.10	Bedding (°)	Nil
Mode of Failure	Disintegration	Test Apparatus	100kN Compression Machine



Notes/Remarks:

Sample/s supplied by client Photo not to scale Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

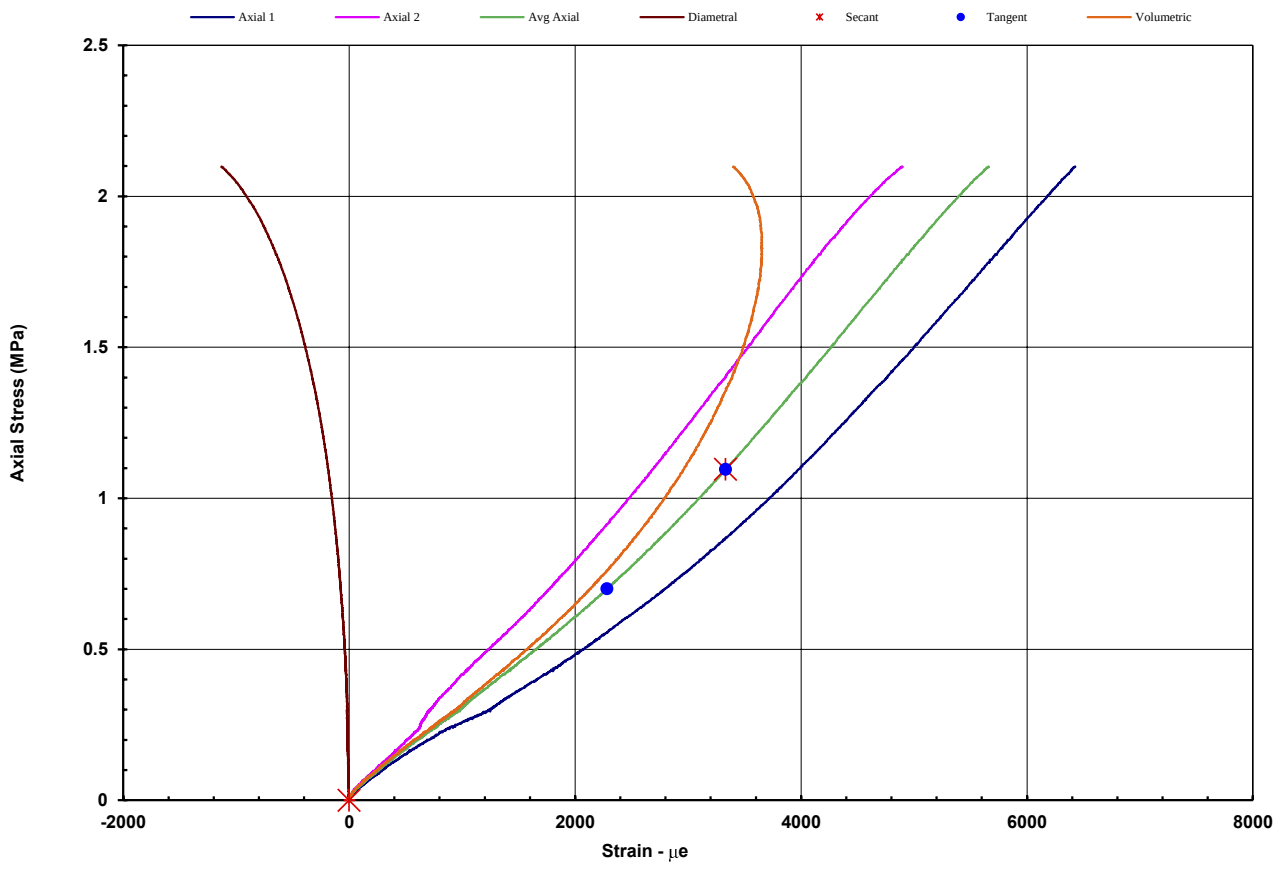
Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101566-MOD
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR1
		Test Date	3/12/2018
Project	Inland Rail Package 13	**Report Date**	7/12/2018
Project No.	1893802	**Client Sample No.**	330-01-BH2303-C02230
Bore Hole	330-01-BH2303	**Depth From (m)** 22.3	**Depth To (m)** 22.4
Description	C		
Sample Type	Single Individual Rock Core Specimen		

Uniaxial Compressive Strength 2.19 MPa

	Young's Modulus	Poisson Ratio	
Tangent	0.377 GPa	0.056	from 32 % to 50 % of Max UCS
Secant	0.329 GPa	0.056	from 0 % to 50 % of Max UCS

Axial Stress vs Strain Plots



Notes/Remarks:

Sample/s supplied by client Graph not to scale Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory
C.N. Madison

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

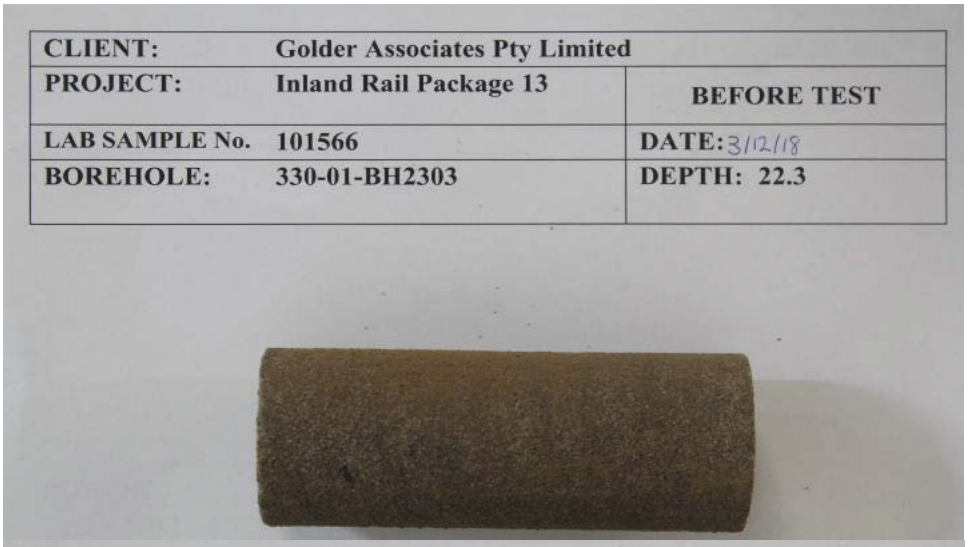
Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

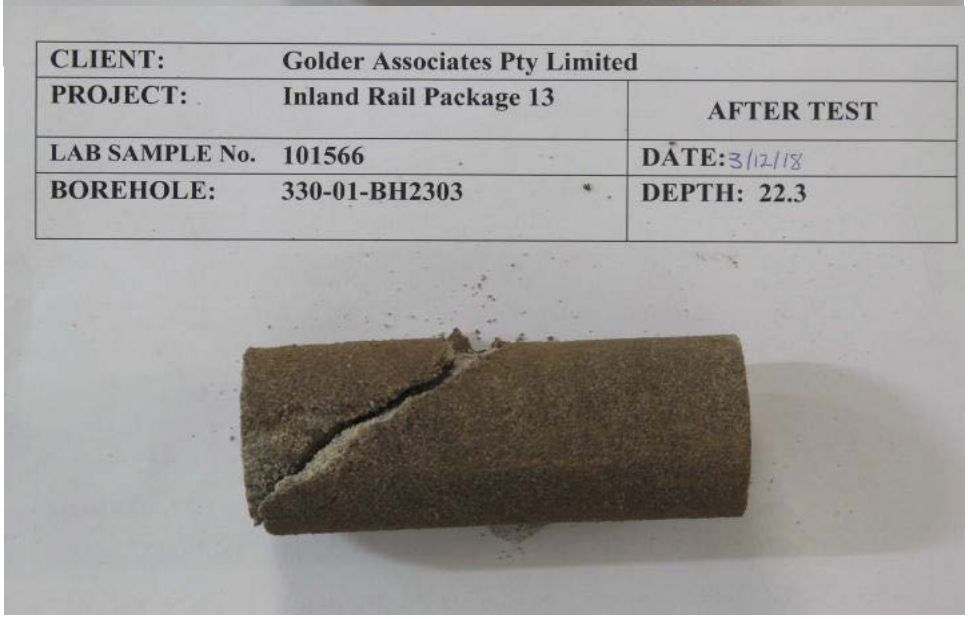
UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101566-MOD

Average Sample Diameter (mm)	51.7	Moisture Content (%)	8.9
Sample Height (mm)	129.7	Wet Density (t/m^3)	2.36
Duration of Test (min)	22.35	Dry Density (t/m^3)	2.16
Rate of Displacement (mm/min)	0.10	Bedding (°)	30
Mode of Failure	Shear	Test Apparatus	100kN Compression Machine





Notes/Remarks:

Sample/s supplied by client Photo not to scale Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

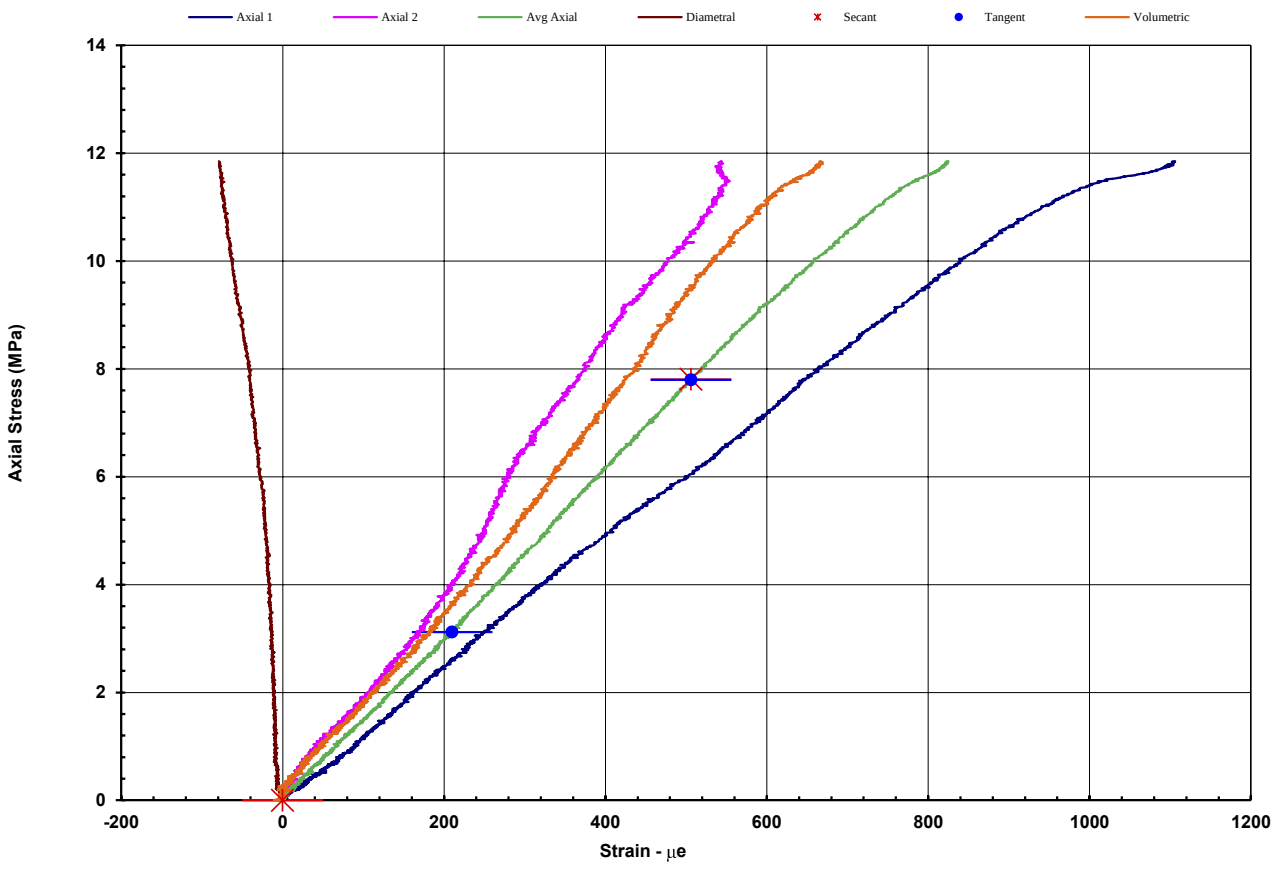
Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101581-MOD
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR2
		Test Date	10/12/2018
Project	Inland Rail Package 13	**Report Date**	11/12/2018
Project No.	1893802	**Client Sample No.**	330-01-BH2101-C07000
Bore Hole	330-01-BH2101	**Depth From (m)** 70	**Depth To (m)** 71
Description	C		
Sample Type	Single Individual Rock Core Specimen		

Uniaxial Compressive Strength 15.6 MPa

	Young's Modulus	Poisson Ratio	
Tangent	15.8 GPa	0.079	from 20 % to 50 % of Max UCS
Secant	15.4 GPa	0.082	from 0 % to 50 % of Max UCS

Axial Stress vs Strain Plots



Notes/Remarks:

Sample/s supplied by client Graph not to scale Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory
C.N. Madison

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

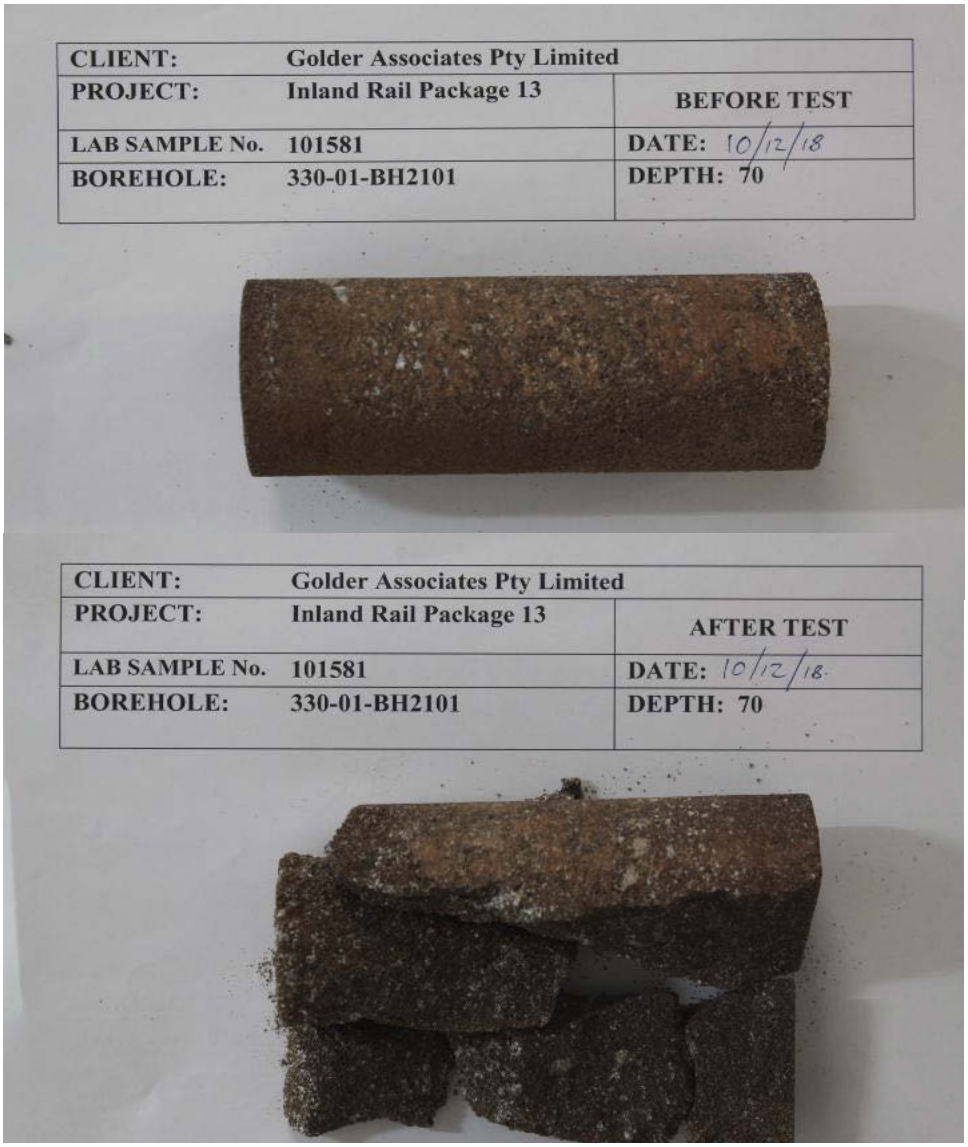
Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101581-MOD

Average Sample Diameter (mm)	60.9	Moisture Content (%)	3.9
Sample Height (mm)	162.4	Wet Density (t/m^3)	2.13
Duration of Test (min)	21.07	Dry Density (t/m^3)	2.05
Rate of Displacement (mm/min)	0.10	Bedding (°)	Nil
Mode of Failure	Conical	Test Apparatus	100kN Compression Machine



Notes/Remarks:

Sample/s supplied by client Photo not to scale Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

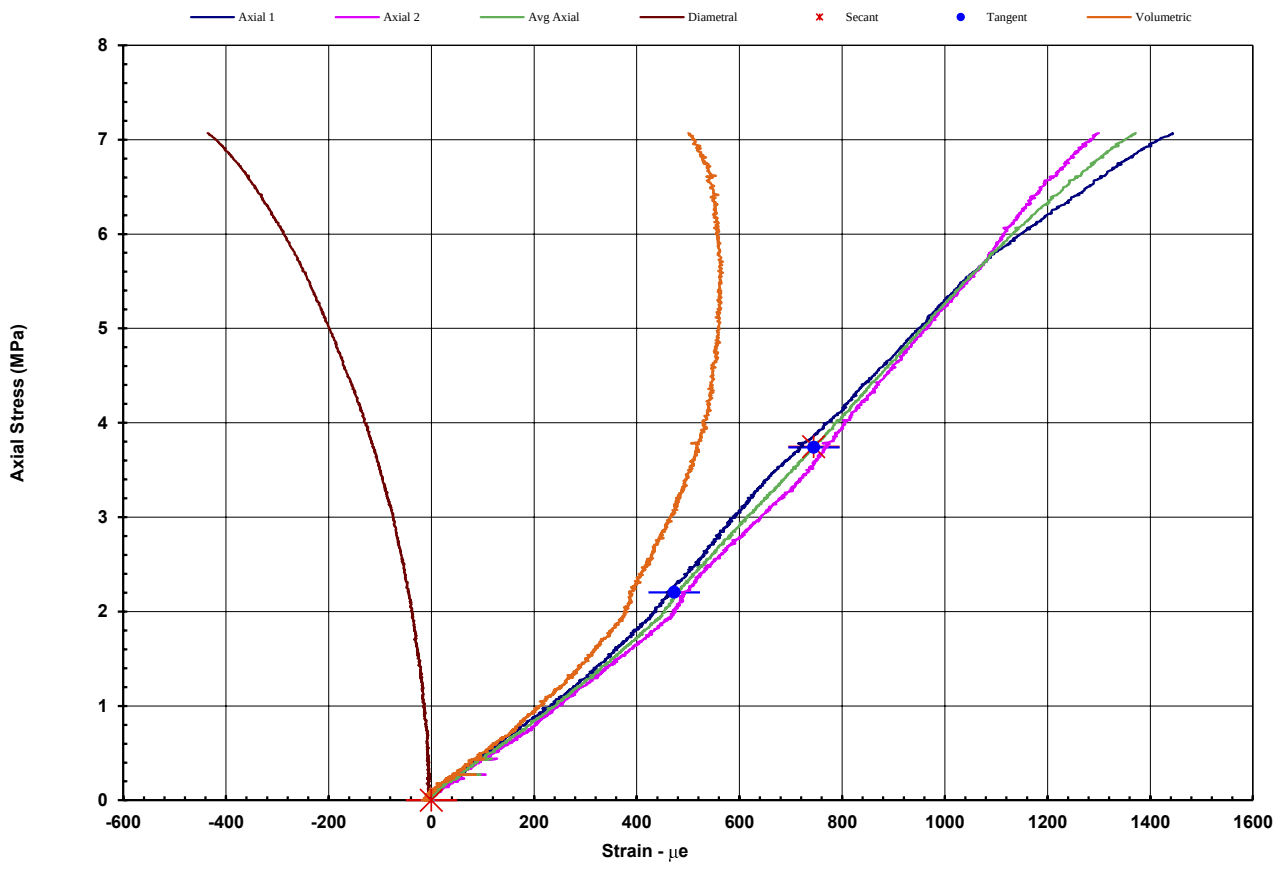
Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101589-MOD
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR2
		Test Date	10/12/2018
Project	Inland Rail Package 13	**Report Date**	11/12/2018
Project No.	1893802	**Client Sample No.**	330-01-BH2101-C07200
Bore Hole	330-01-BH2101	**Depth From (m)** 72.2	**Depth To (m)** 72.36
Description	C		
Sample Type	Single Individual Rock Core Specimen		

Uniaxial Compressive Strength 7.47 MPa

	Young's Modulus	Poisson Ratio	
Tangent	5.65 GPa	0.151	from 29 % to 50 % of Max UCS
Secant	5.03 GPa	0.153	from 0 % to 50 % of Max UCS

Axial Stress vs Strain Plots



Notes/Remarks:

Sample/s supplied by client Graph not to scale Tested as received. **Page 1 of 2** EP13402

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory
C.N. Madison

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

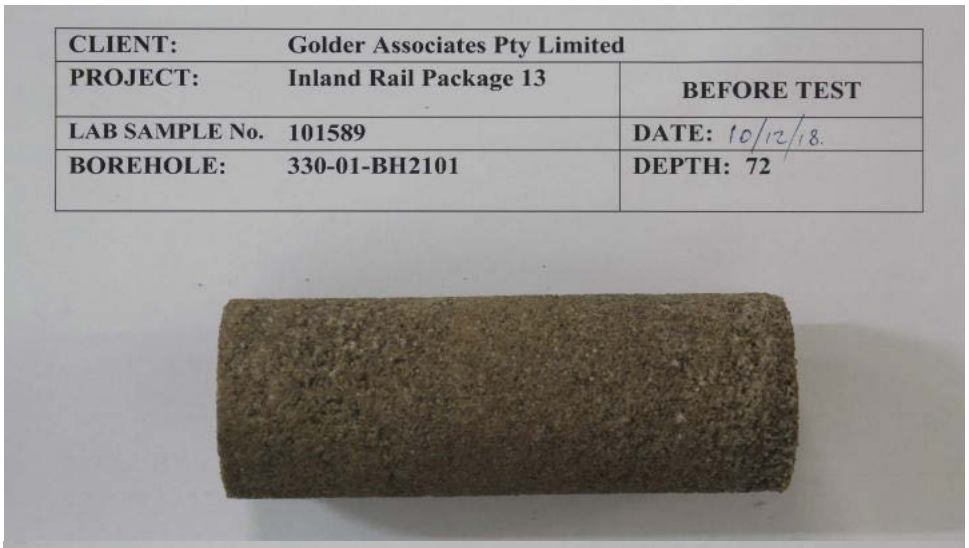
Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101589-MOD

Average Sample Diameter (mm)	60.7	Moisture Content (%)	7.7
Sample Height (mm)	158.2	Wet Density (t/m^3)	2.10
Duration of Test (min)	17.33	Dry Density (t/m^3)	1.95
Rate of Displacement (mm/min)	0.10	Bedding (°)	Nil
Mode of Failure	Conical	Test Apparatus	100kN Compression Machine



Notes/Remarks:

Sample/s supplied by client Photo not to scale Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

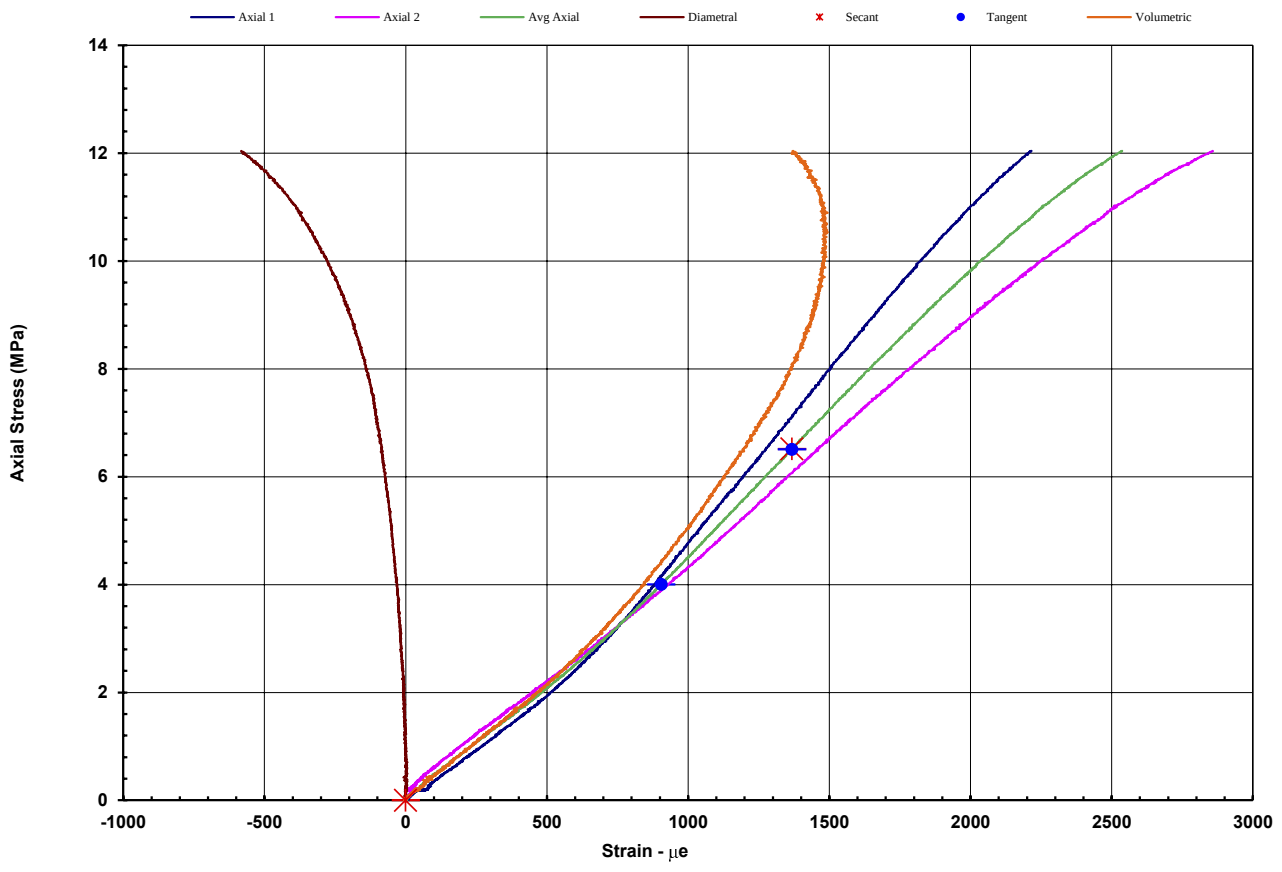
Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101600-MOD
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR2
		Test Date	10/12/2018
Project	Inland Rail Package 13	**Report Date**	11/12/2018
Project No.	1893802	**Client Sample No.**	330-01-BH2101-C08100
Bore Hole	330-01-BH2101	**Depth From (m)** 81.26	**Depth To (m)** 81.42
Description	C		
Sample Type	Single Individual Rock Core Specimen		

Uniaxial Compressive Strength 13.0 MPa

Young's Modulus		Poisson Ratio	
Tangent	5.40 GPa	0.063	from 31 % to 50 % of Max UCS
Secant	4.76 GPa	0.064	from 0 % to 50 % of Max UCS

Axial Stress vs Strain Plots



Notes/Remarks:

Sample/s supplied by client Graph not to scale Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory
C.N. Madison

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101600-MOD

Average Sample Diameter (mm)	60.8	Moisture Content (%)	8.6
Sample Height (mm)	162.7	Wet Density (t/m^3)	2.23
Duration of Test (min)	21.43	Dry Density (t/m^3)	2.05
Rate of Displacement (mm/min)	0.10	Bedding (°)	15
Mode of Failure	Shear	Test Apparatus	100kN Compression Machine

Notes/Remarks:

Sample/s supplied by client Photo not to scale Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

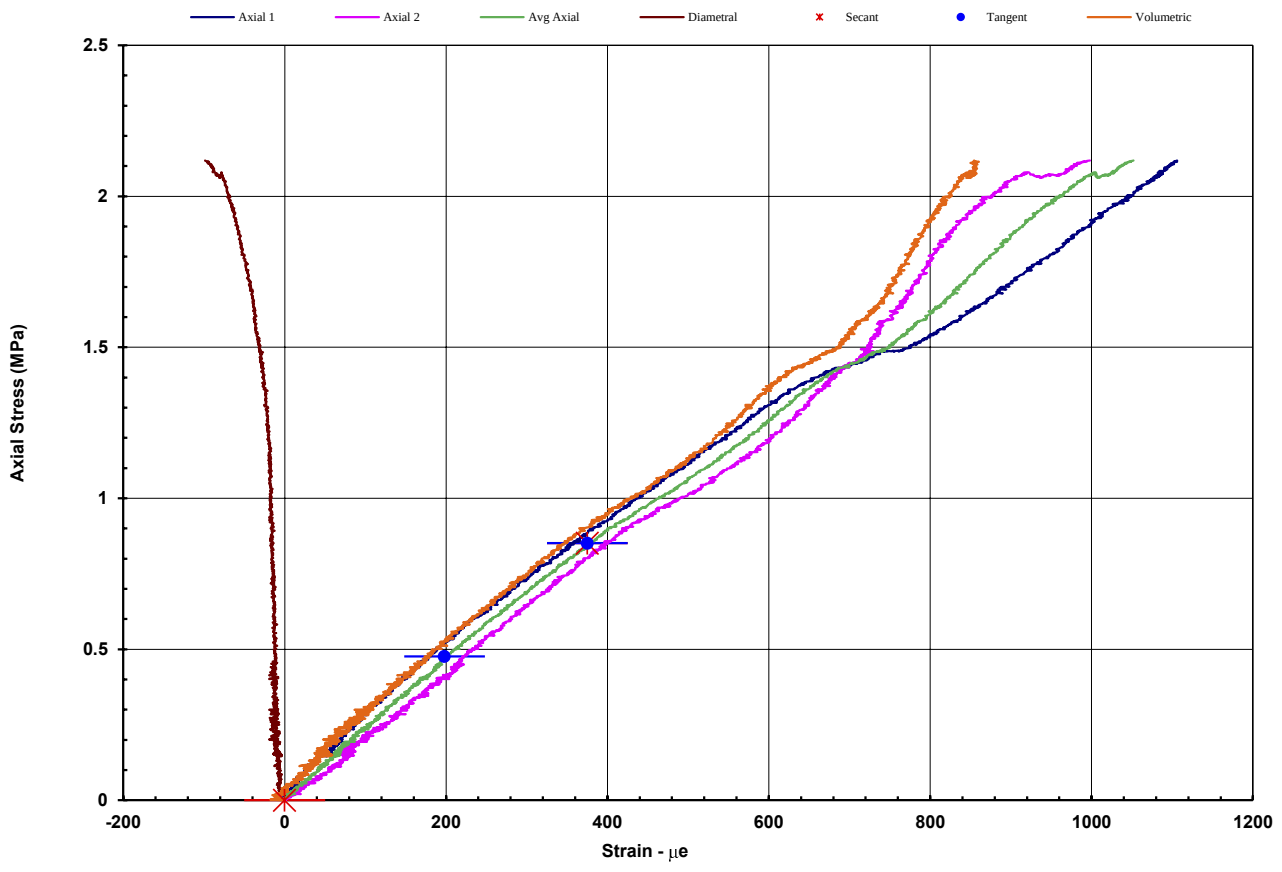
Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101608-MOD
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR2
		Test Date	10/12/2018
Project	Inland Rail Package 13	**Report Date**	11/12/2018
Project No.	1893802	**Client Sample No.**	330-01-BH2101-C08610
Bore Hole	330-01-BH2101	**Depth From (m)** 86.18	**Depth To (m)** 86.34
Description	C		
Sample Type	Single Individual Rock Core Specimen		

Uniaxial Compressive Strength 2.37 MPa

Young's Modulus		Poisson Ratio	
Tangent	2.12 GPa	0.036	from 20 % to 36 % of Max UCS
Secant	2.27 GPa	0.036	from 0 % to 36 % of Max UCS

Axial Stress vs Strain Plots



Notes/Remarks:

The length to diameter ratio falls outside the test method limits of 2.5:1 to 3.0:1.

Sample/s supplied by client Graph not to scale Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory

C.N. Madison

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101608-MOD

Average Sample Diameter (mm)	60.3	Moisture Content (%)	7.3
Sample Height (mm)	149.6	Wet Density (t/m^3)	2.12
Duration of Test (min)	19.98	Dry Density (t/m^3)	1.98
Rate of Displacement (mm/min)	0.10	Bedding (°)	Nil
Mode of Failure	Conical	Test Apparatus	100kN Compression Machine

Notes/Remarks:

The length to diameter ratio falls outside the test method limits of 2.5:1 to 3.0:1.

Sample/s supplied by client Photo not to scale Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

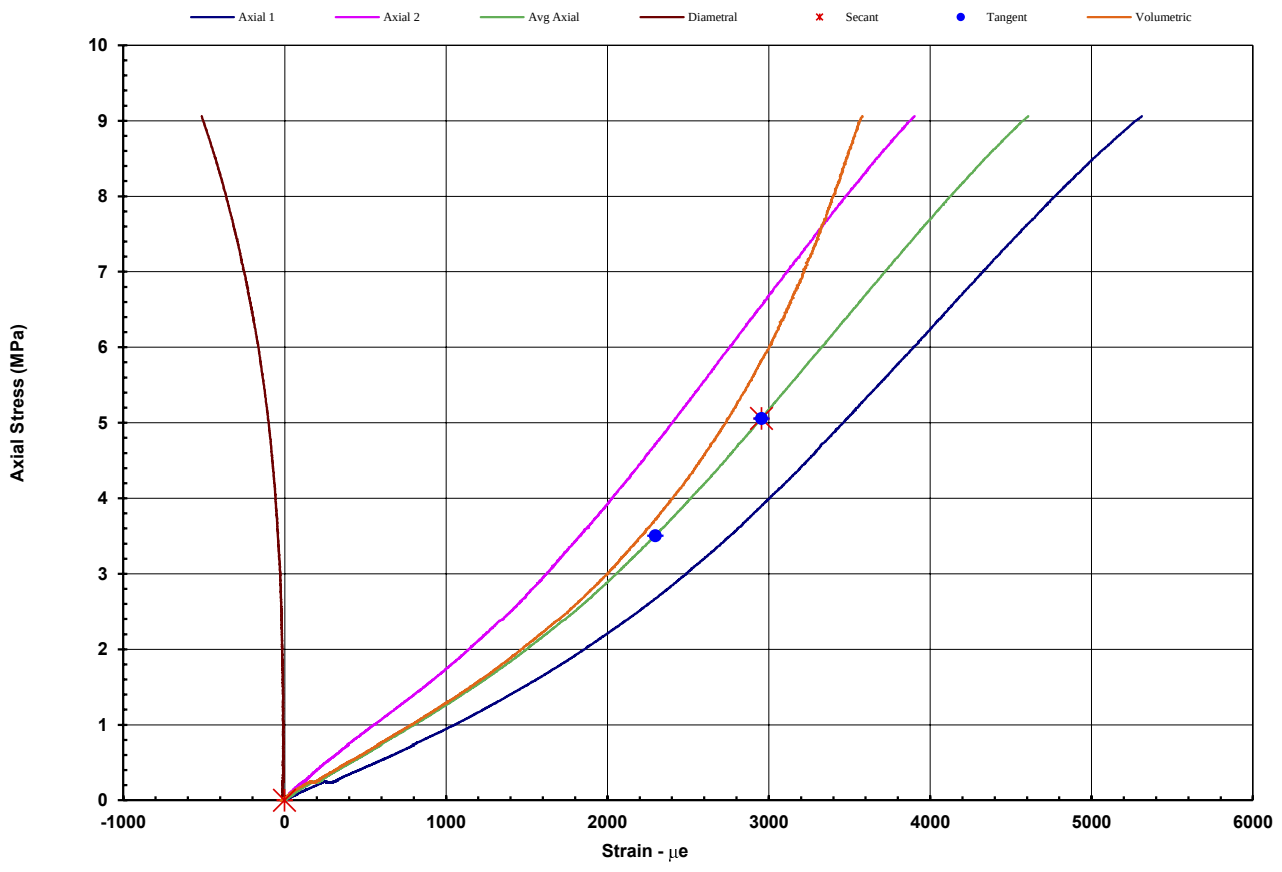
Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101615-MOD
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR2
		Test Date	10/12/2018
Project	Inland Rail Package 13	**Report Date**	11/12/2018
Project No.	1893802	**Client Sample No.**	330-01-BH2101-C08700
Bore Hole	330-01-BH2101	**Depth From (m)** 87.04	**Depth To (m)** 87.21
Description	C		
Sample Type	Single Individual Rock Core Specimen		

Uniaxial Compressive Strength 10.1 MPa

Young's Modulus		Poisson Ratio	
Tangent	2.36 GPa	0.035	from 35 % to 50 % of Max UCS
Secant	1.71 GPa	0.035	from 0 % to 50 % of Max UCS

Axial Stress vs Strain Plots



Notes/Remarks:

Sample/s supplied by client Graph not to scale Tested as received. **Page 1 of 2** EP13402

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory
C.N. Madison

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101615-MOD

Average Sample Diameter (mm)	60.7	Moisture Content (%)	5.3
Sample Height (mm)	160.7	Wet Density (t/m^3)	2.31
Duration of Test (min)	32.20	Dry Density (t/m^3)	2.19
Rate of Displacement (mm/min)	0.10	Bedding (°)	10
Mode of Failure	Conical	Test Apparatus	100kN Compression Machine

Notes/Remarks:

Sample/s supplied by client Photo not to scale Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

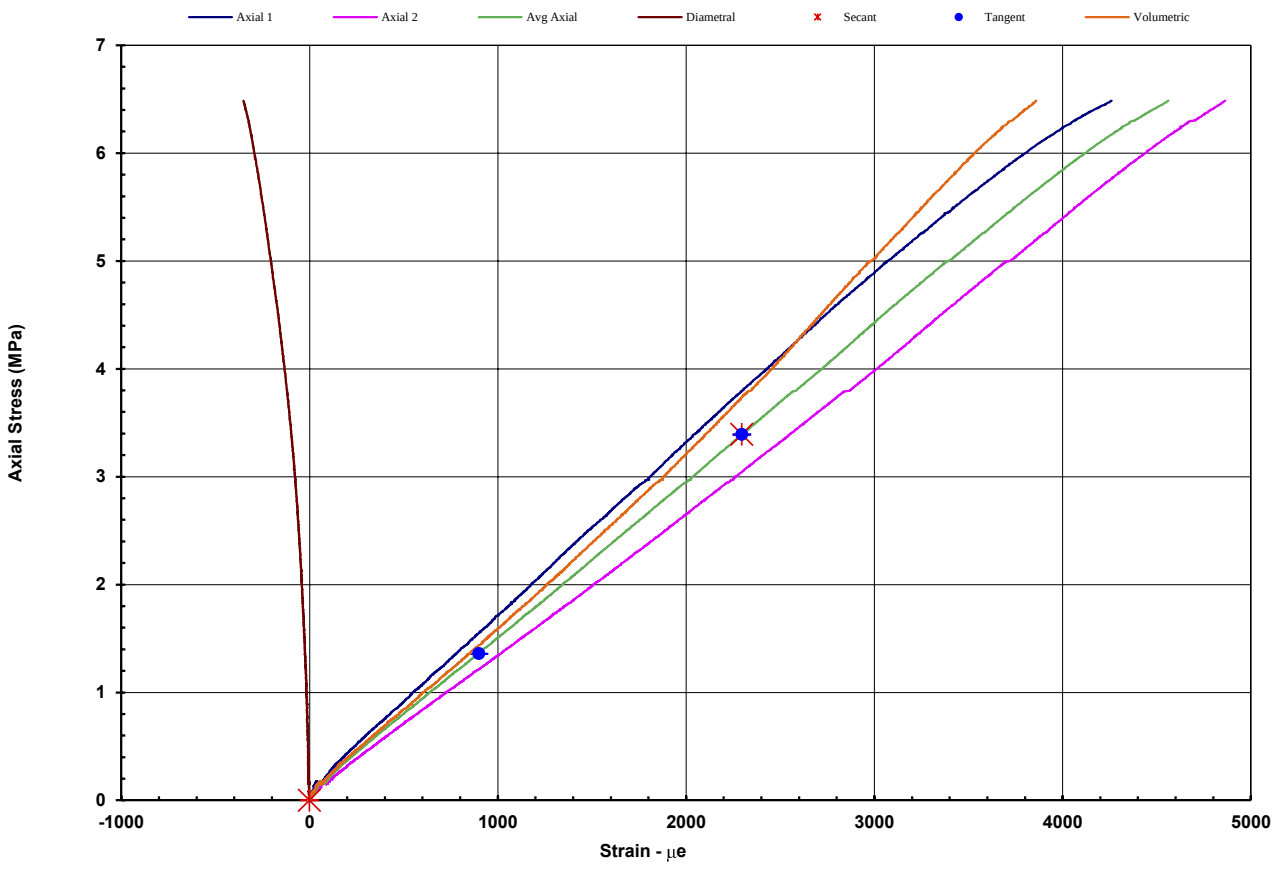
Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101634-MOD
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR2
		Test Date	11/12/2018
Project	Inland Rail Package 13	**Report Date**	12/12/2018
Project No.	1893802	**Client Sample No.**	330-01-BH2101-C09600
Bore Hole	330-01-BH2101	**Depth From (m)** 96.05	**Depth To (m)** 96.2
Description	C		
Sample Type	Single Individual Rock Core Specimen		

Uniaxial Compressive Strength 6.78 MPa

	Young's Modulus	Poisson Ratio	
Tangent	1.46 GPa	0.043	from 20 % to 50 % of Max UCS
Secant	1.48 GPa	0.043	from 0 % to 50 % of Max UCS

Axial Stress vs Strain Plots



Notes/Remarks:

Sample/s supplied by client Graph not to scale Tested as received. **Page 1 of 2** EP13402

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory
C.N. Madison

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

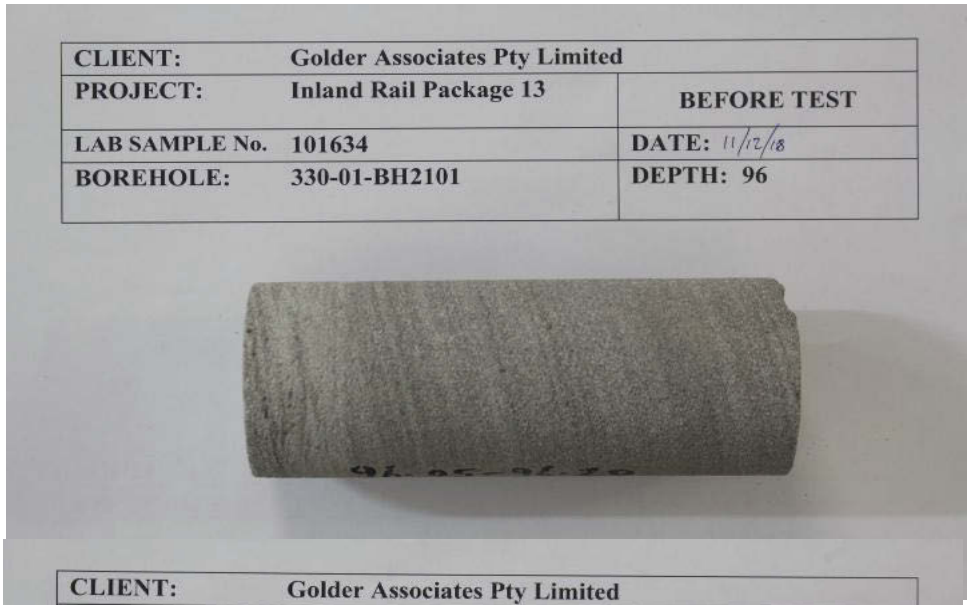
Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

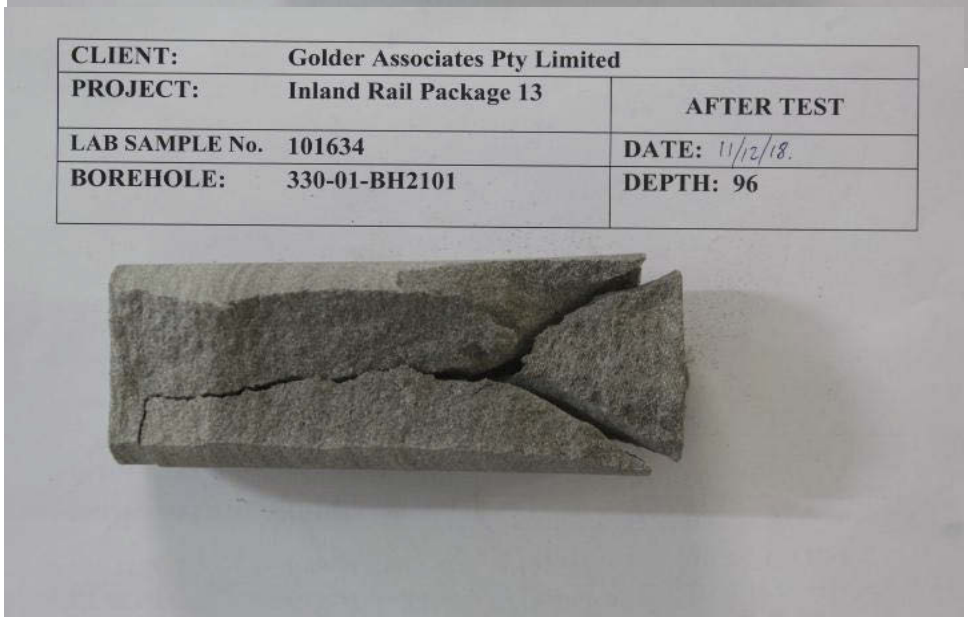
UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101634-MOD

Average Sample Diameter (mm)	60.7	Moisture Content (%)	5.0
Sample Height (mm)	153.4	Wet Density (t/m^3)	2.35
Duration of Test (min)	23.08	Dry Density (t/m^3)	2.24
Rate of Displacement (mm/min)	0.10	Bedding (°)	15
Mode of Failure	Conical	Test Apparatus	100kN Compression Machine





Notes/Remarks:

Sample/s supplied by client Photo not to scale Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

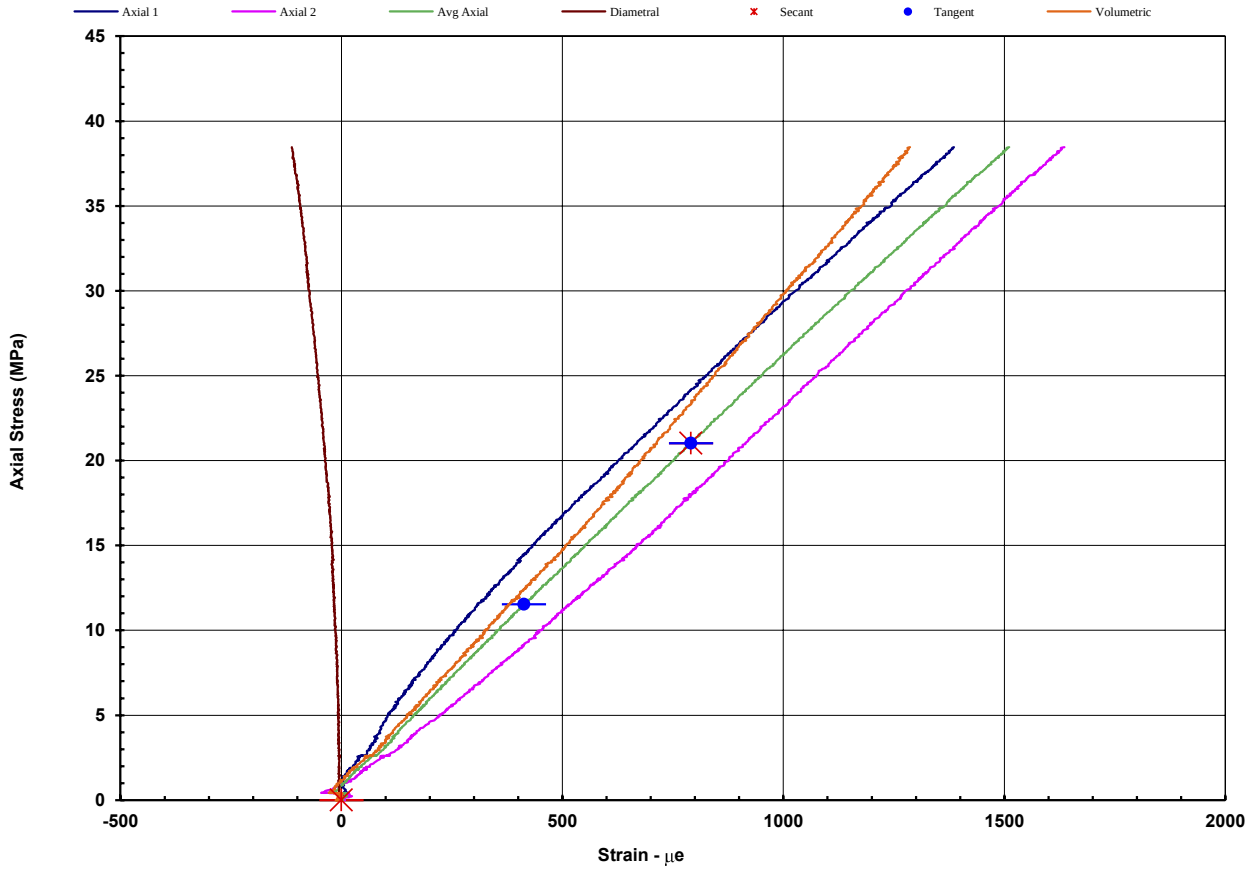
Test Method: AS 4133.4.3.1

Client	Golder Associates Pty Limited	**Report No.**	GA101642-MOD
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR2
		Test Date	11/12/2018
Project	Inland Rail Package 13	**Report Date**	12/12/2018
Project No.	1893802	**Client Sample No.**	330-01-BH2101-C09970
Bore Hole	330-01-BH2101	**Depth From (m)**	99.7
		Depth To (m)	99.86
Description	C		
Sample Type	Single Individual Rock Core Specimen		

Uniaxial Compressive Strength 57.7 MPa

	Young's Modulus	Poisson Ratio	
Tangent	25.1 GPa	0.049	from 20 % to 36 % of Max UCS
Secant	26.6 GPa	0.049	from 0 % to 36 % of Max UCS

Axial Stress vs Strain Plots



Notes/Remarks:

Sample/s supplied by client | Graph not to scale | Tested as received. | **Page 1 of 2** | REP03603

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory
C. Mardon

NATA ACCREDITED FOR TECHNICAL COMPETENCE
Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

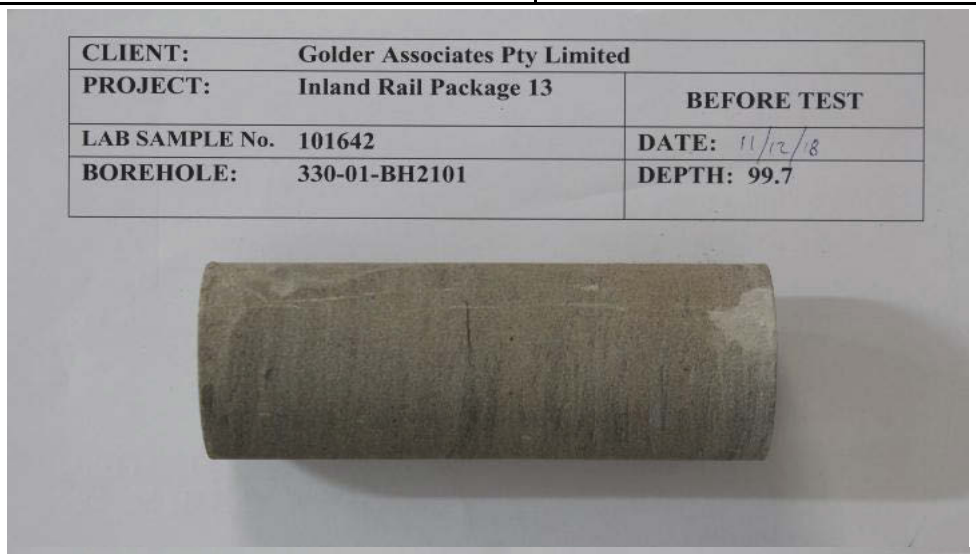
Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

Test Method: AS 4133.4.3.1

Client	Golder Associates Pty Limited	**Report No.**	GA101642-MOD

Average Sample Diameter (mm)	60.9	Moisture Content (%)	2.5
Sample Height (mm)	159.9	Wet Density (t/m^3)	2.80
Duration of Test (min)	11.18	Dry Density (t/m^3)	2.73
Rate of Loading (MPa/min)	5.16	Bedding (°)	5
Mode of Failure	Conical	Test Apparatus	Kelba 1000kN Load Cell



Notes/Remarks:

Sample/s supplied by client | Graph not to scale | Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory
N. Maddison

NATA ACCREDITED FOR TECHNICAL COMPETENCE
Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

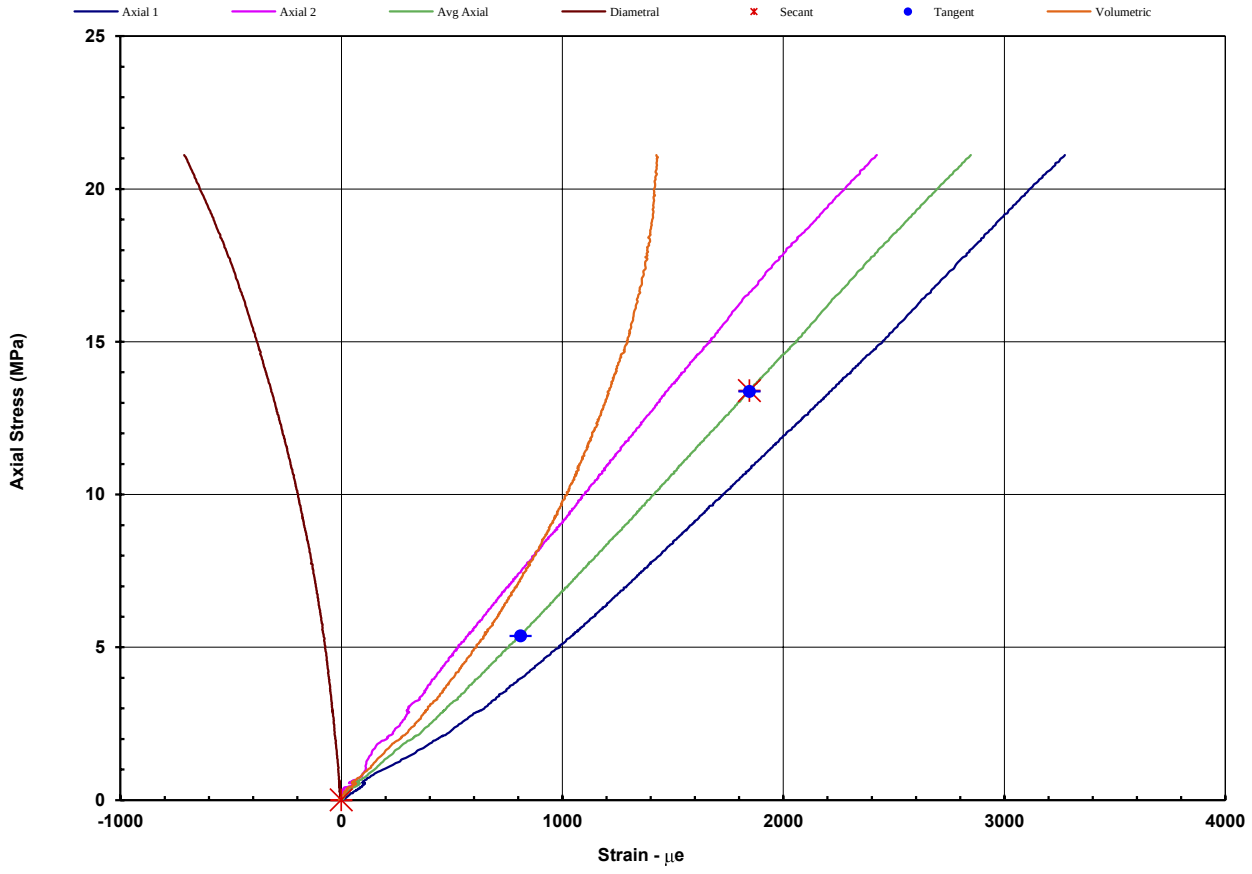
Test Method: AS 4133.4.3.1

Client	Golder Associates Pty Limited	**Report No.**	GA101660-MOD
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR2
		Test Date	11/12/2018
Project	Inland Rail Package 13	**Report Date**	12/12/2018
Project No.	1893802	**Client Sample No.**	330-01-BH2101-C11400
Bore Hole	330-01-BH2101	**Depth From (m)** 114	**Depth To (m)** 114.17
Description	C		
Sample Type	Single Individual Rock Core Specimen		

Uniaxial Compressive Strength 26.7 MPa

	Young's Modulus	Poisson Ratio	
Tangent	7.73 GPa	0.172	from 20 % to 50 % of Max UCS
Secant	7.26 GPa	0.172	from 0 % to 50 % of Max UCS

Axial Stress vs Strain Plots



Notes/Remarks:

Sample/s supplied by client | Graph not to scale | Tested as received. | **Page 1 of 2** | REP03603

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory
C. Mardon

NATA ACCREDITED FOR TECHNICAL COMPETENCE
Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

Test Method: AS 4133.4.3.1

Client	Golder Associates Pty Limited	**Report No.**	GA101660-MOD

Average Sample Diameter (mm)	60.9	Moisture Content (%)	3.7
Sample Height (mm)	160.9	Wet Density (t/m^3)	2.45
Duration of Test (min)	6.75	Dry Density (t/m^3)	2.36
Rate of Loading (MPa/min)	3.96	Bedding (°)	5
Mode of Failure	Conical	Test Apparatus	Kelba 1000kN Load Cell

Notes/Remarks:

Sample/s supplied by client | Graph not to scale | Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory

N. Maddison

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

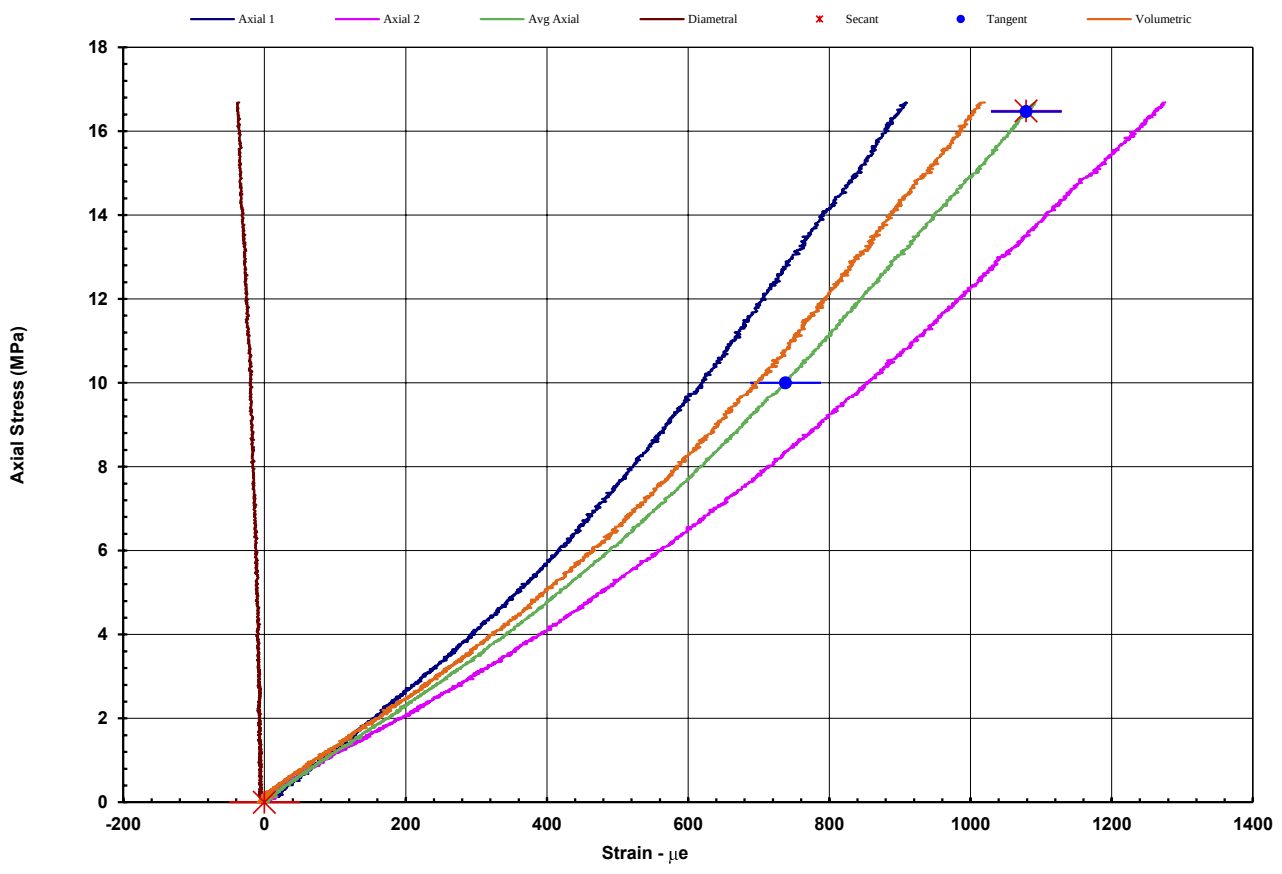
Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101669-MOD
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR2
		Test Date	11/12/2018
Project	Inland Rail Package 13	**Report Date**	12/12/2018
Project No.	1893802	**Client Sample No.**	330-01-BH2101-C11700
Bore Hole	330-01-BH2101	**Depth From (m)** 117	**Depth To (m)** 117.17
Description	C		
Sample Type	Single Individual Rock Core Specimen		

Uniaxial Compressive Strength 32.9 MPa

	Young's Modulus	Poisson Ratio	
Tangent	19.0 GPa	0.035	from 30 % to 50 % of Max UCS
Secant	15.3 GPa	0.036	from 0 % to 50 % of Max UCS

Axial Stress vs Strain Plots



Notes/Remarks:

Sample/s supplied by client Graph not to scale Tested as received. **Page 1 of 2** EP13402

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory
C.N. Madison

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101669-MOD

Average Sample Diameter (mm)	60.9	Moisture Content (%)	3.7
Sample Height (mm)	161.2	Wet Density (t/m^3)	2.41
Duration of Test (min)	34.45	Dry Density (t/m^3)	2.33
Rate of Displacement (mm/min)	0.10	Bedding (°)	10
Mode of Failure	Conical	Test Apparatus	100kN Compression Machine

Notes/Remarks:

Sample/s supplied by client Photo not to scale Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

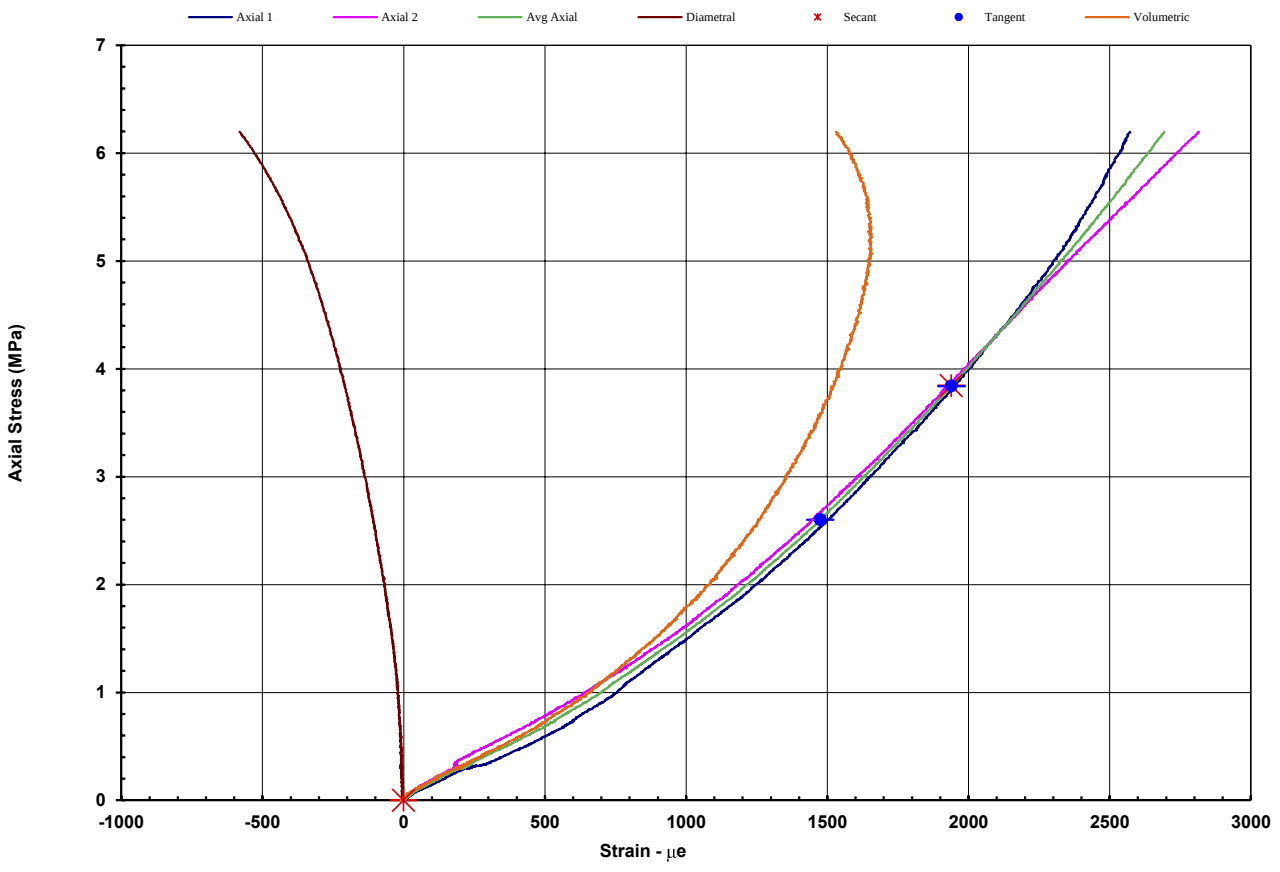
Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101686-MOD
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR2
		Test Date	10/12/2018
Project	Inland Rail Package 13	**Report Date**	11/12/2018
Project No.	1893802	**Client Sample No.**	330-01-BH2102-C00365
Bore Hole	330-01-BH2102	**Depth From (m)** 3.65	**Depth To (m)** 3.80
Description	C		
Sample Type	Single Individual Rock Core Specimen		

Uniaxial Compressive Strength 7.67 MPa

Young's Modulus		Poisson Ratio	
Tangent	2.67 GPa	0.107	from 34 % to 50 % of Max UCS
Secant	1.98 GPa	0.107	from 0 % to 50 % of Max UCS

Axial Stress vs Strain Plots



Notes/Remarks:

Sample/s supplied by client Graph not to scale Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory
C.N. Madison

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

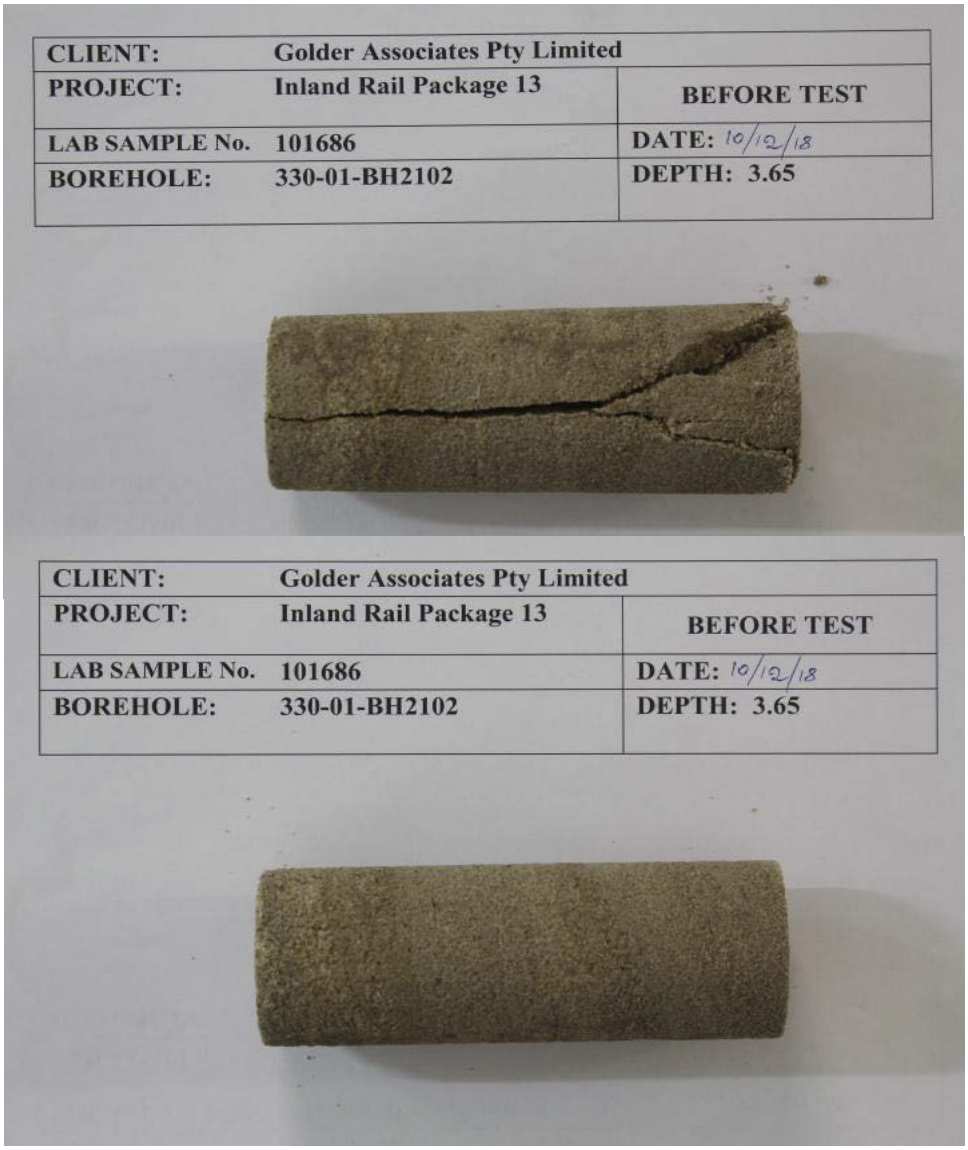
Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101686-MOD

Average Sample Diameter (mm)	50.8	Moisture Content (%)	8.6
Sample Height (mm)	142.7	Wet Density (t/m^3)	2.26
Duration of Test (min)	17.77	Dry Density (t/m^3)	2.08
Rate of Displacement (mm/min)	0.10	Bedding (°)	20
Mode of Failure	Conical	Test Apparatus	100kN Compression Machine



Notes/Remarks:

Sample/s supplied by client Photo not to scale Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

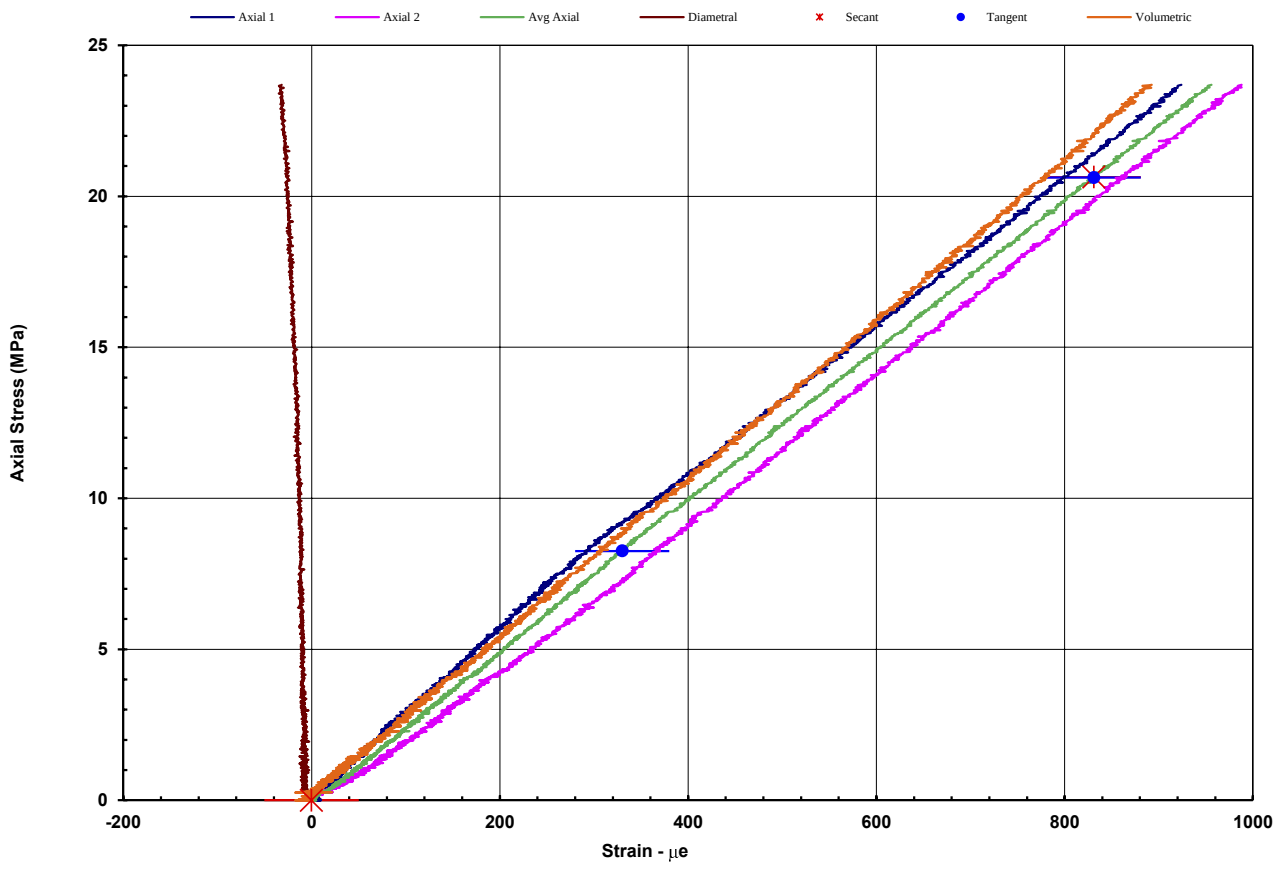
Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101695-MOD
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR2
		Test Date	10/12/2018
Project	Inland Rail Package 13	**Report Date**	11/12/2018
Project No.	1893802	**Client Sample No.**	330-01-BH2102-C01020
Bore Hole	330-01-BH2102	**Depth From (m)** 10.24	**Depth To (m)** 10.38
Description	C		
Sample Type	Single Individual Rock Core Specimen		

Uniaxial Compressive Strength 41.2 MPa

Young's Modulus		Poisson Ratio	
Tangent	24.7 GPa	0.030	from 20 % to 50 % of Max UCS
Secant	24.8 GPa	0.031	from 0 % to 50 % of Max UCS

Axial Stress vs Strain Plots



Notes/Remarks:

Sample/s supplied by client Graph not to scale Tested as received. **Page 1 of 2** EP13402

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory
C.N. Hardison

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

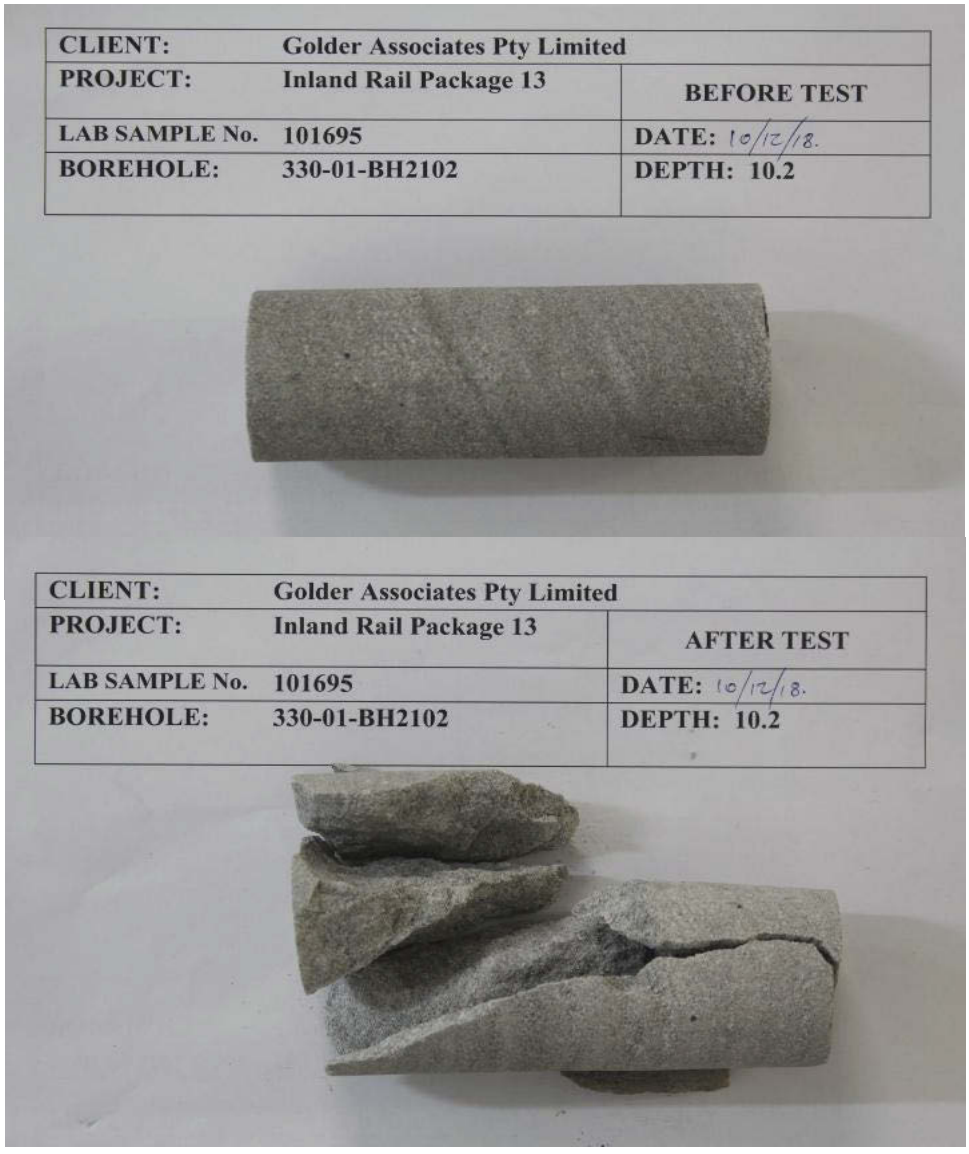
Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101695-MOD

Average Sample Diameter (mm)	51.7	Moisture Content (%)	4.2
Sample Height (mm)	141.6	Wet Density (t/m^3)	2.44
Duration of Test (min)	28.28	Dry Density (t/m^3)	2.34
Rate of Displacement (mm/min)	0.10	Bedding (°)	30
Mode of Failure	Conical	Test Apparatus	100kN Compression Machine



Notes/Remarks:

Sample/s supplied by client Photo not to scale Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

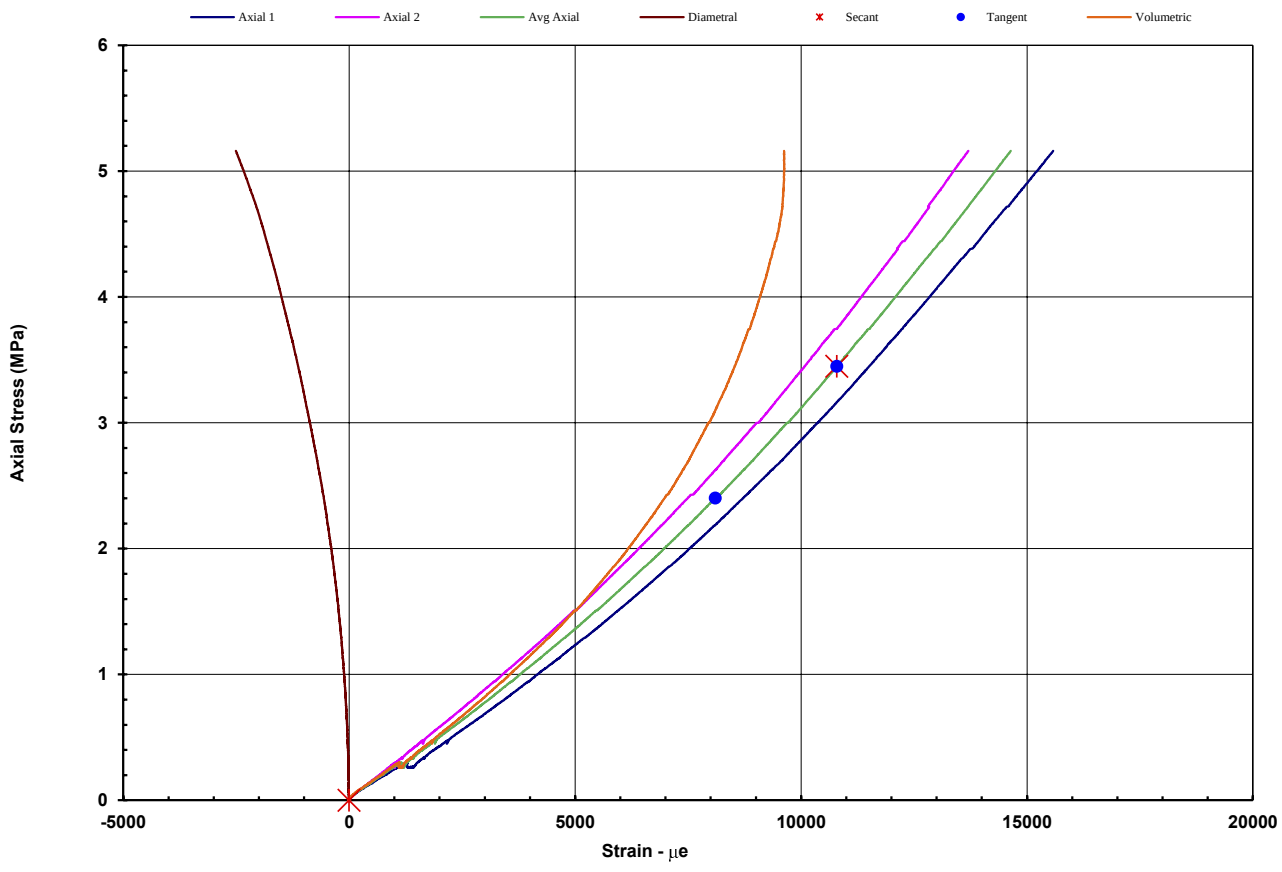
Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101725-MOD
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR2
		Test Date	11/12/2018
Project	Inland Rail Package 13	**Report Date**	12/12/2018
Project No.	1893802	**Client Sample No.**	330-01-BH2103-C01700
Bore Hole	330-01-BH2103	**Depth From (m)** 17	**Depth To (m)** 17.15
Description	C		
Sample Type	Single Individual Rock Core Specimen		

Uniaxial Compressive Strength 6.89 MPa

Young's Modulus		Poisson Ratio	
Tangent	0.389 GPa	0.105	from 35 % to 50 % of Max UCS
Secant	0.319 GPa	0.105	from 0 % to 50 % of Max UCS

Axial Stress vs Strain Plots



Notes/Remarks:

Sample/s supplied by client Graph not to scale Tested as received. **Page 1 of 2** EP13402

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory
C.N. Madison

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101725-MOD

Average Sample Diameter (mm)	51.7	Moisture Content (%)	5.7
Sample Height (mm)	139.5	Wet Density (t/m^3)	2.31
Duration of Test (min)	32.85	Dry Density (t/m^3)	2.18
Rate of Displacement (mm/min)	0.10	Bedding (°)	5
Mode of Failure	Conical	Test Apparatus	100kN Compression Machine

Notes/Remarks:

Sample/s supplied by client Photo not to scale Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

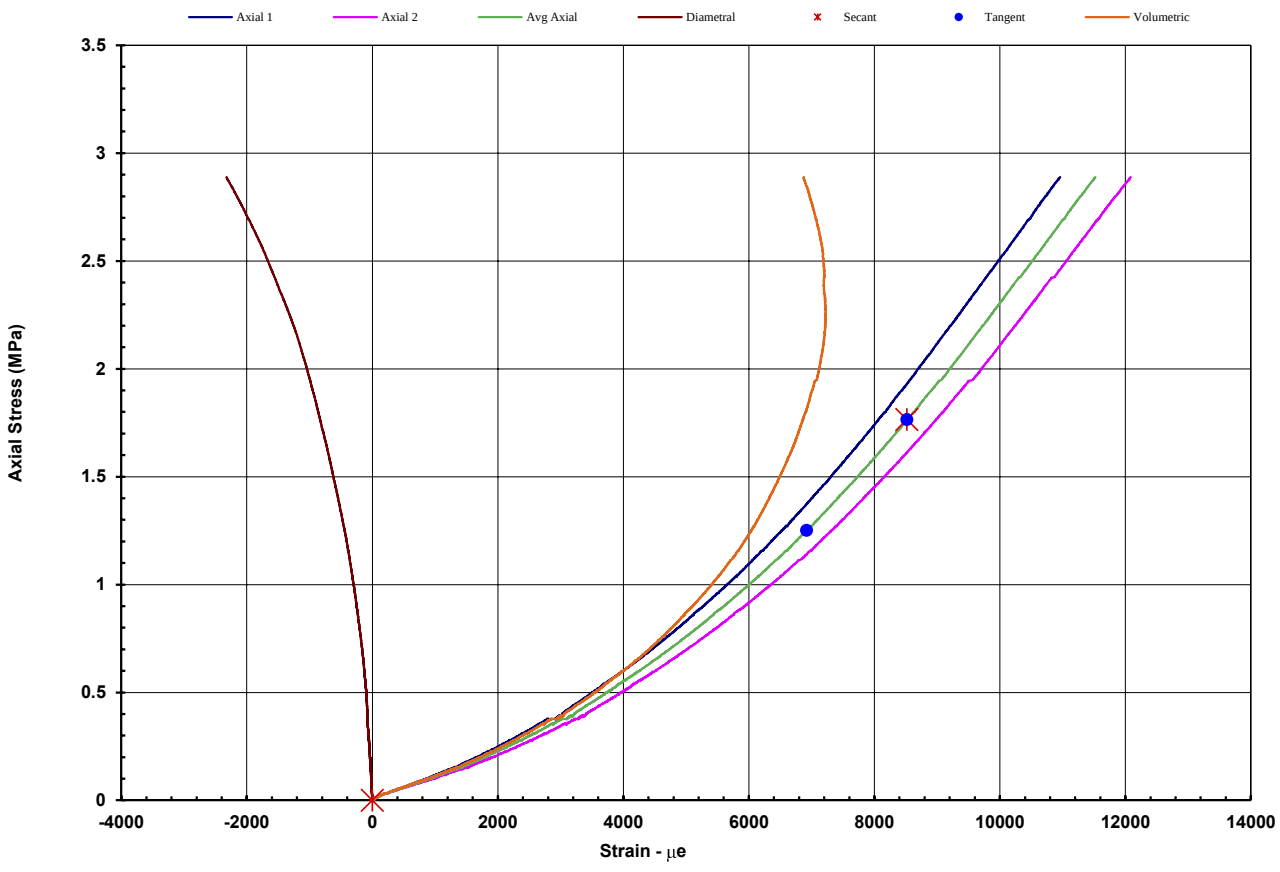
Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101729-MOD
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR2
		Test Date	11/12/2018
Project	Inland Rail Package 13	**Report Date**	12/12/2018
Project No.	1893802	**Client Sample No.**	330-01-BH2103-C01920
Bore Hole	330-01-BH2103	**Depth From (m)** 19.55	**Depth To (m)** 19.7
Description	C		
Sample Type	Single Individual Rock Core Specimen		

Uniaxial Compressive Strength 3.53 MPa

	Young's Modulus	Poisson Ratio	
Tangent	0.321 GPa	0.098	from 35 % to 50 % of Max UCS
Secant	0.207 GPa	0.098	from 0 % to 50 % of Max UCS

Axial Stress vs Strain Plots



Notes/Remarks:

Sample/s supplied by client Graph not to scale Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory
C.N. Madison

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

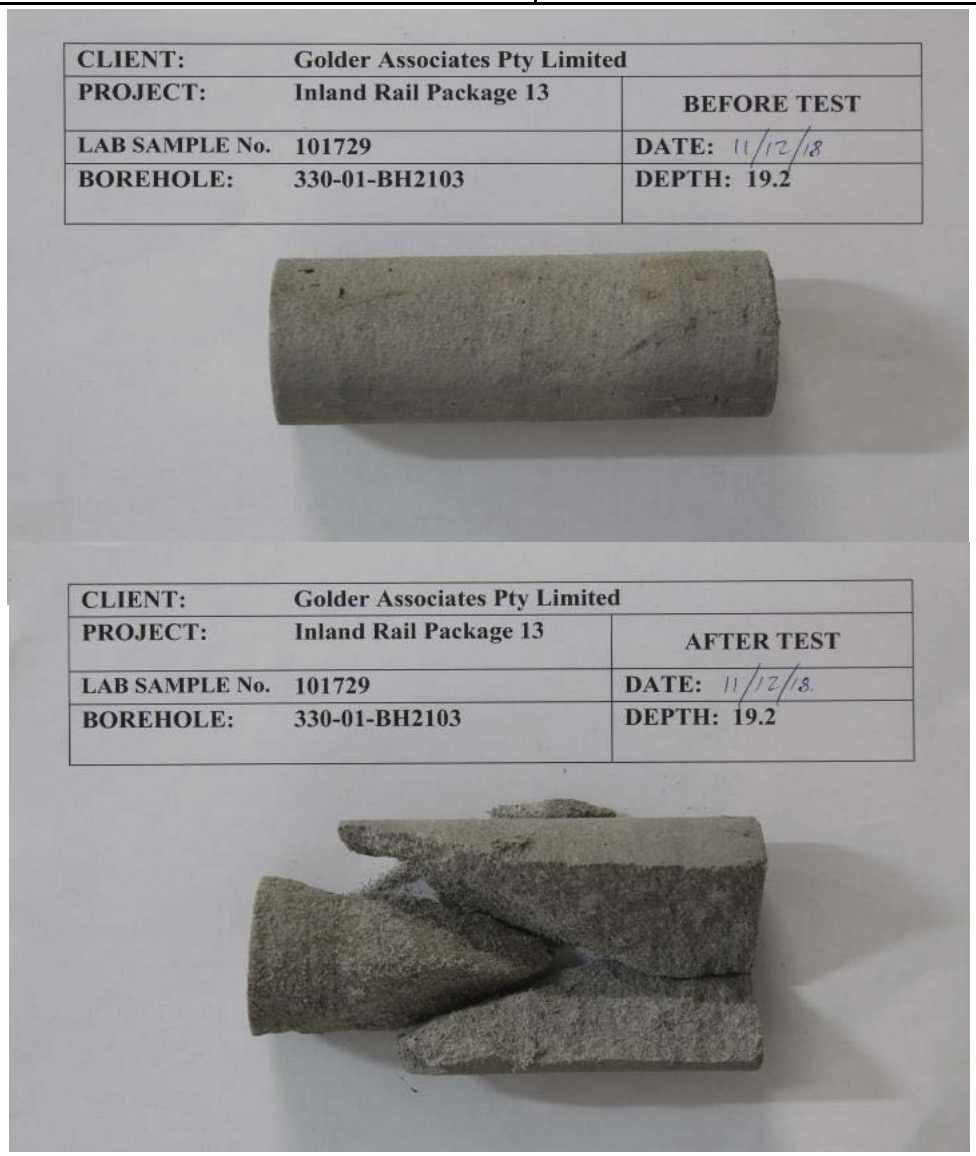
Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101729-MOD

Average Sample Diameter (mm)	51.7	Moisture Content (%)	10.2
Sample Height (mm)	141.5	Wet Density (t/m^3)	2.27
Duration of Test (min)	33.45	Dry Density (t/m^3)	2.06
Rate of Displacement (mm/min)	0.10	Bedding (°)	Nil
Mode of Failure	Conical	Test Apparatus	100kN Compression Machine



Notes/Remarks:

Sample/s supplied by client Photo not to scale Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

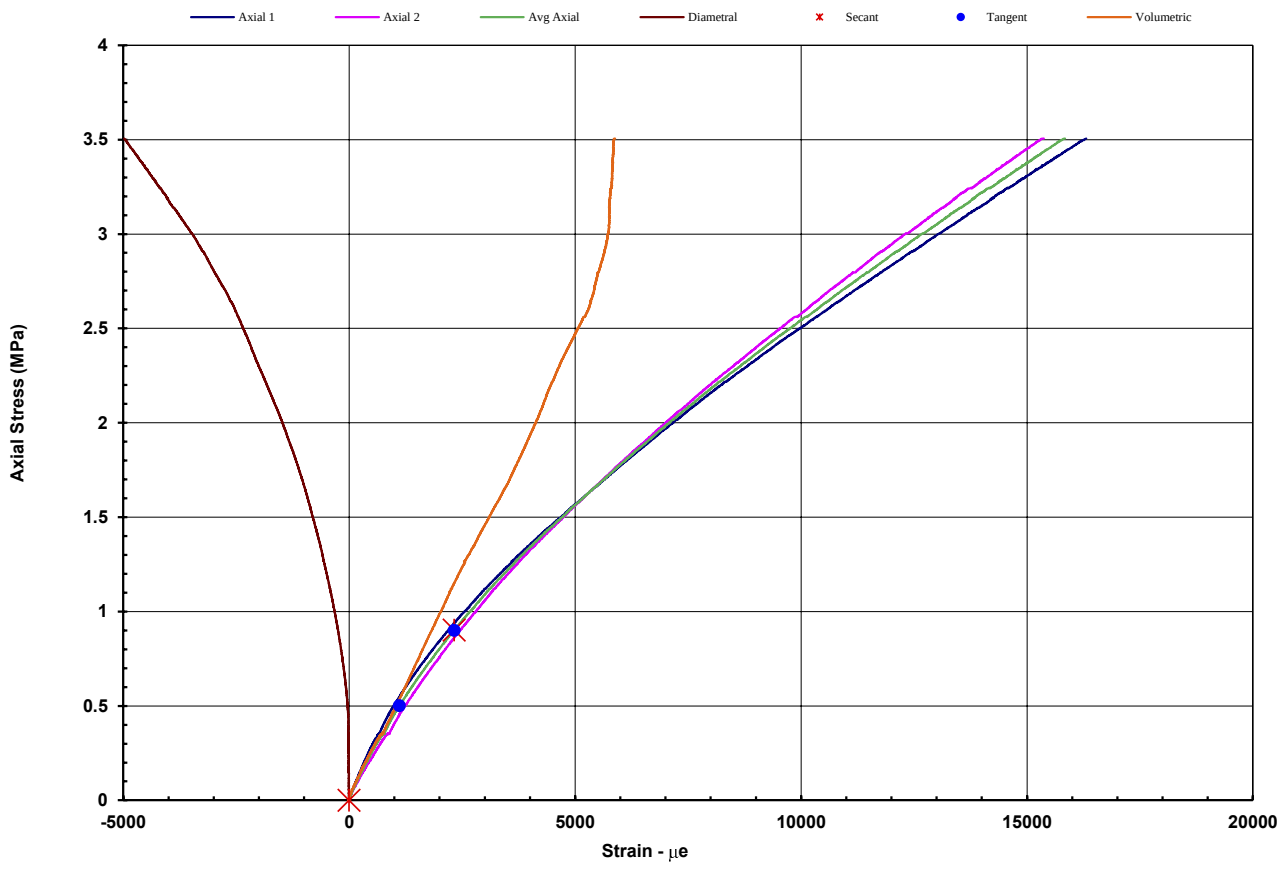
Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101731-MOD
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR2
		Test Date	11/12/2018
Project	Inland Rail Package 13	**Report Date**	12/12/2018
Project No.	1893802	**Client Sample No.**	330-01-BH2103-C02175
Bore Hole	330-01-BH2103	**Depth From (m)** 21.85	**Depth To (m)** 22
Description	C		
Sample Type	Single Individual Rock Core Specimen		

Uniaxial Compressive Strength 3.98 MPa

	Young's Modulus	Poisson Ratio	
Tangent	0.329 GPa	0.106	from 13 % to 23 % of Max UCS
Secant	0.388 GPa	0.107	from 0 % to 23 % of Max UCS

Axial Stress vs Strain Plots



Notes/Remarks:

Sample/s supplied by client Graph not to scale Tested as received. **Page 1 of 2** EP13402

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory
C.N. Madison

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

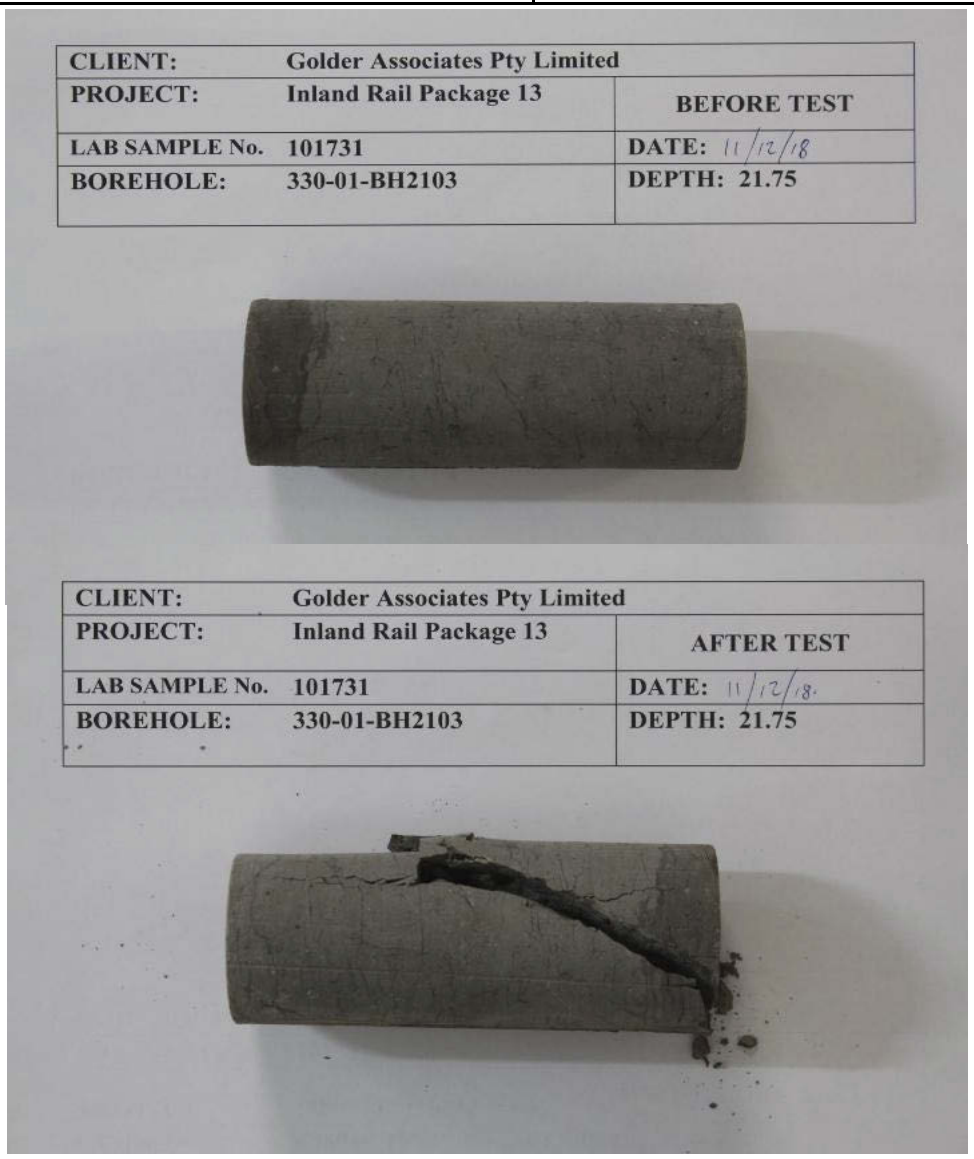
Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101731-MOD

Average Sample Diameter (mm)	51.8	Moisture Content (%)	10.5
Sample Height (mm)	141.3	Wet Density (t/m^3)	2.25
Duration of Test (min)	35.58	Dry Density (t/m^3)	2.03
Rate of Displacement (mm/min)	0.10	Bedding (°)	10
Mode of Failure	Shear	Test Apparatus	100kN Compression Machine



Notes/Remarks:

Sample/s supplied by client Photo not to scale Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

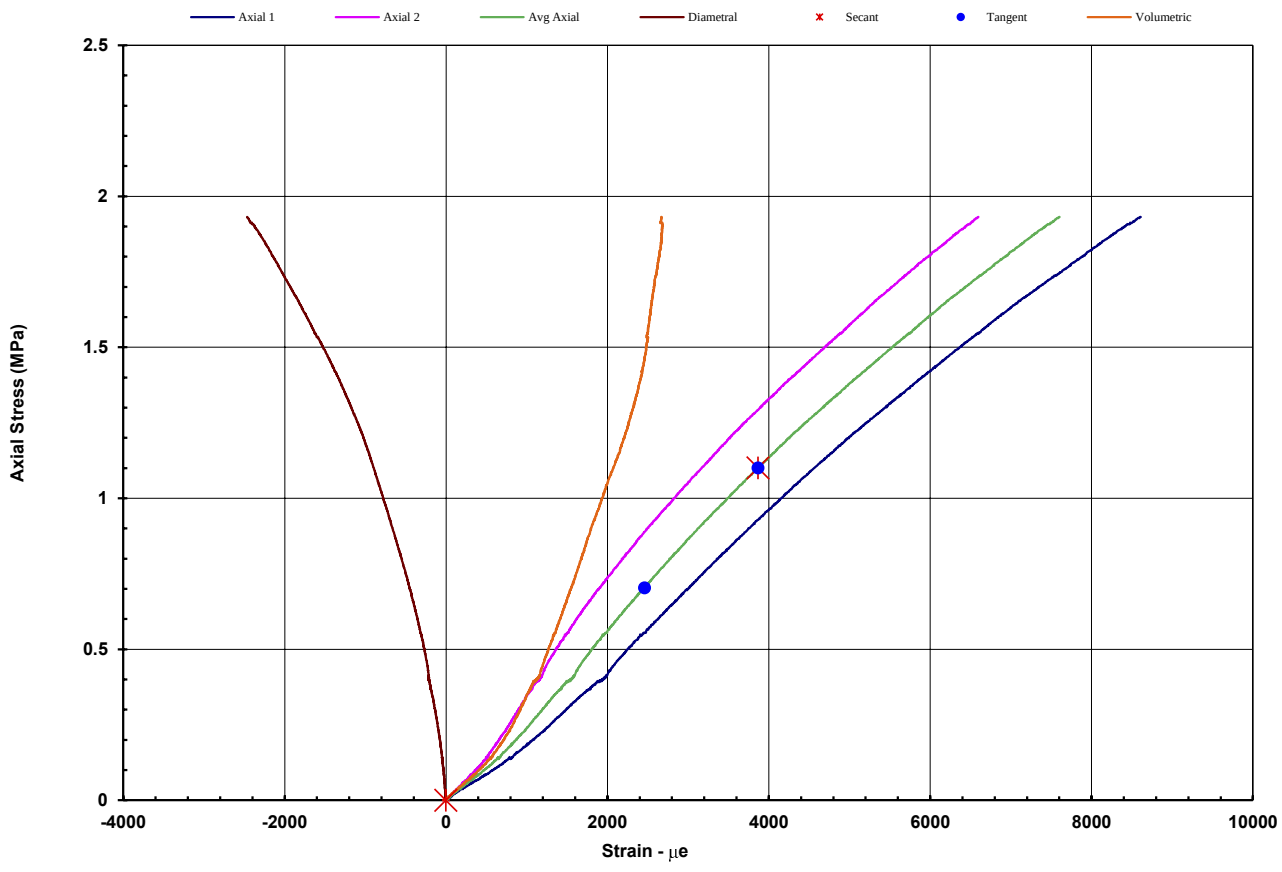
Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101733-MOD
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR2
		Test Date	10/12/2018
Project	Inland Rail Package 13	**Report Date**	11/12/2018
Project No.	1893802	**Client Sample No.**	330-01-BH2103-C02260
Bore Hole	330-01-BH2103	**Depth From (m)** 22.73	**Depth To (m)** 22.85
Description	C		
Sample Type	Single Individual Rock Core Specimen		

Uniaxial Compressive Strength 3.52 MPa

	Young's Modulus	Poisson Ratio	
Tangent	0.283 GPa	0.232	from 20 % to 31 % of Max UCS
Secant	0.285 GPa	0.232	from 0 % to 31 % of Max UCS

Axial Stress vs Strain Plots



Notes/Remarks:

The length to diameter ratio falls outside the test method limits of 2.5:1 to 3.0:1.

Sample/s supplied by client Graph not to scale Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory
C.N. Madison

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

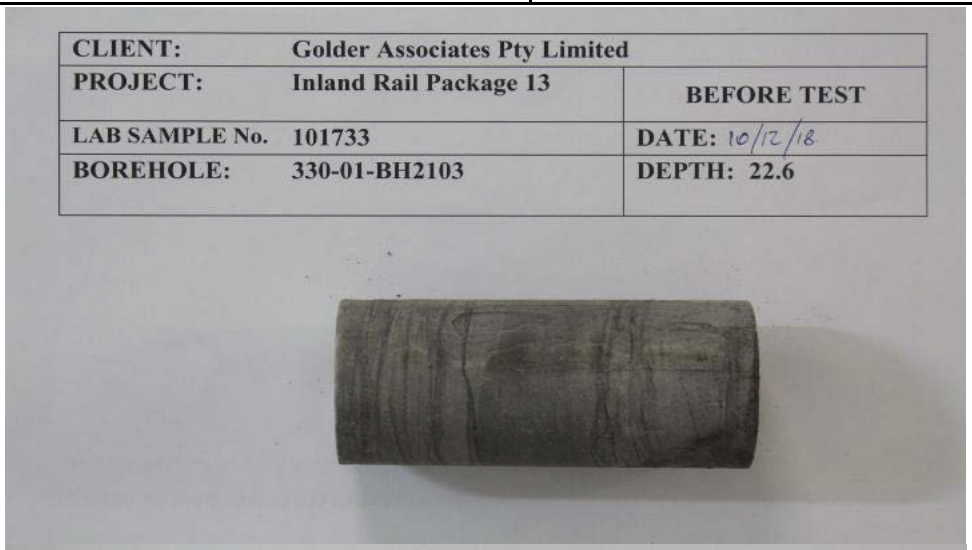
Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

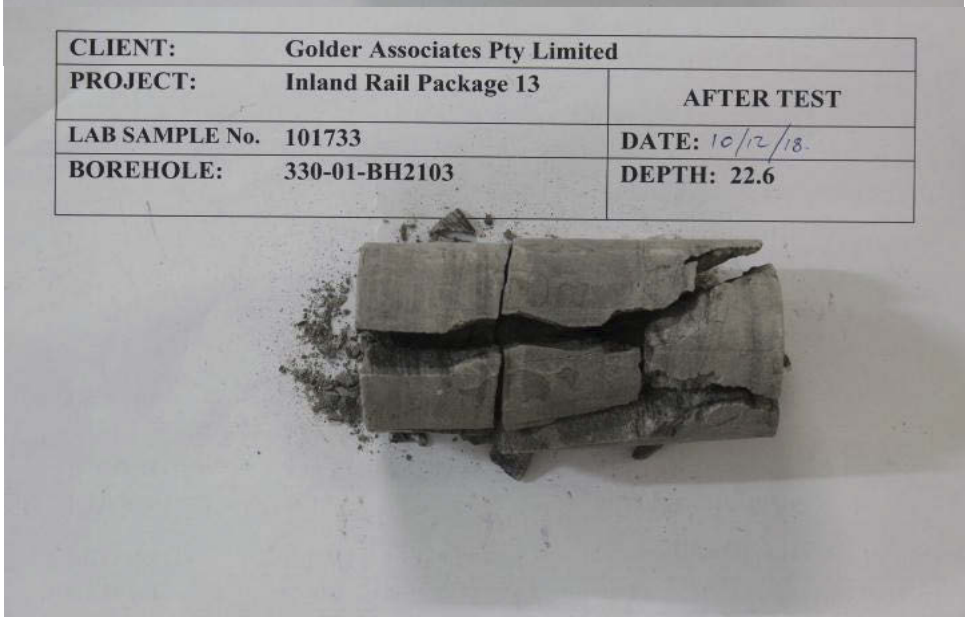
UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101733-MOD

Average Sample Diameter (mm)	51.3	Moisture Content (%)	10.8
Sample Height (mm)	118.2	Wet Density (t/m^3)	2.24
Duration of Test (min)	30.35	Dry Density (t/m^3)	2.02
Rate of Displacement (mm/min)	0.10	Bedding (°)	5
Mode of Failure	Conical	Test Apparatus	100kN Compression Machine





Notes/Remarks:

The length to diameter ratio falls outside the test method limits of 2.5:1 to 3.0:1.

Sample/s supplied by client Photo not to scale Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

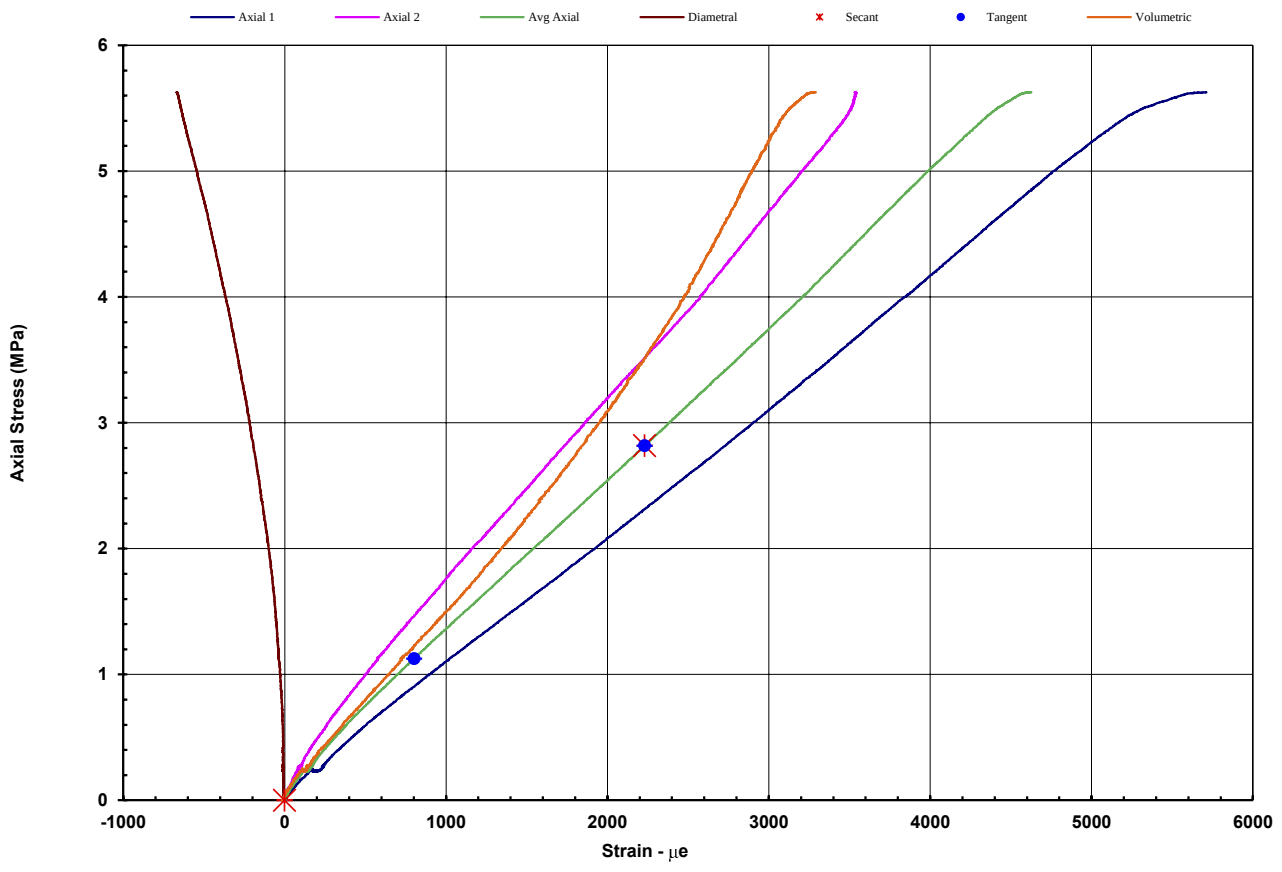
Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101735-MOD
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR2
		Test Date	11/12/2018
Project	Inland Rail Package 13	**Report Date**	12/12/2018
Project No.	1893802	**Client Sample No.**	330-01-BH2103-C02555
Bore Hole	330-01-BH2103	**Depth From (m)** 27.12	**Depth To (m)** 27.3
Description	C		
Sample Type	Single Individual Rock Core Specimen		

Uniaxial Compressive Strength 5.63 MPa

Young's Modulus		Poisson Ratio	
Tangent	1.18 GPa	0.087	from 20 % to 50 % of Max UCS
Secant	1.26 GPa	0.087	from 0 % to 50 % of Max UCS

Axial Stress vs Strain Plots



Notes/Remarks:

Sample/s supplied by client Graph not to scale Tested as received. **Page 1 of 2** EP13402

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory
C.N. Madison

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

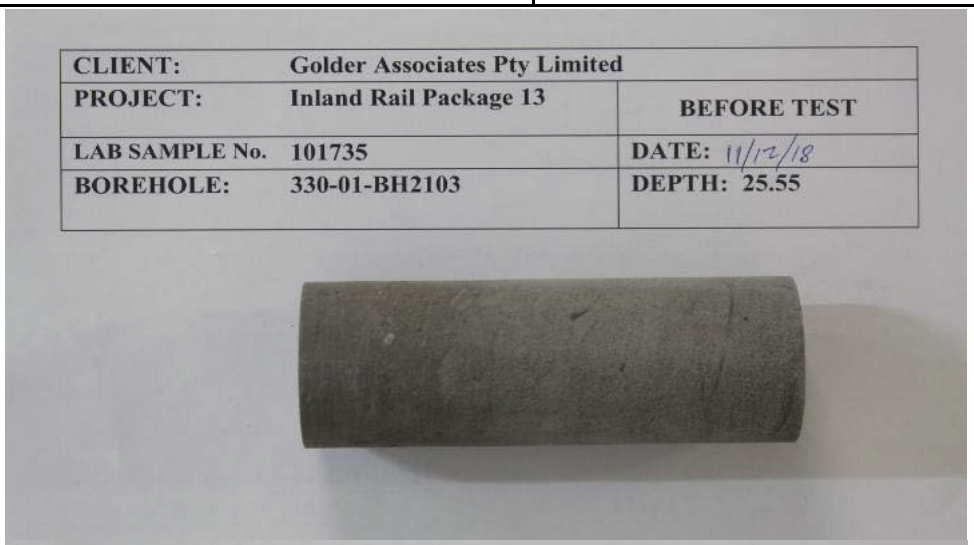
Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

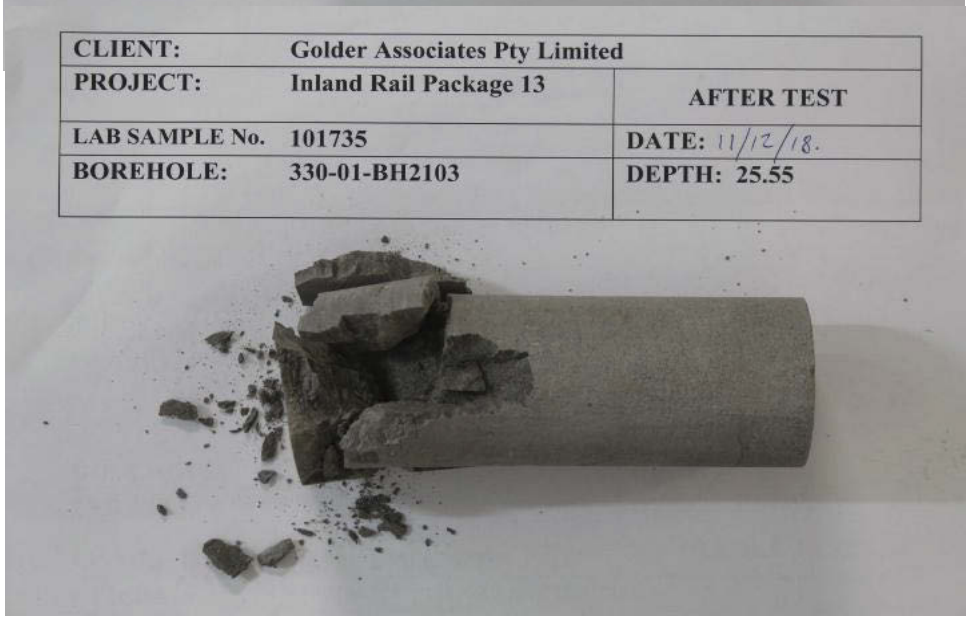
UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101735-MOD

Average Sample Diameter (mm)	51.8	Moisture Content (%)	6.7
Sample Height (mm)	141.6	Wet Density (t/m^3)	2.37
Duration of Test (min)	23.53	Dry Density (t/m^3)	2.22
Rate of Displacement (mm/min)	0.10	Bedding (°)	10
Mode of Failure	Conical	Test Apparatus	100kN Compression Machine





Notes/Remarks:

Sample/s supplied by client Photo not to scale Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

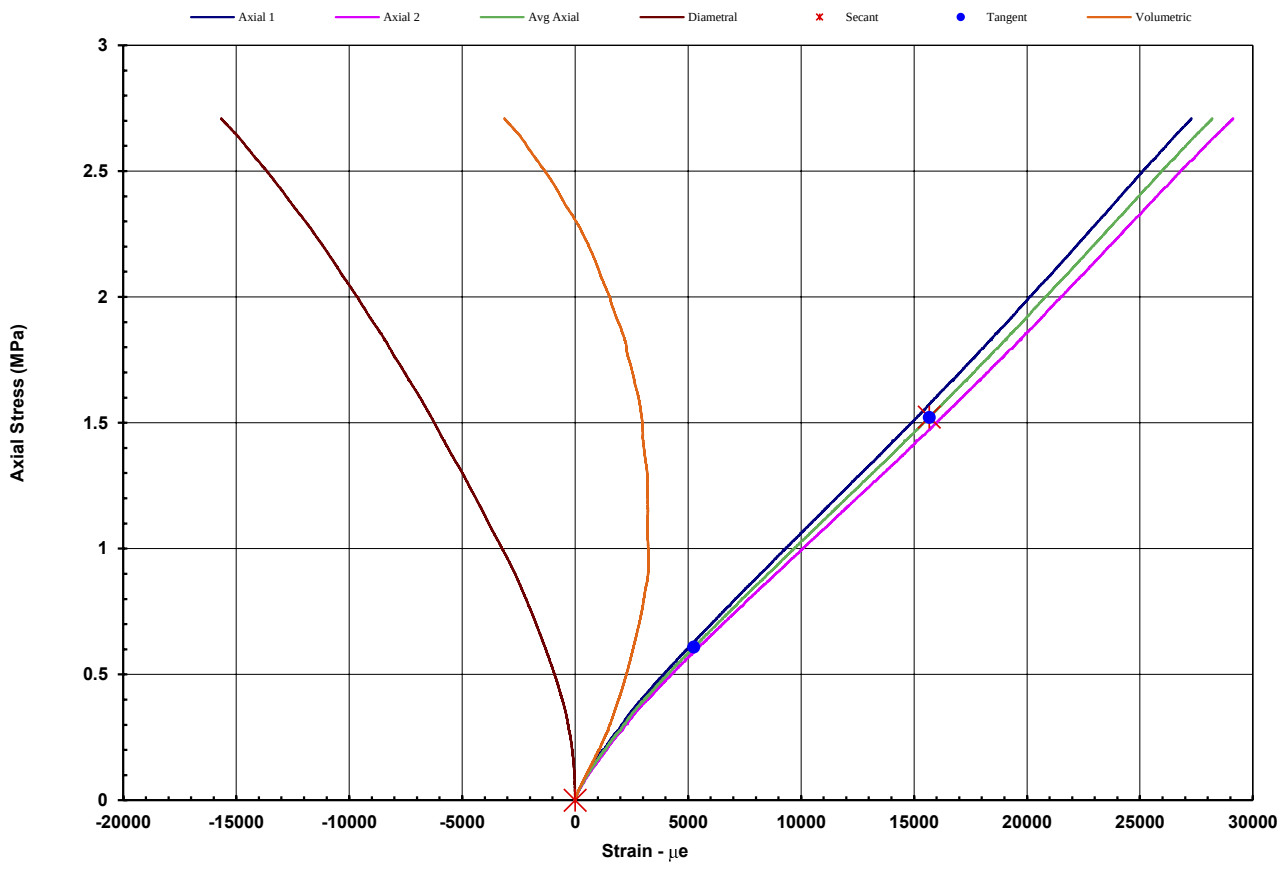
Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101752-MOD
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR2
		Test Date	8/12/2018
Project	Inland Rail Package 13	**Report Date**	10/12/2018
Project No.	1893802	**Client Sample No.**	330-01-BH2104-C01600
Bore Hole	330-01-BH2104	**Depth From (m)** 16	**Depth To (m)** 16.35
Description	C		
Sample Type	Single Individual Rock Core Specimen		

Uniaxial Compressive Strength 3.04 MPa

	Young's Modulus	Poisson Ratio	
Tangent	0.087 GPa	0.406	from 20 % to 50 % of Max UCS
Secant	0.097 GPa	0.406	from 0 % to 50 % of Max UCS

Axial Stress vs Strain Plots



Notes/Remarks:

The length to diameter ratio falls outside the test method limits of 2.5:1 to 3.0:1.

Sample/s supplied by client Graph not to scale Tested as received. **Page 1 of 2** EP13402

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory
C.N. Madison

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

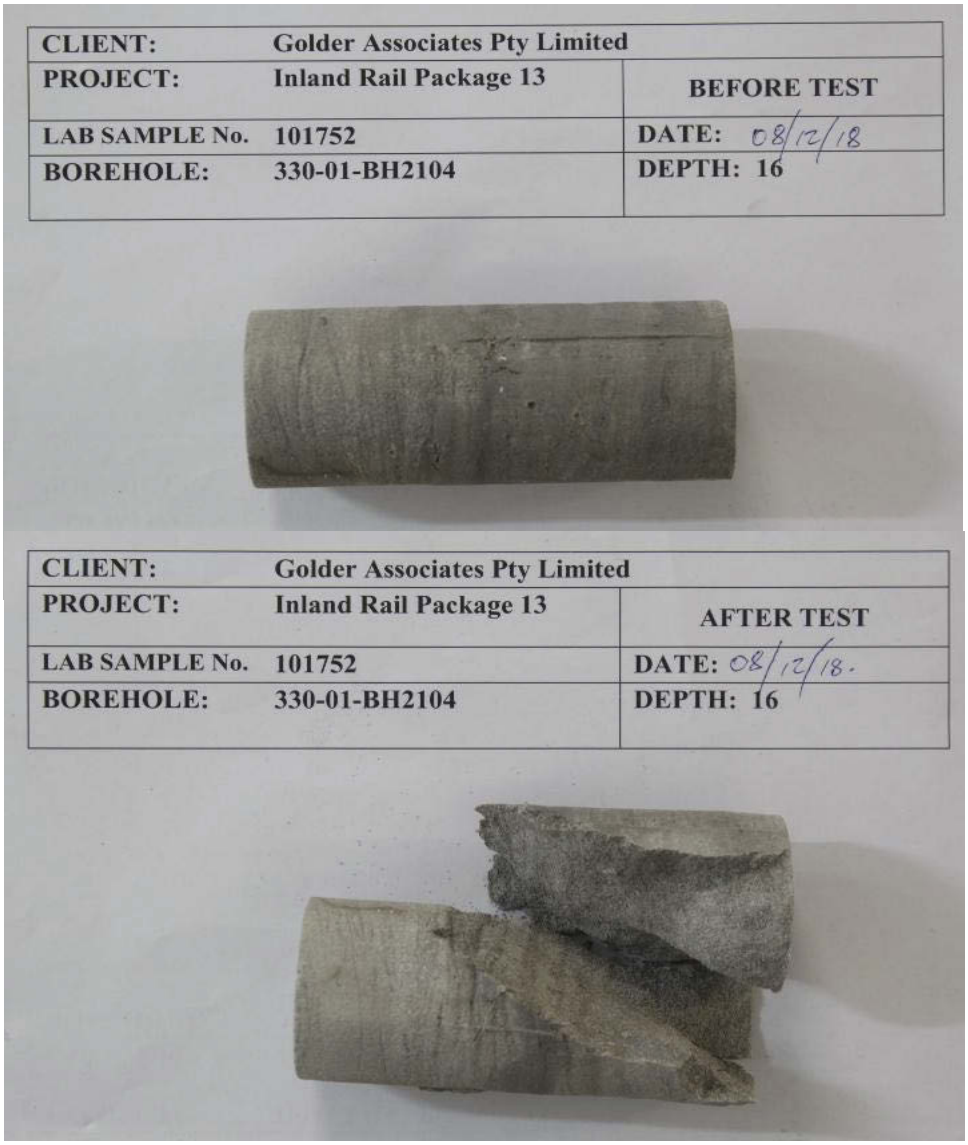
Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101752-MOD

Average Sample Diameter (mm)	51.9	Moisture Content (%)	7.7
Sample Height (mm)	128.6	Wet Density (t/m^3)	2.34
Duration of Test (min)	43.55	Dry Density (t/m^3)	2.17
Rate of Displacement (mm/min)	0.10	Bedding (°)	5
Mode of Failure	Shear	Test Apparatus	100kN Compression Machine



Notes/Remarks:

The length to diameter ratio falls outside the test method limits of 2.5:1 to 3.0:1.

Sample/s supplied by client Photo not to scale Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

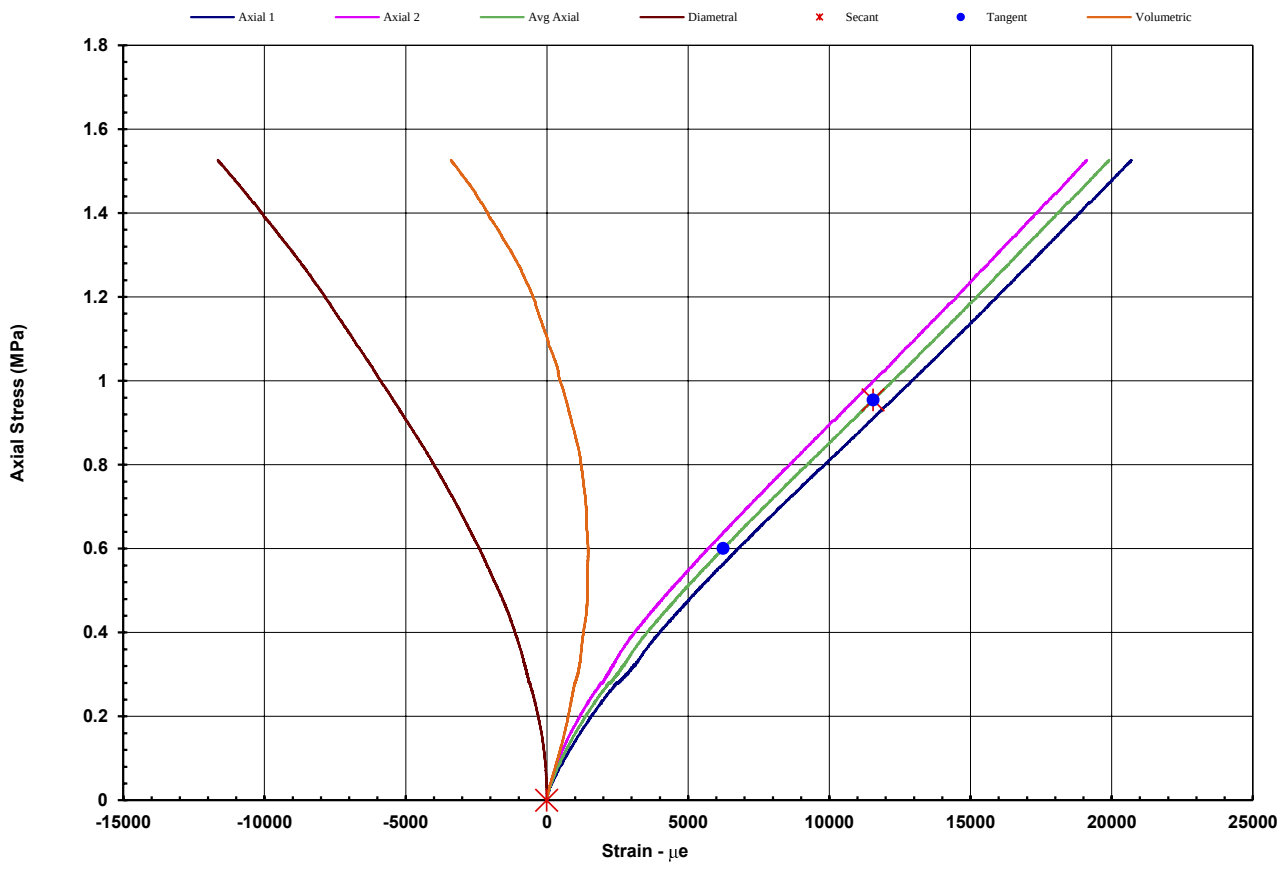
Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101754-MOD
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR2
		Test Date	8/12/2018
Project	Inland Rail Package 13	**Report Date**	10/12/2018
Project No.	1893802	**Client Sample No.**	330-01-BH2104-C01965
Bore Hole	330-01-BH2104	**Depth From (m)** 19.65	**Depth To (m)** 20
Description	C		
Sample Type	Single Individual Rock Core Specimen		

Uniaxial Compressive Strength 1.91 MPa

	Young's Modulus	Poisson Ratio	
Tangent	0.067 GPa	0.471	from 31 % to 50 % of Max UCS
Secant	0.083 GPa	0.471	from 0 % to 50 % of Max UCS

Axial Stress vs Strain Plots



Notes/Remarks:

Sample/s supplied by client Graph not to scale Tested as received. **Page 1 of 2** EP13402

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory
C.N. Madison

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101754-MOD

Average Sample Diameter (mm)	52.2	Moisture Content (%)	8.5
Sample Height (mm)	140.2	Wet Density (t/m^3)	2.32
Duration of Test (min)	45.77	Dry Density (t/m^3)	2.14
Rate of Displacement (mm/min)	0.10	Bedding (°)	20
Mode of Failure	Conical	Test Apparatus	100kN Compression Machine

Notes/Remarks:

Sample/s supplied by client Photo not to scale Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

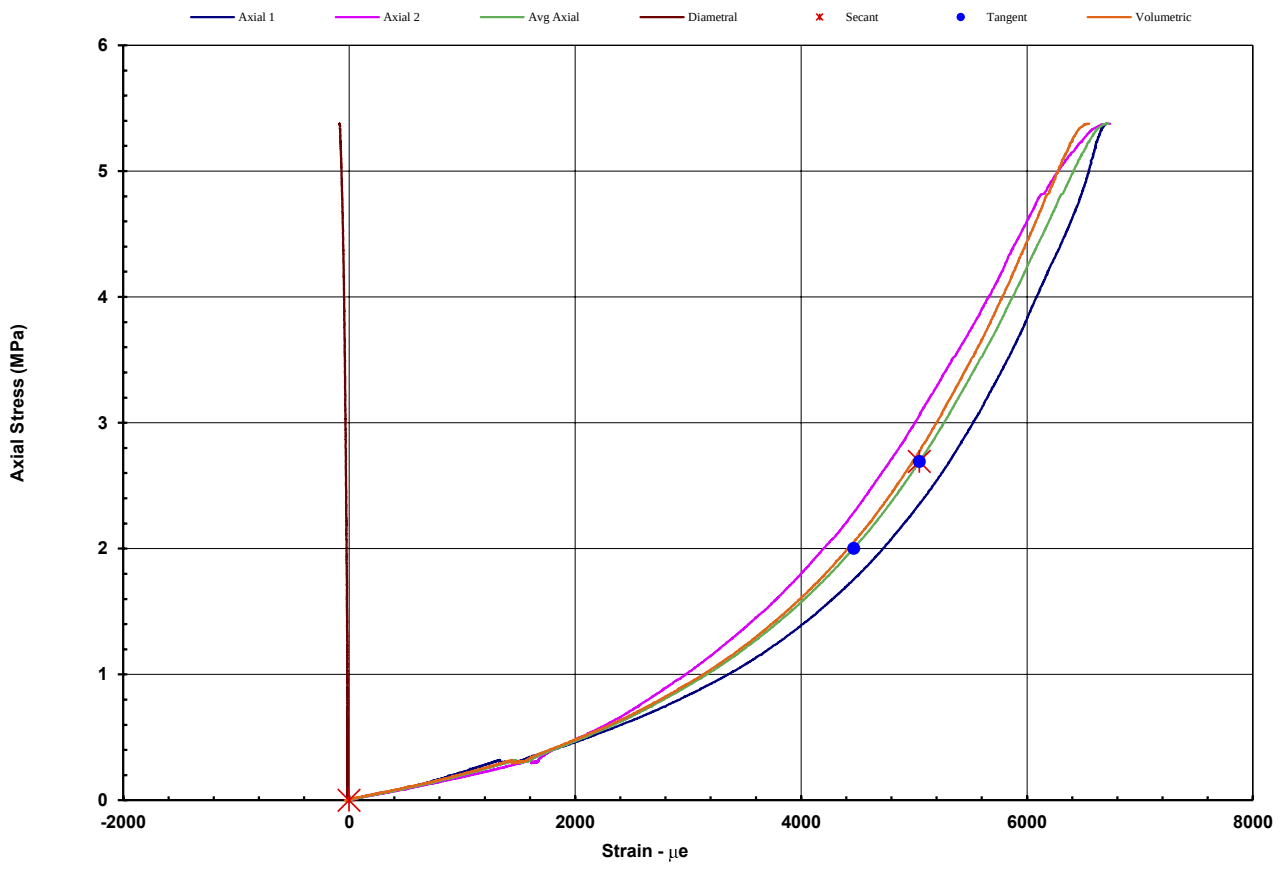
Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101757-MOD
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR2
		Test Date	8/12/2018
Project	Inland Rail Package 13	**Report Date**	10/12/2018
Project No.	1893802	**Client Sample No.**	330-01-BH2104-C02152
Bore Hole	330-01-BH2104	**Depth From (m)** 21.52	**Depth To (m)** 22.1
Description	C		
Sample Type	Single Individual Rock Core Specimen		

Uniaxial Compressive Strength 5.38 MPa

Young's Modulus		Poisson Ratio	
Tangent	1.19 GPa	0.006	from 37 % to 50 % of Max UCS
Secant	0.533 GPa	0.006	from 0 % to 50 % of Max UCS

Axial Stress vs Strain Plots



Notes/Remarks:

Sample/s supplied by client Graph not to scale Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory
C.N. Madison

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101757-MOD

Average Sample Diameter (mm)	51.9	Moisture Content (%)	6.5
Sample Height (mm)	140.7	Wet Density (t/m^3)	2.30
Duration of Test (min)	25.07	Dry Density (t/m^3)	2.16
Rate of Displacement (mm/min)	0.10	Bedding (°)	0
Mode of Failure	Conical	Test Apparatus	100kN Compression Machine

Notes/Remarks:

Sample/s supplied by client Photo not to scale Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

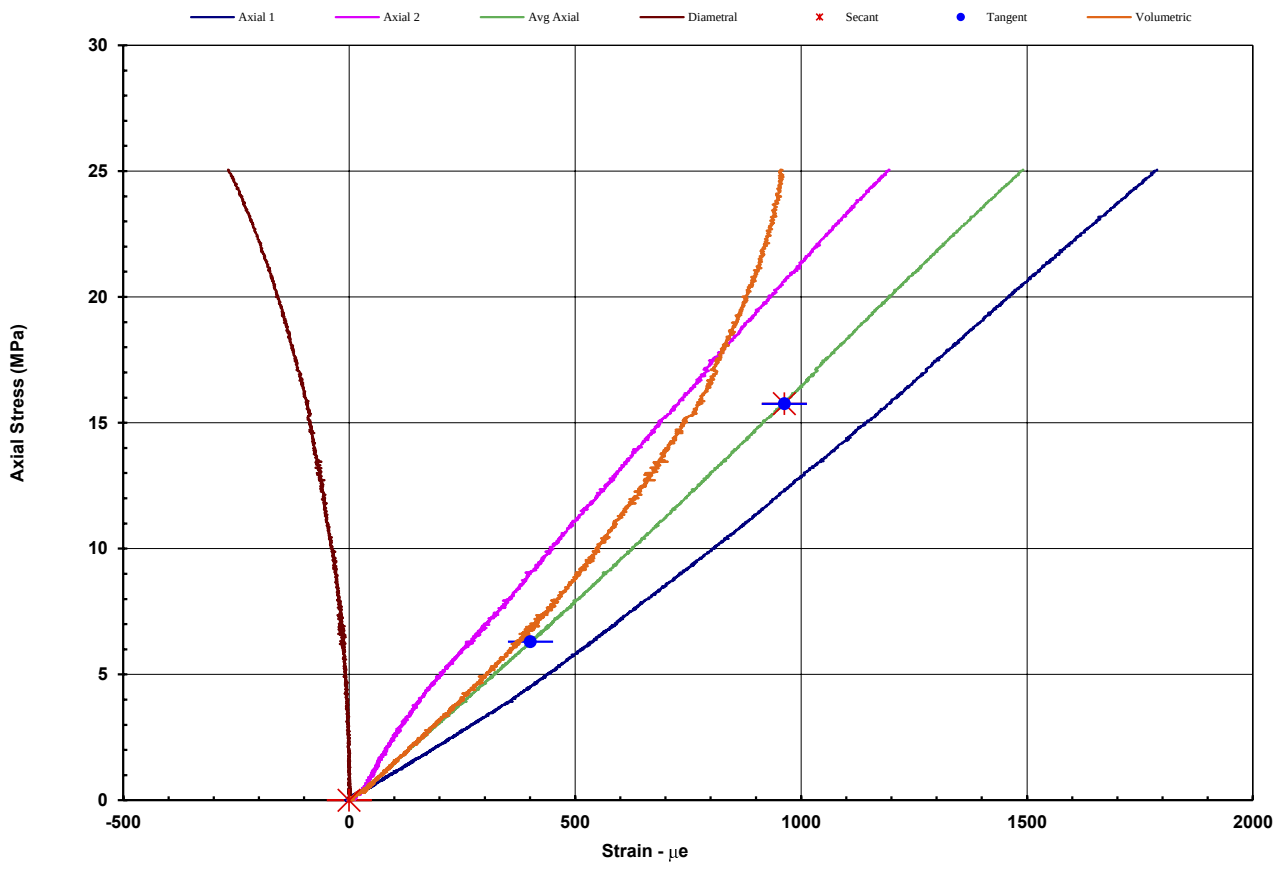
Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101760-MOD
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR2
		Test Date	10/12/2018
Project	Inland Rail Package 13	**Report Date**	11/12/2018
Project No.	1893802	**Client Sample No.**	330-01-BH2104-C02505
Bore Hole	330-01-BH2104	**Depth From (m)** 25.05	**Depth To (m)** 25.20
Description	C		
Sample Type	Single Individual Rock Core Specimen		

Uniaxial Compressive Strength 31.5 MPa

	Young's Modulus	Poisson Ratio	
Tangent	16.8 GPa	0.099	from 20 % to 50 % of Max UCS
Secant	16.4 GPa	0.099	from 0 % to 50 % of Max UCS

Axial Stress vs Strain Plots



Notes/Remarks:

Sample/s supplied by client Graph not to scale Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory
C.N. Madison

NATA ACCREDITED FOR TECHNICAL COMPETENCE
Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101760-MOD

Average Sample Diameter (mm)	51.7	Moisture Content (%)	3.8
Sample Height (mm)	141.1	Wet Density (t/m^3)	2.39
Duration of Test (min)	26.63	Dry Density (t/m^3)	2.30
Rate of Displacement (mm/min)	0.10	Bedding (°)	30
Mode of Failure	Conical	Test Apparatus	100kN Compression Machine

Notes/Remarks:

Sample/s supplied by client Photo not to scale Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

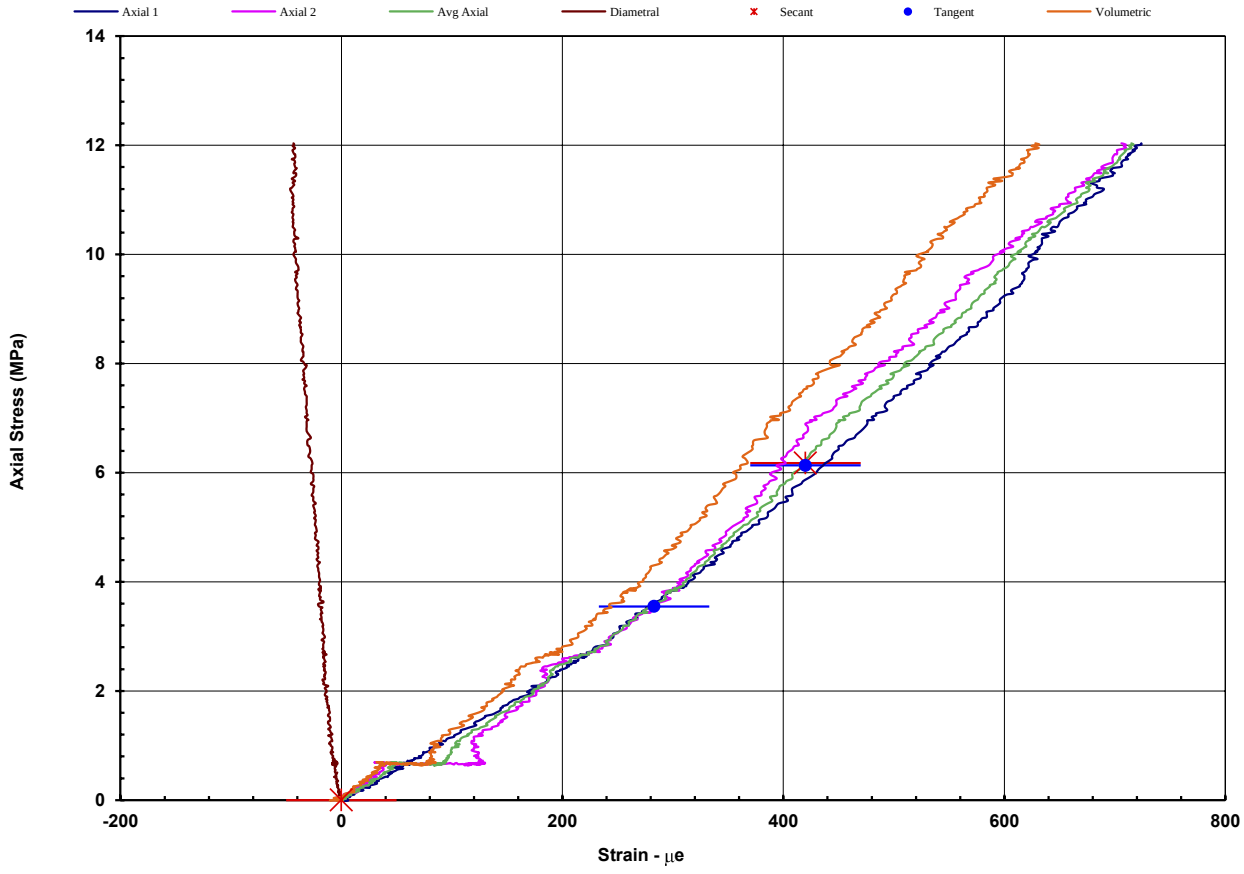
Test Method: AS 4133.4.3.1

Client	Golder Associates Pty Limited	**Report No.**	GA101762-MOD
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR2
		Test Date	11/12/2018
Project	Inland Rail Package 13	**Report Date**	12/12/2018
Project No.	1893802	**Client Sample No.**	330-01-BH2104-C02545
Bore Hole	330-01-BH2104	**Depth From (m)**	25.45
Depth To (m)	25.58		
Description	C		
Sample Type	Single Individual Rock Core Specimen		

Uniaxial Compressive Strength 17.7 MPa

	Young's Modulus	Poisson Ratio	
Tangent	18.9 GPa	0.062	from 20 % to 34 % of Max UCS
Secant	14.7 GPa	0.064	from 0 % to 34 % of Max UCS

Axial Stress vs Strain Plots



Notes/Remarks:

The length to diameter ratio falls outside the test method limits of 2.5:1 to 3.0:1.

Sample/s supplied by client Graph not to scale Tested as received. **Page 1 of 2** REP03603

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory
C. Mardon

NATA ACCREDITED FOR TECHNICAL COMPETENCE
Laboratory No. 9926

ACCURATE QUALITY RESULTS FOR TOMORROW'S ENGINEERING

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

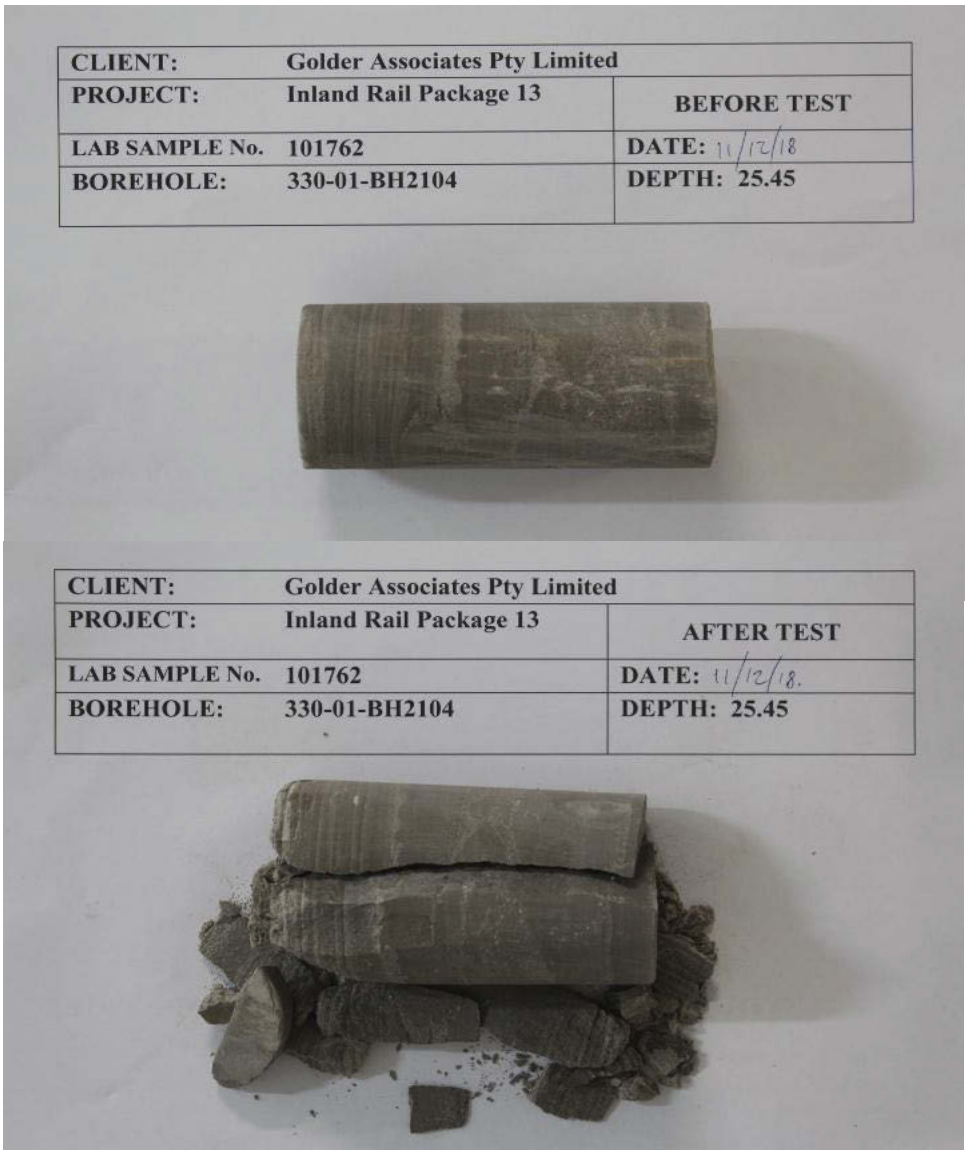
Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

Test Method: AS 4133.4.3.1

Client	Golder Associates Pty Limited	**Report No.**	GA101762-MOD

Average Sample Diameter (mm)	51.7	Moisture Content (%)	2.4
Sample Height (mm)	117.9	Wet Density (t/m^3)	3.08
Duration of Test (min)	6.03	Dry Density (t/m^3)	3.01
Rate of Loading (MPa/min)	2.93	Bedding (°)	5
Mode of Failure	Conical	Test Apparatus	Kelba 1000kN Load Cell



Notes/Remarks:

The length to diameter ratio falls outside the test method limits of 2.5:1 to 3.0:1.

Sample/s supplied by client | Graph not to scale | Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory

N. Maddison

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

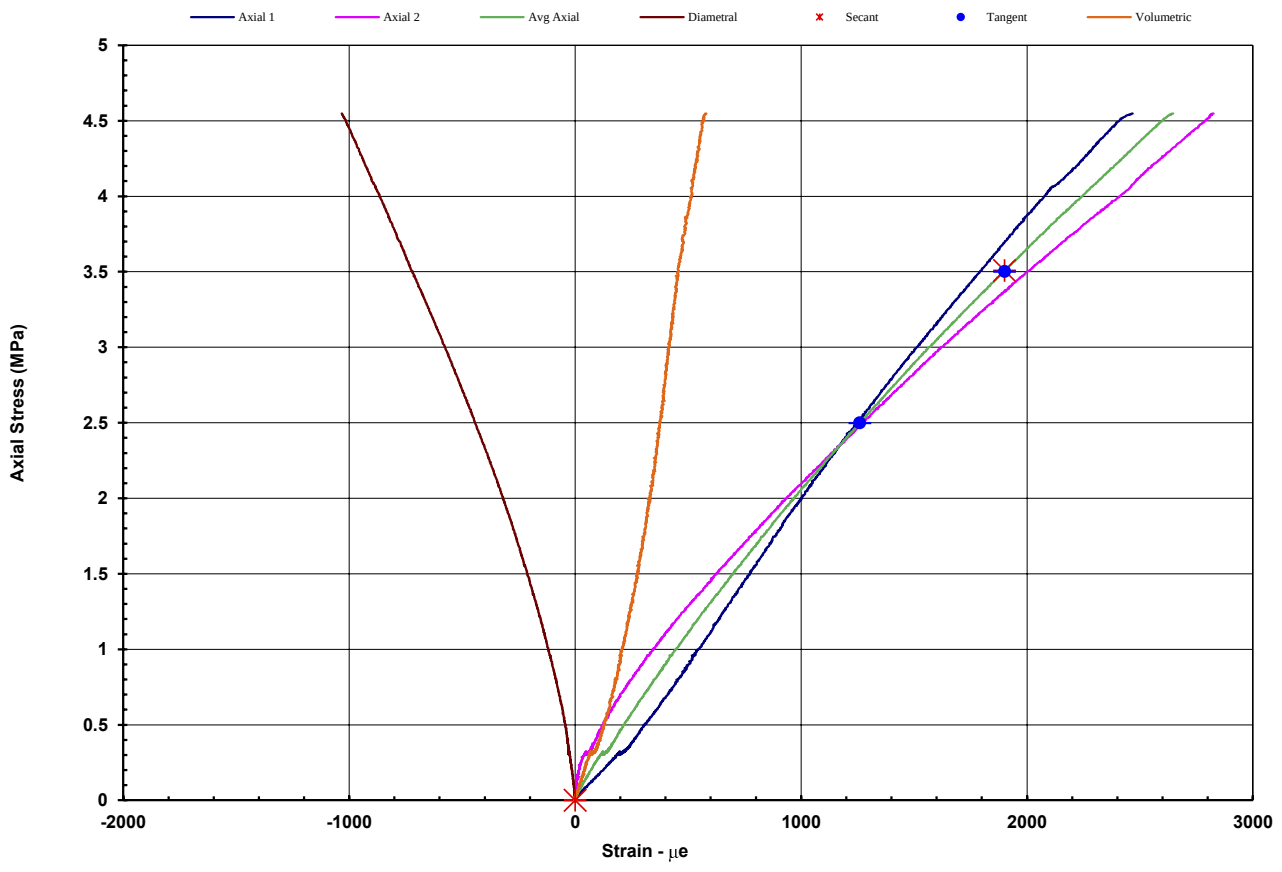
Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101764-MOD
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR2
		Test Date	8/12/2018
Project	Inland Rail Package 13	**Report Date**	10/12/2018
Project No.	1893802	**Client Sample No.**	330-01-BH2104-C02700
Bore Hole	330-01-BH2104	**Depth From (m)** 27	**Depth To (m)** 27.4
Description	C		
Sample Type	Single Individual Rock Core Specimen		

Uniaxial Compressive Strength 12.5 MPa

Young's Modulus		Poisson Ratio	
Tangent	1.56 GPa	0.378	from 20 % to 28 % of Max UCS
Secant	1.85 GPa	0.380	from 0 % to 28 % of Max UCS

Axial Stress vs Strain Plots



Notes/Remarks:

Sample/s supplied by client Graph not to scale Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory
C.N. Madison

NATA ACCREDITED FOR TECHNICAL COMPETENCE
Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

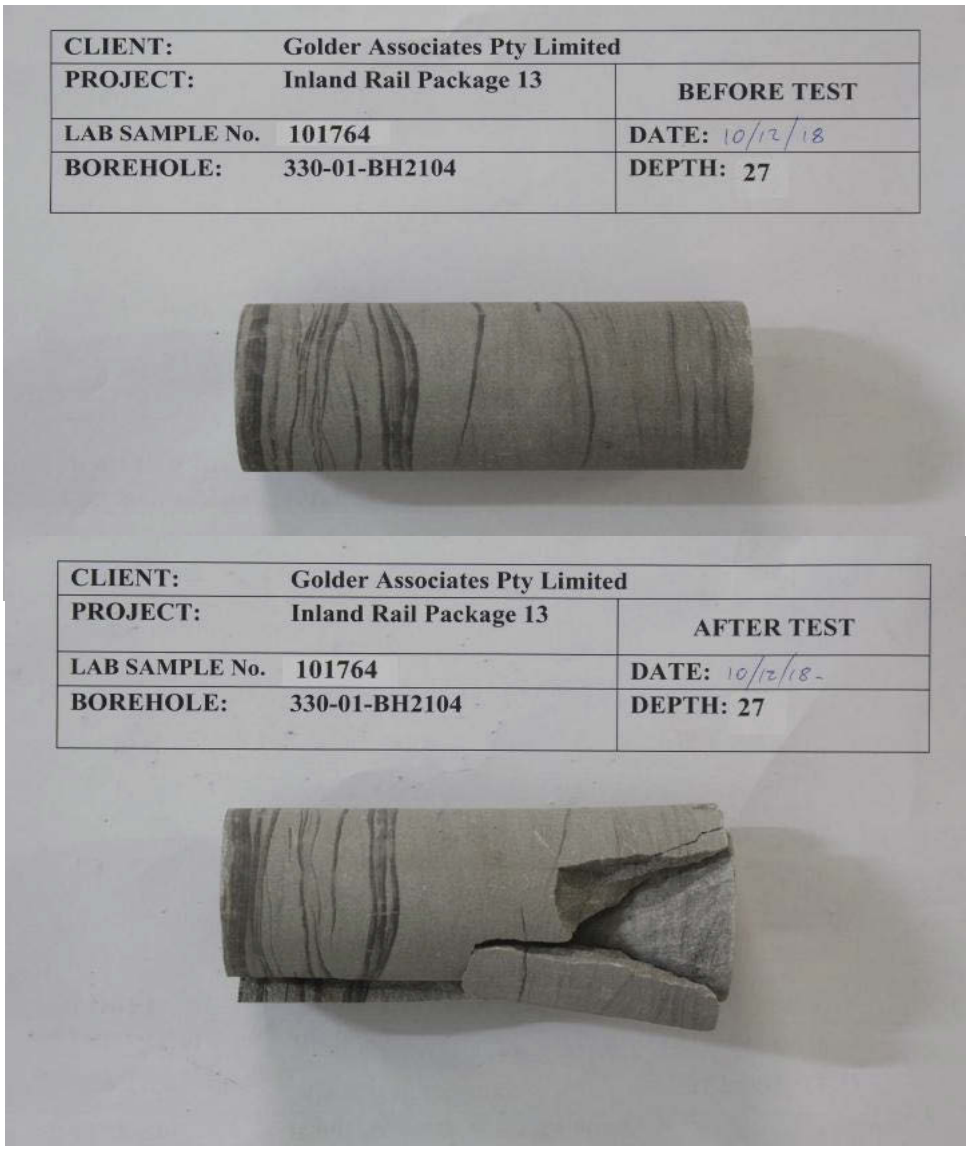
Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101764-MOD

Average Sample Diameter (mm)	51.7	Moisture Content (%)	6.9
Sample Height (mm)	142.3	Wet Density (t/m^3)	2.40
Duration of Test (min)	30.22	Dry Density (t/m^3)	2.25
Rate of Displacement (mm/min)	0.10	Bedding (°)	10
Mode of Failure	Axial Splitting	Test Apparatus	100kN Compression Machine



Notes/Remarks:

Sample/s supplied by client Photo not to scale Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

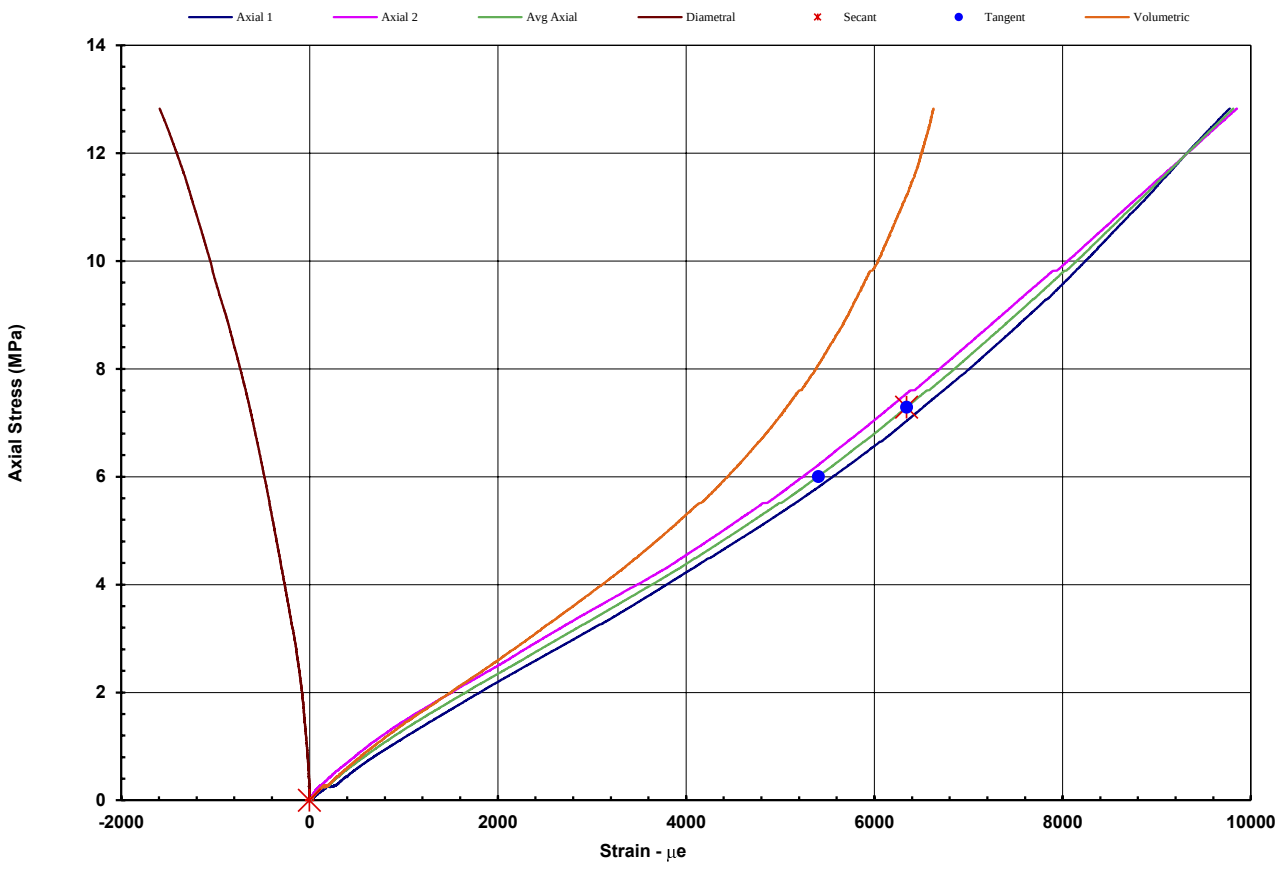
Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101766-MOD
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR2
		Test Date	10/12/2018
Project	Inland Rail Package 13	**Report Date**	11/12/2018
Project No.	1893802	**Client Sample No.**	330-01-BH2104-C03000
Bore Hole	330-01-BH2104	**Depth From (m)** 30	**Depth To (m)** 30.15
Description	C		
Sample Type	Single Individual Rock Core Specimen		

Uniaxial Compressive Strength 14.6 MPa

	Young's Modulus	Poisson Ratio	
Tangent	1.37 GPa	0.100	from 41 % to 50 % of Max UCS
Secant	1.15 GPa	0.100	from 0 % to 50 % of Max UCS

Axial Stress vs Strain Plots



Notes/Remarks:

Sample/s supplied by client Graph not to scale Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory
C.N. Madison

NATA ACCREDITED FOR TECHNICAL COMPETENCE
Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

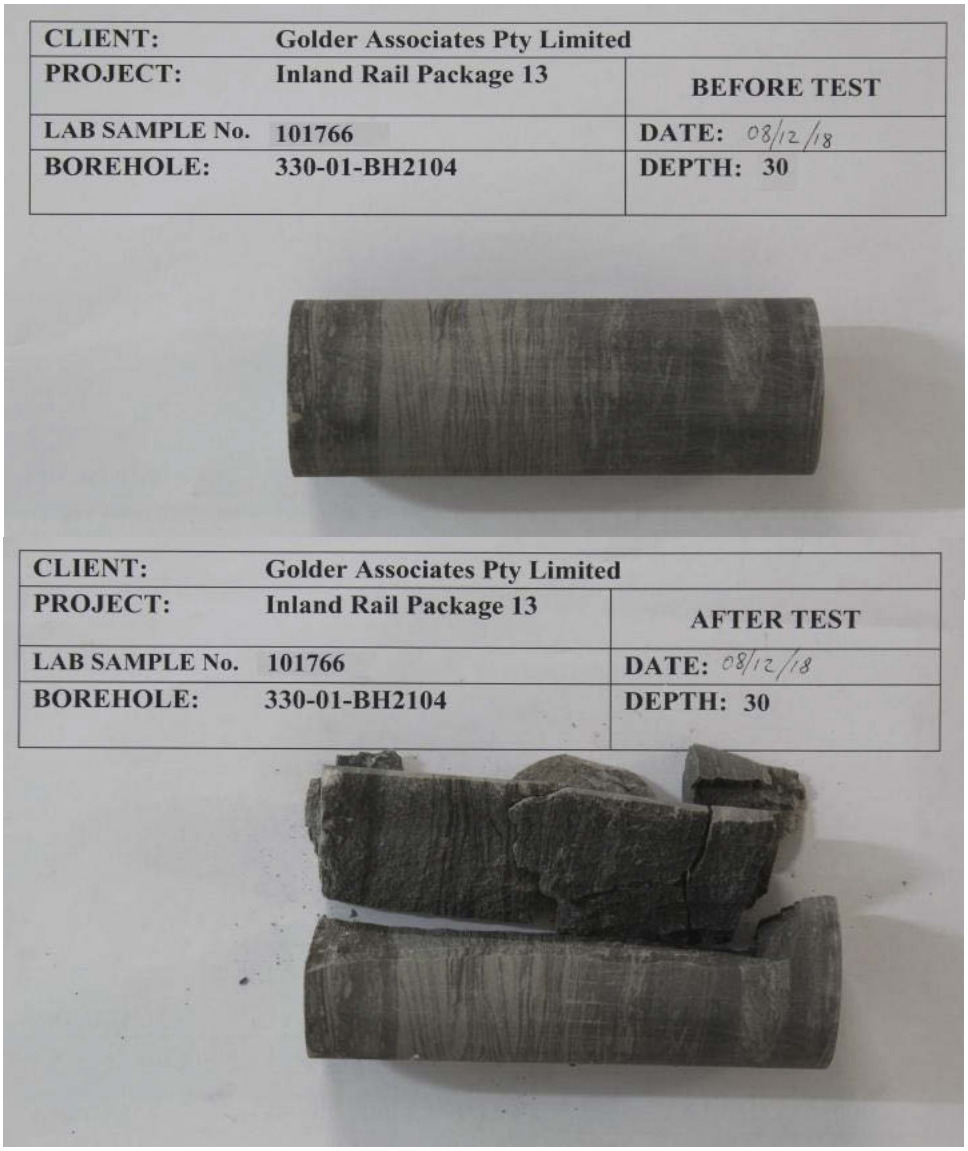
Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101766-MOD

Average Sample Diameter (mm)	51.6	Moisture Content (%)	5.3
Sample Height (mm)	140.8	Wet Density (t/m^3)	2.38
Duration of Test (min)	32.95	Dry Density (t/m^3)	2.26
Rate of Displacement (mm/min)	0.10	Bedding (°)	5
Mode of Failure	Conical	Test Apparatus	100kN Compression Machine



Notes/Remarks:

Sample/s supplied by client Photo not to scale Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

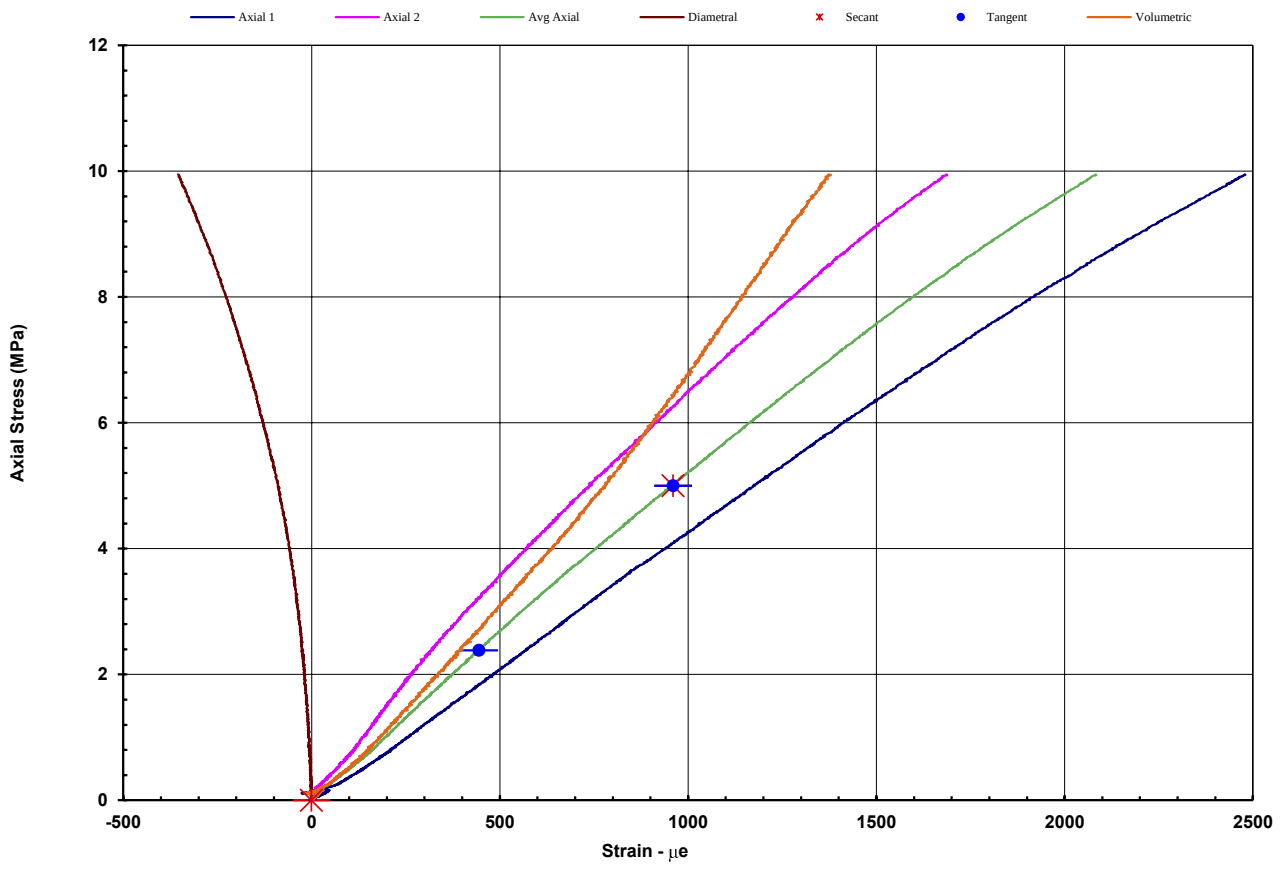
Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101839-MOD
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR3
		Test Date	3/01/2019
Project	Inland Rail Package 13	**Report Date**	7/01/2019
Project No.	1893802	**Client Sample No.**	330-01-BH2306-C00440
Bore Hole	330-01-BH2306	**Depth From (m)** 4.51	**Depth To (m)** 4.67
Description	C		
Sample Type	Single Individual Rock Core Specimen		

Uniaxial Compressive Strength 11.9 MPa

	Young's Modulus	Poisson Ratio	
Tangent	5.08 GPa	0.093	from 20 % to 42 % of Max UCS
Secant	5.21 GPa	0.093	from 0 % to 42 % of Max UCS

Axial Stress vs Strain Plots



Notes/Remarks:

Sample/s supplied by client Graph not to scale Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory
C.N. Madison

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

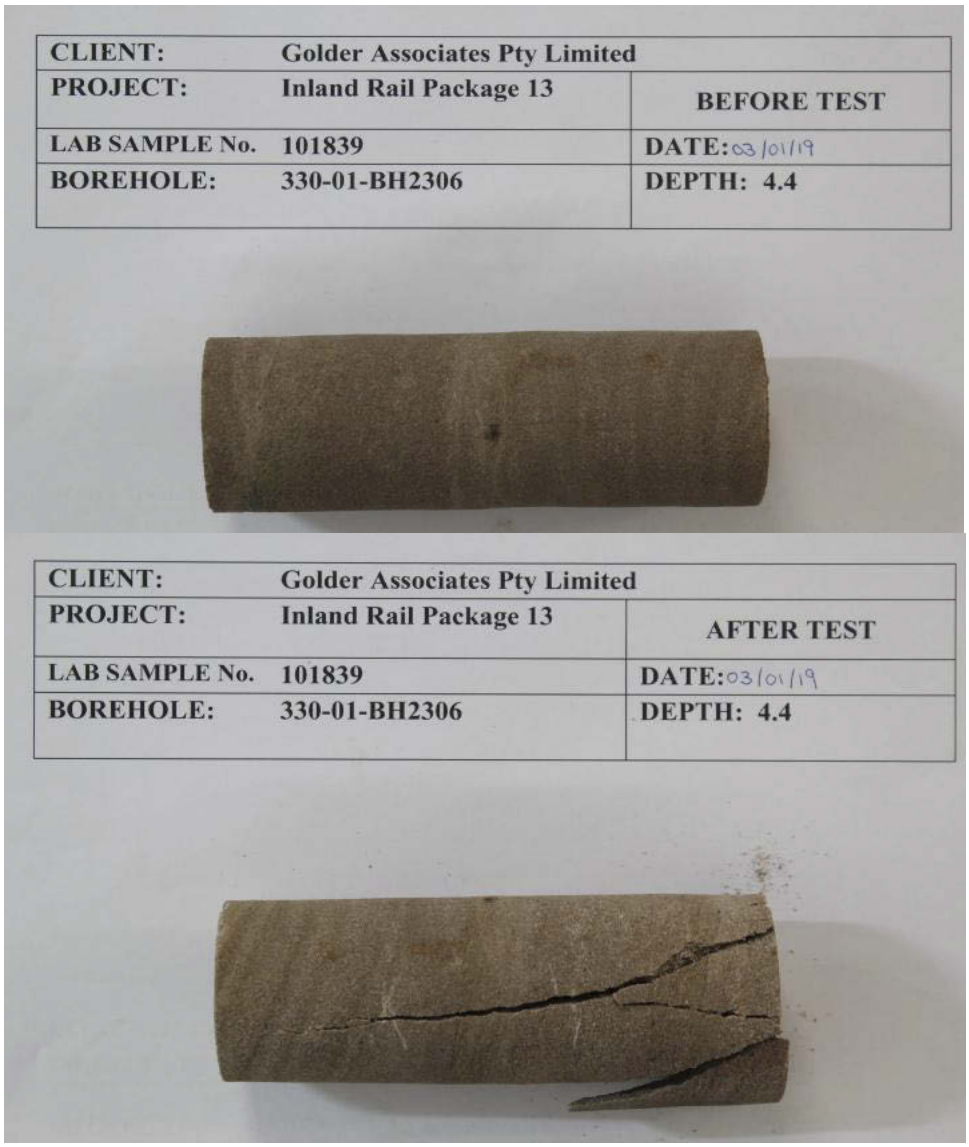
Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101839-MOD

Average Sample Diameter (mm)	51.1	Moisture Content (%)	4.7
Sample Height (mm)	148.5	Wet Density (t/m^3)	2.42
Duration of Test (min)	21.28	Dry Density (t/m^3)	2.31
Rate of Displacement (mm/min)	0.10	Bedding (°)	20
Mode of Failure	Conical	Test Apparatus	100kN Compression Machine



Notes/Remarks:

Sample/s supplied by client Photo not to scale Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

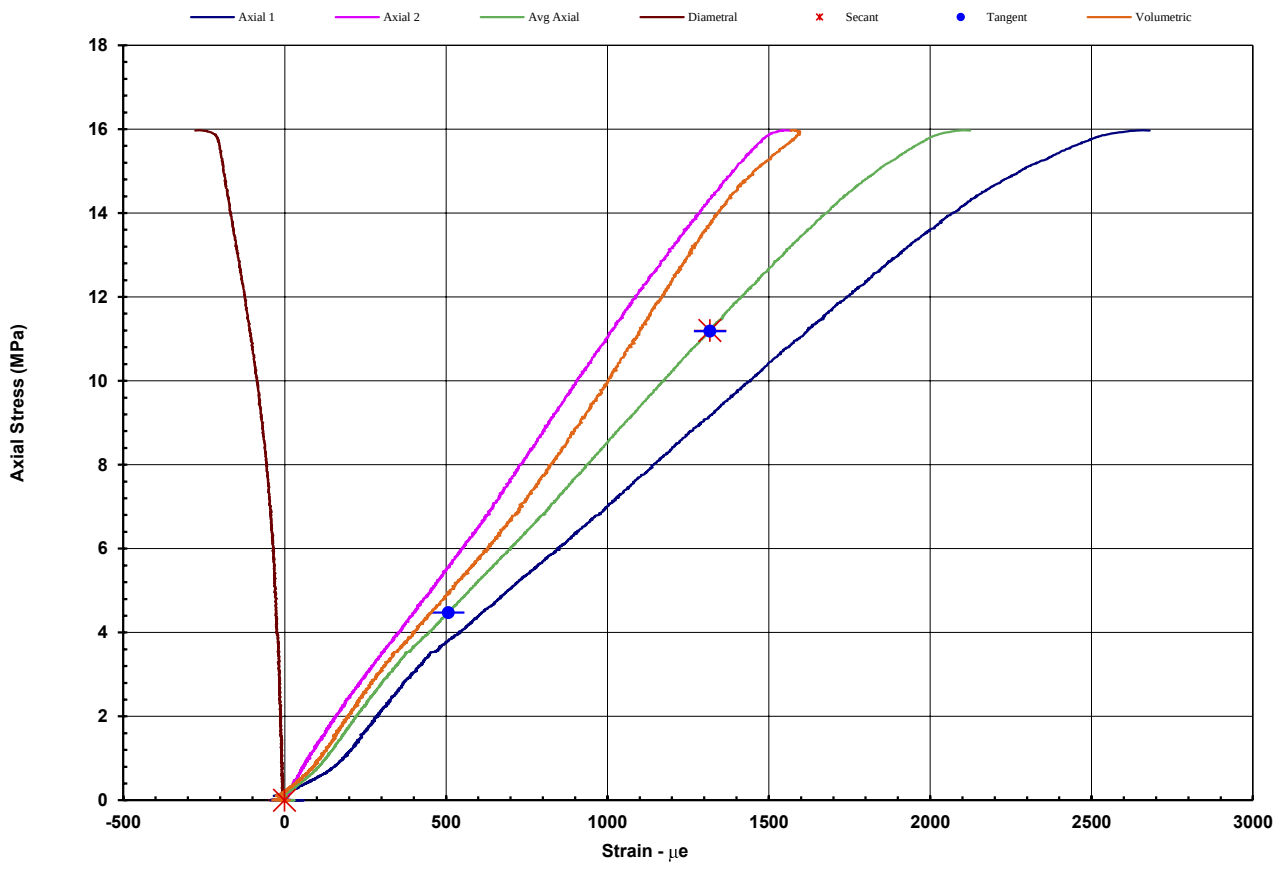
Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101841-MOD
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR3
		Test Date	3/01/2019
Project	Inland Rail Package 13	**Report Date**	7/01/2019
Project No.	1893802	**Client Sample No.**	330-01-BH2306-C01150
Bore Hole	330-01-BH2306	**Depth From (m)** 11.64	**Depth To (m)** 11.79
Description	C		
Sample Type	Single Individual Rock Core Specimen		

Uniaxial Compressive Strength 22.4 MPa

Young's Modulus		Poisson Ratio	
Tangent	8.28 GPa	0.082	from 20 % to 50 % of Max UCS
Secant	8.49 GPa	0.083	from 0 % to 50 % of Max UCS

Axial Stress vs Strain Plots



Notes/Remarks:

Sample/s supplied by client Graph not to scale Tested as received. **Page 1 of 2** EP13402

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory
C.N. Madison

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

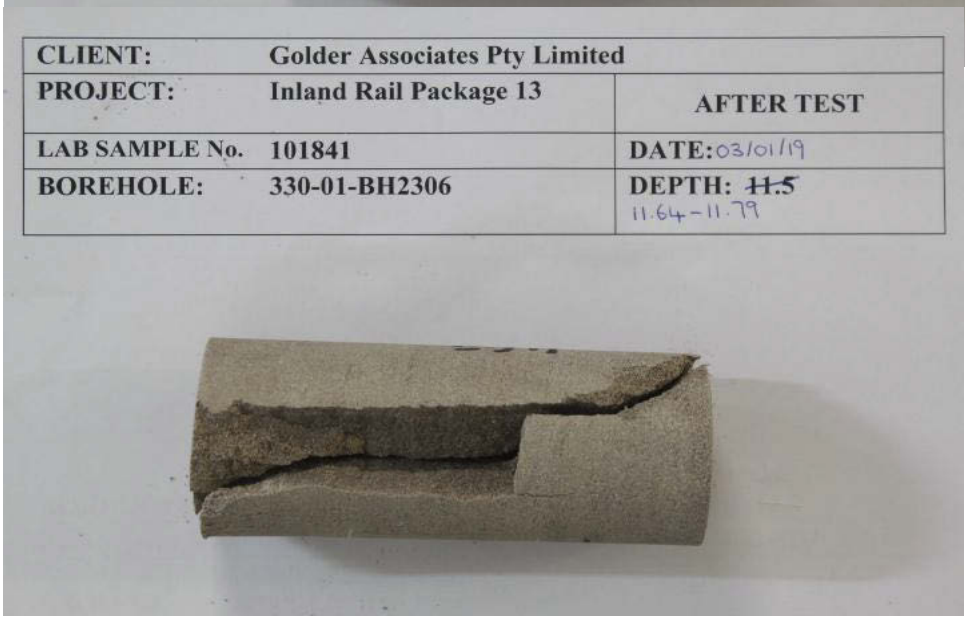
Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101841-MOD

Average Sample Diameter (mm)	51.7	Moisture Content (%)	4.2
Sample Height (mm)	134.5	Wet Density (t/m^3)	2.50
Duration of Test (min)	26.42	Dry Density (t/m^3)	2.40
Rate of Displacement (mm/min)	0.10	Bedding (°)	10
Mode of Failure	Shear	Test Apparatus	100kN Compression Machine



Notes/Remarks:

Sample/s supplied by client Photo not to scale Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

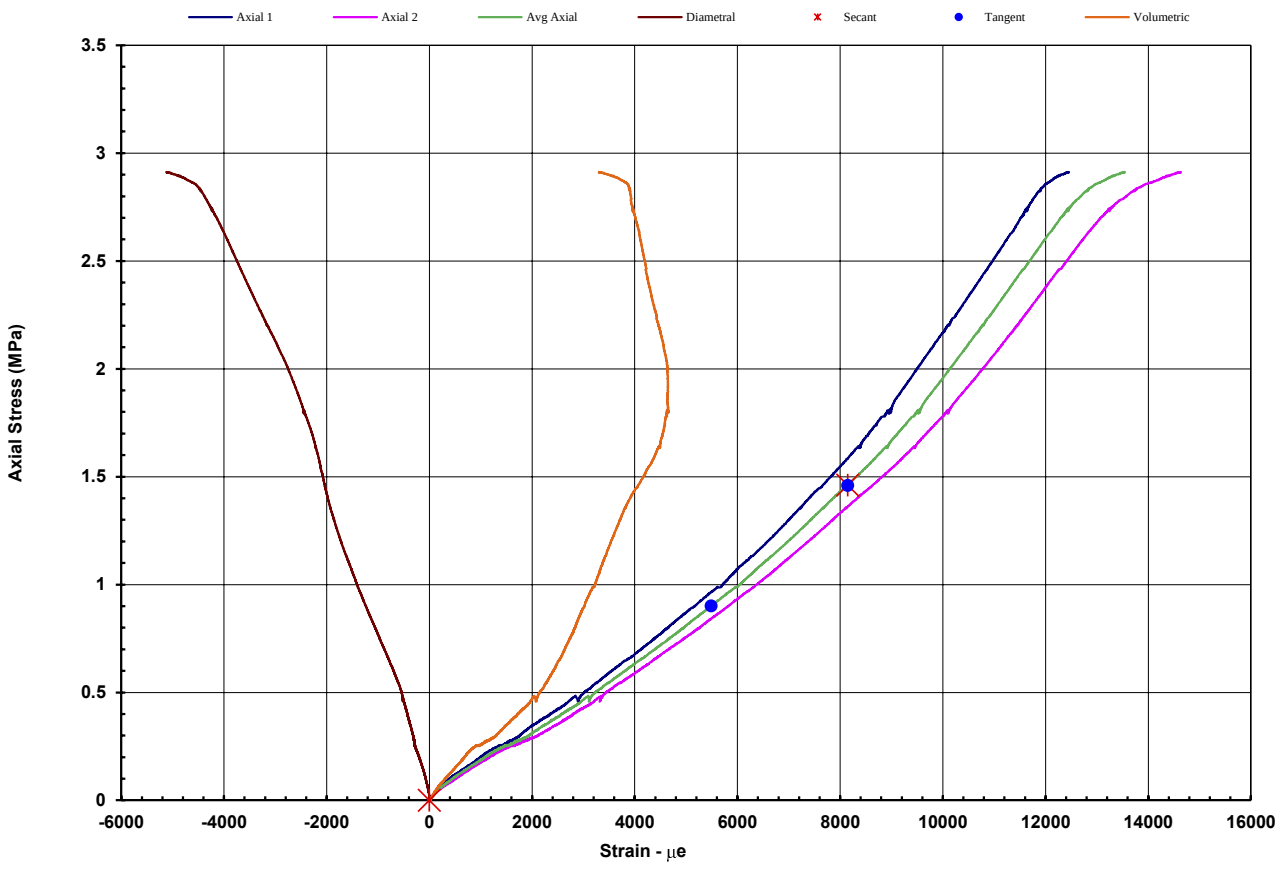
Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101843-MOD
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR3
		Test Date	3/01/2019
Project	Inland Rail Package 13	**Report Date**	7/01/2019
Project No.	1893802	**Client Sample No.**	330-01-BH2306-C01500
Bore Hole	330-01-BH2306	**Depth From (m)** 15.65	**Depth To (m)** 15.79
Description	C		
Sample Type	Single Individual Rock Core Specimen		

Uniaxial Compressive Strength 2.91 MPa

	Young's Modulus	Poisson Ratio	
Tangent	0.210 GPa	0.250	from 31 % to 50 % of Max UCS
Secant	0.179 GPa	0.250	from 0 % to 50 % of Max UCS

Axial Stress vs Strain Plots



Notes/Remarks:

Sample/s supplied by client Graph not to scale Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory
C.N. Hamilton

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

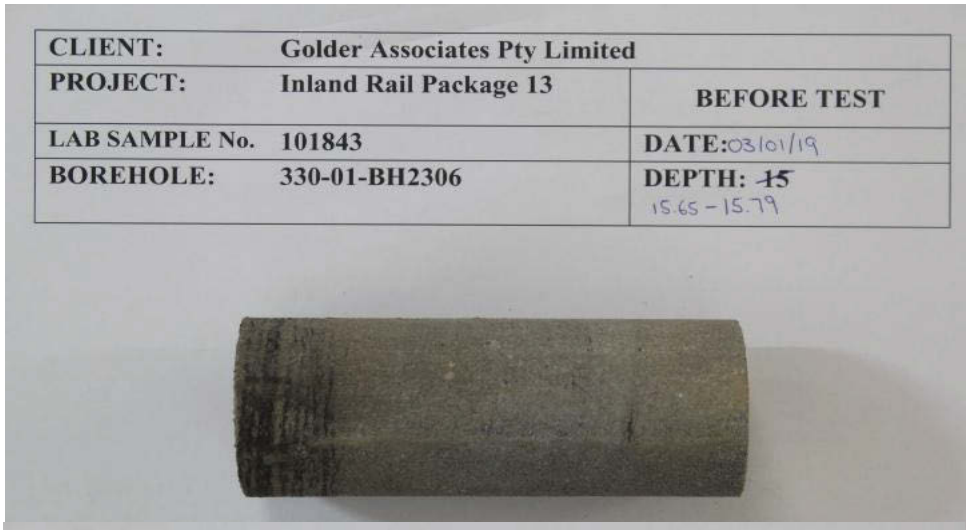
Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

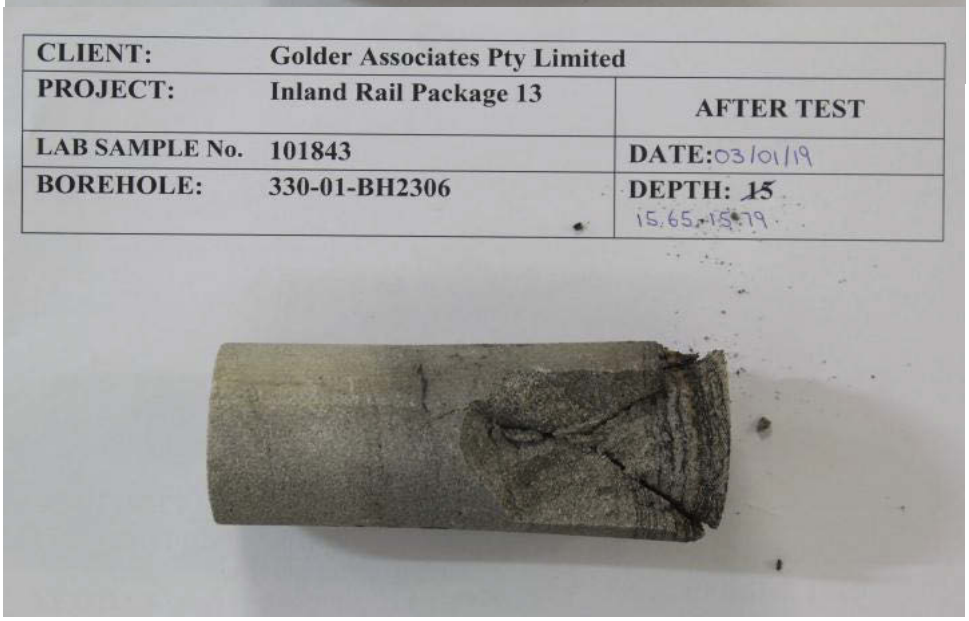
UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101843-MOD

Average Sample Diameter (mm)	51.7	Moisture Content (%)	8.1
Sample Height (mm)	134.1	Wet Density (t/m^3)	2.34
Duration of Test (min)	31.95	Dry Density (t/m^3)	2.17
Rate of Displacement (mm/min)	0.10	Bedding (°)	15
Mode of Failure	Conical	Test Apparatus	100kN Compression Machine





Notes/Remarks:

Sample/s supplied by client Photo not to scale Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

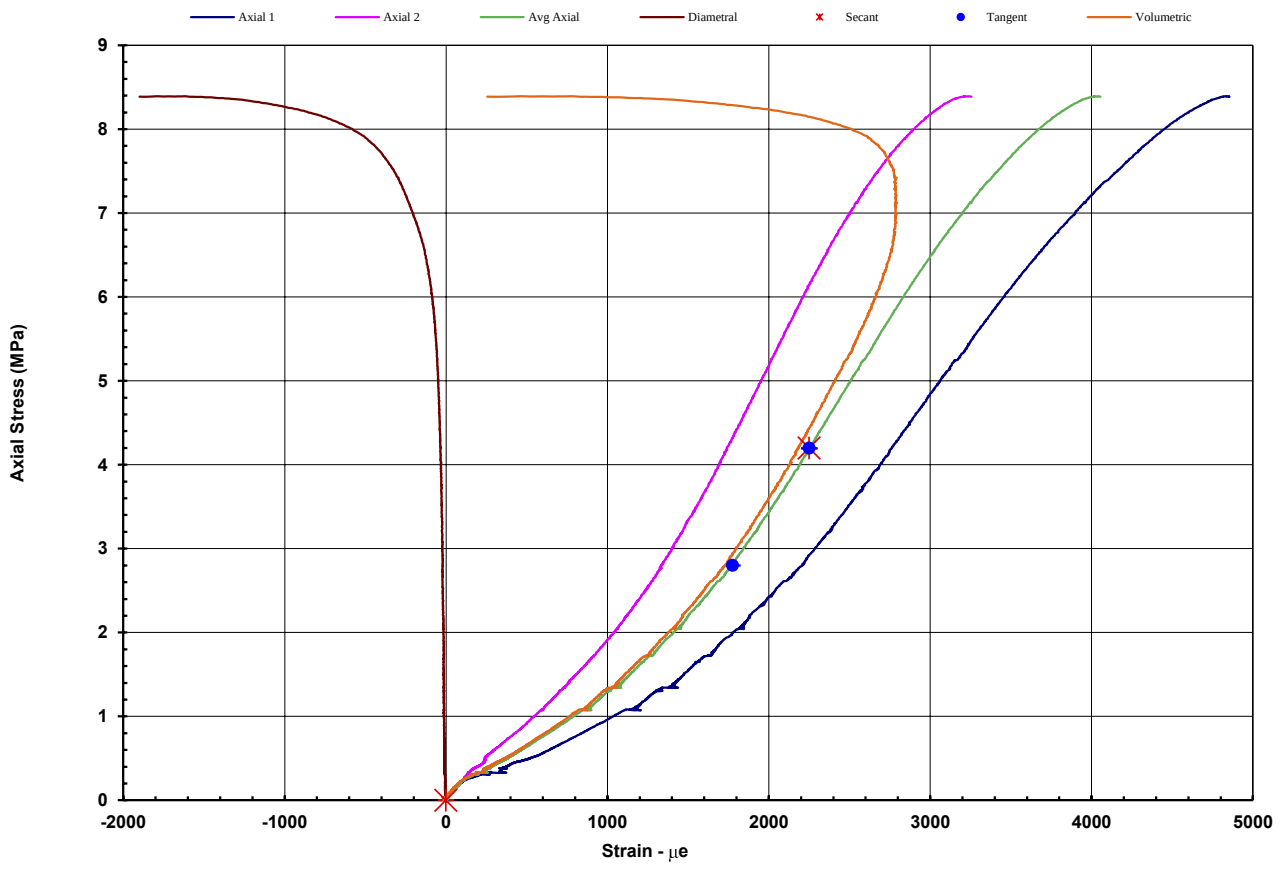
Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101847-MOD
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR3
		Test Date	3/12/2019
Project	Inland Rail Package 13	**Report Date**	7/12/2019
Project No.	1893802	**Client Sample No.**	330-01-BH2306-C02150
Bore Hole	330-01-BH2306	**Depth From (m)** 21.58	**Depth To (m)** 21.71
Description	C		
Sample Type	Single Individual Rock Core Specimen		

Uniaxial Compressive Strength 8.39 MPa

Young's Modulus		Poisson Ratio	
Tangent	2.94 GPa	0.015	from 33 % to 50 % of Max UCS
Secant	1.86 GPa	0.015	from 0 % to 50 % of Max UCS

Axial Stress vs Strain Plots



Notes/Remarks:

Sample/s supplied by client Graph not to scale Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory
C.N. Madison

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

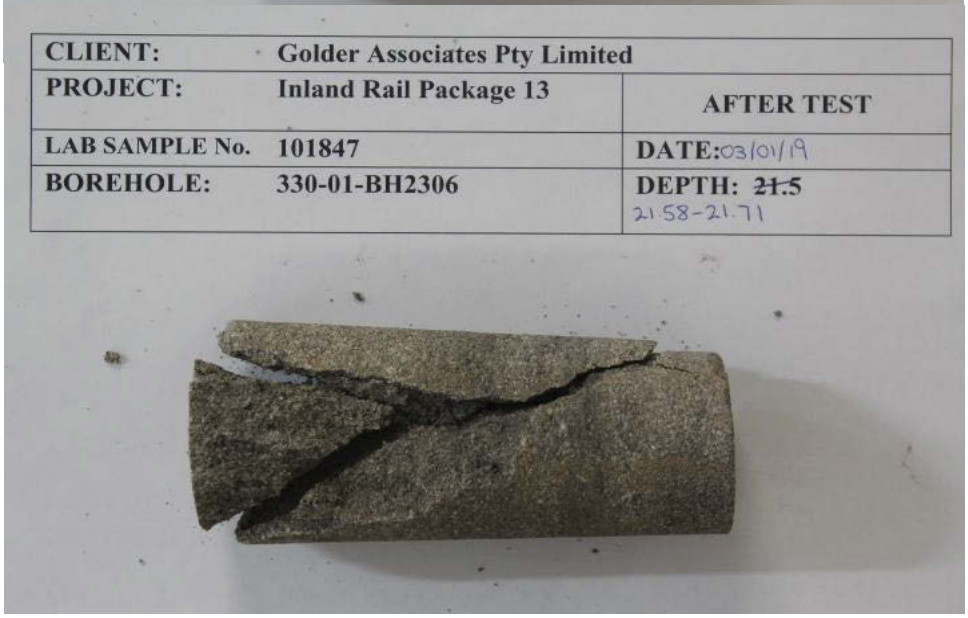
Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101847-MOD

Average Sample Diameter (mm)	51.6	Moisture Content (%)	6.8
Sample Height (mm)	135.9	Wet Density (t/m^3)	2.37
Duration of Test (min)	19.17	Dry Density (t/m^3)	2.22
Rate of Displacement (mm/min)	0.10	Bedding (°)	10
Mode of Failure	Conical	Test Apparatus	100kN Compression Machine



Notes/Remarks:

Sample/s supplied by client Photo not to scale Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

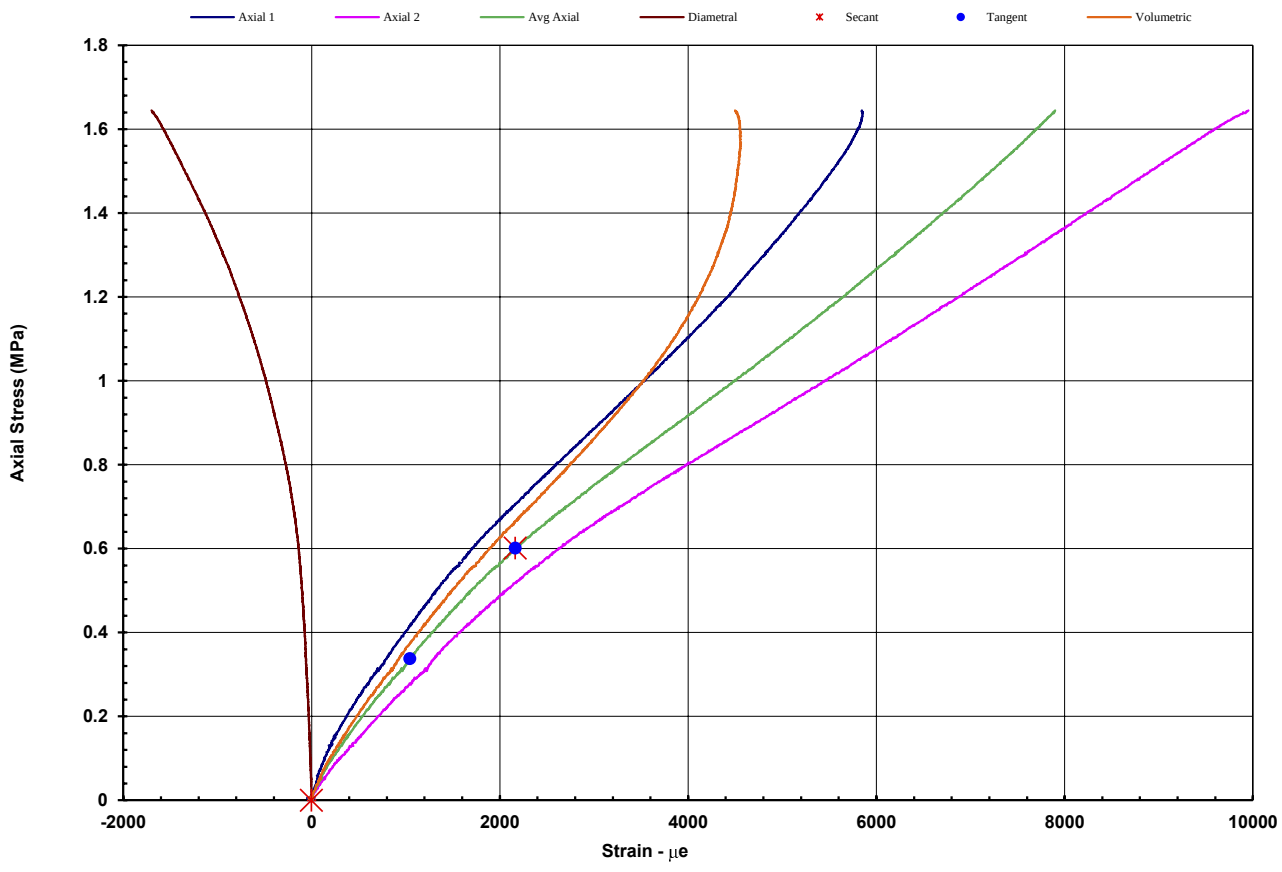
Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101848-MOD
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR3
		Test Date	3/01/2019
Project	Inland Rail Package 13	**Report Date**	7/01/2019
Project No.	1893802	**Client Sample No.**	330-01-BH2306-C02400
Bore Hole	330-01-BH2306	**Depth From (m)** 23.83	**Depth To (m)** 23.97
Description	C		
Sample Type	Single Individual Rock Core Specimen		

Uniaxial Compressive Strength 1.67 MPa

	Young's Modulus	Poisson Ratio	
Tangent	0.236 GPa	0.064	from 20 % to 36 % of Max UCS
Secant	0.278 GPa	0.064	from 0 % to 36 % of Max UCS

Axial Stress vs Strain Plots



Notes/Remarks:

Sample/s supplied by client Graph not to scale Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory

C.N. Madison

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

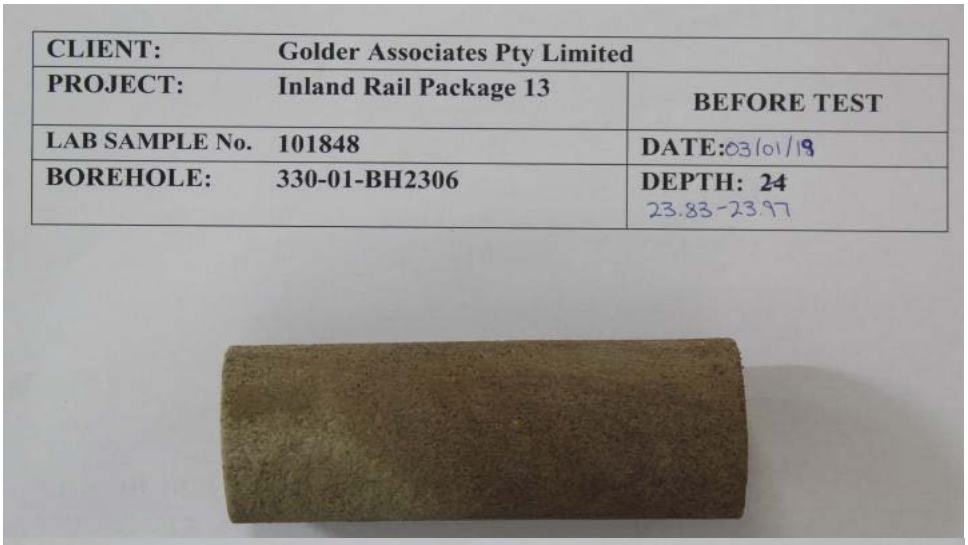
Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

UNIAXIAL COMPRESSIVE STRENGTH & DEFORMATION TEST REPORT

Test Method: AS 4133.4.3.2 & AS 4133.1.1.1

Client	Golder Associates Pty Limited	**Report No.**	GA101848-MOD

Average Sample Diameter (mm)	51.8	Moisture Content (%)	17.8
Sample Height (mm)	137.1	Wet Density (t/m^3)	2.17
Duration of Test (min)	21.33	Dry Density (t/m^3)	1.84
Rate of Displacement (mm/min)	0.10	Bedding (°)	Nil
Mode of Failure	Shear	Test Apparatus	100kN Compression Machine



Notes/Remarks:

Sample/s supplied by client Photo not to scale Tested as received.

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Brazilian Test Indirect Tensile

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

INDIRECT TENSILE - BRAZILIAN TEST REPORT

Test Method: ASTM D3967 - Standard Test Method for Splitting Tensile Strength of Intact Rock Core Specimens

Client	Golder Associates Pty Limited	**Report No.**	GA101587-BR
Address	PO Box 1734 MILTON BC QLD 4064	**Test Date**	30/11/2018
		Report Date	04/12/2018
Project	Inland Rail Package 13		

Sample No.	101587	101595	101601	101621	101630	101640
Client ID	330-01-BH2101-C07000	330-01-BH2101-C07200	330-01-BH2101-C08100	330-01-BH2101-C08700	330-01-BH2101-C09100	330-01-BH2101-C09600
Depth (m)	70.00-71.00	72.00-72.90	81.00-82.00	87.00-87.50	91.00-91.70	96.00-96.90
Description	C	C	C	C	C	C
Wet Density (t/m^3)	2.11	2.05	2.17	2.17	2.20	2.28
Moisture Content (%)	8.4	8.1	9.3	6.8	9.2	7.8
Specimen Length (mm)	36.1	38.7	41.5	40.7	35	42.1
Specimen Diameter (mm)	60.9	60.8	60.8	60.3	60.9	60.7
Bedding Angle with Relation to Axial Plane (°)	Nil	Nil	15	10	5	15
Bedding Parallel or Perpendicular to Direction of Loading	N/A	N/A	Parallel	Parallel	Parallel	Parallel
Mode of Failure	Axial Splitting	Axial Splitting	Axial Splitting	Axial Splitting	Axial Splitting	Axial Splitting
Test Duration (min:sec)	1:29	1:16	1:23	1:35	1:04	1:02
Average Load Rate (MPa/sec)	0.017	0.01	0.012	0.004	0.004	0.021
Load at Primary Failure (N)	5259	2779	4079	1610	878	5190
TENSILE STRENGTH (MPa) $TS = 0.636 \times (Load/(Diameter \times Length))$ MPa	1.52	0.751	1.03	0.417	0.262	1.29

NOTES/REMARKS:

Sample/s supplied by the client

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

INDIRECT TENSILE - BRAZILIAN TEST REPORT

Test Method: ASTM D3967 - Standard Test Method for Splitting Tensile Strength of Intact Rock Core Specimens

Client	Golder Associates Pty Limited	**Report No.**	GA101643-BR
Address	PO Box 1734 MILTON BC QLD 4064	**Test Date**	30/11/2018
		Report Date	04/12/2018
Project	Inland Rail Package 13		

Sample No.	101643	101656	101666	101670	101679	101701
Client ID	330-01-BH2101-C09970	330-01-BH2101-C10820	330-01-BH2101-C11400	330-01-BH2101-C11700	330-01-BH2101-C12030	330-01-BH2102-C01020
Depth (m)	99.70-99.90	108.20-109.00	114.00-115.00	117.00-117.90	120.30-120.90	10.20-11.00
Description	C	C	C	C	C	C
Wet Density (t/m^3)	2.66	2.05	2.30	2.31	2.34	2.46
Moisture Content (%)	3.0	7.7	6.0	6.8	8.0	4.2
Specimen Length (mm)	34.5	36.3	40.3	45.6	38.4	31.1
Specimen Diameter (mm)	60.7	60.7	60.9	60.9	60.6	51.7
Bedding Angle with Relation to Axial Plane (°)	5	5	5	10	5	30
Bedding Parallel or Perpendicular to Direction of Loading	Parallel	Parallel	Parallel	Parallel	Parallel	Parallel
Mode of Failure	Axial Splitting	Axial Splitting	Axial Splitting	Axial Splitting	Axial Splitting	Axial Splitting
Test Duration (min:sec)	1:37	0:43	1:08	1:12	1:10	3:02
Average Load Rate (MPa/sec)	0.084	0.005	0.036	0.037	0.028	0.041
Load at Primary Failure (N)	26727	718	9526	11535	7106	18780
TENSILE STRENGTH (MPa) $TS = 0.636 \times (Load/(Diameter \times Length))$ MPa	8.12	0.207	2.47	2.64	1.94	7.43

NOTES/REMARKS:

Sample/s supplied by the client

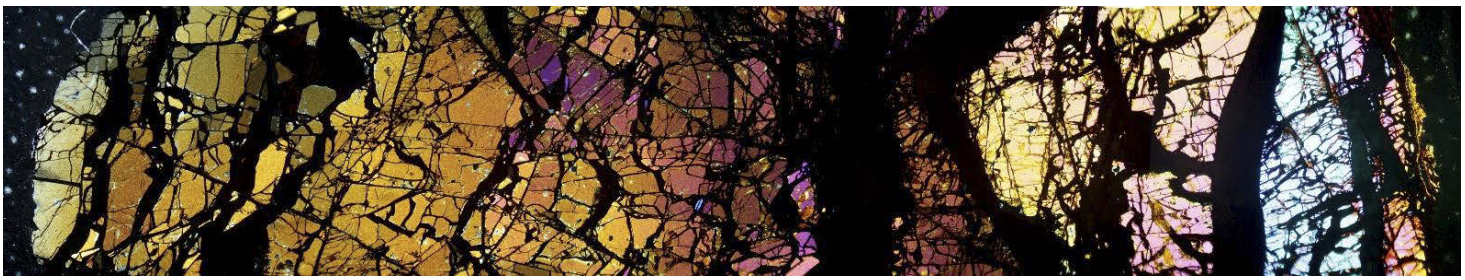
Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Petrographic Reports



Geochempet Services

ABN 980 6945 3445
PETROLOGICAL and GEOCHEMICAL CONSULTANTS
Principals: K.E. Spring B.Sc. (Hons), MAppSc and H.M. Spring B.Sc.

5/14 Redcliffe Gardens Drive
Clontarf, QLD 4019

Telephone: (07) 3284 0020

Email: info@geochempet.com
www.geochempet.com

PETROGRAPHIC REPORT ON A DRILL CORE SAMPLE (101580) FROM INLAND RAIL PROJECT

prepared for

TRILAB PTY LTD
BRISBANE OFFICE

Purchase Order:	BNE 1912014
Invoice Number:	00008538
Client Ref:	Chris Channon

Issued by

K. E. Spring BSc (Hons), MAppSc
10 January 2019

GEOCHEMPET SERVICES, BRISBANE

Sample Number:	101580	**Date Sampled**:	Unknown
Sample Type:	Drill Core	**Date Received**:	14/12/2018
Borehole:	330-01-BH2101-C07000	**Depth**:	70.00– 71.00 m
Project ID:	1893802 Inland Rail Package 13		
Work Requested	Petrographic analysis		
Methods	Account taken of ASTM C295 Standard Guide for *Petrographic Assessment of Aggregates for Concrete* and the AS2758.1 – 2014 *Aggregates and rock for engineering purposes part 1; Concrete aggregates (Appendix B)*		
Identification	Ferruginous quartz sandstone		

Description

The sample consisted of a drill core specimen of ferruginous, weathered, moderately robust, medium to coarse-grained dark reddish sandstone. The core can be unevenly scratched by a steel tool but a thin slab can be broken by hand pressure, fretted by a fingernail and is apparently water absorbent.

Plate 1: Photograph of supplied drill core.

A thin section was prepared from the drill core for detailed microscopic examination in transmitted polarized light. An approximate mineralogical composition of the rock, expressed in volume percent and based on a brief count of 100 widely spaced observation points in thin section, is:

Hard, Durable Components

33%	quartz sand grains
17%	feldspar sand grains
<1%	other resistate mineral grains (tourmaline)
6%	quartzite clasts
2%	chert clasts
2%	vein quartz clasts
4%	feldspar sand grains
1%	acid tuffaceous/volcanic sand clasts
1%	intermediate volcanic clasts

Soft, Weak &/Or Deleterious Components

1%	free muscovite flakes
<1%	argillized and sericitized clasts of uncertain origin
3%	kaolinite
27%	earthy secondary iron oxide (hematite)
3%	pores

In thin section, the framework of the rock is seen to consist of conspicuous sub-rounded, moderately sorted quartz grains which range in size from about 0.02 to 1 mm cemented by dominantly by hematite and minor kaolinite.

This sample is a subtly graded, medium to coarse grained, matrix-supported sandstone dominated by sub-rounded grains of quartz with fine-grained deep red iron oxides aggregated along grain boundaries. The detrital quartz grains are almost all mildly to moderately-strained, sometimes occurring as polycrystalline grains and occasionally carry a few mica inclusions. A careful searched showed a few accessory bluish tourmaline grains that support a granite/granite gneiss source. The presence of a few clouded microcline feldspar grains as well as lithic clasts of acid and intermediate volcanics are observed. Other framework grains include a few detrital mica flakes and some buff coloured extremely fine-grained siliceous lithic clasts of cherty, quartzite and heavily-strained vein quartz style along with occasional argillized/sericitized clasts.

The matrix cement between framework grains in this rock consists of volumetrically dominant earthy blebs, linings and fillings of a red iron oxide or hydroxide (probably hematite) along with some minor clots of kaolinite.

Irregular pores are also observed in the hematitic cement and may the result of thin section preparation washing out some of the clays.

Comments and Interpretations

The supplied drill core sample (labelled 101580) from the Inland Rail Project is identified as coarse-grained, quartz sandstone ferruginized by a hematite cementing matrix.

For engineering purposes, the rock in the supplied drill core sample may be summarised as consisting of:

- **quartz sandstone** (a sedimentary rock type)
- slightly porous (about 3% pores)
- moderately to heavily weathered
- hematite-cemented
- contains about 31% of soft, weak minerals mostly as an earthy hematitic cement
- **essentially hard**
- **moderately strong**

The rock is predicted to be **moderately durable**.

Free Silica Content

The free silica or quartz content is estimated to be about 60%.

Carbonate content

The carbonate content is estimated to be nil.

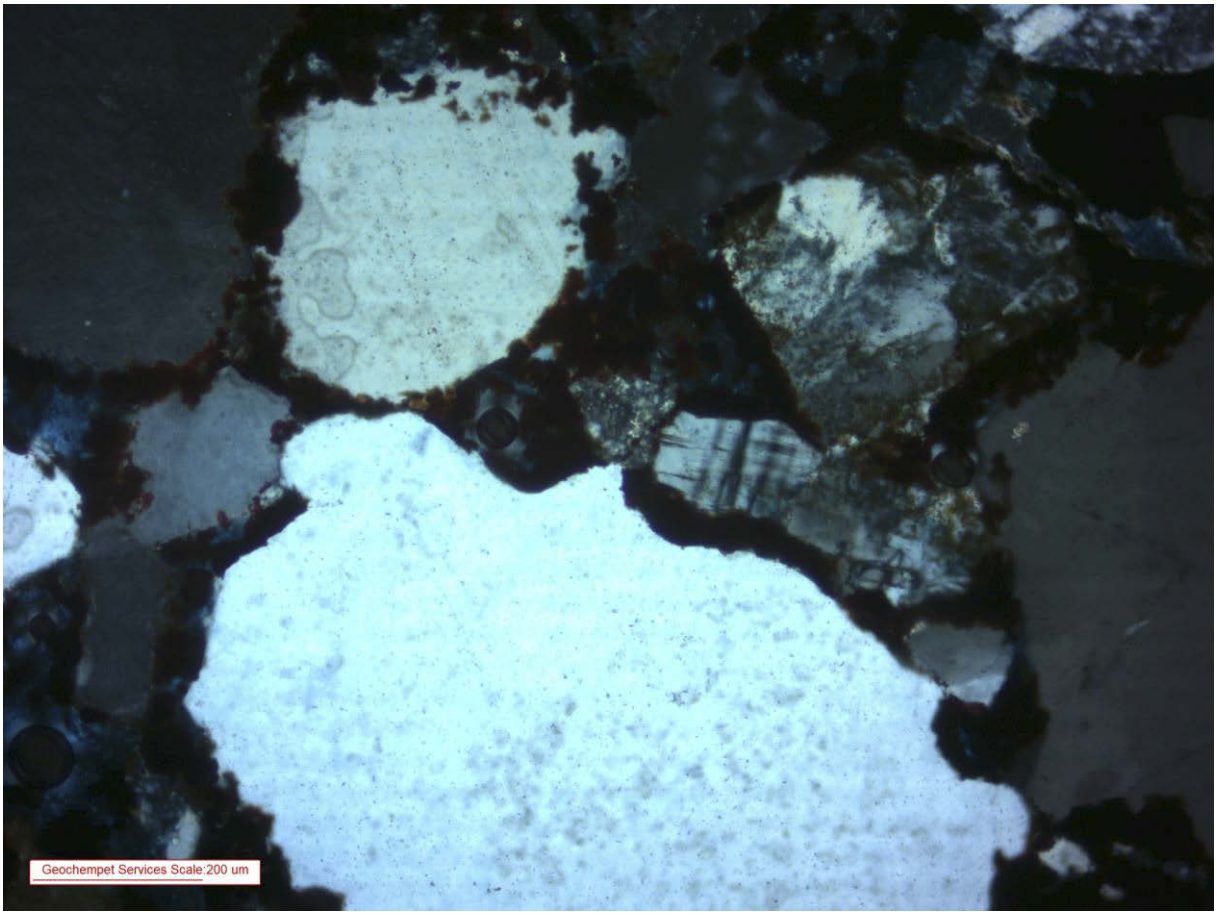
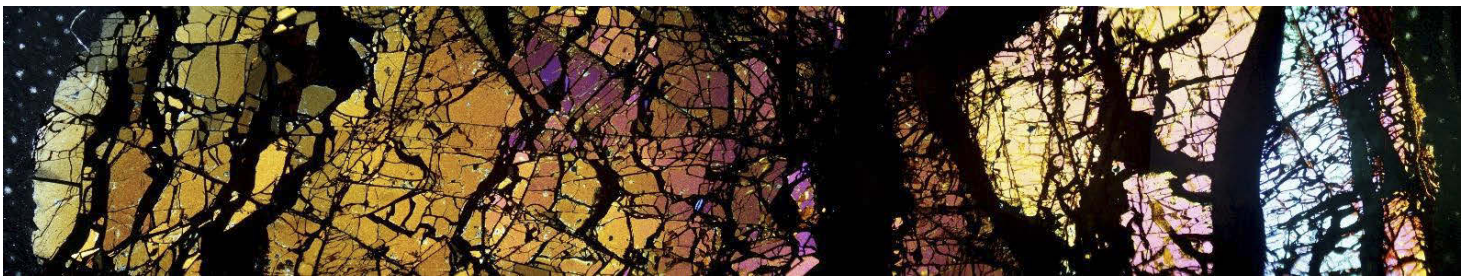


Plate 2: Low magnification, cross polarised light image of the sandstone, showing quartz and feldspar grains in a hematitic matrix.



Geochempet Services

ABN 980 6945 3445
PETROLOGICAL and GEOCHEMICAL CONSULTANTS
Principals: K.E. Spring B.Sc. (Hons), MAppSc and H.M. Spring B.Sc.

5/14 Redcliffe Gardens Drive
Clontarf, QLD 4019

Telephone: (07) 3284 0020

Email: info@geochempet.com
www.geochempet.com

PETROGRAPHIC REPORT ON A DRILL CORE SAMPLE (101599) FROM INLAND RAIL PROJECT

prepared for

TRILAB PTY LTD
BRISBANE OFFICE

Purchase Order: BNE 1912014
Invoice Number: 00008538
Client Ref: Chris Channon

Issued by

C. A. Bruggemann
BAppSc, MEngSC, MIEAust
10 January 2019

Reviewed by

K. E. Spring
BSc (Hons), MAppSc
10 January 2019

GEOCHEMPET SERVICES, BRISBANE

Sample Number:	101599	**Date Sampled**:	Unknown
Sample Type:	Drill Core	**Date Received**:	14/12/2018
Borehole:	330-01-BH2101-C08100	**Depth**:	81.00 – 82.00 m
Project ID:	1893802 Inland Rail Package 13		

Work Requested Petrographic analysis and determination of quartz and carbonate content

Methods Account taken of ASTM C295 Standard Guide for *Petrographic Assessment of Aggregates for Concrete* and the AS2758.1 – 2014 *Aggregates and rock for engineering purposes part 1; Concrete aggregates (Appendix B)*

Identification Carbonated quartzofeldspathic and lithic sandstone

Description

The sample consisted of a drill core specimen which is very slightly weathered, grey sandstone with slight bedding evident. Weathering is expressed through weathered/argillized clasts scattered throughout the core. The core can be scratched by a steel tool. It seems to consist of a mixture of minerals, some as hard as quartz and others as soft as clay. The rock is medium grained and is slowly hygroscopic.

Plate 1: Photograph of supplied drill core.

A thin section was prepared from the drill core for detailed microscopic examination in transmitted polarized light. An approximate mineralogical composition of the rock, expressed in volume percent and based on a brief count of 100 widely spaced observation points in thin section, is:

Hard, Durable Components

36%	quartz sand grains
9%	feldspar sand grains
2%	other mineral grains (opaque oxide, leucoxene (1%), zircon, hornblende (1%))
5%	quartzite clasts
4%	acid tuffaceous/volcanic sand clasts (1% fine microcrystalline quartz)
4%	intermediate volcanic clasts (largely argillized)
<1%	basalt clasts
<1%	meta-pelite clasts

Moderately Durable Components

25%	carbonate

Soft, Weak &/Or Deleterious Components

2%	muscovite
<1%	argillized and sericitized clasts of uncertain origin
4%	interstitial sericite-smectite clays
8%	zeolite
<1%	earthy secondary iron oxide
<1%	carbonaceous matter
1%	pores

In thin section, the rock is a medium grained, carbonated, quartzofeldspathic and lithic sandstone with an average grainsize of about 0.2 to 0.6 mm. It is relatively well sorted, and shows a weak bedding defined by grainsize grading.

The framework grains are dominated by sub-rounded to sub-angular lithic clasts, some of which are quite argillized, along with quartz and feldspar grains. Lithic clasts were very fine-grained quartzo-feldspathic grains with strong pale brown sericite-smectite alteration. Due to their fine grainsize, it is difficult to be sure that these were derived from formerly glassy rhyolite/dacite lava fragments along with minor intermediate volcanics. Equant to sub-rounded detrital quartz and blocky sub-rounded to euhedral feldspar grains are relatively common suggesting derivation from phenocrysts in felsic volcanic or explosive volcaniclastic rocks. Occasionally, there are detrital muscovite flakes (about 0.1 mm long) with long axes sub-parallel to the bedding along with some opaque oxides and carbonaceous specks. Other lithic clasts comprise of quartzite, basalt and meta-pelite.

The matrix of this rock is now composed of largely fine quartz and extremely fine-grained sericite/smectite clays which have been partly altered to carbonate and zeolite.

Comments and Interpretations

The supplied drill core sample (labelled 101599) from the Inland Rail Project is identified as medium grained, carbonated, quartzofeldspathic and lithic sandstone. The sandstone carries some argillized lithic clasts which indicate a felsic volcanic source. Alteration is largely diagenetic dewatering of the sediment but subsequent carbonation of the rock has replaced parts of the matrix cement and hardened the sandstone.

For engineering purposes, the rock in the supplied drill core sample may be summarised as consisting of:

- **carbonated, quartzofeldspathic and lithic sandstone** (a sedimentary rock type)
- slightly porous (1% pores)
- very slightly weathered
- carbonated (25%)
- contains about 14% of soft, weak minerals as interstitial material and in altered lithic clasts
- **essentially hard**
- **essentially strong**

The rock is predicted to be **essentially durable**.

Free Silica Content

The free silica content is estimated to be about 42%.

Carbonate Content

The carbonate content is estimated to be about 25%.

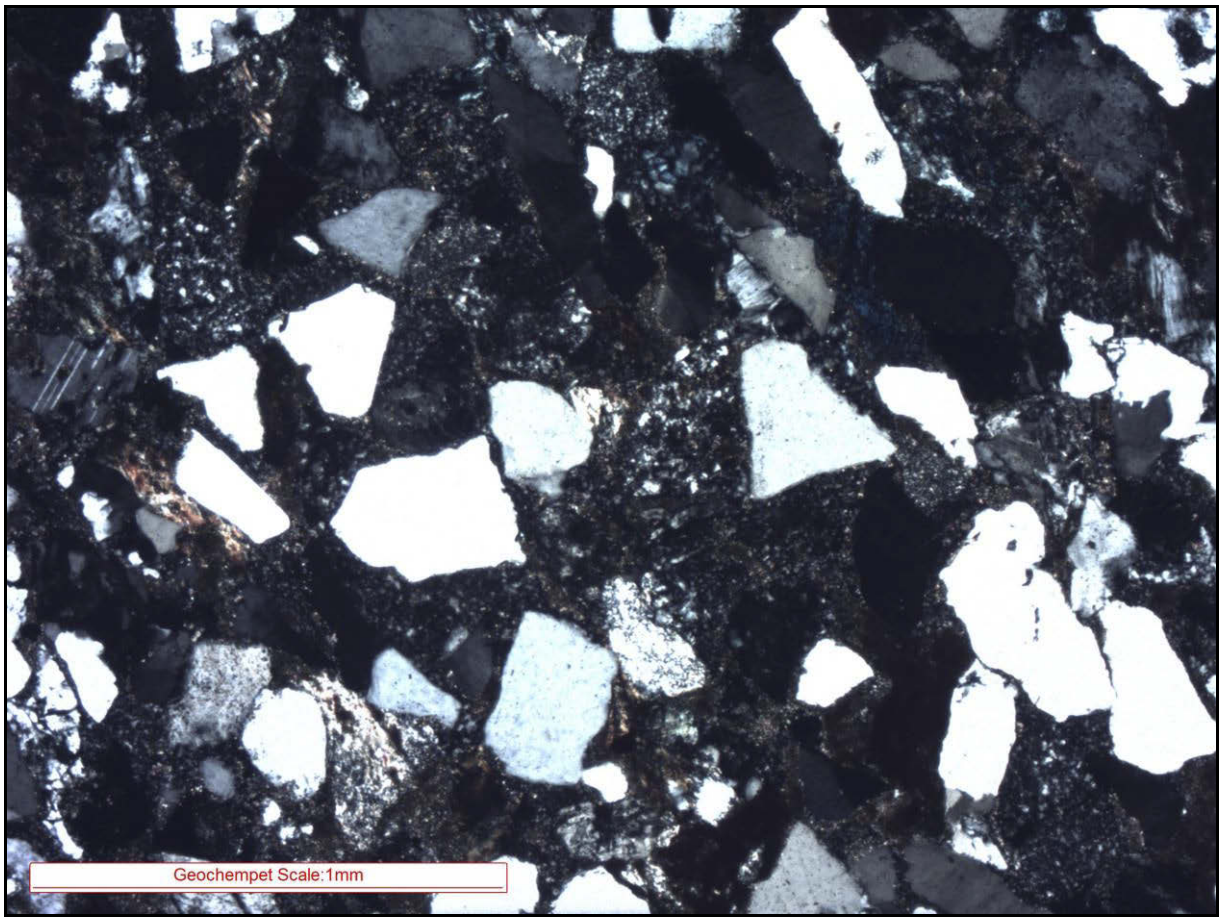
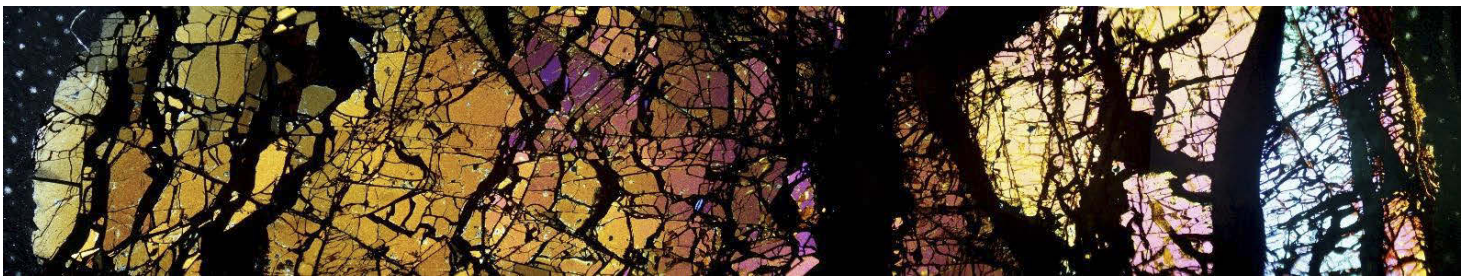


Plate 2: Low magnification, cross polarised light image of the sandstone, showing quartz and lithic grains. Note the carbonate replacing part of the matrix.



Geochempet Services

ABN 980 6945 3445
PETROLOGICAL and GEOCHEMICAL CONSULTANTS
Principals: K.E. Spring B.Sc. (Hons), MAppSc and H.M. Spring B.Sc.

5/14 Redcliffe Gardens Drive
Clontarf, QLD 4019

Telephone: (07) 3284 0020

Email: info@geochempet.com
www.geochempet.com

PETROGRAPHIC REPORT ON A DRILL CORE SAMPLE (101614) FROM INLAND RAIL PROJECT

prepared for

TRILAB PTY LTD
BRISBANE OFFICE

Purchase Order: BNE 1912014
Invoice Number: 00008538
Client Ref: Chris Channon

Issued by

C. A. Bruggemann
BAppSc, MEngSC, MIEAust
10 January 2019

Reviewed by

K. E. Spring
BSc (Hons), MAppSc
10 January 2019

Sample Number:	101614	**Date Sampled**:	Unknown
Sample Type:	Drill Core	**Date Received**:	14/12/2018
Borehole:	330-01-BH2101-C08700	**Depth**:	87.00 – 87.50 m
Project ID:	1893802 Inland Rail Package 13		
Work Requested	Petrographic analysis and determination of quartz and carbonate content		
Methods	Account taken of ASTM C295 Standard Guide for *Petrographic Assessment of Aggregates for Concrete* and the AS2758.1 – 2014 *Aggregates and rock for engineering purposes part 1; Concrete aggregates (Appendix B)*		
Identification	Clay-cemented quartz sandstone		

Description

The sample consisted of a drill core specimen which slightly weathered, pale grey, clay-cemented quartz sandstone which is easily broken under finger pressure. The rock can be deeply gouged by a steel tool. The rock appears to be mostly composed of fine to medium quartz grains (becoming coarser grained towards the base) with some clays in the interstitial matrix and carbonaceous matter denoting bedding. When soaked in water, the rock rapidly disaggregated.

Plate 1: Photograph of the supplied drill core.

A thin section was prepared from the drill core for detailed microscopic examination in transmitted polarized light. An approximate mineralogical composition of the rock, expressed in volume percent and based on a brief count of 100 widely spaced observation points in thin section, is:

Durable Minerals

55%	quartz
3%	feldspar
1%	other mineral grains (leucoxene (1%) rutile and zircon)
6%	quartzite clasts
1%	chert clasts
1%	acid tuffaceous/volcanic sand clasts (<1% fine microcrystalline quartz)

Moderately Durable Components

1%	carbonate

Weak &/or Deleterious Components

1%	muscovite
5%	argillized and sericitized clasts
11%	smectite clay cement
12%	zeolite
1%	earthy secondary iron oxide
<1%	carbonaceous matter
2%	pores

In thin section, the sandstone displays textures of poorly sorted quartz grains in a fine to medium-grained sandstone (mainly 0.05 to 0.35 mm in size, with rare clasts up to 0.6 mm). Preferred orientation of quartz grains is observed, defining bedding within the sandstone.

Most of the rock consists of simple but strained quartz grains (angular to sub-rounded in shape), a few seem to be composite grains of quartzite style, and there are minor blocky grains of clouded feldspars, as well as small detrital heavy mineral grains (leucoxene, zircon and rutile). Minor lithic clasts observed included chert and acid tuffaceous/volcanic rock fragments. The sandstone also carries some argillized and sericitized clasts, most likely after feldspars. Occasionally, there are detrital muscovite flakes (about 0.2 mm long) with long axes sub-parallel to the bedding along with some carbonaceous specks.

The sandstone is cemented by a thin connected, interstitial network of a high birefringent smectitic style of clay, which has been partly altered to carbonate and zeolite. Washouts of the clay matrix during thin section preparation has induced some porosity.

Comments and Interpretations

The supplied drill core sample (labelled 101614) from the Inland Rail Project is considered to consist of slightly weathered, clay-cemented quartz sandstone, a sedimentary rock type probably derived from a metamorphic terrain, because of the straining evident in quartz grains.

For engineering purposes, the rock represented in the supplied drill core sample may be summarised as:

- **quartz sandstone** (sedimentary rock type)
- clay-cemented
- slightly porous (2% pores)
- slightly weathered
- carries about 1% of moderately durable carbonate
- carries about 30% of weak, soft minerals as interstitial material and in altered lithic clasts
- **moderately hard**
- **moderately strong**

The rock is predicted to be **moderately durable**; because it is anticipated that in exposed conditions, wetting and drying cycles will cause the rock to disintegrate.

Free Silica Content

The free silica content is estimated to be about 62%.

Carbonate Content

The carbonate content is estimated to be about 1%.

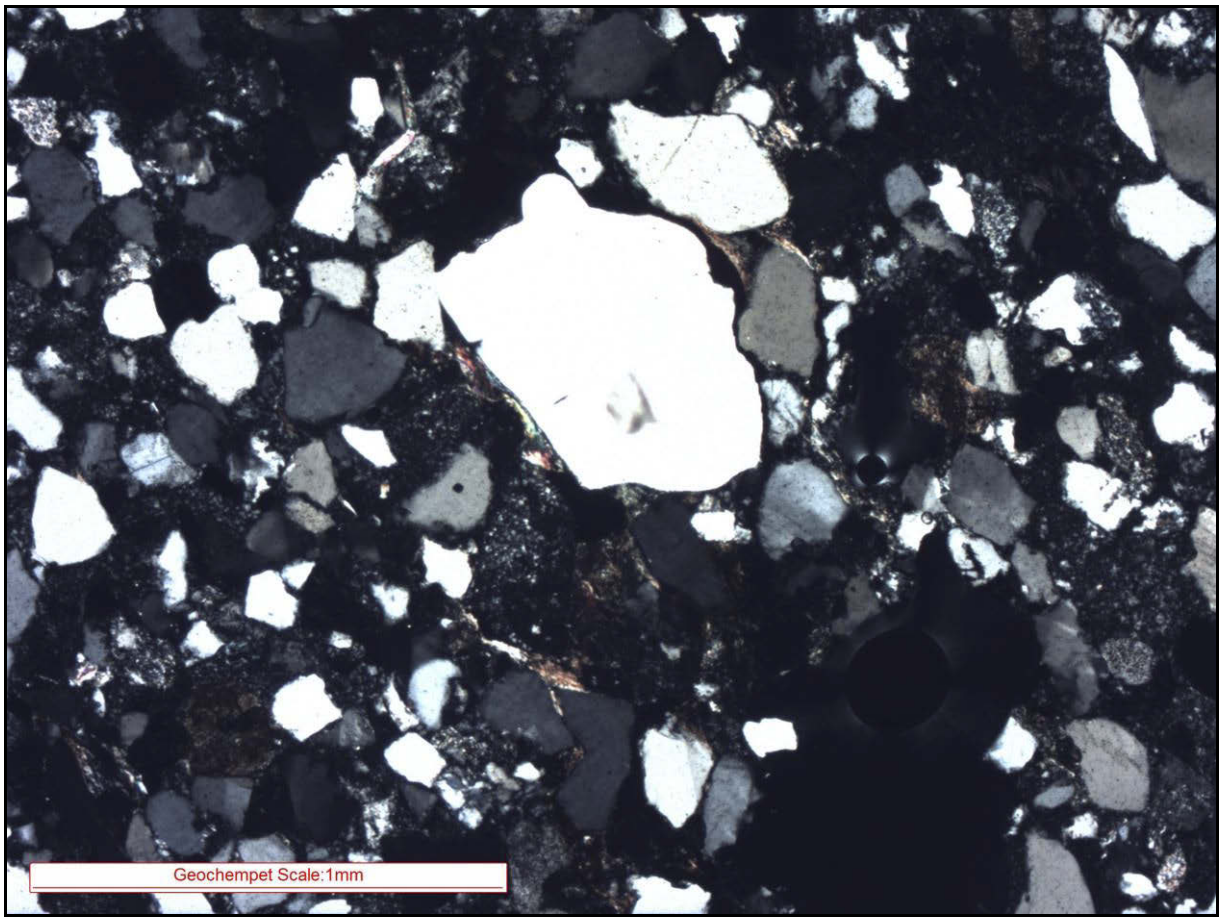
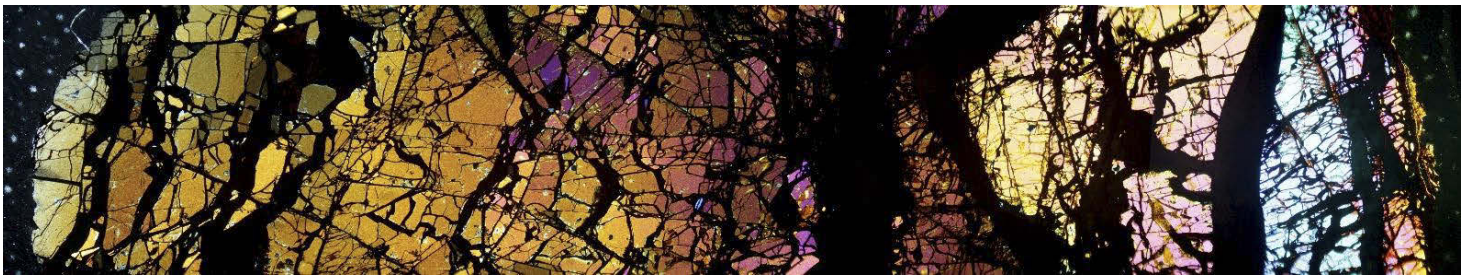


Plate 2: Low magnification, cross polarised light image of clay-cemented quartz sandstone. View is dominated by quartz grains with a thin interstitial clay cement and zeolite between grains, along with minor muscovite flakes.



Geochempet Services

ABN 980 6945 3445
PETROLOGICAL and GEOCHEMICAL CONSULTANTS
Principals: K.E. Spring B.Sc. (Hons), MAppSc and H.M. Spring B.Sc.

5/14 Redcliffe Gardens Drive
Clontarf, QLD 4019

Telephone: (07) 3284 0020

Email: info@geochempet.com
www.geochempet.com

PETROGRAPHIC REPORT ON A DRILL CORE SAMPLE (101623) FROM INLAND RAIL PROJECT

prepared for

TRILAB PTY LTD
BRISBANE OFFICE

Purchase Order: BNE 1912014
Invoice Number: 00008538
Client Ref: Chris Channon

Issued by

K. E. Spring BSc (Hons), MAppSc
10 January 2019

Sample Number:	101623	**Date Sampled**:	Unknown
Sample Type:	Drill Core	**Date Received**:	14/12/2018
Borehole:	330-01-BH2101-C09100	**Depth**:	91.00– 91.70 m
Project ID:	1893802 Inland Rail Package 13		
Work Requested	Petrographic analysis		
Methods	Account taken of ASTM C295 Standard Guide for *Petrographic Assessment of Aggregates for Concrete* and the AS2758.1 – 2014 *Aggregates and rock for engineering purposes part 1; Concrete aggregates (Appendix B)*		
Identification	Thinly laminated labile siltstone		

Description

The sample consisted of a drill core specimen which is unweathered, dark grey siltstone with thin carbonaceous laminations. The core can be deeply scratched with a steel tool leaving a grey to brown streak. It seems to consist of a mixture of minerals, some as hard as quartz and others as soft as clay. The rock is very fine grained and is soft and friable along laminations. The rock is slowly hygroscopic and will part very easily along its laminations.

Plate 1: Photograph of supplied drill core.

A thin section was prepared from the drill core for detailed microscopic examination in transmitted polarized light. An approximate mineralogical composition of the rock, expressed in volume percent and based on a brief count of 100 widely spaced observation points in thin section, is:

Hard, Durable Components

12%	quartz grains
4%	remnant feldspar grains
1%	hematized, leucoxenized or finely rutilated clasts of former detrital opaque oxides
2%	lithic clasts of acid tuffaceous clasts (<1% finely microcrystalline quartz)

Soft, Weak &/Or Deleterious Components

12%	sericitized and argillized clasts
61%	sericitic/illitic clay cement variably stained by secondary iron oxide
3%	detrital mica (muscovite flakes)
trace	pyrite
4%	carbonaceous wisps
1%	open fractures

In thin section the rock displays primary textures of finely laminated, clayey to silty style. It consists of minor sub-rounded to angular sand clasts which are mainly 0.05 to 0.1 mm in size. Bedding is delineated by grainsize variations.

Very little of the rock persist as simple quartz and feldspar grains. Other robust mineral grains comprise hematized, leucoxenized or finely rutilated clasts of former detrital opaque oxides.

Detrital flakes of mica (up to about 0.1 mm long but most are smaller) comprise muscovite flakes. Most feldspars are now almost completely argillized. Some carbonaceous wisps occur as small wisps and blebs throughout the matrix. The carbonaceous flakes are mostly aligned to bedding but some randomly distributed deformed carbonaceous seams are observed.

The siltstone is cemented by a connected, interstitial network of a sericitic/illitic style of clay heavily stained brownish by very fine carbonaceous matter and overprinted by tiny diagenetic pyrite spheres.

Comments and Interpretations

The supplied drill core sample (labelled 101623) from the Inland Rail Project is identified as thinly laminated labile siltstone. The environment had to be of low current energy in order to deposit the matrix clays, micaceous flakes and the weak carbonaceous material and is probably marginal marine due to the presence of traces of diagenetic pyrite. Alteration is light, largely diagenetic dewatering of the sediment.

For engineering purposes, the rock in the supplied drill core sample may be summarised as consisting of:

- **thinly laminated labile siltstone** (a sedimentary rock type)
- thinly fractured (about 1% open fractures)
- unweathered
- contains about 80% of soft, weak or otherwise non-durable components (sericite/illite and mica flakes as well as carbonaceous matter)
- carries a trace of pyrite, an oxidisable mineral
- **moderately hard**
- **weak to moderately strong**

The siltstone is predicted to be **non-durable to moderately durable.** The rock separated at laminations very easily (especially when wet). Its network of cementing clay will result in reduced wet strength which along with other mica flakes and oxidisable carbonaceous matter along bedding planes will lead to splitting, fretting and slow disaggregation of the siltstone upon cyclic wetting and drying.

Free silica content

The free silica or quartz content is estimated to be about 12%.

Carbonate content

The carbonate content is estimated to be nil.

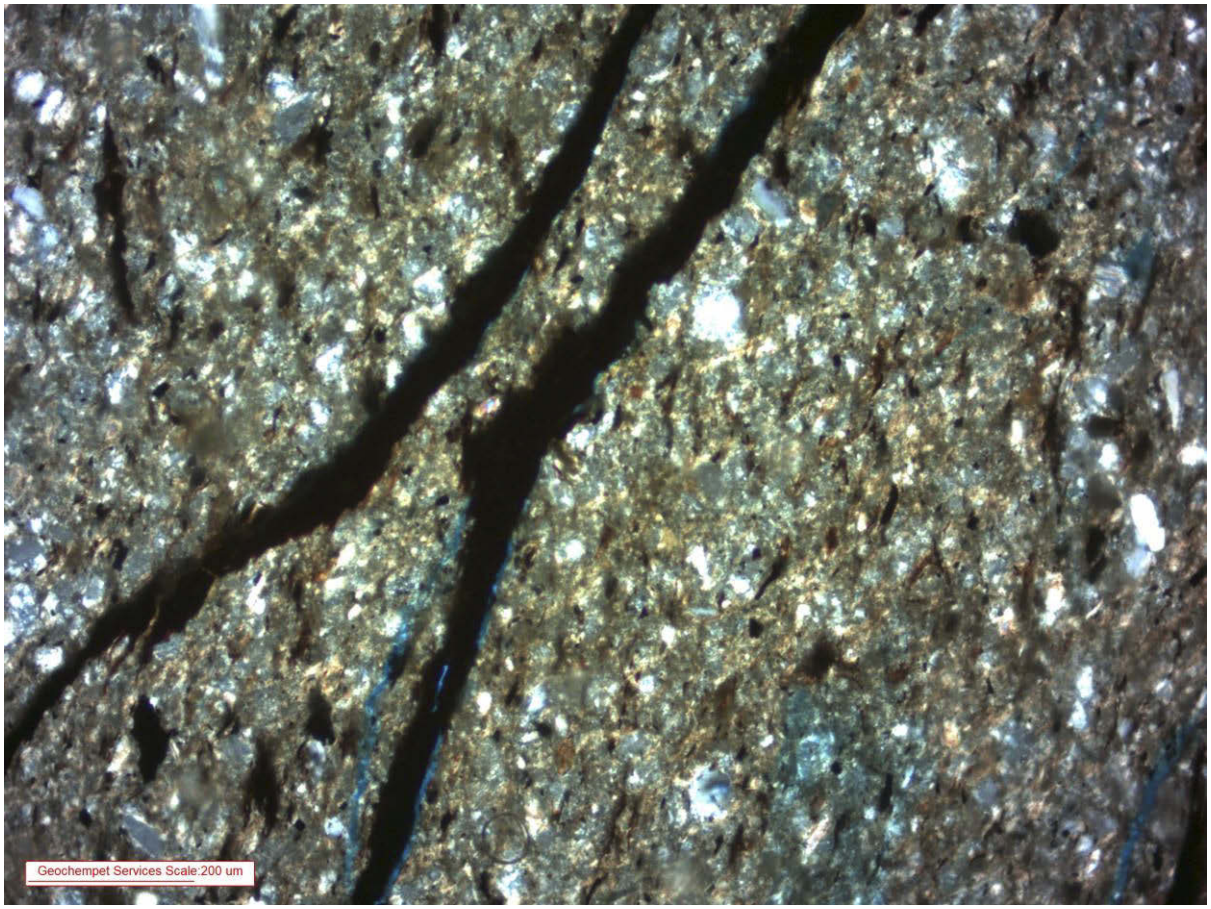
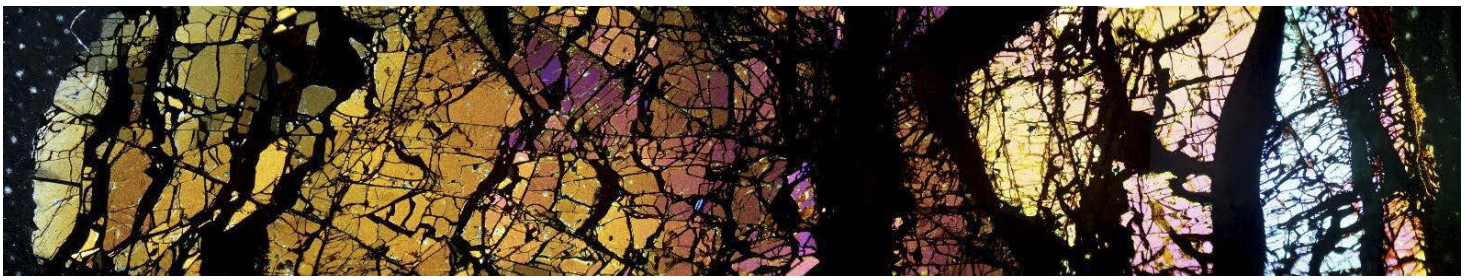


Plate 2: Medium magnification, cross polarised light image of the siltstone showing mostly sericite/illite matrix clay with some silty grains of quartz and feldspar. Note the deformed carbonaceous seams.



Geochempet Services

ABN 980 6945 3445
PETROLOGICAL and GEOCHEMICAL CONSULTANTS
Principals: K.E. Spring B.Sc. (Hons), MAppSc and H.M. Spring B.Sc.

5/14 Redcliffe Gardens Drive
Clontarf, QLD 4019

Telephone: (07) 3284 0020

Email: info@geochempet.com
www.geochempet.com

PETROGRAPHIC REPORT ON A DRILL CORE SAMPLE (101633) FROM INLAND RAIL PROJECT

prepared for

TRILAB PTY LTD
BRISBANE OFFICE

Purchase Order: BNE 1912014
Invoice Number: 00008538
Client Ref: Chris Channon

Issued by

C. A. Bruggemann
BAppSc, MEngSC, MIEAust
10 January 2019

Reviewed by

K. E. Spring
BSc (Hons), MAppSc
10 January 2019

Sample Number:	101633	**Date Sampled**:	Unknown
Sample Type:	Drill Core	**Date Received**:	14/12/2018
Borehole:	330-01-BH2101-C09600	**Depth**:	96.00 – 96.90 m
Project ID:	1893802 Inland Rail Package 13		
Work Requested	Petrographic analysis and determination of quartz and carbonate content		
Methods	Account taken of ASTM C295 Standard Guide for *Petrographic Assessment of Aggregates for Concrete* and the AS2758.1 – 2014 *Aggregates and rock for engineering purposes part 1; Concrete aggregates (Appendix B)*		
Identification	Quartzofeldspathic and lithic sandstone		

Description

The sample consisted of a drill core specimen which is apparently unweathered, grey finely laminated sandstone with bedding evident. The core can be deeply scratched by a steel tool and can be broken along bedding planes. It seems to consist of a mixture of minerals, some as hard as quartz and others as soft as clay. The rock is fine to medium grained and is hygroscopic.

Plate 1: Photograph of supplied drill core.

A thin section was prepared from the drill core for detailed microscopic examination in transmitted polarized light. An approximate mineralogical composition of the rock, expressed in volume percent and based on a brief count of 100 widely spaced observation points in thin section, is:

Hard, Durable Components

43%	quartz sand grains
7%	feldspar sand grains
1%	other mineral grains (opaque oxide, leucoxene (1%), zircon, garnet)
6%	quartzite clasts
2%	chert clasts
1%	acid tuffaceous/volcanic sand clasts (<1% fine microcrystalline quartz)
2%	intermediate volcanic clasts (largely argillized)

Moderately Durable Components

<1%	carbonate

Soft, Weak &/Or Deleterious Components

<1%	muscovite
4%	argillized and sericitized clasts of uncertain origin
22%	interstitial sericite-smectite clays
9%	zeolite
<1%	earthy secondary iron oxide
<1%	carbonaceous matter
3%	pores

In thin section, the rock is a fine to medium-grained, quartzofeldspathic and lithic sandstone with an average grainsize of about 0.1 to 0.5 mm, with minor clasts ranging up to 0.8 m. It is relatively well sorted, and shows a weak bedding defined by preferred orientation of grains.

The framework grains are dominated by sub-rounded to sub-angular lithic clasts which are quite argillized, along with quartz and feldspar grains. Lithic clasts were very fine-grained quartzo-feldspathic grains with strong pale brown sericite-smectite alteration. Due to their fine grainsize, it is difficult to be sure that these were derived from formerly glassy rhyolite/dacite lava fragments along with minor intermediate volcanics. Equant to sub-rounded detrital quartz and blocky sub-rounded to euhedral feldspar grains are relatively common suggesting derivation from phenocrysts in felsic volcanic or explosive volcaniclastic rocks. Occasionally, there are detrital muscovite flakes (about 0.3 mm long) with long axes sub-parallel to the bedding along with some opaque oxides and carbonaceous specks.

The matrix of this rock is now composed of largely fine quartz and extremely fine-grained sericite/smectite clays which have been partly altered to zeolite and minor carbonate.

Comments and Interpretations

The supplied drill core sample (labelled 101633) from the Inland Rail Project is identified as fine to medium-grained, quartzofeldspathic and lithic sandstone. The sandstone carries an abundance of argillized lithic clasts which indicate a felsic volcanic source.

For engineering purposes, the rock in the supplied drill core sample may be summarised as consisting of:

- **quartzofeldspathic and lithic sandstone** (a sedimentary rock type)
- slightly porous (3% pores)
- apparently unweathered
- finely laminated
- contains about 35% of soft, weak minerals as interstitial material and in altered lithic clasts
- **moderately hard**
- **essentially strong**

The rock is predicted to be **moderately durable to durable**.

Free Silica Content

The free silica content is estimated to be about 51%.

Carbonate Content

The carbonate content is estimated to be about <1%.

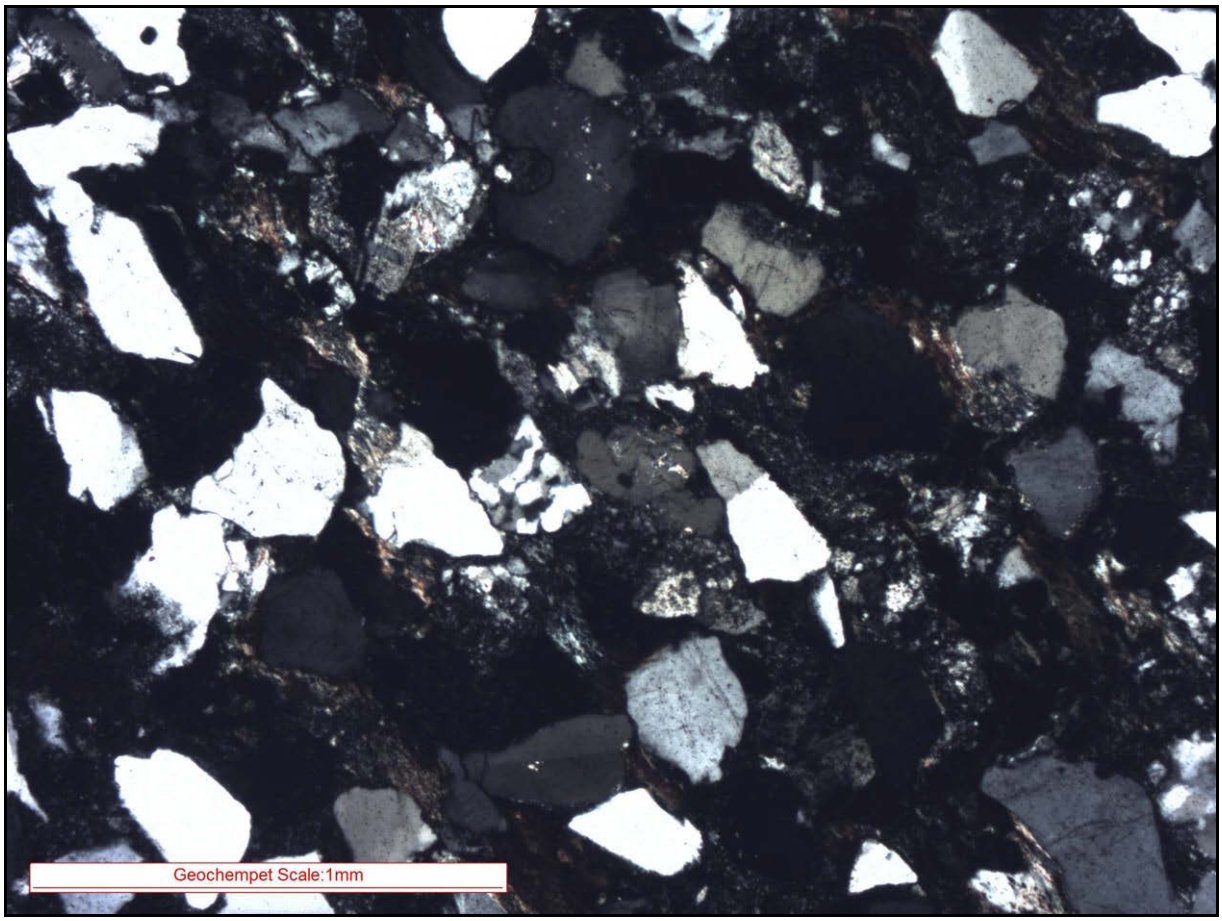
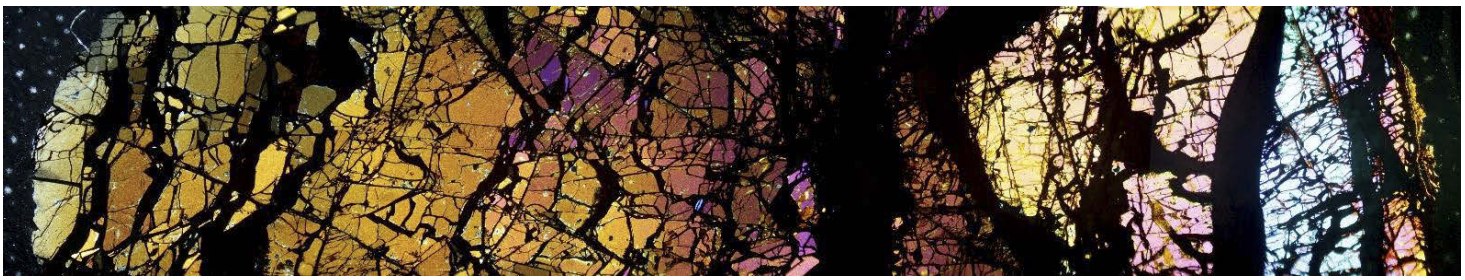


Plate 2: Low magnification, cross polarised light image of the sandstone, showing quartz and lithic grains with a thin interstitial clay cement and zeolite between grains.



Geochempet Services

ABN 980 6945 3445
PETROLOGICAL and GEOCHEMICAL CONSULTANTS
Principals: K.E. Spring B.Sc. (Hons), MAppSc and H.M. Spring B.Sc.

5/14 Redcliffe Gardens Drive
Clontarf, QLD 4019

Telephone: (07) 3284 0020

Email: info@geochempet.com
www.geochempet.com

PETROGRAPHIC REPORT ON A DRILL CORE SAMPLE (101644) FROM INLAND RAIL PROJECT

prepared for

TRILAB PTY LTD
BRISBANE OFFICE

Purchase Order: BNE 1912014
Invoice Number: 00008538
Client Ref: Chris Channon

Issued by

C. A. Bruggemann
BAppSc, MEngSC, MIEAust
10 January 2019

Reviewed by

K. E. Spring
BSc (Hons), MAppSc
10 January 2019

GEOCHEMPET SERVICES, BRISBANE

Sample Number:	101644	**Date Sampled**:	Unknown
Sample Type:	Drill Core	**Date Received**:	14/12/2018
Borehole:	330-01-BH2101-C09970	**Depth**:	99.70 – 99.90 m
Project ID:	1893802 Inland Rail Package 13		

Work Requested Petrographic analysis and determination of quartz and carbonate content

Methods Account taken of ASTM C295 Standard Guide for *Petrographic Assessment of Aggregates for Concrete* and the AS2758.1 – 2014 *Aggregates and rock for engineering purposes part 1; Concrete aggregates (Appendix B)*

Identification Carbonated, quartzofeldspathic and lithic sandstone

Description

The sample consisted of a drill core specimen which is very slightly weathered, light brownish-grey sandstone with slight bedding evident. Weathering is expressed through weathered/argillized clasts scattered throughout the core. The core can be lightly scratched by a steel tool. It seems to consist of a mixture of minerals, some as hard as quartz and others as soft as clay. The rock is fine-grained and is slowly hygroscopic.

Plate 1: Photograph of supplied drill core.

A thin section was prepared from the drill core for detailed microscopic examination in transmitted polarized light. An approximate mineralogical composition of the rock, expressed in volume percent and based on a brief count of 100 widely spaced observation points in thin section, is:

Hard, Durable Components

15%	quartz sand grains
7%	feldspar sand grains
<1%	other mineral grains (opaque oxide, leucoxene, zircon)
1%	quartzite clasts
1%	chert
3%	acid tuffaceous/volcanic sand clasts (1% fine microcrystalline quartz)
1%	intermediate volcanic clasts (largely argillized)
1%	basalt clasts
<1%	meta-pelite clasts

Moderately Durable Components

51%	carbonate

Soft, Weak &/Or Deleterious Components

2%	muscovite
11%	argillized and sericitized clasts of uncertain origin
<1%	interstitial sericite-smectite clays
1%	zeolite
<1%	earthy secondary iron oxide
6%	carbonaceous matter
<1%	pores

In thin section, the rock is a fine-grained, quartzofeldspathic and lithic sandstone with an average grainsize of about 0.1 to 0.2 mm. It is relatively well sorted, and shows a weak bedding defined by the alignment of grains.

The framework grains are dominated by sub-rounded to sub-angular lithic clasts which are quite argillized, along with quartz and feldspar grains. Lithic clasts were very fine-grained quartzo-feldspathic grains with strong pale brown sericite-smectite alteration. Due to their fine grainsize, it is difficult to be sure that these were derived from formerly glassy rhyolite/dacite lava fragments along with minor intermediate volcanics. Equant to sub-rounded detrital quartz and blocky sub-rounded to euhedral feldspar grains are relatively common suggesting derivation from phenocrysts in felsic volcanic or explosive volcaniclastic rocks. Occasionally, there are detrital muscovite flakes (about 0.2 mm long) with long axes sub-parallel to the bedding along with some opaque oxides and carbonaceous specks. Other lithic clasts comprise of quartzite, chert, basalt and meta-pelite.

The matrix of this rock is now composed of largely fine quartz and extremely fine-grained sericite/smectite clays which have now been almost completely altered to carbonate, with minor zeolite. A thin coal seam is observed in the sandstone.

Comments and Interpretations

The supplied drill core sample (labelled 101644) from the Inland Rail Project is identified as fine-grained, carbonated, quartzofeldspathic and lithic sandstone. The sandstone carries an abundance of argillized lithic clasts which indicate a felsic volcanic source.

For engineering purposes, the rock in the supplied drill core sample may be summarised as consisting of:

- **carbonated, quartzofeldspathic and lithic sandstone** (a sedimentary rock type)
- very slightly porous (<1% pores)
- very slightly weathered
- heavily carbonated
- contains about 20% of soft, weak minerals as interstitial material and in altered lithic clasts along including carbonaceous/plant matter (6%)
- **essentially hard**
- **essentially strong**

The rock is predicted to be **essentially durable**.

Free Silica Content

The free silica content is estimated to be about 18%.

Carbonate Content

The carbonate content is estimated to be about 51%.

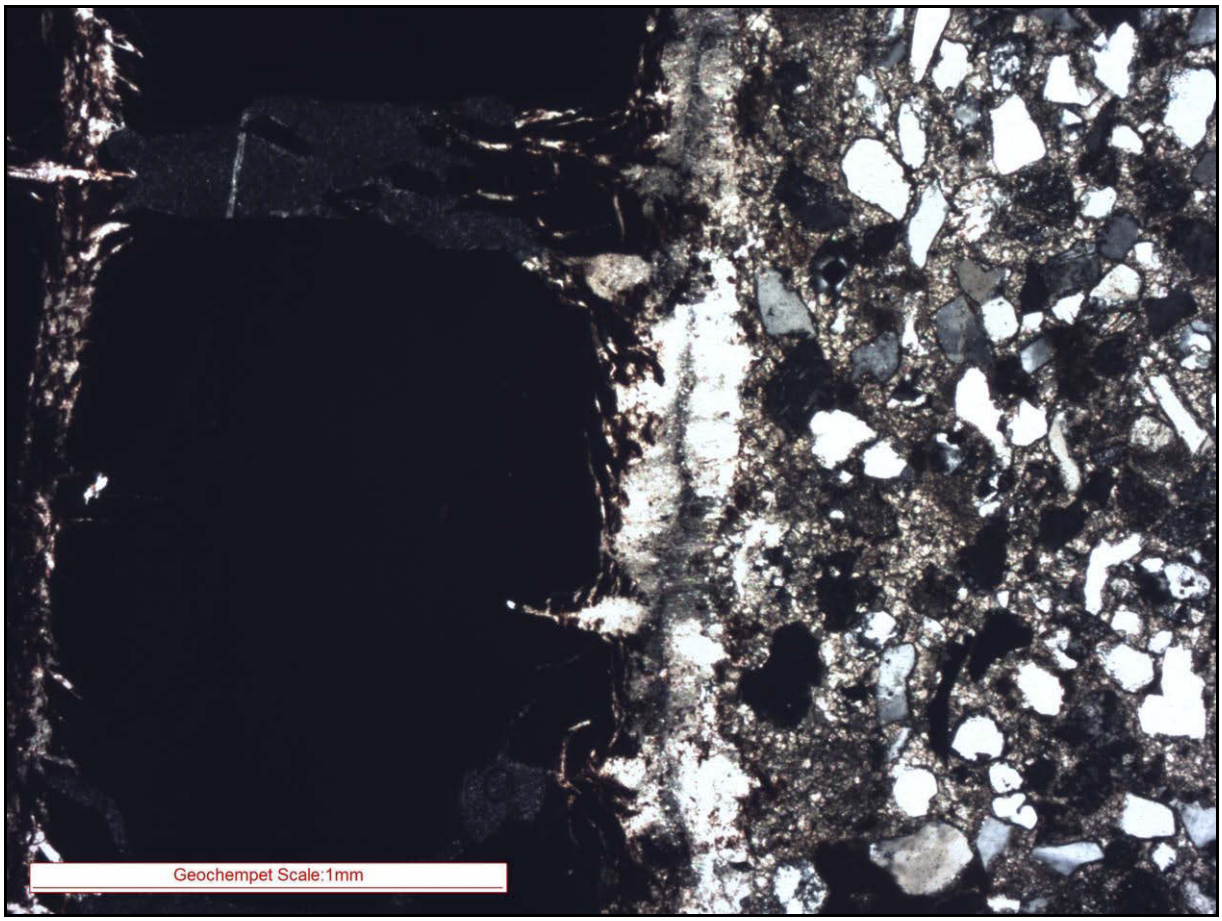
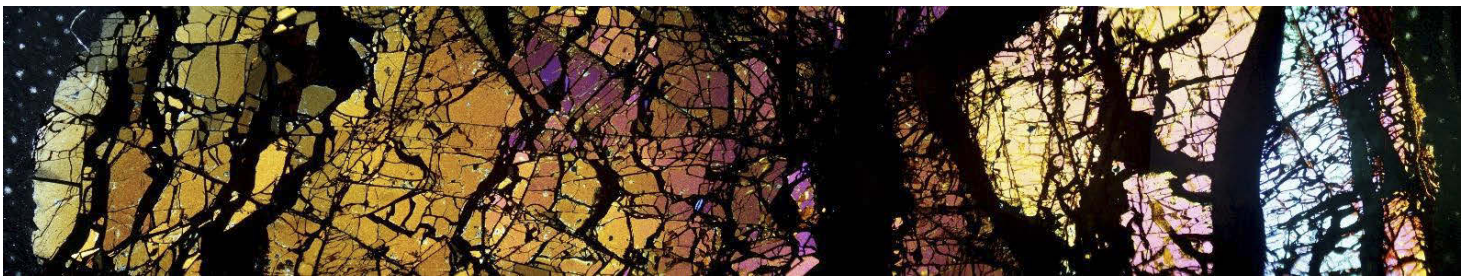


Plate 2: Low magnification, cross polarised light image of the sandstone, showing quartz, feldspar, muscovite and lithic grains in a carbonated matrix with carbonaceous/plant matter to the left of the image.



Geochempet Services

ABN 980 6945 3445
PETROLOGICAL and GEOCHEMICAL CONSULTANTS
Principals: K.E. Spring B.Sc. (Hons), MAppSc and H.M. Spring B.Sc.

5/14 Redcliffe Gardens Drive
Clontarf, QLD 4019

Telephone: (07) 3284 0020

Email: info@geochempet.com
www.geochempet.com

PETROGRAPHIC REPORT ON A DRILL CORE SAMPLE (101659) FROM INLAND RAIL PROJECT

prepared for

TRILAB PTY LTD
BRISBANE OFFICE

Purchase Order: BNE 1912014
Invoice Number: 00008538
Client Ref: Chris Channon

Issued by

C. A. Bruggemann
BAppSc, MEngSC, MIEAust
10 January 2019

Reviewed by

K. E. Spring
BSc (Hons), MAppSc
10 January 2019

Sample Number:	101659	**Date Sampled**:	Unknown
Sample Type:	Drill Core	**Date Received**:	14/12/2018
Borehole:	330-01-BH2101-C11400	**Depth**:	114.00 – 115.00 m
Project ID:	1893802 Inland Rail Package 13		

Work Requested Petrographic analysis and determination of quartz and carbonate content

Methods Account taken of ASTM C295 Standard Guide for *Petrographic Assessment of Aggregates for Concrete* and the AS2758.1 – 2014 *Aggregates and rock for engineering purposes part 1; Concrete aggregates (Appendix B)*

Identification Quartzofeldspathic and lithic sandstone

Description

The sample consisted of a drill core specimen which is apparently unweathered, grey sandstone with slight bedding evident. The core can be scratched by a steel tool. It seems to consist of a mixture of minerals, some as hard as quartz and others as soft as clay. The rock is fine to medium-grained and is slowly hygroscopic.

Plate 1: Photograph of supplied drill core.

A thin section was prepared from the drill core for detailed microscopic examination in transmitted polarized light. An approximate mineralogical composition of the rock, expressed in volume percent and based on a brief count of 100 widely spaced observation points in thin section, is:

Hard, Durable Components

44%	quartz sand grains
7%	feldspar sand grains
1%	other mineral grains (opaque oxide, leucoxene (1%), zircon)
2%	quartzite clasts
4%	acid tuffaceous/volcanic sand clasts (1% fine microcrystalline quartz)
6%	intermediate volcanic clasts (largely argillized)
2%	basalt clasts
2%	meta-pelite clasts

Moderately Durable Components

1%	carbonate

Soft, Weak &/Or Deleterious Components

2%	muscovite
6%	argillized and sericitized clasts of uncertain origin
11%	interstitial sericite-smectite clays
8%	zeolite
<1%	earthy secondary iron oxide
<1%	carbonaceous matter
4%	pores

In thin section, the rock is a fine to medium-grained, quartzofeldspathic and lithic sandstone with an average grainsize of about 0.1 to 0.4 mm. It is relatively well sorted, and shows a weak bedding defined by grainsize grading.

The framework grains are dominated by sub-rounded to sub-angular lithic clasts which are quite argillized, along with quartz and feldspar grains. Lithic clasts were very fine-grained quartzo-feldspathic grains with strong pale brown sericite-smectite alteration. Due to their fine grainsize, it is difficult to be sure that these were derived from formerly glassy rhyolite/dacite lava fragments along with minor intermediate volcanics. Equant to sub-rounded detrital quartz and blocky sub-rounded to euhedral feldspar grains are relatively common suggesting derivation from phenocrysts in felsic volcanic or explosive volcaniclastic rocks. Occasionally, there are detrital muscovite flakes (about 0.2 mm long) with long axes sub-parallel to the bedding along with some opaque oxides and carbonaceous specks. Other lithic clasts comprise of quartzite, basalt and meta-pelite.

The matrix of this rock is now composed of largely fine quartz and extremely fine-grained sericite/smectite clays which have been partly altered to zeolite and minor carbonate.

Comments and Interpretations

The supplied drill core sample (labelled 101659) from the Inland Rail Project is identified as fine to medium-grained, quartzofeldspathic and lithic sandstone. The sandstone carries an abundance of argillized lithic clasts which indicate a felsic volcanic source.

For engineering purposes, the rock in the supplied drill core sample may be summarised as consisting of:

- **quartzofeldspathic and lithic sandstone** (a sedimentary rock type)
- slightly porous (4% pores)
- apparently unweathered
- contains about 27% of soft, weak minerals as interstitial material and in altered lithic clasts
- **essentially hard**
- **essentially strong**

The rock is predicted to be **essentially durable**.

Free Silica Content

The free silica content is estimated to be about 47%.

Carbonate Content

The carbonate content is estimated to be about 1%.

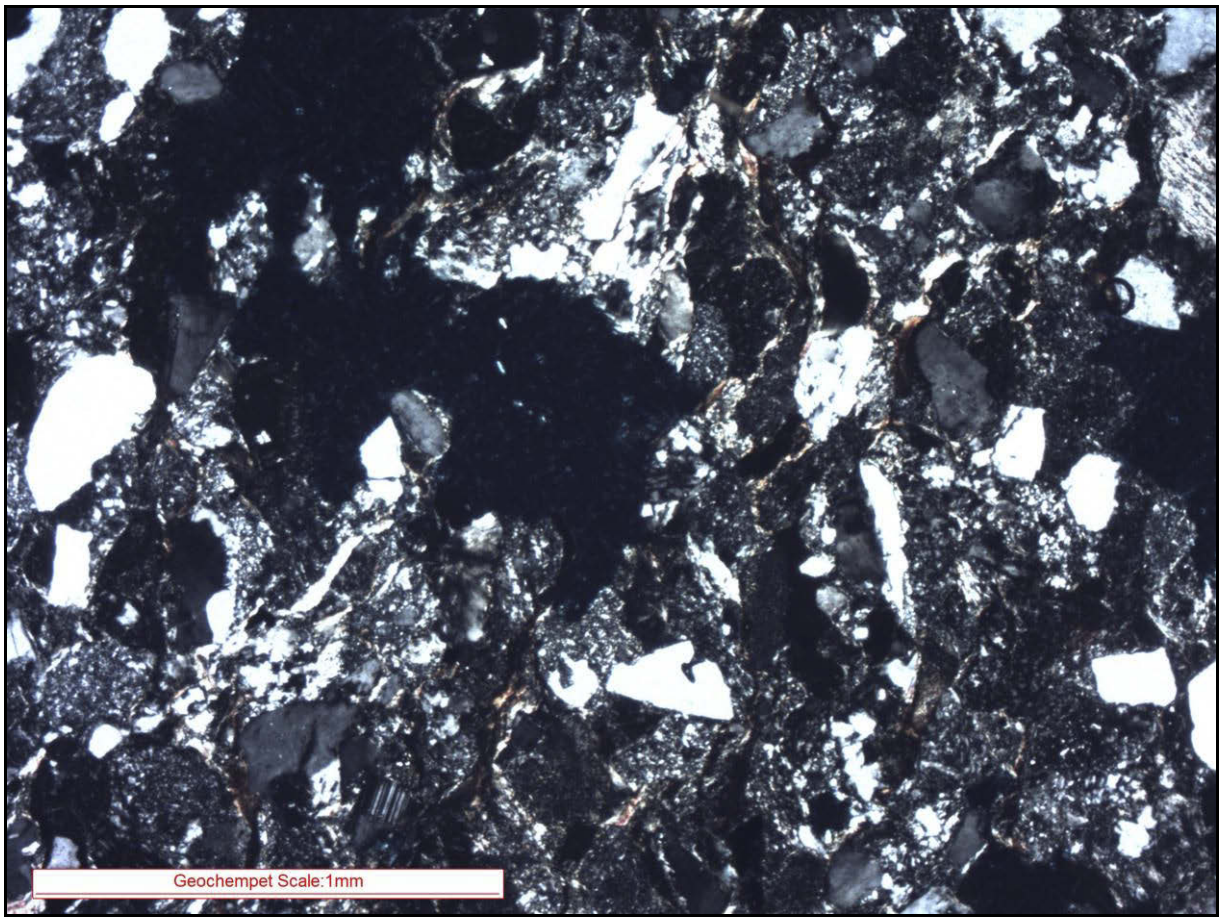
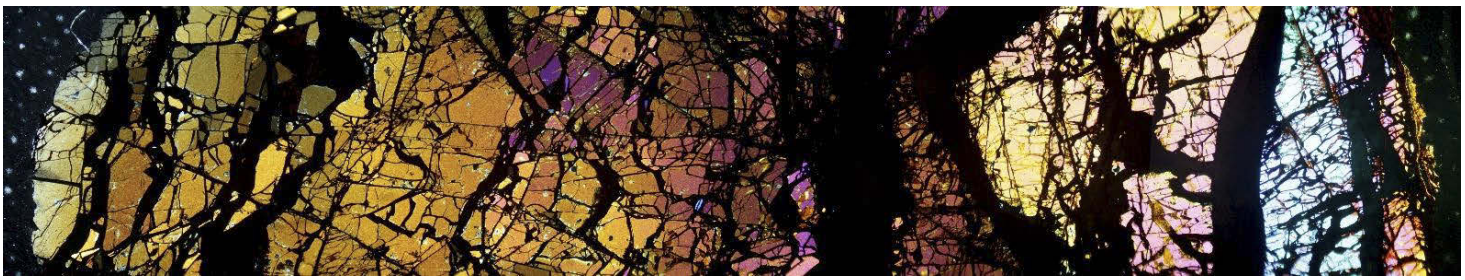


Plate 2: Low magnification, cross polarised light image of the sandstone, showing quartz and lithic grains in a clay matrix along with some porosity.



Geochempet Services

ABN 980 6945 3445
PETROLOGICAL and GEOCHEMICAL CONSULTANTS
Principals: K.E. Spring B.Sc. (Hons), MAppSc and H.M. Spring B.Sc.

5/14 Redcliffe Gardens Drive
Clontarf, QLD 4019

Telephone: (07) 3284 0020

Email: info@geochempet.com
www.geochempet.com

PETROGRAPHIC REPORT ON A DRILL CORE SAMPLE (101668) FROM INLAND RAIL PROJECT

prepared for

TRILAB PTY LTD
BRISBANE OFFICE

Purchase Order: BNE 1912014
Invoice Number: 00008538
Client Ref: Chris Channon

Issued by

C. A. Bruggemann
BAppSc, MEngSC, MIEAust
10 January 2019

Reviewed by

K. E. Spring
BSc (Hons), MAppSc
10 January 2019

Sample Number:	101668	**Date Sampled**:	Unknown
Sample Type:	Drill Core	**Date Received**:	14/12/2018
Borehole:	330-01-BH2101-C11700	**Depth**:	117.00 – 117.90 m
Project ID:	1893802 Inland Rail Package 13		
Work Requested	Petrographic analysis and determination of quartz and carbonate content		
Methods	Account taken of ASTM C295 Standard Guide for *Petrographic Assessment of Aggregates for Concrete* and the AS2758.1 – 2014 *Aggregates and rock for engineering purposes part 1; Concrete aggregates (Appendix B)*		
Identification	Quartzofeldspathic and lithic sandstone		

Description

The sample consisted of a drill core specimen which is very slightly weathered, grey sandstone with slight bedding evident through variations in grain size. Weathering is expressed through weathered/argillized clasts scattered throughout the core. The core can be lightly scratched by a steel tool. It seems to consist of a mixture of minerals, some as hard as quartz and others as soft as clay. The rock is medium to coarse-grained and is slowly hygroscopic.

Plate 1: Photograph of supplied drill core.

A thin section was prepared from the drill core for detailed microscopic examination in transmitted polarized light. An approximate mineralogical composition of the rock, expressed in volume percent and based on a brief count of 100 widely spaced observation points in thin section, is:

Hard, Durable Components

46%	quartz sand grains
3%	feldspar sand grains
<1%	other mineral grains (opaque oxide, leucoxene, zircon)
7%	quartzite clasts
2%	vein quartz
4%	acid tuffaceous/volcanic sand clasts (1% fine microcrystalline quartz)
6%	intermediate volcanic clasts (largely argillized)
1%	basalt clasts
3%	meta-pelite clasts

Moderately Durable Components

2%	carbonate

Soft, Weak &/Or Deleterious Components

1%	muscovite
5%	argillized and sericitized clasts of uncertain origin
7%	interstitial sericite-smectite clays
11%	zeolite
<1%	earthy secondary iron oxide
<1%	carbonaceous matter
2%	pores

In thin section, the rock is a medium to coarse-grained, quartzofeldspathic and lithic sandstone with an average grainsize of about 0.25 to 1.5 mm. It is relatively well sorted, and shows a weak bedding defined by grainsize grading.

The framework grains are dominated by sub-rounded to sub-angular lithic clasts which are quite argillized, along with quartz and feldspar grains. Some quartz grains show overgrowths. Lithic clasts were very fine-grained quartzo-feldspathic grains with strong pale brown sericite-smectite alteration. Due to their fine grainsize, it is difficult to be sure that these were derived from formerly glassy rhyolite/dacite lava fragments along with minor intermediate volcanics. Equant to sub-rounded detrital quartz and blocky sub-rounded to euhedral feldspar grains are relatively common suggesting derivation from phenocrysts in felsic volcanic or explosive volcaniclastic rocks. Occasionally, there are detrital muscovite flakes (about 0.25 mm long) with long axes sub-parallel to the bedding along with some opaque oxides and carbonaceous specks. Other lithic clasts comprise of quartzite, vein quartz, basalt and meta-pelite.

The matrix of this rock is now composed of largely fine quartz and extremely fine-grained sericite/smectite clays which have been partly altered to carbonate and zeolite.

Comments and Interpretations

The supplied drill core sample (labelled 101668) from the Inland Rail Project is identified as medium to coarse-grained, quartzofeldspathic and lithic sandstone. The sandstone carries an abundance of argillized lithic clasts which indicate a felsic volcanic source.

For engineering purposes, the rock in the supplied drill core sample may be summarised as consisting of:

- **quartzofeldspathic and lithic sandstone** (a sedimentary rock type)
- slightly porous (2% pores)
- very slightly weathered
- contains about 24% of soft, weak minerals as interstitial material and in altered lithic clasts
- **essentially hard**
- **essentially strong**

The rock is predicted to be **essentially durable**. Although 24% of the rock contains soft, weak minerals, the quartz overgrowths observed have strengthened the rock.

Free Silica Content

The free silica content is estimated to be about 56%.

Carbonate Content

The carbonate content is estimated to be about 2%.

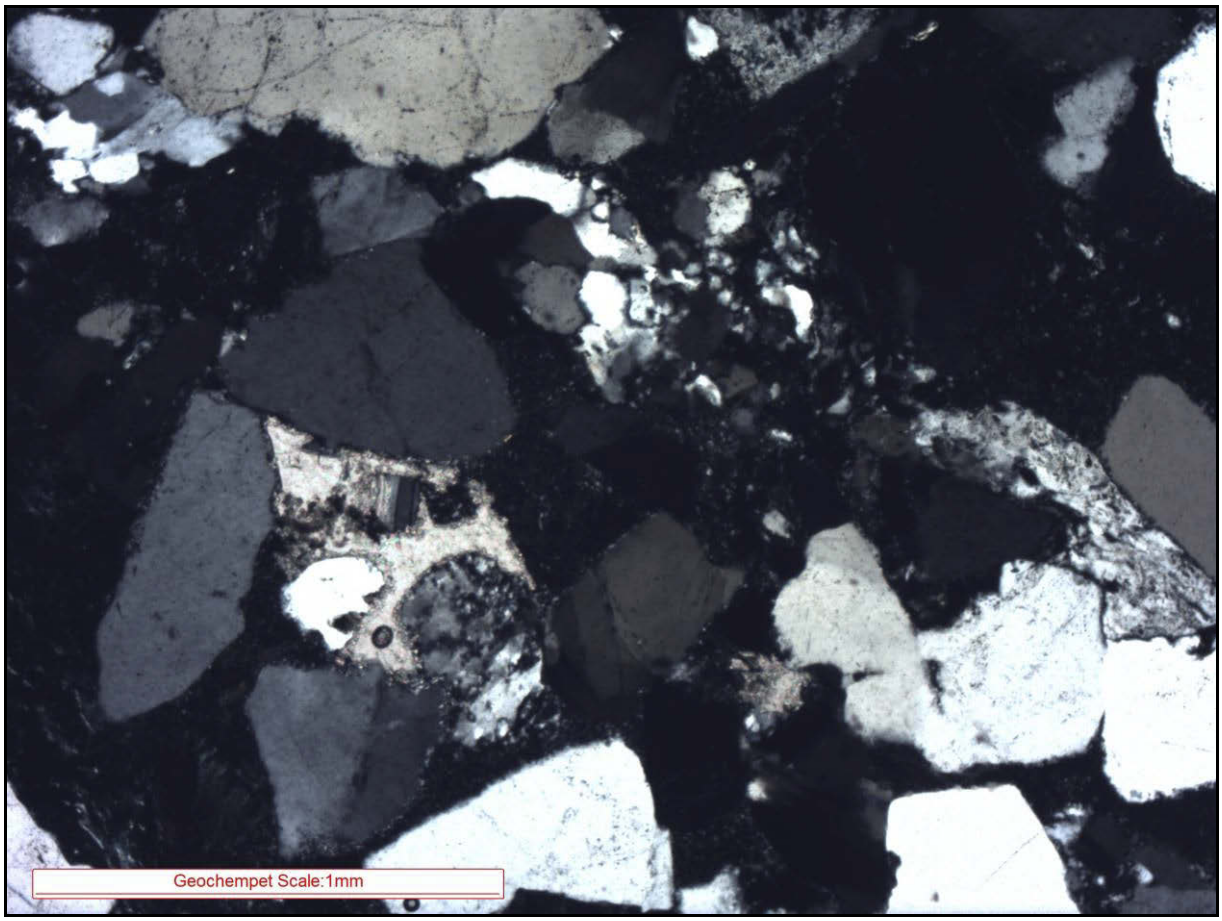
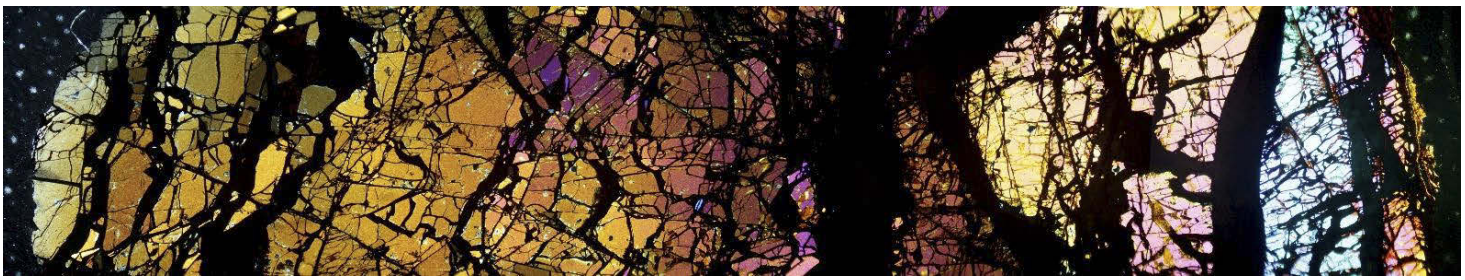


Plate 2: Low magnification, cross polarised light image of the sandstone, showing quartz, feldspar and lithic grains along with part of the matrix being slightly carbonated.



Geochempet Services

ABN 980 6945 3445
PETROLOGICAL and GEOCHEMICAL CONSULTANTS
Principals: K.E. Spring B.Sc. (Hons), MAppSc and H.M. Spring B.Sc.

5/14 Redcliffe Gardens Drive
Clontarf, QLD 4019

Telephone: (07) 3284 0020

Email: info@geochempet.com
www.geochempet.com

PETROGRAPHIC REPORT ON A DRILL CORE SAMPLE (101694) FROM INLAND RAIL PROJECT

prepared for

TRILAB PTY LTD
BRISBANE OFFICE

Purchase Order: BNE 1912014
Invoice Number: 00008538
Client Ref: Chris Channon

Issued by

C. A. Bruggemann
BAppSc, MEngSC, MIEAust
10 January 2019

Reviewed by

K. E. Spring
BSc (Hons), MAppSc
10 January 2019

Sample Number:	101694	**Date Sampled**:	Unknown
Sample Type:	Drill Core	**Date Received**:	14/12/2018
Borehole:	330-01-BH2102-C01020	**Depth**:	10.20 – 11.00 m
Project ID:	1893802 Inland Rail Package 13		
Work Requested	Petrographic analysis and determination of quartz and carbonate content		
Methods	Account taken of ASTM C295 Standard Guide for *Petrographic Assessment of Aggregates for Concrete* and the AS2758.1 – 2014 *Aggregates and rock for engineering purposes part 1; Concrete aggregates (Appendix B)*		
Identification	Quartzofeldspathic and lithic sandstone		

Description

The sample consisted of a drill core specimen which is very slightly weathered, brownish-grey sandstone with slight bedding evident. Weathering is expressed through weathered/argillized clasts scattered throughout the core. The core can be lightly scratched by a steel tool. It seems to consist of a mixture of minerals, some as hard as quartz and others as soft as clay. The rock is medium-grained and is slowly hygroscopic.

Plate 1: Photograph of supplied drill core.

A thin section was prepared from the drill core for detailed microscopic examination in transmitted polarized light. An approximate mineralogical composition of the rock, expressed in volume percent and based on a brief count of 100 widely spaced observation points in thin section, is:

Hard, Durable Components

50%	quartz sand grains
12%	feldspar sand grains
<1%	other mineral grains (opaque oxide, leucoxene, zircon)
5%	quartzite clasts
2%	vein quartz
4%	acid tuffaceous/volcanic sand clasts (1% fine microcrystalline quartz)
1%	intermediate volcanic clasts (largely argillized)
<1%	basalt clasts
2%	meta-pelite clasts

Moderately Durable Components

3%	carbonate

Soft, Weak &/Or Deleterious Components

2%	muscovite
9%	argillized and sericitized clasts of uncertain origin
5%	interstitial sericite-smectite clays
3%	zeolite
<1%	earthy secondary iron oxide
<1%	carbonaceous matter
2%	pores

In thin section, the rock is a medium -grained, quartzofeldspathic and lithic sandstone with an average grainsize of about 0.1 to 0.5 mm, with some grains ranging up to 0.7 mm and rare grains up to 1 mm. It is relatively well sorted, and shows a weak bedding defined by grainsize grading.

The framework grains are dominated by sub-rounded to sub-angular lithic clasts which are quite argillized, along with quartz and feldspar grains. Lithic clasts were very fine-grained quartzo-feldspathic grains with strong pale brown sericite-smectite alteration. Due to their fine grainsize, it is difficult to be sure that these were derived from formerly glassy rhyolite/dacite lava fragments along with minor intermediate volcanics. Equant to sub-rounded detrital quartz and blocky sub-rounded to euhedral feldspar grains are relatively common suggesting derivation from phenocrysts in felsic volcanic or explosive volcaniclastic rocks. Occasionally, there are detrital muscovite flakes (about 0.1 mm long) with long axes sub-parallel to the bedding along with some opaque oxides and carbonaceous specks. Other lithic clasts comprise of quartzite, basalt and meta-pelite.

The matrix of this rock is now composed of largely fine quartz and extremely fine-grained sericite/smectite clays which have been partly altered to carbonate and zeolite.

Comments and Interpretations

The supplied drill core sample (labelled 101694) from the Inland Rail Project is identified as medium-grained, quartzofeldspathic and lithic sandstone. The sandstone carries an abundance of argillized lithic clasts which indicate a felsic volcanic source.

For engineering purposes, the rock in the supplied drill core sample may be summarised as consisting of:

- **quartzofeldspathic and lithic sandstone** (a sedimentary rock type)
- slightly porous (2% pores)
- very slightly weathered
- contains about 19% of soft, weak minerals as interstitial material and in altered lithic clasts
- **essentially hard**
- **essentially strong**

The rock is predicted to be **essentially durable**.

Free Silica Content

The free silica content is estimated to be about 58%.

Carbonate Content

The carbonate content is estimated to be about 3%.

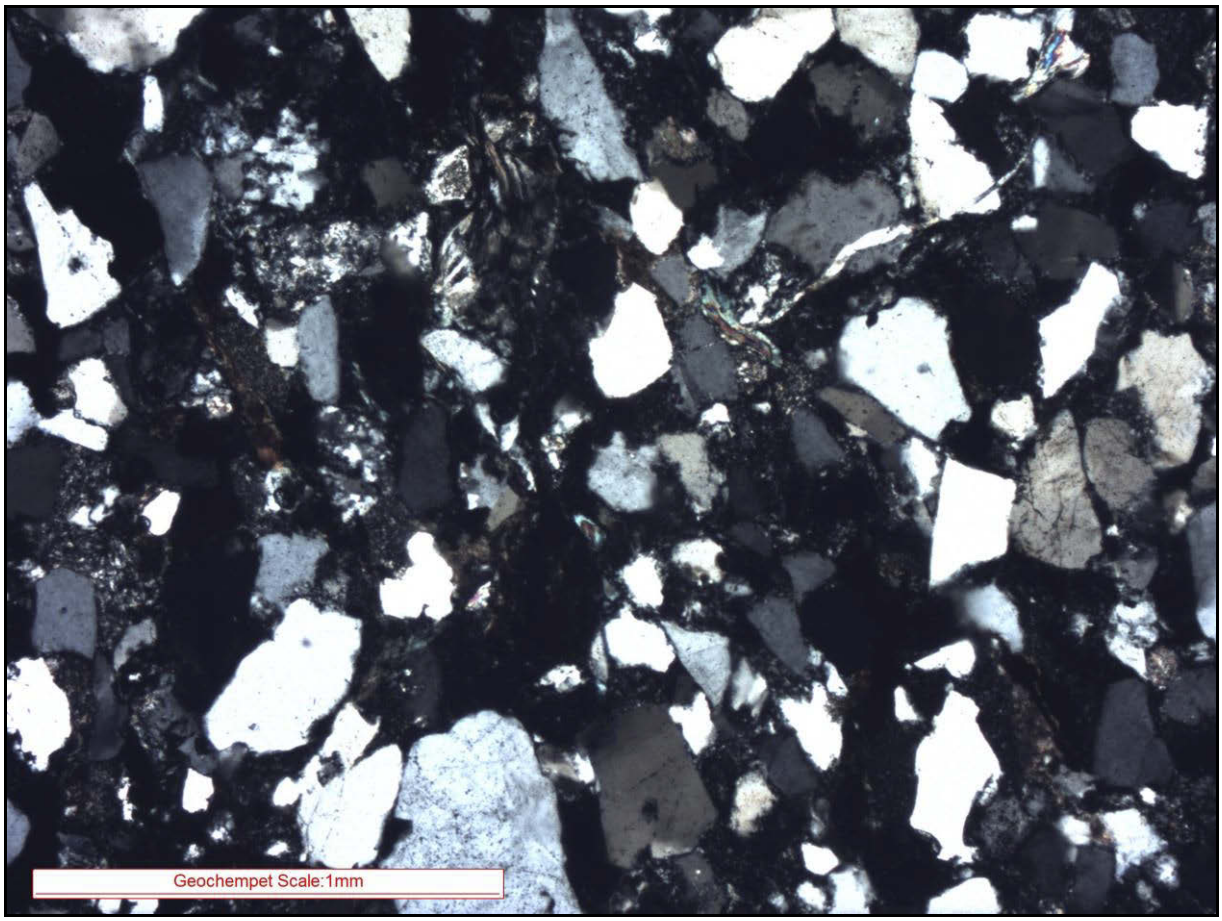
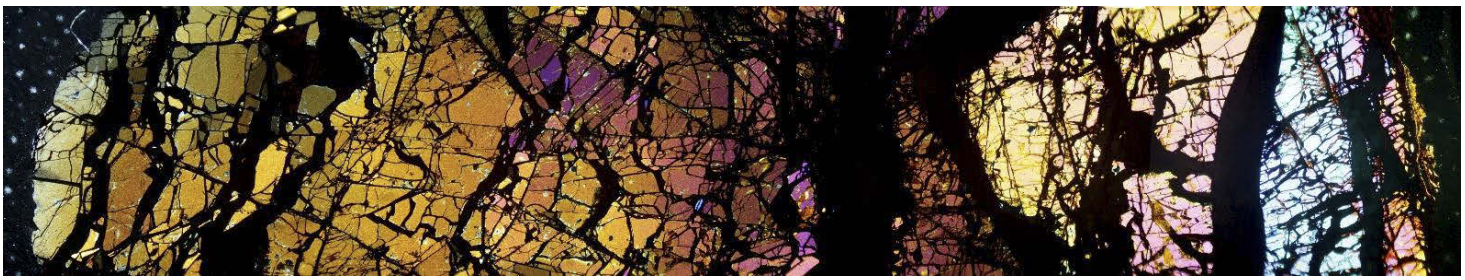


Plate 2: Low magnification, cross polarised light image of the sandstone, showing quartz and lithic grains along with a single muscovite flake.



Geochempet Services

ABN 980 6945 3445
PETROLOGICAL and GEOCHEMICAL CONSULTANTS
Principals: K.E. Spring B.Sc. (Hons), MAppSc and H.M. Spring B.Sc.

5/14 Redcliffe Gardens Drive
Clontarf, QLD 4019

Telephone: (07) 3284 0020

Email: info@geochempet.com
www.geochempet.com

PETROGRAPHIC REPORT
ON A DRILL CORE SAMPLE (101727)
FROM INLAND RAIL PROJECT

prepared for

TRILAB PTY LTD
BRISBANE OFFICE

Purchase Order: BNE 1912014

Invoice Number: 00008538

Client Ref: Chris Channon

Issued by
T. F. D. Spring BAppSc. MAppSc
10 January 2019

Reviewed by
K. E. Spring BSc (Hons), MAppSc
10 January 2019

Sample Number:	101727	**Date Sampled**:	Unknown
Sample Type:	Drill Core	**Date Received**:	14/12/2018
Borehole:	330-01-BH2103-C01738	**Depth**:	17.38 – 17.60 m
Project ID:	1893802 Inland Rail Package 13		
Work Requested	Petrographic analysis and determination of quartz and carbonate content		
Methods	Account taken of ASTM C295 Standard Guide for *Petrographic Assessment of Aggregates for Concrete* and the AS2758.1 – 2014 *Aggregates and rock for engineering purposes part 1; Concrete aggregates (Appendix B)*		
Identification	Quartzofeldspathic and lithic sandstone		

Description

The sample consisted of a drill core specimen which is very slightly weathered, grey sandstone with bedding evident. Weathering is expressed through weathered/argillized clasts scattered throughout the core. The core can be deeply scratched by a steel tool and can be broken along bedding planes. It seems to consist of a mixture of minerals, some as hard as quartz and others as soft as clay. The rock is fine to medium grained and is hygroscopic.

Plate 1: Photograph of supplied drill core.

A thin section was prepared from the drill core for detailed microscopic examination in transmitted polarized light. An approximate mineralogical composition of the rock, expressed in volume percent and based on a brief count of 100 widely spaced observation points in thin section, is:

Hard, Durable Components

42%	quartz sand grains
11%	feldspar sand grains
2%	other mineral grains (opaque oxide, leucoxene (1%), zircon, garnet)
4%	quartzite clasts
1%	chert clasts
3%	acid tuffaceous/volcanic sand clasts (1% fine microcrystalline quartz)
8%	intermediate volcanic clasts (largely argillized)
3%	epidote

Moderately Durable Components

1%	carbonate

Soft, Weak &/Or Deleterious Components

6%	muscovite
5%	argillized and sericitized clasts of uncertain origin
10%	interstitial sericite-smectite clays
4%	zeolite
<1%	earthy secondary iron oxide
<1%	carbonaceous matter
<1%	pores

In thin section, the rock is a fine to medium-grained, quartzofeldspathic and lithic sandstone with an average grainsize of about 0.05 to 0.2 mm, with minor clasts ranging up to 0.8 m. It is relatively well sorted, and shows a weak bedding defined by preferred orientation of grains.

The framework grains are dominated by sub-rounded to sub-angular lithic clasts which are quite argillized, along with quartz and feldspar grains. Lithic clasts were very fine-grained quartzo-feldspathic grains with strong pale brown sericite-smectite alteration. Due to their fine grainsize, it is difficult to be sure that these were derived from formerly glassy rhyolite/dacite lava fragments along with minor intermediate volcanics. Equant to sub-rounded detrital quartz and blocky sub-rounded to euhedral feldspar grains are relatively common suggesting derivation from phenocrysts in felsic volcanic or explosive volcaniclastic rocks. Occasionally, there are detrital muscovite flakes (about 0.3 mm long) with long axes sub-parallel to the bedding along with some opaque oxides and carbonaceous specks.

The matrix of this rock is now composed of largely fine quartz and extremely fine-grained sericite/smectite clays which have been partly altered to zeolite and minor carbonate.

Comments and Interpretations

The supplied drill core sample (labelled 101727) from the Inland Rail Project is identified as fine to medium-grained, quartzofeldspathic and lithic sandstone. The sandstone carries an abundance of argillized lithic clasts which indicate a felsic volcanic source.

For engineering purposes, the rock in the supplied drill core sample may be summarised as consisting of:

- **quartzofeldspathic and lithic sandstone** (a sedimentary rock type)
- very slightly porous (<1% pores)
- very slightly weathered
- contains 1% moderately durable carbonate
- contains about 25% of soft, weak minerals as interstitial material and in altered lithic clasts
- **essentially hard**
- **essentially strong**

The rock is predicted to be **essentially durable**.

Free Silica Content

The free silica content is estimated to be about 48%.

Carbonate Content

The carbonate content is estimated to be about 1%.

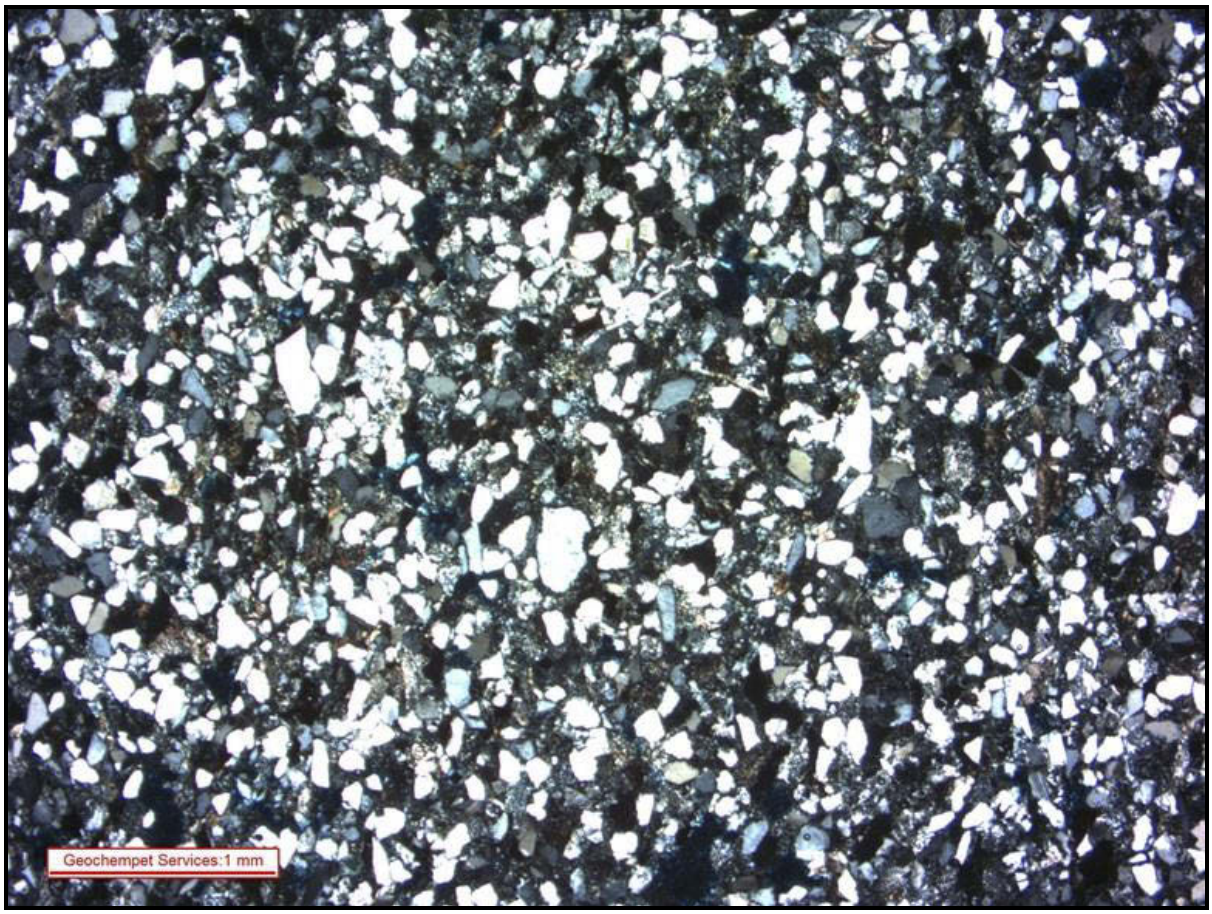
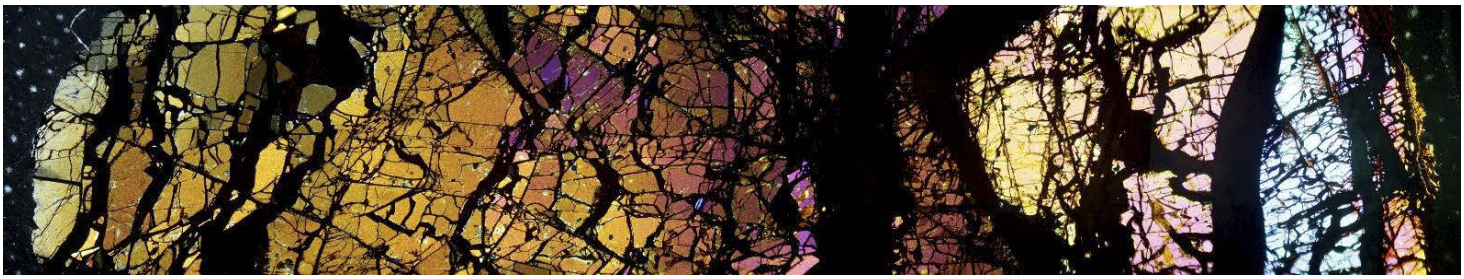


Plate 2: Micrograph taken at low magnification in transmitted cross polarised light of part of the sandstone, showing quartz and lithic grains with a thin interstitial clay cement and zeolite between grains.



Geochempet Services

ABN 980 6945 3445
PETROLOGICAL and GEOCHEMICAL CONSULTANTS
Principals: K.E. Spring B.Sc. (Hons), MAppSc and H.M. Spring B.Sc.

5/14 Redcliffe Gardens Drive
Clontarf, QLD 4019

Telephone: (07) 3284 0020

Email: info@geochempet.com
www.geochempet.com

PETROGRAPHIC REPORT ON A DRILL CORE SAMPLE (101738) FROM INLAND RAIL PROJECT

prepared for

TRILAB PTY LTD
BRISBANE OFFICE

Purchase Order: BNE 1912014
Invoice Number: 00008538
Client Ref: Chris Channon

Issued by

K. E. Spring BSc (Hons), MAppSc
10 January 2019

Sample Number:	101738	**Date Sampled**:	Unknown
Sample Type:	Drill Core	**Date Received**:	14/12/2018
Borehole:	330-01-BH2103-C02800	**Depth**:	28.00– 28.30 m
Project ID:	1893802 Inland Rail Package 13		
Work Requested	Petrographic analysis		
Methods	Account taken of ASTM C295 Standard Guide for *Petrographic Assessment of Aggregates for Concrete* and the AS2758.1 – 2014 *Aggregates and rock for engineering purposes part 1; Concrete aggregates (Appendix B)*		
Identification	Labile siltstone		

Description

The sample consisted of a drill core specimen which is unweathered, subtly laminated, dark grey siltstone. The core can be deeply scratched with a steel tool leaving a grey to brown streak. It seems to consist of a mixture of minerals, some as hard as quartz and others as soft as clay. The rock is very fine grained and is moderately hard. The rock is slowly hygroscopic.

Plate 1: Photograph of supplied drill core.

A thin section was prepared from the drill core for detailed microscopic examination in transmitted polarized light. An approximate mineralogical composition of the rock, expressed in volume percent and based on a brief count of 100 widely spaced observation points in thin section, is:

Hard, Durable Components

12%	quartz grains
3%	vein quartz
6%	remnant feldspar grains
1%	hematized, leucoxenized or finely rutilated clasts of former detrital opaque oxides
3%	lithic clasts of acid tuffaceous clasts (about 1% finely microcrystalline quartz)

Moderately Durable Components

3%	calcite and/or siderite

Soft, Weak &/Or Deleterious Components

12%	sericitized and argillized clasts
56%	sericitic/illitic clay cement variably stained by secondary iron oxide
2%	detrital mica (muscovite flakes)
trace	pyrite
1%	carbonaceous wisps
1%	open fractures

In thin section the rock displays primary textures of finely laminated, clayey to silty style. It consists of minor sub-rounded to angular sand clasts which are mainly 0.05 to 0.1 mm in size. An oval-shaped dropstone (about 9 mm long) is composed of heavily-strained vein quartz is also observed. Bedding is delineated by grainsize variations.

Very little of the rock persist as simple quartz and feldspar grains. Other robust mineral grains comprise hematized, leucoxenized or finely rutilated clasts of former detrital opaque oxides.

Detrital flakes of mica (up to about 0.1 mm long but most are smaller) comprise muscovite flakes. Most feldspars are now almost completely argillized. Some carbonaceous wisps occur as small wisps and blebs throughout the matrix. The carbonaceous flakes are mostly aligned to bedding.

The siltstone is cemented by a connected, interstitial network of a sericitic/illitic style of clay heavily stained brownish by very fine carbonaceous matter and overprinted by a few scattered tiny diagenetic pyrite spheres. The matrix cement is spotted by later replacement carbonates.

Comments and Interpretations

The supplied drill core sample (labelled 101738) from the Inland Rail Project is identified as labile siltstone. The environment had to be of low current energy in order to deposit the matrix clays, micaceous flakes and the weak carbonaceous material and is probably marginal marine due to the presence of traces of diagenetic pyrite. Alteration is light, largely diagenetic dewatering of the sediment but subsequent light carbonation of the rock has replaced spots in the matrix cement and hardened the siltstone.

For engineering purposes, the rock in the supplied drill core sample may be summarised as consisting of:

- **labile siltstone** (a sedimentary rock type)
- thinly fractured (about 1% open fractures)
- unweathered
- comprised of 3% moderately robust carbonates
- contains about 71% of soft, weak or otherwise non-durable components (sericite/illite and mica flakes as well as carbonaceous matter)
- carries a trace of pyrite, an oxidisable mineral
- **moderately hard**
- **weak to moderately strong**

The siltstone is predicted to be **non-durable to moderately durable.** The rock separated at laminations very easily (especially when wet). Its network of cementing clay will result in reduced wet strength which along with other mica flakes and oxidisable carbonaceous matter along bedding planes will lead to splitting, fretting and slow disaggregation of the siltstone upon cyclic wetting and drying.

Free silica content

The free silica or quartz content is estimated to be about 16%.

Carbonate content

The carbonate content is estimated to be about 3%.

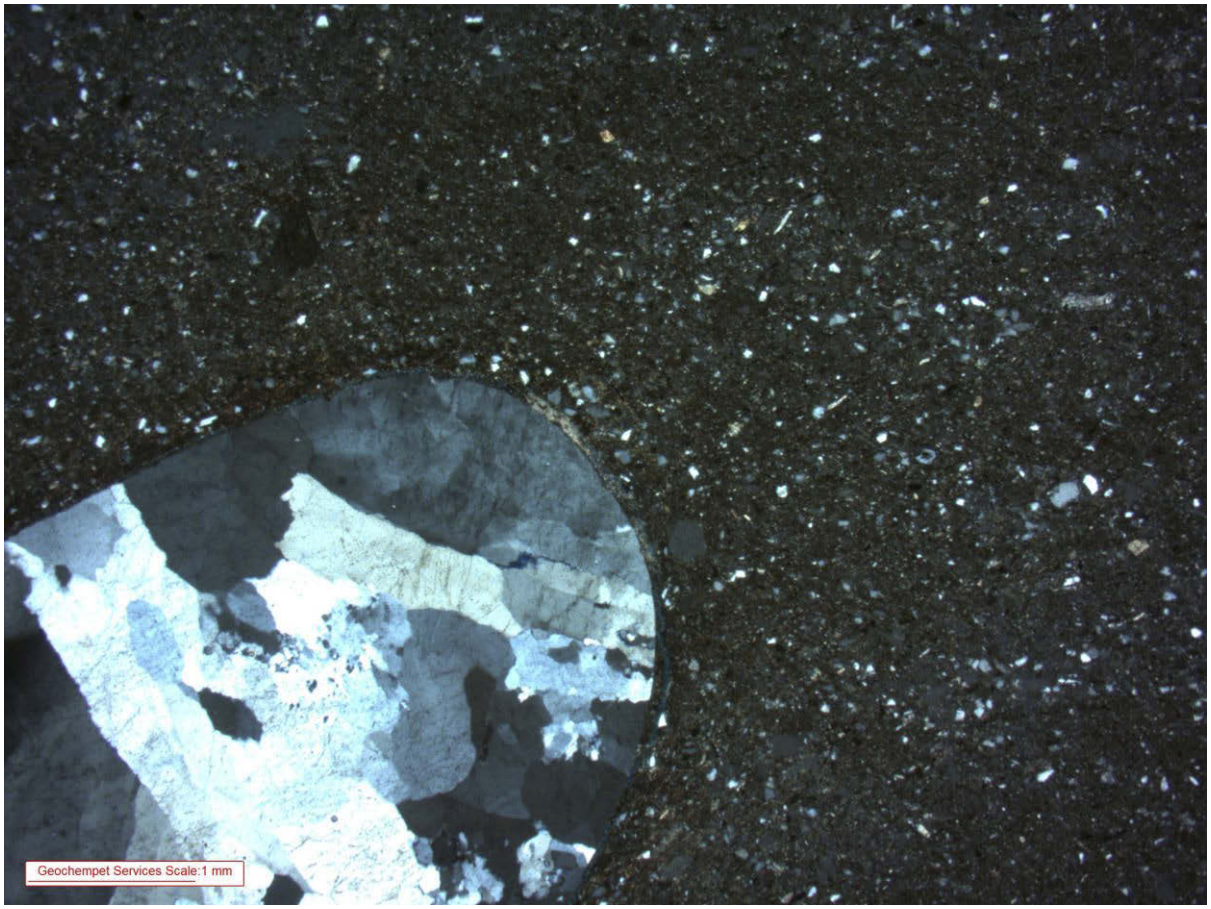
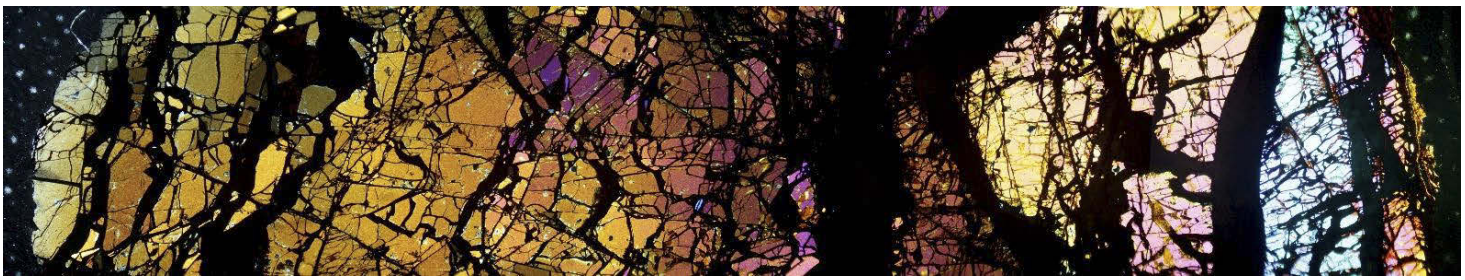


Plate 2: Low magnification, cross polarised light image of the siltstone showing a dropstone of vein quartz in a mostly sericite/illite matrix clay with some silty grains of quartz and feldspar. Note the thin carbonate lining on the edge of the dropstone.



Geochempet Services

ABN 980 6945 3445
PETROLOGICAL and GEOCHEMICAL CONSULTANTS
Principals: K.E. Spring B.Sc. (Hons), MAppSc and H.M. Spring B.Sc.

5/14 Redcliffe Gardens Drive
Clontarf, QLD 4019

Telephone: (07) 3284 0020

Email: info@geochempet.com
www.geochempet.com

PETROGRAPHIC REPORT
ON A DRILL CORE SAMPLE (101756)
FROM INLAND RAIL PROJECT

prepared for

TRILAB PTY LTD
BRISBANE OFFICE

Purchase Order: BNE 1912014

Invoice Number: 00008538

Client Ref: Chris Channon

Issued by
T. F. D. Spring BAppSc. MAppSc
10 January 2019

Reviewed by
K. E. Spring BSc (Hons), MAppSc
10 January 2019

Sample Number:	101756	**Date Sampled**:	Unknown
Sample Type:	Drill Core	**Date Received**:	14/12/2018
Borehole:	330-01-BH2104-C02000	**Depth**:	20.00 – 20.15 m
Project ID:	1893802 Inland Rail Package 13		

Work Requested Petrographic analysis and determination of quartz and carbonate content

Methods Account taken of ASTM C295 Standard Guide for *Petrographic Assessment of Aggregates for Concrete* and the AS2758.1 – 2014 *Aggregates and rock for engineering purposes part 1; Concrete aggregates (Appendix B)*

Identification Carbonated, quartzofeldspathic and lithic sandstone

Description

The sample consisted of a drill core specimen which is very slightly weathered, light brownish-grey sandstone with bedding evident. Weathering is expressed through weathered/argillized clasts scattered throughout the core. The core can be deeply scratched by a steel tool and can be broken along bedding planes. It seems to consist of a mixture of minerals, some as hard as quartz and others as soft as clay. The rock is fine to medium grained and is hygroscopic.

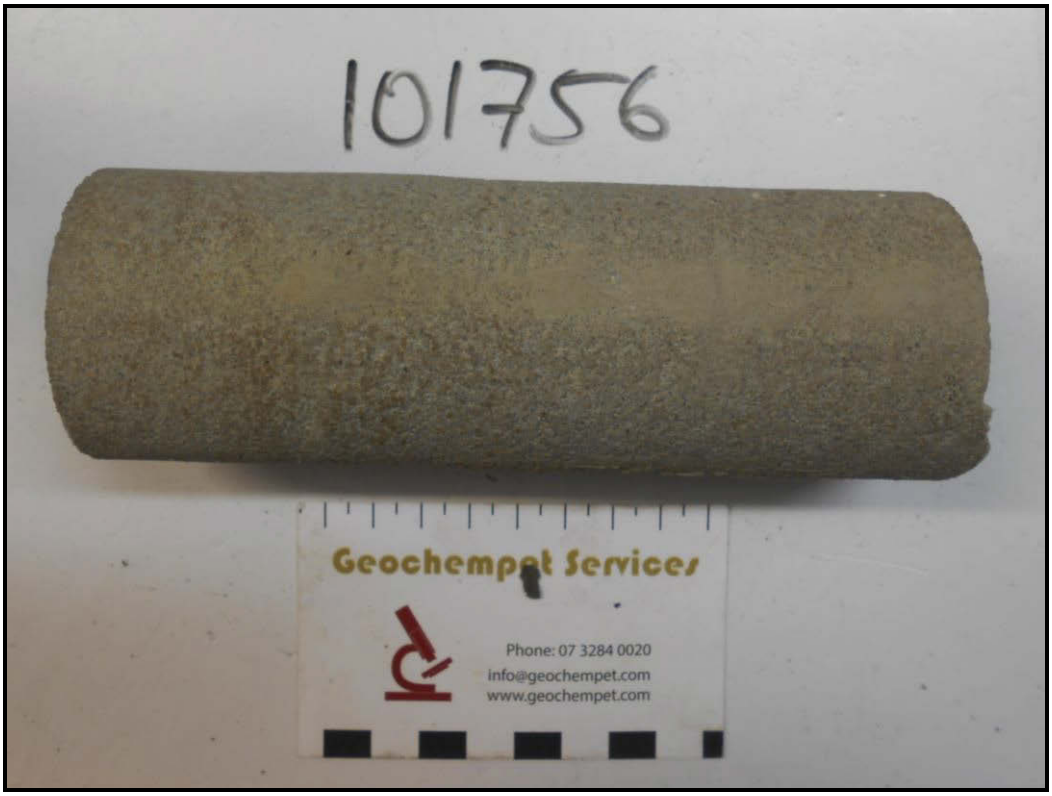


Plate 1: Photograph of supplied drill core.

A thin section was prepared from the drill core for detailed microscopic examination in transmitted polarized light. An approximate mineralogical composition of the rock, expressed in volume percent and based on a brief count of 100 widely spaced observation points in thin section, is:

Hard, Durable Components

31%	quartz sand grains
7%	feldspar sand grains
1%	other mineral grains (opaque oxide, leucoxene (1%), zircon, garnet)
6%	quartzite clasts
3%	chert clasts
2%	acid tuffaceous/volcanic sand clasts (<1% fine microcrystalline quartz)
5%	intermediate volcanic clasts (largely argillized)
2%	basalt clasts
2%	granite clasts (1% quartz)

Moderately Durable Components

17%	carbonate

Soft, Weak &/Or Deleterious Components

1%	muscovite
10%	argillized and sericitized clasts of uncertain origin
6%	interstitial sericite-smectite clays
7%	zeolite
<1%	earthy secondary iron oxide
<1%	carbonaceous matter
<1%	pores

In thin section, the rock is a fine to medium-grained, quartzofeldspathic and lithic sandstone with an average grainsize of about 0.1 to 0.5 mm, with minor clasts ranging up to 0.8 m. It is relatively well sorted, and shows a weak bedding defined by preferred orientation of grains.

The framework grains are dominated by sub-rounded to sub-angular lithic clasts which are quite argillized, along with quartz and feldspar grains. Lithic clasts were very fine-grained quartzo-feldspathic grains with strong pale brown sericite-smectite alteration. Due to their fine grainsize, it is difficult to be sure that these were derived from formerly glassy rhyolite/dacite lava fragments along with minor intermediate volcanics. Equant to sub-rounded detrital quartz and blocky sub-rounded to euhedral feldspar grains are relatively common suggesting derivation from phenocrysts in felsic volcanic or explosive volcaniclastic rocks. Occasionally, there are detrital muscovite flakes (about 0.3 mm long) with long axes sub-parallel to the bedding along with some opaque oxides and carbonaceous specks.

The matrix of this rock is now composed of largely fine quartz and extremely fine-grained sericite/smectite clays which have been partly altered to zeolite and minor carbonate.

Comments and Interpretations

The supplied drill core sample (labelled 101756) from the Inland Rail Project is identified as fine to medium-grained, quartzofeldspathic and lithic sandstone. The sandstone carries an abundance of argillized lithic clasts which indicate a felsic volcanic source. Alteration is largely diagenetic dewatering of the sediment but subsequent carbonation of the rock has replaced parts of the matrix cement and hardened the sandstone.

For engineering purposes, the rock in the supplied drill core sample may be summarised as consisting of:

- **carbonated, quartzofeldspathic and lithic sandstone** (a sedimentary rock type)
- very slightly porous (<1% pores)
- very slightly weathered
- contains 17% moderately durable carbonate
- contains about 24% of soft, weak minerals as interstitial material and in altered lithic clasts
- **essentially hard**
- **essentially strong**

The rock is predicted to be **essentially durable**.

Free Silica Content

The free silica content is estimated to be about 40%.

Carbonate Content

The carbonate content is estimated to be about 17%.

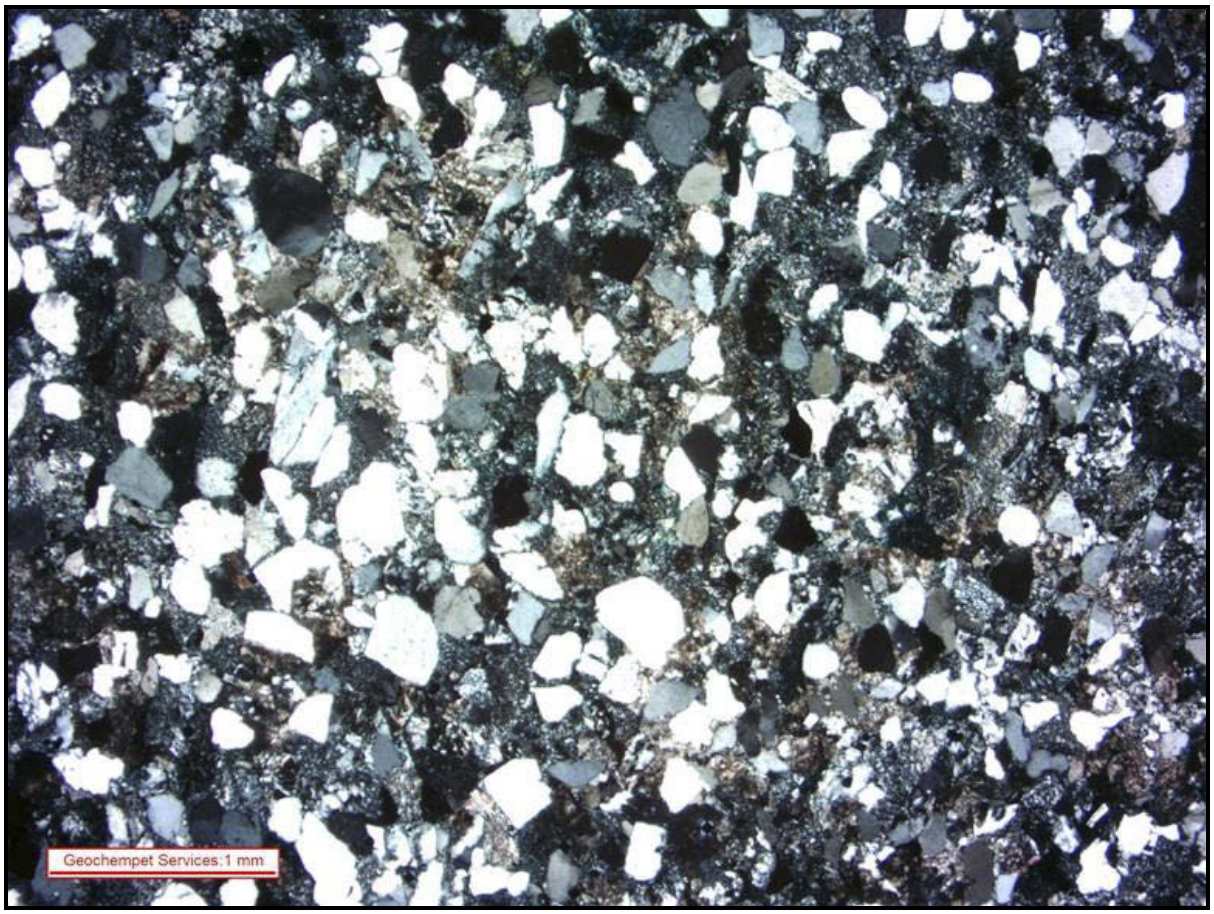
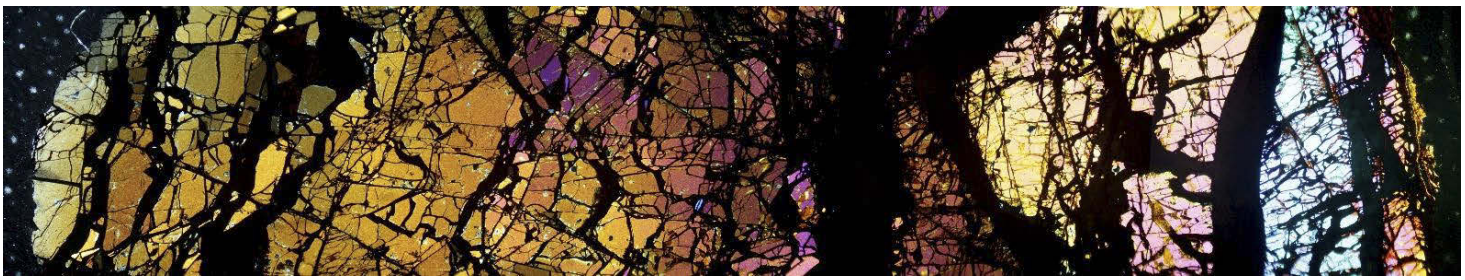


Plate 2: Micrograph taken at low magnification in transmitted cross polarised light of part of the sandstone, showing quartz and lithic grains with a thin interstitial clay cement and zeolite between grains.



Geochempet Services

ABN 980 6945 3445
PETROLOGICAL and GEOCHEMICAL CONSULTANTS
Principals: K.E. Spring B.Sc. (Hons), MAppSc and H.M. Spring B.Sc.

5/14 Redcliffe Gardens Drive
Clontarf, QLD 4019

Telephone: (07) 3284 0020

Email: info@geochempet.com
www.geochempet.com

PETROGRAPHIC REPORT
ON A DRILL CORE SAMPLE (101763)
FROM INLAND RAIL PROJECT

prepared for

TRILAB PTY LTD
BRISBANE OFFICE

Purchase Order: BNE 1912014

Invoice Number: 00008538

Client Ref: Chris Channon

Issued by
T. F. D. Spring BAppSc. MAppSc
10 January 2019

Reviewed by
K. E. Spring BSc (Hons), MAppSc
10 January 2019

Sample Number:	101763	**Date Sampled**:	Unknown
Sample Type:	Drill Core	**Date Received**:	14/12/2018
Borehole:	330-01-BH2104-C02492	**Depth**:	24.92 – 25.00 m
Project ID:	1893802 Inland Rail Package 13		

Work Requested Petrographic analysis and determination of quartz and carbonate content

Methods Account taken of ASTM C295 Standard Guide for *Petrographic Assessment of Aggregates for Concrete* and the AS2758.1 – 2014 *Aggregates and rock for engineering purposes part 1; Concrete aggregates (Appendix B)*

Identification Carbonated, quartzofeldspathic and lithic sandstone

Description

The sample consisted of a drill core specimen which is very slightly weathered, brownish-grey sandstone with slight bedding evident through variations in grain size. A deformed coal seam is noted in the core. Weathering is expressed through weathered/argillized clasts scattered throughout the core. The core can be lightly scratched by a steel tool. It seems to consist of a mixture of minerals, some as hard as quartz and others as soft as clay. The rock is medium to coarse-grained and is slowly hygroscopic.

Plate 1: Photograph of supplied drill core.

A thin section was prepared from the drill core for detailed microscopic examination in transmitted polarized light. An approximate mineralogical composition of the rock, expressed in volume percent and based on a brief count of 100 widely spaced observation points in thin section, is:

Hard, Durable Components

38%	quartz sand grains
6%	feldspar sand grains
<1%	other mineral grains (opaque oxide, leucoxene, zircon)
7%	quartzite clasts
6%	vein quartz
3%	acid tuffaceous/volcanic sand clasts (1% fine microcrystalline quartz)
4%	intermediate volcanic clasts (largely argillized)
2%	basalt clasts
2%	meta-pelite clasts
1%	epidote

Moderately Durable Components

11%	carbonate

Soft, Weak &/Or Deleterious Components

2%	muscovite
6%	argillized and sericitized clasts of uncertain origin
8%	interstitial sericite-smectite clays
3%	zeolite
<1%	earthy secondary iron oxide
<1%	carbonaceous matter
1%	pores

In thin section, the rock is a medium to coarse-grained, quartzofeldspathic and lithic sandstone with an average grainsize of about 0.25 to 1.5 mm. It is relatively well sorted, and shows a weak bedding defined by grainsize grading.

The framework grains are dominated by sub-rounded to sub-angular lithic clasts which are quite argillized, along with quartz and feldspar grains. Some quartz grains show overgrowths. Lithic clasts were very fine-grained quartzo-feldspathic grains with strong pale brown sericite-smectite alteration. Due to their fine grainsize, it is difficult to be sure that these were derived from formerly glassy rhyolite/dacite lava fragments along with minor intermediate volcanics. Equant to sub-rounded detrital quartz and blocky sub-rounded to euhedral feldspar grains are relatively common suggesting derivation from phenocrysts in felsic volcanic or explosive volcaniclastic rocks. Occasionally, there are detrital muscovite flakes (about 0.25 mm long) with long axes sub-parallel to the bedding along with some opaque oxides and carbonaceous specks. Other lithic clasts comprise of quartzite, vein quartz, basalt and meta-pelite.

The matrix of this rock is now composed of largely fine quartz and extremely fine-grained sericite/smectite clays which have been partly altered to carbonate and zeolite.

Comments and Interpretations

The supplied drill core sample (labelled 101763) from the Inland Rail Project is identified as medium to coarse-grained, quartzofeldspathic and lithic sandstone. The sandstone carries an abundance of argillized lithic clasts which indicate a felsic volcanic source.

For engineering purposes, the rock in the supplied drill core sample may be summarised as consisting of:

- **carbonated, quartzofeldspathic and lithic sandstone** (a sedimentary rock type)
- slightly porous (1% pores)
- very slightly weathered
- contains 11% moderately robust carbonate
- contains about 19% of soft, weak minerals as interstitial material and in altered lithic clasts
- **essentially hard**
- **essentially strong**

The rock is predicted to be **essentially durable**.

Free Silica Content

The free silica content is estimated to be about 52%.

Carbonate Content

The carbonate content is estimated to be about 11%.

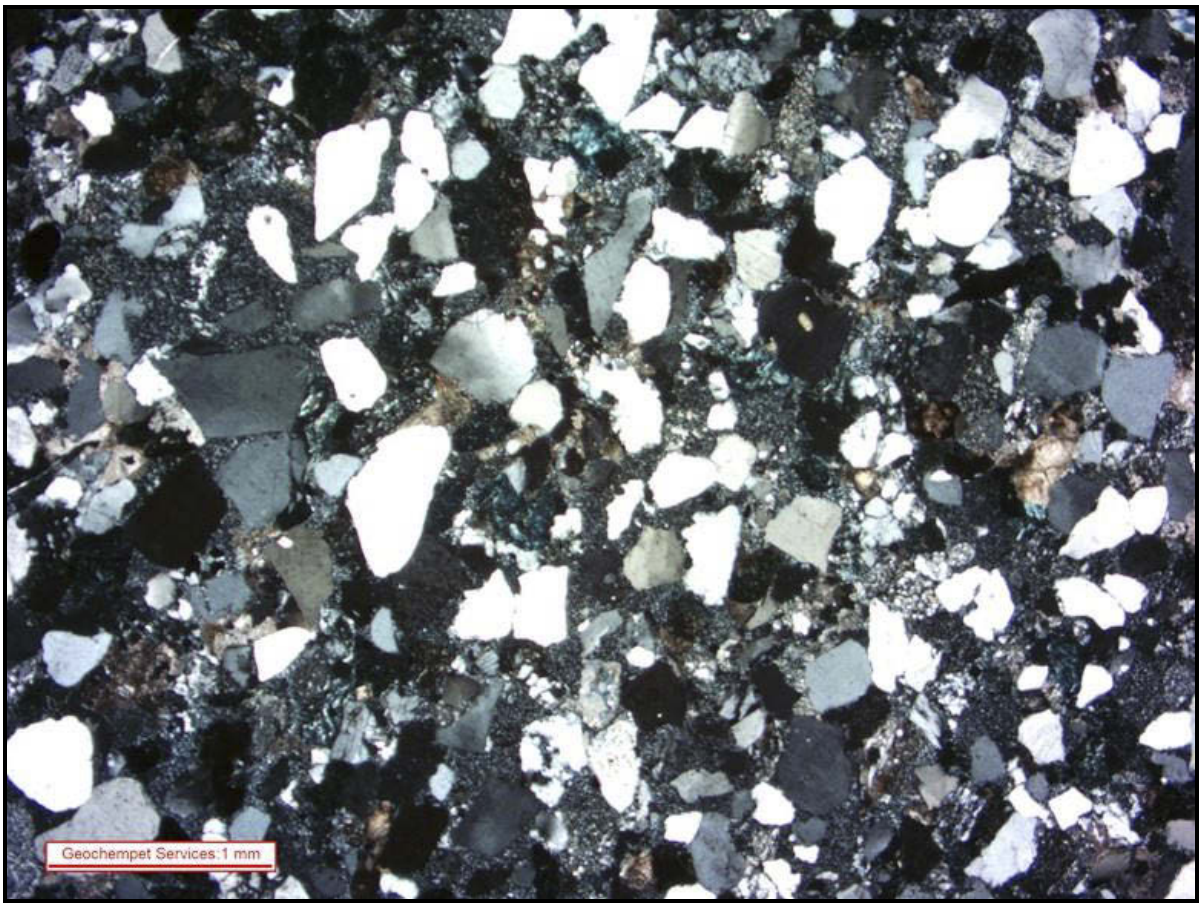


Plate 2: Micrograph taken at low magnification in transmitted cross polarised light of part of the sandstone. Image shows quartz, feldspar and lithic grains along with part of the matrix being slightly carbonated.

Slake Durability Index

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

SLAKE DURABILITY INDEX TEST REPORT

Test Method: AS 4133.3.4

Client	Golder Associates Pty Limited	**Report No.**	GA101511-SD
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR1
		Test Date	26/11/2018
Project	Inland Rail Package 13	**Report Date**	04/12/2018
Project No	1893802	**Client Sample No.**	330-01-BH2301-C00500

Sample No.	101511
BoreHole	330-01-BH2301
Depth From (m)	5.00
Depth To (m)	6.00
Description	C
Slake Durability (1st cycle) (%)	88.9
Slake Durability (2nd cycle) (%)	80.2
Slake Durability (3rd cycle) (%)	-
Slake Durability (4th cycle) (%)	-
Water Used	Tap Water
Temperature (^{o}C)	26.8
Appearance of fragments retained in the drum	Slight Deterioration
Appearance of fragments passing through the drum	Fragments & Fines

NOTES/REMARKS:

Sample/s supplied by the client

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

A **Authorised Signatory**

N. Maddison

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

SLAKE DURABILITY INDEX TEST REPORT

Test Method: AS 4133.3.4

Client	Golder Associates Pty Limited	**Report No.**	GA101516-SD
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR1
		Test Date	26/11/2018
Project	Inland Rail Package 13	**Report Date**	04/12/2018
Project No	1893802	**Client Sample No.**	330-01-BH2301-C01000

Sample No.	101516
BoreHole	330-01-BH2301
Depth From (m)	10
Depth To (m)	11
Description	C
Slake Durability (1st cycle) (%)	96.4
Slake Durability (2nd cycle) (%)	93.7
Slake Durability (3rd cycle) (%)	-
Slake Durability (4th cycle) (%)	-
Water Used	Tap Water
Temperature (^{o}C)	26.8
Appearance of fragments retained in the drum	Slight Deterioration
Appearance of fragments passing through the drum	Fragments & Fines

NOTES/REMARKS:

Sample/s supplied by the client

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

SLAKE DURABILITY INDEX TEST REPORT

Test Method: AS 4133.3.4

Client	Golder Associates Pty Limited	**Report No.**	GA101552-SD
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR1
		Test Date	30/11/2018
Project	Inland Rail Package 13	**Report Date**	04/12/2018
Project No	1893802	**Client Sample No.**	330-01-BH2303-C00500

Sample No.	101552
BoreHole	330-01-BH2303
Depth From (m)	5
Depth To (m)	6
Description	C
Slake Durability (1st cycle) (%)	98.8
Slake Durability (2nd cycle) (%)	97.9
Slake Durability (3rd cycle) (%)	-
Slake Durability (4th cycle) (%)	-
Water Used	Tap Water
Temperature (^{o}C)	27.8
Appearance of fragments retained in the drum	Original Form
Appearance of fragments passing through the drum	Fines

NOTES/REMARKS:

Sample/s supplied by the client

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

SLAKE DURABILITY INDEX TEST REPORT

Test Method: AS 4133.3.4

Client	Golder Associates Pty Limited	**Report No.**	GA101558-SD
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR1
		Test Date	29/11/2018
Project	Inland Rail Package 13	**Report Date**	04/12/2018
Project No	1893802	**Client Sample No.**	330-01-BH2303-C01000

Sample No.	101558
BoreHole	330-01-BH2303
Depth From (m)	10
Depth To (m)	11
Description	C
Slake Durability (1st cycle) (%)	97.8
Slake Durability (2nd cycle) (%)	96.7
Slake Durability (3rd cycle) (%)	-
Slake Durability (4th cycle) (%)	-
Water Used	Tap Water
Temperature (^{o}C)	26.1
Appearance of fragments retained in the drum	Original Form
Appearance of fragments passing through the drum	Fragments & Fines

NOTES/REMARKS:

Sample/s supplied by the client

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

SLAKE DURABILITY INDEX TEST REPORT

Test Method: AS 4133.3.4

Client	Golder Associates Pty Limited	**Report No.**	GA101692-SD
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR2
		Test Date	28/11/2018
Project	Inland Rail Package 13	**Report Date**	04/12/2018
Project No	1893802	**Client Sample No.**	330-01-BH2102-C00420

Sample No.	101692
BoreHole	330-01-BH2102
Depth From (m)	4.2
Depth To (m)	5
Description	C
Slake Durability (1st cycle) (%)	68.5
Slake Durability (2nd cycle) (%)	15.5
Slake Durability (3rd cycle) (%)	-
Slake Durability (4th cycle) (%)	-
Water Used	Tap Water
Temperature (^{o}C)	24.7
Appearance of fragments retained in the drum	High Deterioration
Appearance of fragments passing through the drum	Fragments & Fines

NOTES/REMARKS:

Sample/s supplied by the client

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

SLAKE DURABILITY INDEX TEST REPORT

Test Method: AS 4133.3.4

Client	Golder Associates Pty Limited	**Report No.**	GA101842-SD
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR3
		Test Date	15/01/2019
Project	Inland Rail Package 13	**Report Date**	17/01/2019
Project No	1893802	**Client Sample No.**	330-01-BH2306-C01250

Sample No.	101842
BoreHole	330-01-BH2306
Depth From (m)	12.5
Depth To (m)	13
Description	C
Slake Durability (1st cycle) (%)	94.8
Slake Durability (2nd cycle) (%)	90.5
Slake Durability (3rd cycle) (%)	-
Slake Durability (4th cycle) (%)	-
Water Used	Tap Water
Temperature (^{o}C)	28.6
Appearance of fragments retained in the drum	Slight Deterioration
Appearance of fragments passing through the drum	Fines

NOTES/REMARKS:

Sample/s supplied by the client

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

SLAKE DURABILITY INDEX TEST REPORT

Test Method: AS 4133.3.4

Client	Golder Associates Pty Limited	**Report No.**	GA101846-SD
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR3
		Test Date	15/01/2019
Project	Inland Rail Package 13	**Report Date**	17/01/2019
Project No	1893802	**Client Sample No.**	330-01-BH2306-C02100

Sample No.	101846
BoreHole	330-01-BH2306
Depth From (m)	21
Depth To (m)	21.5
Description	C
Slake Durability (1st cycle) (%)	90.6
Slake Durability (2nd cycle) (%)	84.4
Slake Durability (3rd cycle) (%)	-
Slake Durability (4th cycle) (%)	-
Water Used	Tap Water
Temperature (^{o}C)	28.6
Appearance of fragments retained in the drum	Slight Deterioration
Appearance of fragments passing through the drum	Fragments & Fines

NOTES/REMARKS:

Sample/s supplied by the client

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Soil Particle Density

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

SOIL PARTICLE DENSITY TEST REPORT

Test Method: AS 1289 3.5.1

Client	Golder Associates Pty Limited	**Report No.**	GA101459-SG
		Workorder No.	0005107
Address	PO Box 1734 MILTON BC QLD 4064	**Report Date**	06/12/2018

Project Inland Rail Package 13

Sample No.	101459	101463					
Test Date	28/11/2018	28/11/2018					
Client ID	330-01-BH2216-U00650	330-01-BH2216-U01250					
Depth (m)	6.50-6.99	12.50-12.99					
Soil Particle Density (t/m³) (-2.36mm)	2.54	2.58					

Sample No.							
Test Date							
Client ID							
Depth (m)							
Soil Particle Density (t/m³) (-2.36mm)							

NOTES/REMARKS:

Sample/s supplied by the client

Accredited for compliance with ISO/IEC 17025 - Testing.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Aggregate - Particle Density Degradation Crushing Value

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

AGGREGATE TEST REPORT

Client	Golder Associates Pty Limited	**Report No.**	GA101519-AGG
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR1
		Test Date	17/12/18-7/1/19
Project	Inland Rail Package 13	**Report Date**	7/01/2019
Project No.	1893802	**Client Sample No.**	330-01-BH2301-C01300
BoreHole	330-01-BH2301	**Depth From (m)** 13	**Depth To (m)** 15.5
Description	C		

TEST RESULTS

AS 1141.5 Particle Density & Water Absorption	Apparent Particle Density	2.63	t/m^3
	Particle Density - Dry Basis	2.44	t/m^3
	Particle Density - Saturated Surface	2.51	t/m^3
	Water Absorption	2.9	%
AS 1141 25.1 Deg. Factor (Source Rock)	Degradation Factor	2	
	Water Clarity	Not Clear	

Remarks

Sample/s supplied by client

Accredited for compliance with ISO/IEC 17025.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory

C. Park

NATA
ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

AGGREGATE TEST REPORT

Client	Golder Associates Pty Limited	**Report No.**	GA101542-AGG
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR1
		Test Date	17/12/18-7/1/19
Project	Inland Rail Package 13	**Report Date**	7/01/2019

Project No.	1893802	**Client Sample No.**	330-01-BH2303-C00340		
BoreHole	330-01-BH2303	**Depth From (m)**	3.4	**Depth To (m)**	4.9
Description	C				

TEST RESULTS

AS 1141.5 Particle Density & Water Absorption	Apparent Particle Density	2.66	t/m^3
	Particle Density - Dry Basis	2.52	t/m^3
	Particle Density - Saturated Surface	2.57	t/m^3
	Water Absorption	2.0	%
AS 1141 25.1 Deg. Factor (Source Rock)	Degradation Factor	2	
	Water Clarity	Not Clear	

Remarks

Sample/s supplied by client

Accredited for compliance with ISO/IEC 17025.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory

C. Park

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

AGGREGATE TEST REPORT

Client	Golder Associates Pty Limited	**Report No.**	GA101842-BPDC
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR3
		Test Date	23/01/2019-31/01/2019
Project	Inland Rail Package 13	**Report Date**	1/02/2019

Project No.	1893802	**Depth From (m)**	11	**Sample No.**	330-01-BH2306-C01250-BDW : 330-01-BH2306-C01250-MOI
BoreHole	330-01-BH2306	**Depth To (m)**	17		

TEST RESULTS

AS 1141.6.1 Particle Density & Water Absorption	Apparent Particle Density	2.66	t/m^3
	Particle Density - Dry Basis	2.18	t/m^3
	Particle Density - Saturated Surface	2.36	t/m^3
	Water Absorption	8.2	%

Remarks

Sample/s supplied by client

Accredited for compliance with ISO/IEC 17025.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory

C. Park

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

AGGREGATE TEST REPORT

Client	Golder Associates Pty Limited	**Report No.**	GA101842-BPDF
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR3
		Test Date	23/1/19-29/1/19
Project	Inland Rail Package 13	**Report Date**	30/01/2019

Project No.	1893802	**Depth From (m)**	11	**Sample No.**	330-01-BH2306-C01250-BDW : 330-01-BH2306-C01250-MOI
BoreHole	330-01-BH2306	**Depth To (m)**	17		
Description	C				

TEST RESULTS

AS 1141.5 Particle Density & Water Absorption	Apparent Particle Density	2.59	t/m^3
	Particle Density - Dry Basis	2.37	t/m^3
	Particle Density - Saturated Surface	2.45	t/m^3
	Water Absorption	3.7	%

Remarks

Sample/s supplied by client

Accredited for compliance with ISO/IEC 17025.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory

C. Park

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Trilab
Soil Rock Calibration

Brisbane
346A Bilsen Road,
Geebung
QLD 4034
Ph: +61 7 3265 5656

Perth
2 Kimmer Place,
Queens Park
WA 6107
Ph: +61 8 9258 8323

AGGREGATE TEST REPORT

Client	Golder Associates Pty Limited	**Report No.**	GA101842-ACV
Address	PO Box 1734 MILTON BC QLD 4064	**Request No.**	1893802_H2C_TR3
		Test Date	23/01/2019-30/01/2019
Project	Inland Rail Package 13	**Report Date**	30/01/2019

Project No.	1893802	**Depth From (m)**	11	**Sample No.**	330-01-BH2306-C01250-ACV :
BoreHole	330-01-BH2306	**Depth To (m)**	17		
Description	C				

TEST RESULTS

AS 1141.21	Aggregate Crushing Value	Aggregate Crushing Value	41.2	%
		Size Fraction	6.7 - 4.75	mm

Remarks

Sample/s supplied by client

Accredited for compliance with ISO/IEC 17025.
The results of the tests, calibrations, and/or measurements included in this document are traceable to Australian/National Standards.

Tested at Trilab Brisbane Laboratory.

Authorised Signatory

C. Park

NATA ACCREDITED FOR TECHNICAL COMPETENCE

Laboratory No. 9926

Aggressivity

0 0.00 True

CERTIFICATE OF ANALYSIS

Work Order	: **EB1829170**	Page	: 1 of 6
Client	: **TRILAB PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: THE ADMIN RESULTS	Contact	: Customer Services EB
Address	: 346A BILSEN RD GEEBUNG QLD, AUSTRALIA 4031	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: +61 07 3265 5656	Telephone	: +61-7-3243 7222
Project	: 1893802 - Inland Rail Package 13	Date Samples Received	: 28-Nov-2018 13:45
Order number	: BNE 1911046	Date Analysis Commenced	: 29-Nov-2018
C-O-C number	: ----	Issue Date	: 05-Dec-2018 09:48
Sampler	: ----		
Site	: ----		
Quote number	: EN/333		
No. of samples received	: 20		
No. of samples analysed	: 20		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Kim McCabe	Senior Inorganic Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- CORROSION ASSESSMENT: As per Australian Standard (AS2159-1995, section 6), the Exposure Classification for all samples is rated Non Aggressive. ALS is not NATA accredited for this comment.

Analytical Results

Sub-Matrix: **SOIL**
(Matrix: **SOIL**)

Compound	CAS Number	LOR	Unit	Client sample ID	101405 / 330-01-BH2203-S0065 0 / 6.50-6.90m	101407 / 330-01-BH2203-S0095 0 / 9.50-9.77m	101408 / 330-01-BH2203-S0110 0 / 11.00-11.29m	101419 / 330-01-BH2207-S0005 0 / 0.50-0.95m	101423 / 330-01-BH2207-S0065 0 / 6.50-6.65m
				Client sampling date / time	29-Nov-2018 00:00	29-Nov-2018 00:00	29-Nov-2018 00:00	29-Nov-2018 00:00	29-Nov-2018 00:00
					EB1829170-001	EB1829170-002	EB1829170-003	EB1829170-004	EB1829170-005
					Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)									
pH Value	----	0.1	pH Unit		**6.8**	**6.5**	**5.9**	**5.8**	**9.6**
EA055: Moisture Content (Dried @ 105-110°C)									
Moisture Content	----	1.0	%		**10.7**	**6.0**	**10.9**	**3.3**	**10.8**
ED040S : Soluble Sulfate by ICPAES									
Sulfate as SO4 2-	14808-79-8	10	mg/kg		<10	**10**	**10**	**10**	**40**
ED045G: Chloride by Discrete Analyser									
Chloride	16887-00-6	10	mg/kg		**10**	<10	<10	<10	**220**

Analytical Results

Sub-Matrix: **SOIL**
(Matrix: **SOIL**)

Compound	CAS Number	LOR	Unit	Client sample ID	101425 / 330-01-BH2207-S0095 0 / 9.50-9.76m	101436 / 330-01-BH2212-S0005 0 / 0.50-0.95m	101440 / 330-01-BH2212-S0065 0 / 6.50-6.95m	101451 / 330-01-BH2212-S0230 0 / 23.00-23.205m	101456 / 330-01-BH2216-S0020 0 / 2.00-2.45m
				Client sampling date / time	29-Nov-2018 00:00	29-Nov-2018 00:00	29-Nov-2018 00:00	29-Nov-2018 00:00	29-Nov-2018 00:00
				EB1829170-006	EB1829170-007	EB1829170-008	EB1829170-009	EB1829170-010	
				Result	Result	Result	Result	Result	
EA002: pH 1:5 (Soils)									
pH Value	----	0.1	pH Unit	**8.8**	**9.0**	**9.2**	**9.7**	**8.8**	
EA055: Moisture Content (Dried @ 105-110°C)									
Moisture Content	----	1.0	%	**13.0**	**20.5**	**27.3**	**13.6**	**25.8**	
ED040S : Soluble Sulfate by ICPAES									
Sulfate as SO4 2-	14808-79-8	10	mg/kg	**20**	**130**	**20**	<10	**130**	
ED045G: Chloride by Discrete Analyser									
Chloride	16887-00-6	10	mg/kg	**440**	**220**	**920**	**70**	**2870**	

Analytical Results

Sub-Matrix: **SOIL**
(Matrix: **SOIL**)

Compound	CAS Number	LOR	Unit	Client sample ID	101462 / 330-01-BH2216-S0110 0 / 11.00-11.45m	101466 / 330-01-BH2216-S0170 0 / 17.00-17.45m	101473 / 330-01-BH2224-S0035 0 / 3.50-3.95m	101475 / 330-01-BH2224-S0065 0 / 6.50-6.95m	101477 / 330-01-BH2224-S0095 0 / 9.50-9.95m
				Client sampling date / time	29-Nov-2018 00:00	29-Nov-2018 00:00	29-Nov-2018 00:00	29-Nov-2018 00:00	29-Nov-2018 00:00
					EB1829170-011	EB1829170-012	EB1829170-013	EB1829170-014	EB1829170-015
					Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)									
pH Value	----	0.1	pH Unit		**8.9**	**8.6**	**8.7**	**8.7**	**7.9**
EA055: Moisture Content (Dried @ 105-110°C)									
Moisture Content	----	1.0	%		**15.5**	**14.1**	**21.1**	**16.0**	**18.0**
ED040S : Soluble Sulfate by ICPAES									
Sulfate as SO4 2-	14808-79-8	10	mg/kg		**10**	<10	<10	<10	<10
ED045G: Chloride by Discrete Analyser									
Chloride	16887-00-6	10	mg/kg		**400**	**540**	**10**	**10**	**10**

Analytical Results

Sub-Matrix: **SOIL**
(Matrix: **SOIL**)

Compound	CAS Number	LOR	Unit	Client sample ID	101483 / 330-01-BH2224-S0185 0 / 18.50-18.605m	101491 / 330-01-BH2227-S0005 0 / 0.50-0.95m	101495 / 330-01-BH2227-S0065 0 / 6.50-6.95m	101500 / 330-01-BH2227-S0125 0 / 12.50-12.95m	101504 / 330-01-BH2227-S0185 0 / 18.50-18.56m
				Client sampling date / time	29-Nov-2018 00:00	29-Nov-2018 00:00	29-Nov-2018 00:00	29-Nov-2018 00:00	29-Nov-2018 00:00
					EB1829170-016	EB1829170-017	EB1829170-018	EB1829170-019	EB1829170-020
					Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)									
pH Value	----	0.1	pH Unit		**8.3**	**8.4**	**9.3**	**8.7**	**8.9**
EA055: Moisture Content (Dried @ 105-110°C)									
Moisture Content	----	1.0	%		**10.7**	**15.8**	**19.0**	**25.4**	**16.7**
ED040S : Soluble Sulfate by ICPAES									
Sulfate as SO4 2-	14808-79-8	10	mg/kg		<10	**40**	**40**	**10**	<10
ED045G: Chloride by Discrete Analyser									
Chloride	16887-00-6	10	mg/kg		**20**	**320**	**240**	**80**	**60**

0 0.00 True

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EB1829495**	Page	: 1 of 4
Client	: **TRILAB PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: MR CHRIS CHANNON	Contact	: Customer Services EB
Address	: 346A BILSEN RD GEEBUNG QLD, AUSTRALIA 4031	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: +61 07 3265 5656	Telephone	: +61-7-3243 7222
Project	: 1893802 - Inland Rail Package 13	Date Samples Received	: 03-Dec-2018 15:50
Order number	: BNE 1911048	Date Analysis Commenced	: 03-Dec-2018
C-O-C number	: ----	Issue Date	: 06-Dec-2018 08:56
Sampler	: ----		
Site	: ----		
Quote number	: EN/333		
No. of samples received	: 6		
No. of samples analysed	: 6		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Kim McCabe	Senior Inorganic Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- CORROSION ASSESSMENT: As per Australian Standard (AS2159-1995, section 6), the Exposure Classification for all samples is rated Non Aggressive. ALS is not NATA accredited for this comment.

Analytical Results

Sub-Matrix: **SOIL**
(Matrix: **SOIL**)

Compound	CAS Number	LOR	Unit	Client sample ID	GA101713 / 330-01-BH2103-S0005 0 / 0.50-0.95m	GA101715 / 330-01-BH2103-S0035 0 / 3.50-3.95m	GA101717 / 330-01-BH2103-U0060 0 / 6.00-6.29m	GSA101740 / 330-01-BH2104-S0005 0 / 0.50-0.95m	GA101742 / 330-01-BH2104-S0035 0 / 3.50-3.94m
				Client sampling date / time	03-Dec-2018 00:00	03-Dec-2018 00:00	03-Dec-2018 00:00	03-Dec-2018 00:00	03-Dec-2018 00:00
					EB1829495-001	EB1829495-002	EB1829495-003	EB1829495-004	EB1829495-005
					Result	Result	Result	Result	Result
EA002: pH 1:5 (Soils)									
pH Value	----	0.1	pH Unit		**7.7**	**8.4**	**5.4**	**6.9**	**8.2**
EA055: Moisture Content (Dried @ 105-110°C)									
Moisture Content	----	1.0	%		**8.8**	**12.0**	**21.2**	**7.8**	**16.5**
ED040S : Soluble Sulfate by ICPAES									
Sulfate as SO4 2-	14808-79-8	10	mg/kg		**20**	**20**	**140**	<10	**10**
ED045G: Chloride by Discrete Analyser									
Chloride	16887-00-6	10	mg/kg		<10	<10	<10	<10	**30**

Analytical Results

Sub-Matrix: SOIL (Matrix: SOIL)				Client sample ID	GA101745 / 330-01-BH2104-S0080 0 / 8.00-8.45m	----	----	----	----
				Client sampling date / time	03-Dec-2018 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit		EB1829495-006	--------	--------	--------	--------
					Result	----	----	----	----
EA002: pH 1:5 (Soils)									
pH Value	----	0.1	pH Unit		**9.0**	----	----	----	----
EA055: Moisture Content (Dried @ 105-110°C)									
Moisture Content	----	1.0	%		**10.6**	----	----	----	----
ED040S : Soluble Sulfate by ICPAES									
Sulfate as SO4 2-	14808-79-8	10	mg/kg		**40**	----	----	----	----
ED045G: Chloride by Discrete Analyser									
Chloride	16887-00-6	10	mg/kg		**260**	----	----	----	----

QUALITY CONTROL REPORT

Work Order	: **EB1829495**	Page	: 1 of 3
Client	: **TRILAB PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: MR CHRIS CHANNON	Contact	: Customer Services EB
Address	: 346A BILSEN RD GEEBUNG QLD, AUSTRALIA 4031	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: +61 07 3265 5656	Telephone	: +61-7-3243 7222
Project	: 1893802 - Inland Rail Package 13	Date Samples Received	: 03-Dec-2018
Order number	: BNE 1911048	Date Analysis Commenced	: 03-Dec-2018
C-O-C number	: ----	Issue Date	: 06-Dec-2018
Sampler	: ----		
Site	: ----		
Quote number	: EN/333		
No. of samples received	: 6		
No. of samples analysed	: 6		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Kim McCabe	Senior Inorganic Chemist	Brisbane Acid Sulphate Soils, Stafford, QLD
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis. Where the LOR of a reported result differs from standard LOR, this may be due to high moisture

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **SOIL**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EA002: pH 1:5 (Soils) (QC Lot: 2072059)									
EB1829456-001	Anonymous	EA002: pH Value	----	0.1	pH Unit	4.9	5.0	0.00	0% - 20%
EA055: Moisture Content (Dried @ 105-110°C) (QC Lot: 2072068)									
EB1829045-020	Anonymous	EA055: Moisture Content	----	0.1	%	5.5	5.4	0.00	No Limit
EB1829495-004	GSA101740 / 330-01-BH2104-S00050 / 0.50-0.95m	EA055: Moisture Content	----	0.1	%	7.8	7.9	1.66	No Limit
ED040S: Soluble Major Anions (QC Lot: 2072062)									
EB1829495-001	GA101713 / 330-01-BH2103-S00050 / 0.50-0.95m	ED040S: Sulfate as SO4 2-	14808-79-8	10	mg/kg	20	20	0.00	No Limit
ED045G: Chloride by Discrete Analyser (QC Lot: 2072063)									
EB1829495-001	GA101713 / 330-01-BH2103-S00050 / 0.50-0.95m	ED045G: Chloride	16887-00-6	10	mg/kg	<10	<10	0.00	No Limit

Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Spike (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **SOIL**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EA002: pH 1:5 (Soils) (QCLot: 2072059)								
EA002: pH Value	----	----	pH Unit	----	4 pH Unit	100	98	102
				----	7 pH Unit	100	98	102
ED040S: Soluble Major Anions (QCLot: 2072062)								
ED040S: Sulfate as SO4 2-	14808-79-8	10	mg/kg	<10	500 mg/kg	101	90	114
ED045G: Chloride by Discrete Analyser (QCLot: 2072063)								
ED045G: Chloride	16887-00-6	10	mg/kg	<10	50 mg/kg	108	83	119
				<10	5000 mg/kg	108	83	119

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

- **No Matrix Spike (MS) or Matrix Spike Duplicate (MSD) Results are required to be reported.**

ALS Environmental

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **EB1829495**	Page	: 1 of 4
Client	: **TRILAB PTY LTD**	Laboratory	: Environmental Division Brisbane
Contact	: MR CHRIS CHANNON	Telephone	: +61-7-3243 7222
Project	: 1893802 - Inland Rail Package 13	Date Samples Received	: 03-Dec-2018
Site	: ----	Issue Date	: 06-Dec-2018
Sampler	: ----	No. of samples received	: 6
Order number	: BNE 1911048	No. of samples analysed	: 6

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **NO Duplicate outliers occur.**
- **NO Laboratory Control outliers occur.**
- **NO Matrix Spike outliers occur.**
- **For all regular sample matrices, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **NO Analysis Holding Time Outliers exist.**

Outliers : Frequency of Quality Control Samples

- **NO Quality Control Sample Frequency Outliers exist.**

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **SOIL**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA002: pH 1:5 (Soils)							
Snap Lock Bag (EA002)							
GA101713 / 330-01-BH2103-S00050 / 0.50-0.95m, GA101715 / 330-01-BH2103-S00350 / 3.50-3.95m, GA101717 / 330-01-BH2103-U00600 / 6.00-6.29m, GSA101740 / 330-01-BH2104-S00050 / 0.50-0.95m, GA101742 / 330-01-BH2104-S00350 / 3.50-3.94m, GA101745 / 330-01-BH2104-S00800 / 8.00-8.45m	**03-Dec-2018**	**04-Dec-2018**	10-Dec-2018	✓	**04-Dec-2018**	04-Dec-2018	✓
EA055: Moisture Content (Dried @ 105-110°C)							
Snap Lock Bag (EA055)							
GA101713 / 330-01-BH2103-S00050 / 0.50-0.95m, GA101715 / 330-01-BH2103-S00350 / 3.50-3.95m, GA101717 / 330-01-BH2103-U00600 / 6.00-6.29m, GSA101740 / 330-01-BH2104-S00050 / 0.50-0.95m, GA101742 / 330-01-BH2104-S00350 / 3.50-3.94m, GA101745 / 330-01-BH2104-S00800 / 8.00-8.45m	**03-Dec-2018**	**----**	----	----	**03-Dec-2018**	17-Dec-2018	✓
ED040S : Soluble Sulfate by ICPAES							
Snap Lock Bag (ED040S)							
GA101713 / 330-01-BH2103-S00050 / 0.50-0.95m, GA101715 / 330-01-BH2103-S00350 / 3.50-3.95m, GA101717 / 330-01-BH2103-U00600 / 6.00-6.29m, GSA101740 / 330-01-BH2104-S00050 / 0.50-0.95m, GA101742 / 330-01-BH2104-S00350 / 3.50-3.94m, GA101745 / 330-01-BH2104-S00800 / 8.00-8.45m	**03-Dec-2018**	**04-Dec-2018**	31-Dec-2018	✓	**04-Dec-2018**	01-Jan-2019	✓
ED045G: Chloride by Discrete Analyser							
Snap Lock Bag (ED045G)							
GA101713 / 330-01-BH2103-S00050 / 0.50-0.95m, GA101715 / 330-01-BH2103-S00350 / 3.50-3.95m, GA101717 / 330-01-BH2103-U00600 / 6.00-6.29m, GSA101740 / 330-01-BH2104-S00050 / 0.50-0.95m, GA101742 / 330-01-BH2104-S00350 / 3.50-3.94m, GA101745 / 330-01-BH2104-S00800 / 8.00-8.45m	**03-Dec-2018**	**04-Dec-2018**	31-Dec-2018	✓	**04-Dec-2018**	01-Jan-2019	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **SOIL**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Chloride Soluble By Discrete Analyser	ED045G	1	6	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Anions - Soluble	ED040S	1	6	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Moisture Content	EA055	2	13	**15.38**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
pH (1:5)	EA002	1	8	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Chloride Soluble By Discrete Analyser	ED045G	2	6	**33.33**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Anions - Soluble	ED040S	1	6	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
pH (1:5)	EA002	2	8	**25.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Chloride Soluble By Discrete Analyser	ED045G	1	6	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Anions - Soluble	ED040S	1	6	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Brief Method Summaries

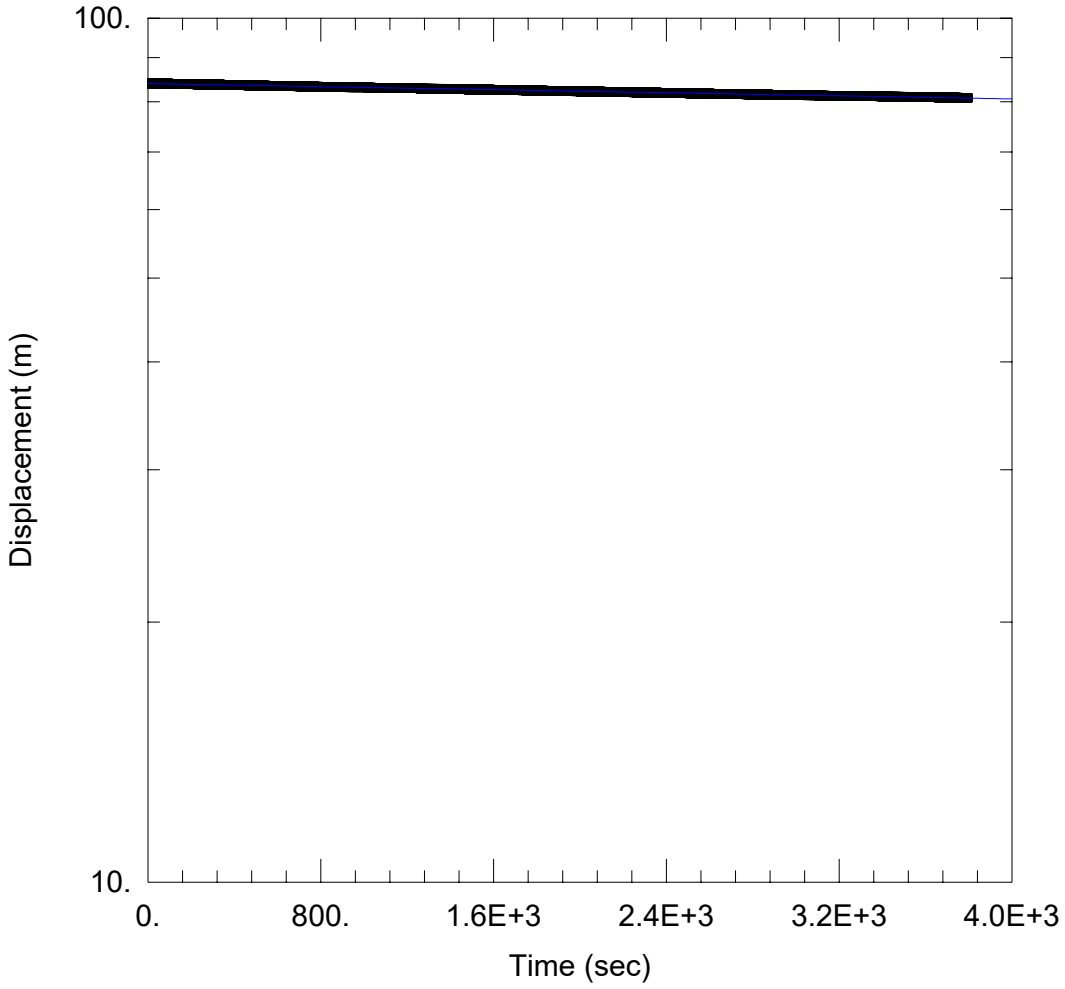
The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
pH (1:5)	EA002	SOIL	In house: Referenced to Rayment and Lyons 4A1 and APHA 4500H+. pH is determined on soil samples after a 1:5 soil/water leach. This method is compliant with NEPM (2013) Schedule B(3)
Moisture Content	EA055	SOIL	In house: A gravimetric procedure based on weight loss over a 12 hour drying period at 105-110 degrees C. This method is compliant with NEPM (2013) Schedule B(3) Section 7.1 and Table 1 (14 day holding time).
Major Anions - Soluble	ED040S	SOIL	In house: Soluble Anions are determined off a 1:5 soil / water extract by ICPAES.
Chloride Soluble By Discrete Analyser	ED045G	SOIL	In house: Referenced to APHA 4500-Cl- E. The thiocyanate ion is liberated from mercuric thiocyanate through sequestration of mercury by the chloride ion to form non-ionised mercuric chloride.in the presence of ferric ions the librated thiocynate forms highly-coloured ferric thiocynate which is measured at 480 nm. Analysis is performed on a 1:5 soil / water leachate.

Preparation Methods	Method	Matrix	Method Descriptions
1:5 solid / water leach for soluble analytes	EN34	SOIL	10 g of soil is mixed with 50 mL of reagent grade water and tumbled end over end for 1 hour. Water soluble salts are leached from the soil by the continuous suspension. Samples are settled and the water filtered off for analysis.

Appendix E
Hydraulic Testing Results

HELIDON TO CALVERT ENVIRONMENTAL IMPACT STATEMENT



330-01-BH2101_FHT-TEST1 (93.5 M T0 130 M)

Data Set: V:\...\330-01-BH2101_FHT_Test1 Hvorslev.aqt
Date: 12/04/18 Time: 16:58:03

PROJECT INFORMATION

Company: Golder
Project: 1893802
Test Well: 330-01-BH2101
Test Date: 25/10/2018

AQUIFER DATA

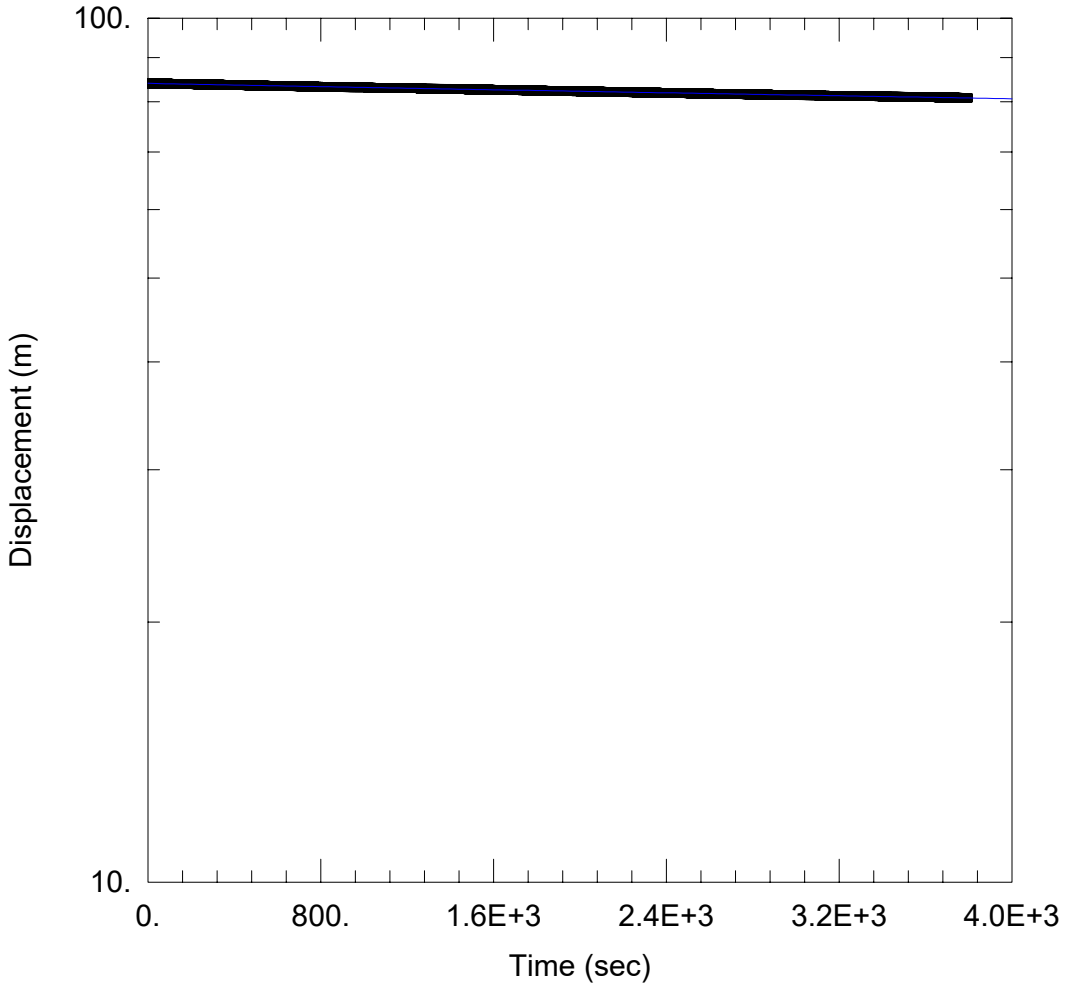
Saturated Thickness: 47.49 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (330-01-BH2101)

Initial Displacement: 84.05 m
Total Well Penetration Depth: 47.49 m
Casing Radius: 0.048 m
Static Water Column Height: 47.49 m
Screen Length: 36.5 m
Well Radius: 0.048 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 2.36E-9 m/sec
y0 = 83.98 m



330-01-BH2101_FHT-TEST1 (93.5 M T0 130 M)

Data Set: V:\...\330-01-BH2101_FHT_Test1 KGS.aqt
Date: 12/04/18 Time: 16:58:54

PROJECT INFORMATION

Company: Golder
Project: 1893802
Test Well: 330-01-BH2101
Test Date: 25/10/2018

AQUIFER DATA

Saturated Thickness: 47.49 m

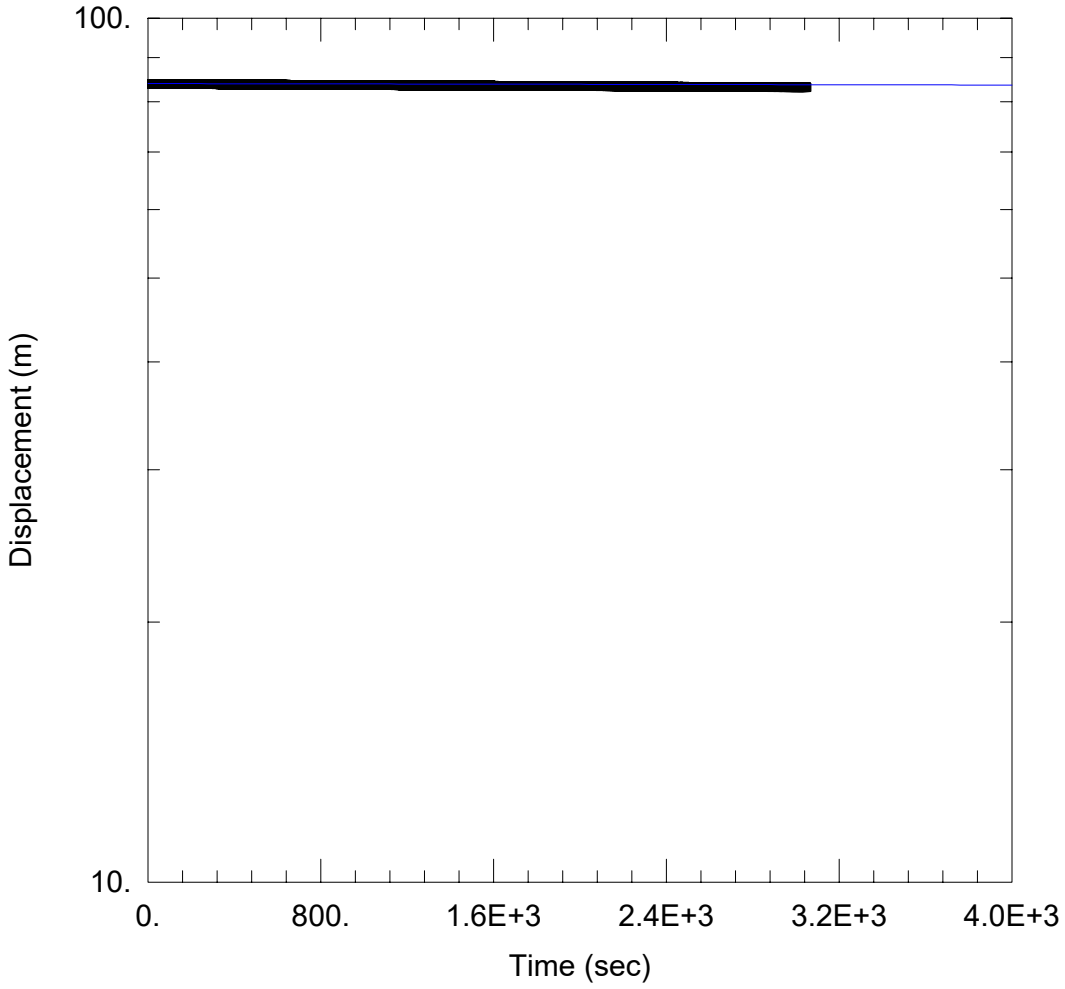
WELL DATA (330-01-BH2101)

Initial Displacement: 84.05 m
Total Well Penetration Depth: 47.49 m
Casing Radius: 0.048 m
Static Water Column Height: 47.49 m
Screen Length: 36.5 m
Well Radius: 0.048 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 1.963E-9 m/sec
Kz/Kr = 1.
Ss = 7.925E-9 m^{-1}



330-01-BH2101_FHT-TEST 2 (87.5 M TO 92.5 M)

Data Set: V:\...\330-01-BH2101_FHT_Test2 Hvorslev.aqt
Date: 12/04/18 Time: 16:59:14

PROJECT INFORMATION

Company: Golder
Project: 1893802
Test Well: 330-01-BH2101
Test Date: 25/10/2018

AQUIFER DATA

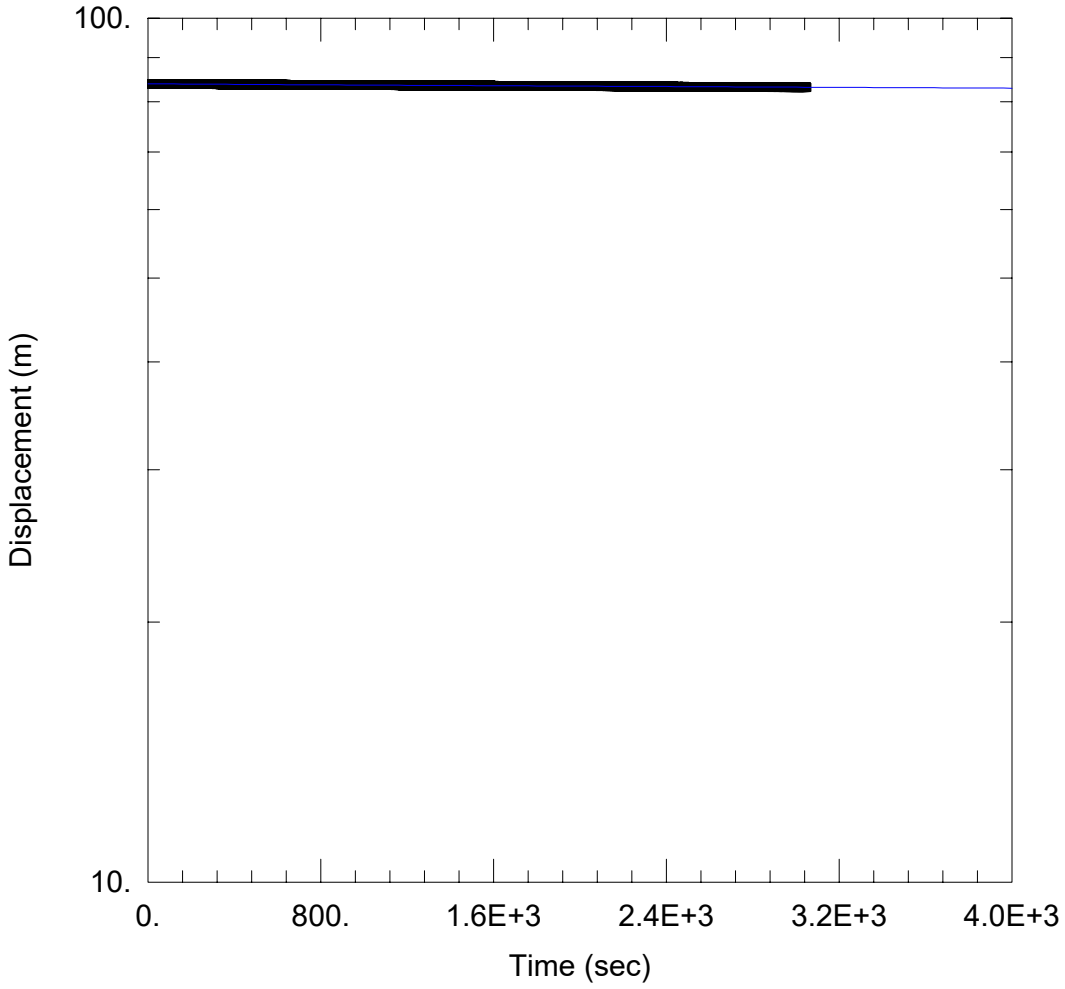
Saturated Thickness: 47.9 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (330-01-BH2101)

Initial Displacement: 83.94 m
Total Well Penetration Depth: 9.99 m
Casing Radius: 0.048 m
Static Water Column Height: 47.49 m
Screen Length: 5. m
Well Radius: 0.048 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 1.05E-9 m/sec
y0 = 83.98 m



330-01-BH2101_FHT-TEST 2 (87.5 M TO 92.5 M)

Data Set: V:\...\330-01-BH2101_FHT_Test2 KGS.aqt
Date: 12/04/18 Time: 16:59:34

PROJECT INFORMATION

Company: Golder
Project: 1893802
Test Well: 330-01-BH2101
Test Date: 25/10/2018

AQUIFER DATA

Saturated Thickness: 47.9 m

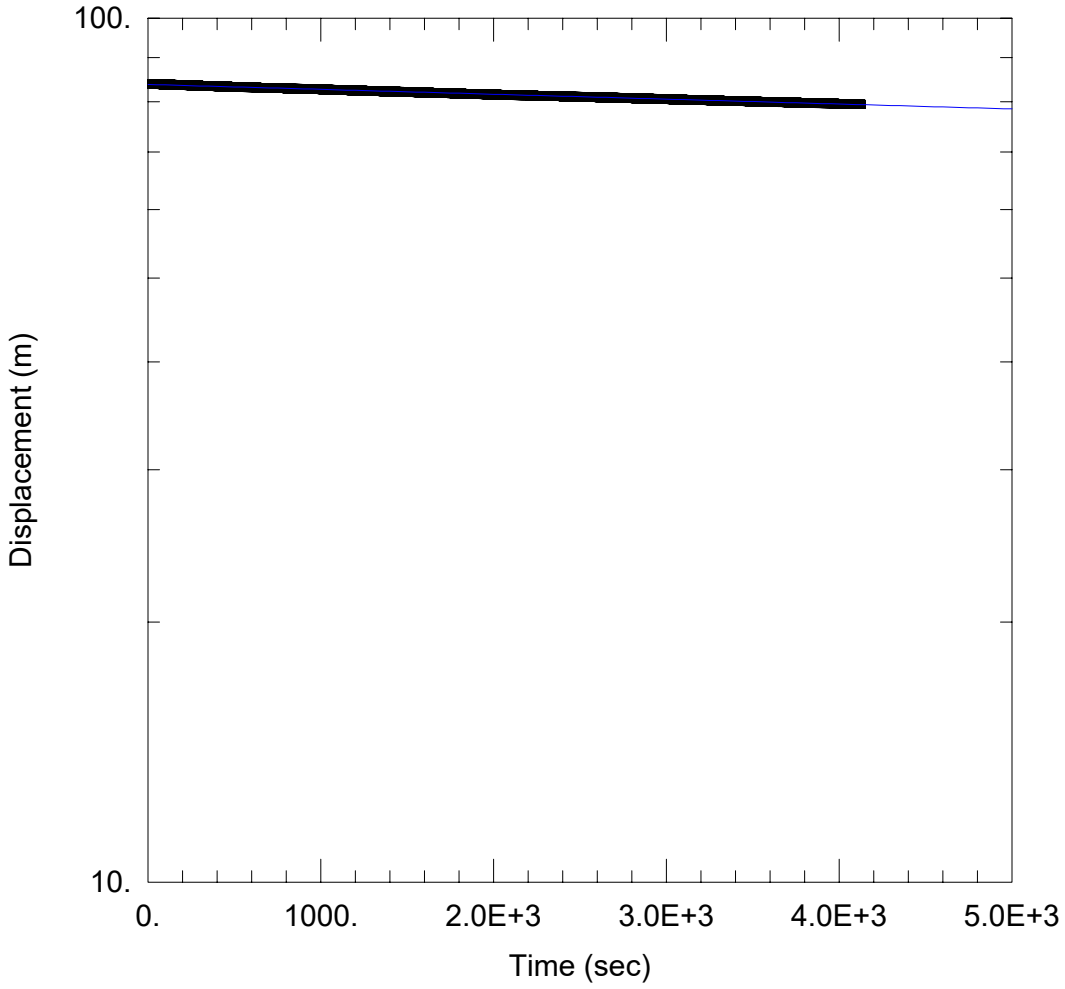
WELL DATA (330-01-BH2101)

Initial Displacement: 83.94 m
Total Well Penetration Depth: 9.99 m
Casing Radius: 0.048 m
Static Water Column Height: 47.49 m
Screen Length: 5. m
Well Radius: 0.048 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 2.259E-9 m/sec
Kz/Kr = 1.
Ss = 2.194E-6 m^{-1}



330-01-BH2101_FHT-TEST 3 (81.5 M TO 86.5 M)

Data Set: V:\...\330-01-BH2101_FHT_Test3 Hvorslev.aqt
Date: 12/04/18 Time: 16:59:55

PROJECT INFORMATION

Company: Golder
Project: 1893802
Test Well: 330-01-BH2101
Test Date: 26/10/2018

AQUIFER DATA

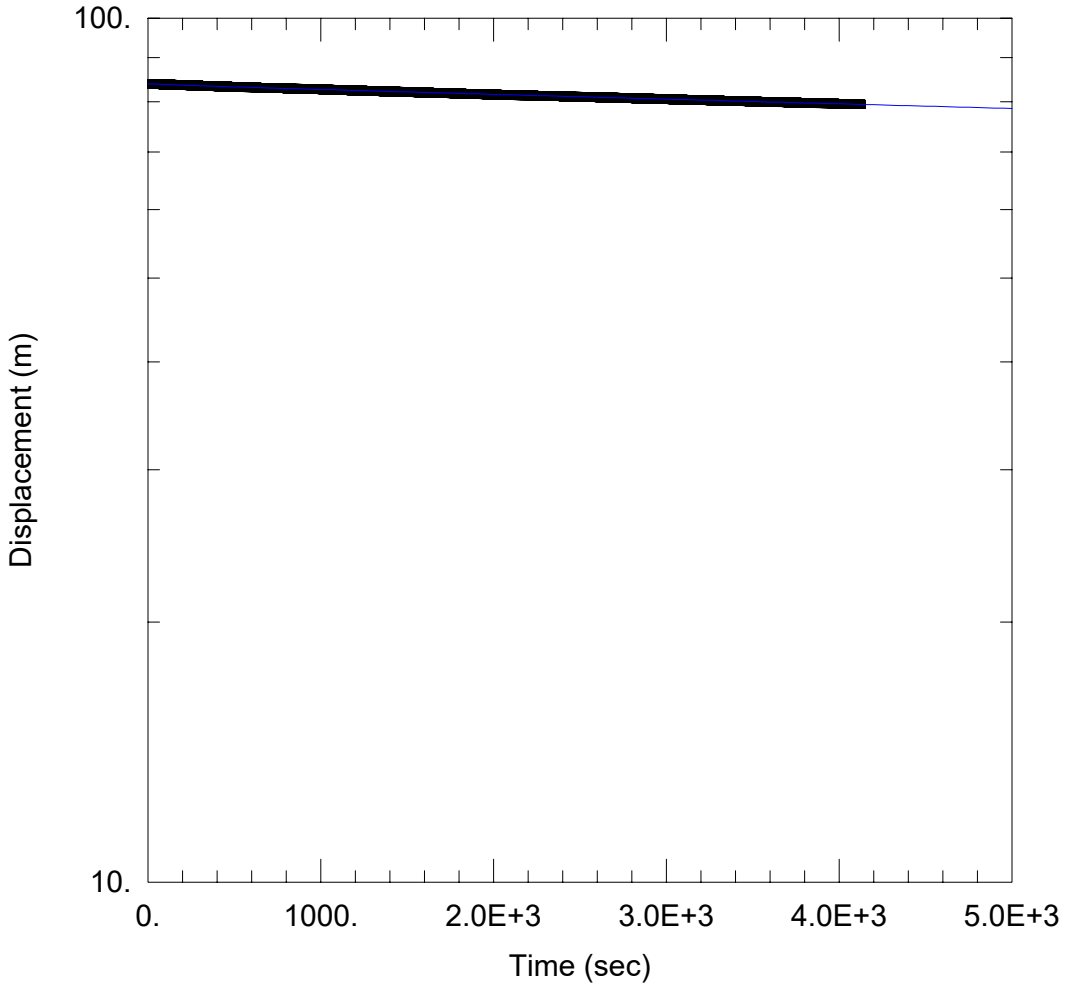
Saturated Thickness: 47.9 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (330-01-BH2101)

Initial Displacement: 83.96 m
Total Well Penetration Depth: 3.99 m
Casing Radius: 0.048 m
Static Water Column Height: 3.99 m
Screen Length: 3.99 m
Well Radius: 0.048 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 1.665E-8 m/sec
y0 = 83.79 m



330-01-BH2101_FHT-TEST 3 (81.5 M TO 86.5 M)

Data Set: V:\...\330-01-BH2101_FHT_Test3 KGS.aqt
Date: 12/04/18 Time: 17:00:15

PROJECT INFORMATION

Company: Golder
Project: 1893802
Test Well: 330-01-BH2101
Test Date: 26/10/2018

AQUIFER DATA

Saturated Thickness: 47.9 m

WELL DATA (330-01-BH2101)

Initial Displacement: 83.96 m
Total Well Penetration Depth: 3.99 m
Casing Radius: 0.048 m
Static Water Column Height: 3.99 m
Screen Length: 3.99 m
Well Radius: 0.048 m

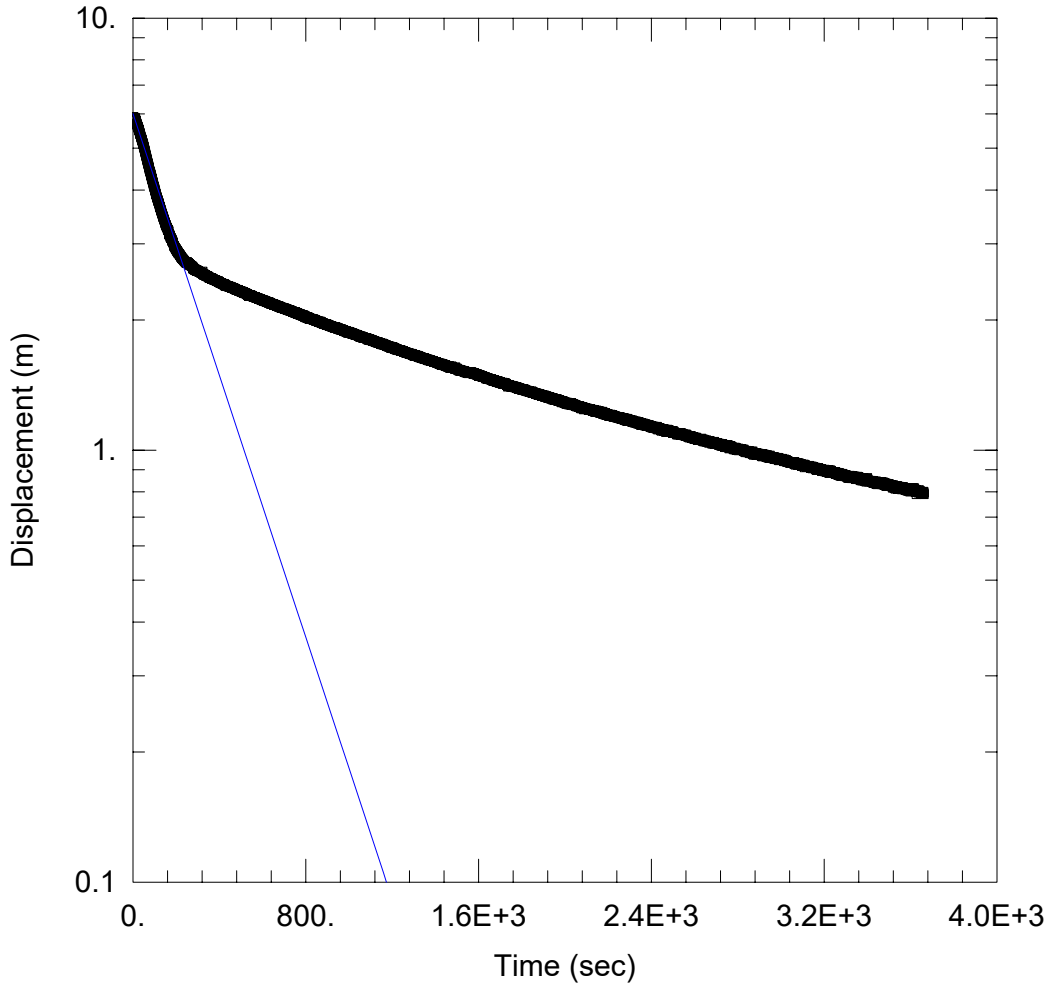
SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 1.192E-8 m/sec
Kz/Kr = 1.
Ss = 1.224E-5 m^{-1}

Appendix F
Slug Testing Results

HELIDON TO CALVERT ENVIRONMENTAL IMPACT STATEMENT



330-01-BH2101_FHT

Data Set: V:\...\330-01-BH2101_FHT_Hvorslev_early.aqt
Date: 03/19/19 Time: 12:15:44

PROJECT INFORMATION

Company: Golder
Project: 1893802
Test Well: 330-01-BH2101
Test Date: 7/12/2018

AQUIFER DATA

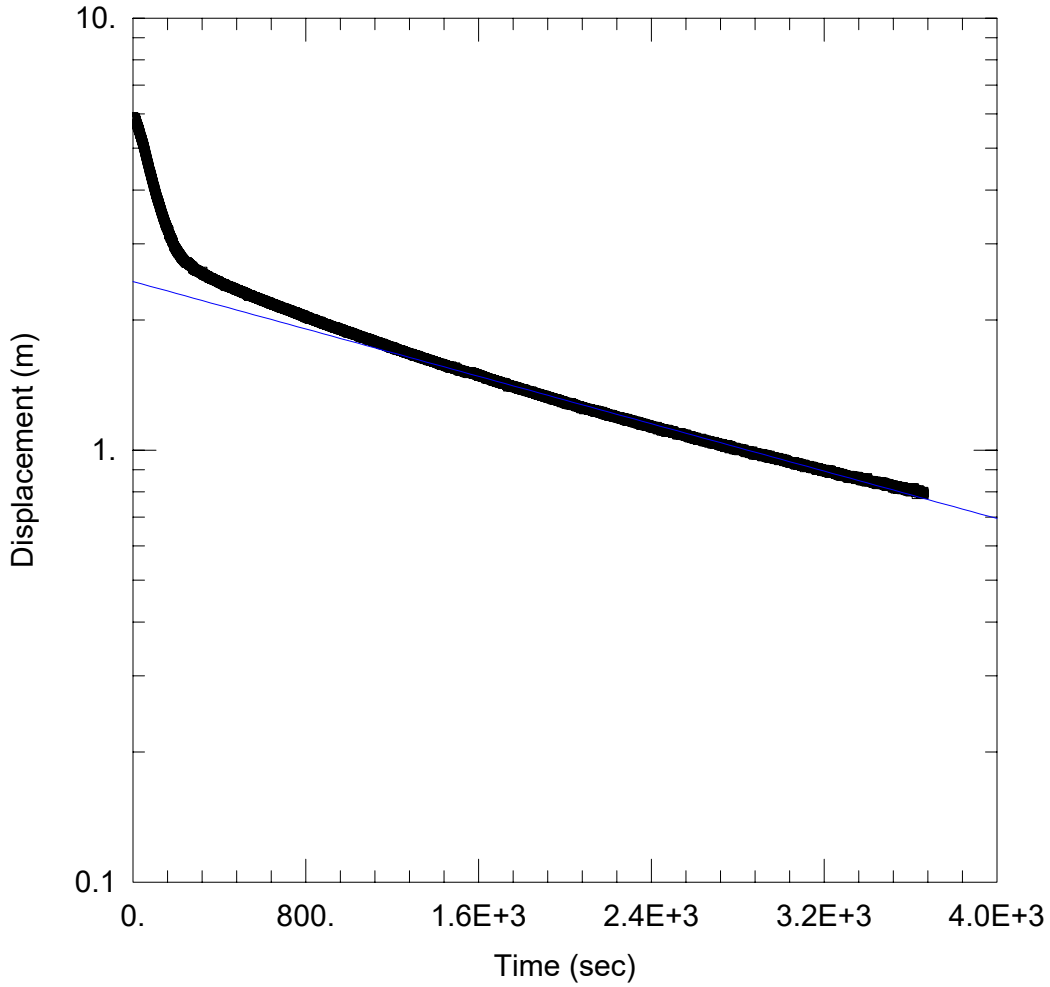
Saturated Thickness: 30. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (330-01-BH2101)

Initial Displacement: 5.9 m
Total Well Penetration Depth: 47. m
Casing Radius: 0.025 m
Static Water Column Height: 47.37 m
Screen Length: 18. m
Well Radius: 0.07 m

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 3.781E-7 m/sec
y0 = 6.009 m



330-01-BH2101_FHT

Data Set: V:\...\330-01-BH2101_FHT_Hvorslev_Late.aqt
Date: 03/19/19 Time: 12:16:28

PROJECT INFORMATION

Company: Golder
Project: 1893802
Test Well: 330-01-BH2101
Test Date: 7/12/2018

AQUIFER DATA

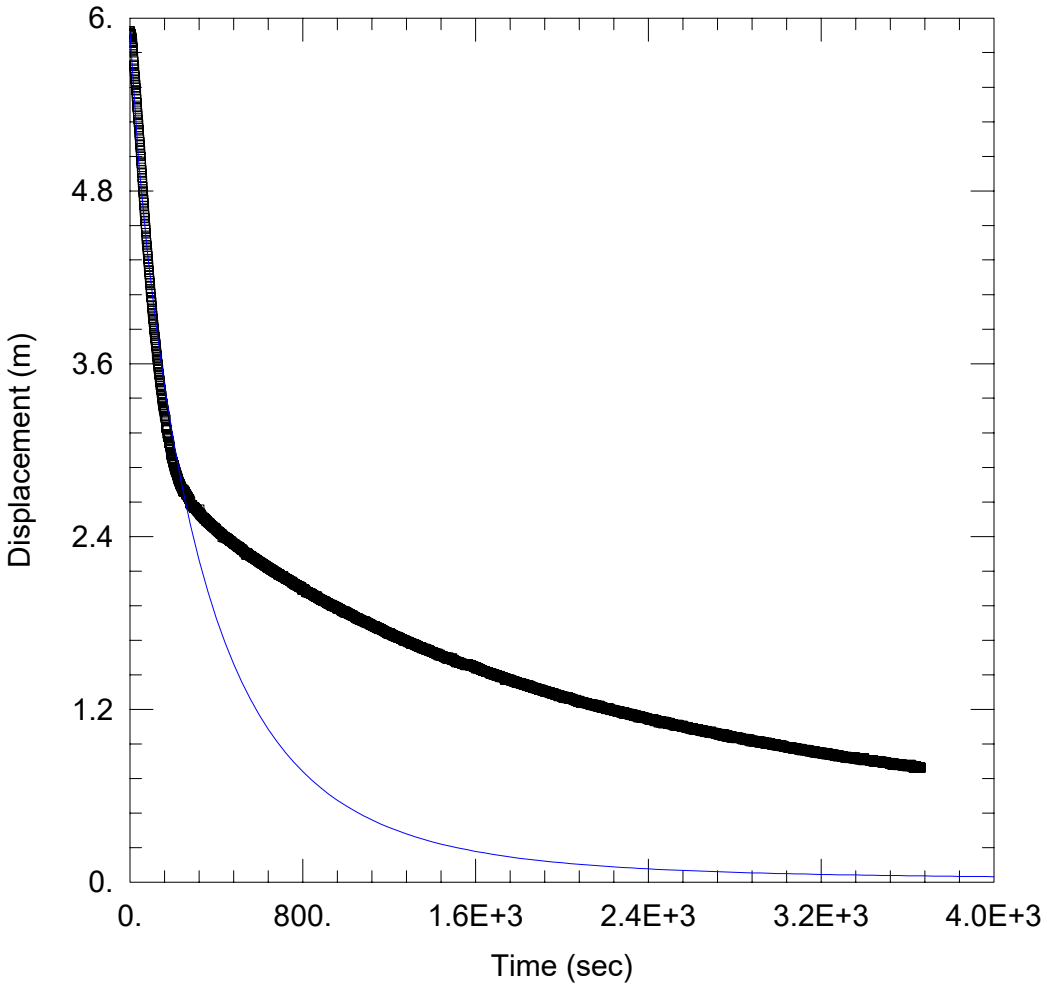
Saturated Thickness: 30. m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (330-01-BH2101)

Initial Displacement: 5.9 m
Total Well Penetration Depth: 47. m
Casing Radius: 0.025 m
Static Water Column Height: 47.37 m
Screen Length: 18. m
Well Radius: 0.07 m

SOLUTION

Aquifer Model: Confined
Solution Method: Hvorslev
K = 3.422E-8 m/sec
y0 = 2.455 m



330-01-BH2101_FHT

Data Set: V:\...\330-01-BH2101_FHT_KGS_early.aqt
Date: 03/19/19 Time: 12:16:53

PROJECT INFORMATION

Company: Golder
Project: 1893802
Test Well: 330-01-BH2101
Test Date: 7/12/2018

AQUIFER DATA

Saturated Thickness: 30. m

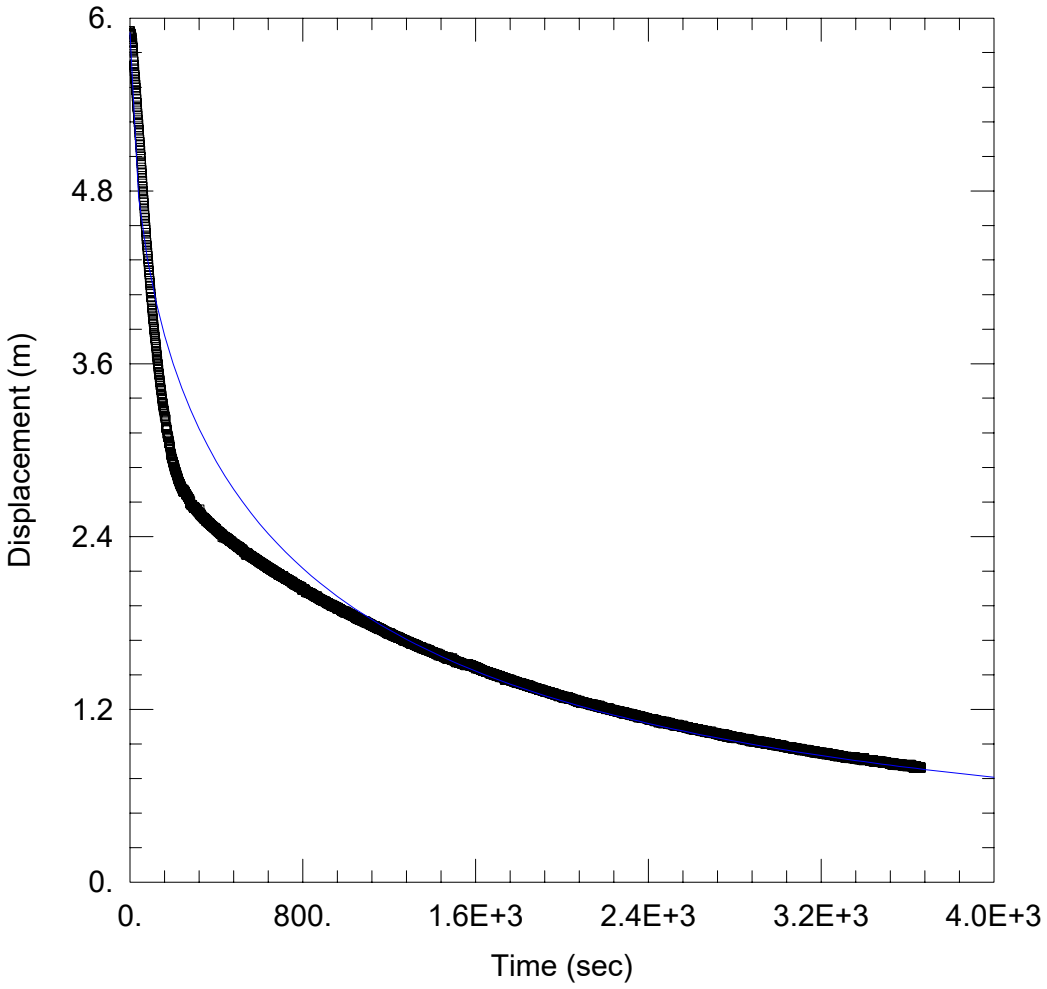
WELL DATA (330-01-BH2101)

Initial Displacement: 5.9 m
Total Well Penetration Depth: 47. m
Casing Radius: 0.025 m
Static Water Column Height: 47.37 m
Screen Length: 18. m
Well Radius: 0.07 m

SOLUTION

Aquifer Model: Confined
Solution Method: KGS Model

Kr = 2.568E-7 m/sec
Kz/Kr = 1.
Ss = 2.871E-6 m^{-1}



330-01-BH2101_FHT

Data Set: V:\...\330-01-BH2101_FHT_KGS_late.aqt
Date: 03/19/19 Time: 12:17:20

PROJECT INFORMATION

Company: Golder
Project: 1893802
Test Well: 330-01-BH2101
Test Date: 7/12/2018

AQUIFER DATA

Saturated Thickness: 30. m

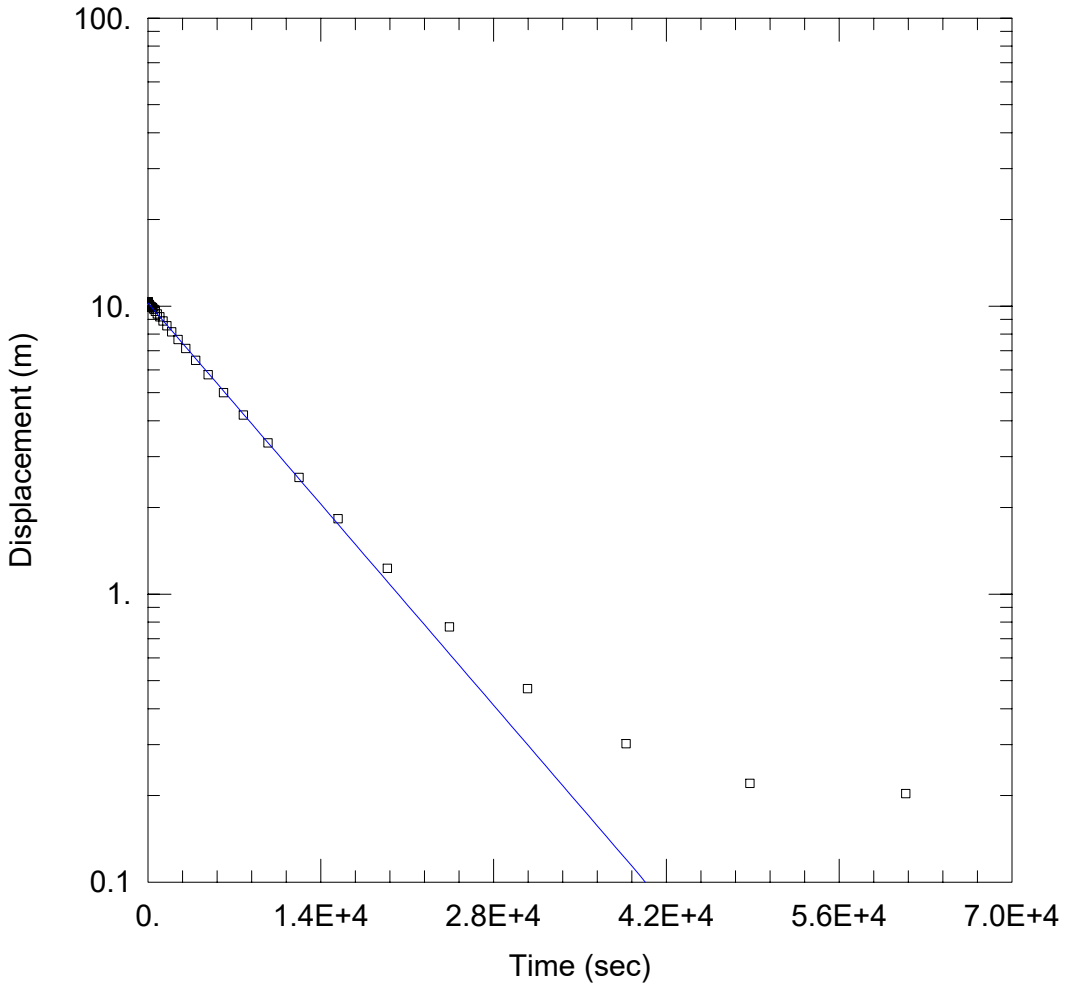
WELL DATA (330-01-BH2101)

Initial Displacement: 5.9 m
Total Well Penetration Depth: 47. m
Casing Radius: 0.025 m
Static Water Column Height: 47.37 m
Screen Length: 18. m
Well Radius: 0.07 m

SOLUTION

Aquifer Model: Confined
Solution Method: KGS Model

Kr = 1.956E-8 m/sec
Kz/Kr = 1.
Ss = 0.003333 m^{-1}



330-01-BH2102_FHT

Data Set: V:\...\330-01-BH2102_FHT_Hvorslev.aqt
Date: 11/20/18 Time: 14:39:43

PROJECT INFORMATION

Company: Golder
Project: 1893802
Test Well: 330-01-BH2102
Test Date: 1/11/2018

AQUIFER DATA

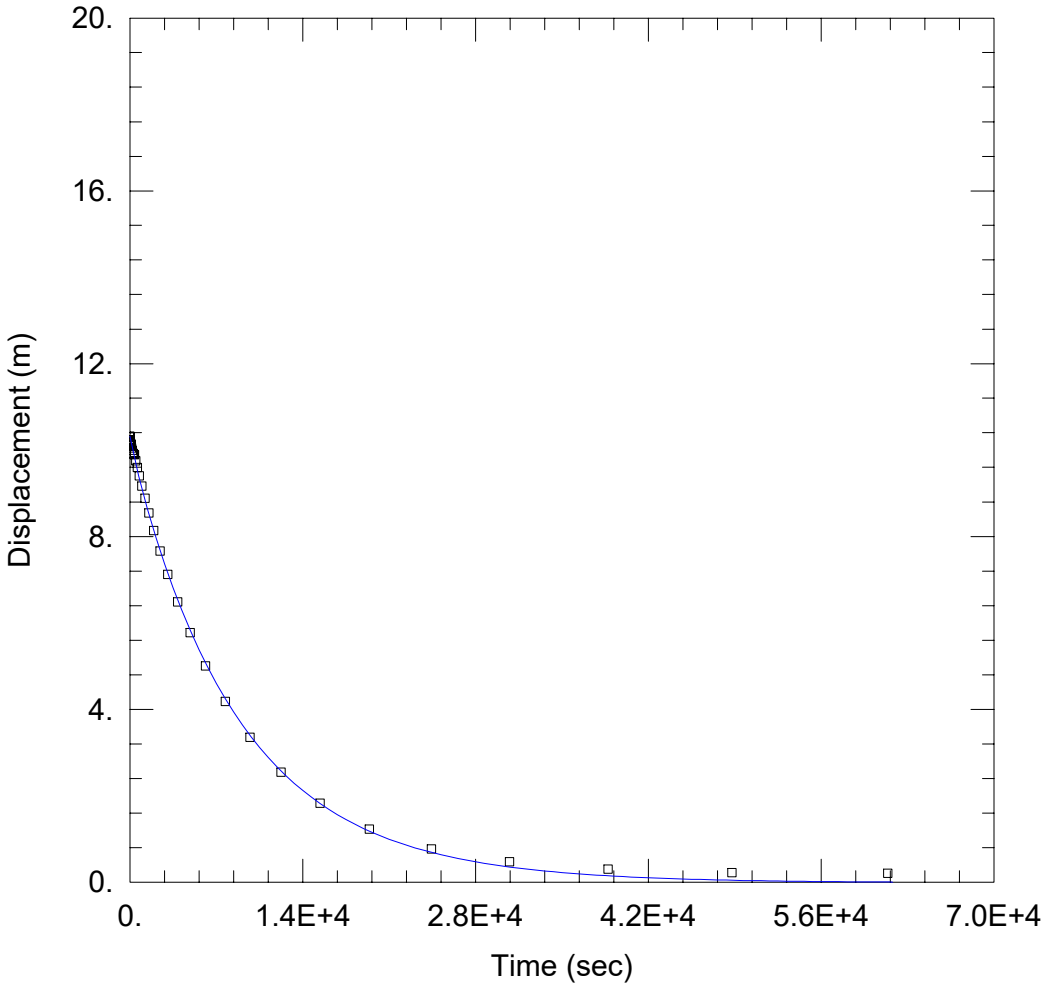
Saturated Thickness: 23.5 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (330-01-BH2102)

Initial Displacement: 10.31 m
Total Well Penetration Depth: 23.5 m
Casing Radius: 0.025 m
Static Water Column Height: 23.5 m
Screen Length: 23.5 m
Well Radius: 0.048 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 8.09E-9 m/sec
y0 = 10.24 m



330-01-BH2102_FHT

Data Set: V:\...\330-01-BH2102_FHT_KGS.aqt
Date: 11/20/18 Time: 14:40:59

PROJECT INFORMATION

Company: Golder
Project: 1893802
Test Well: 330-01-BH2102
Test Date: 1/11/2018

AQUIFER DATA

Saturated Thickness: 23.5 m

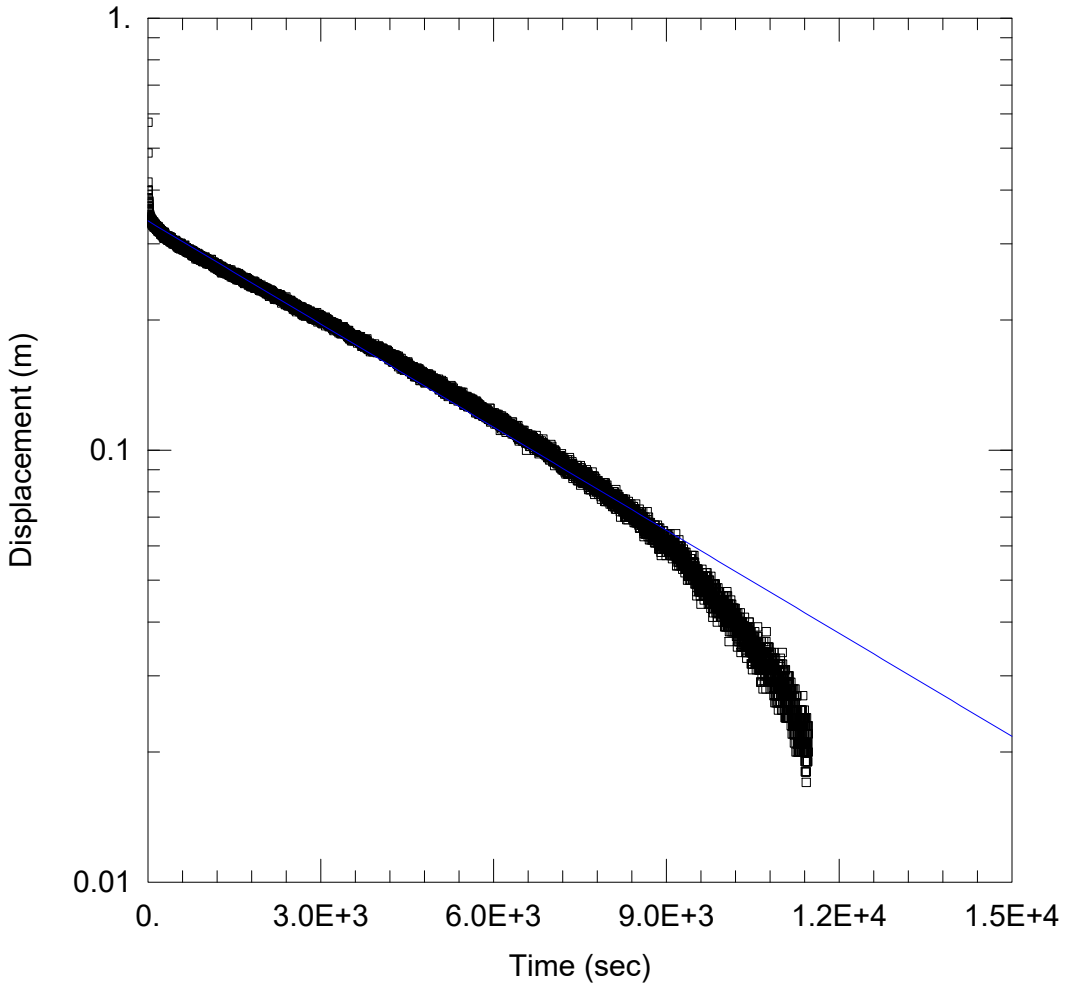
WELL DATA (330-01-BH2102)

Initial Displacement: 10.31 m
Total Well Penetration Depth: 23.5 m
Casing Radius: 0.025 m
Static Water Column Height: 23.5 m
Screen Length: 23.5 m
Well Radius: 0.048 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 8.357E-9 m/sec
Kz/Kr = 1.
Ss = 1.06E-7 m^{-1}



330-01-BH2103 (SLUG IN)

Data Set: V:\...\330-01-BH2103_SlugIn_Hvorslev.aqt
Date: 11/23/18 Time: 08:28:00

PROJECT INFORMATION

Company: Golder
Project: 1893802
Test Well: 330-01-BH2103
Test Date: 20/11/2018

AQUIFER DATA

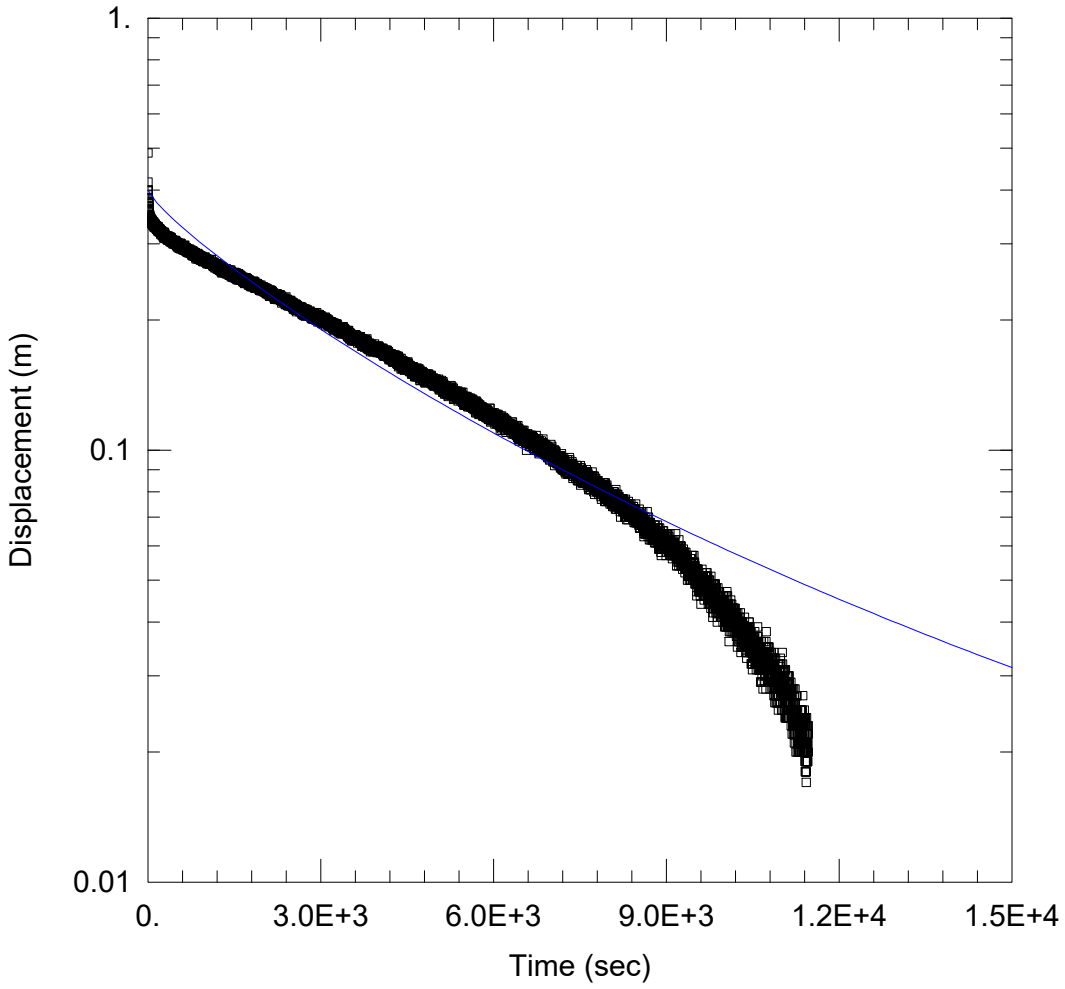
Saturated Thickness: 10.79 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (330-01-BH2103)

Initial Displacement: 0.574 m
Total Well Penetration Depth: 10.74 m
Casing Radius: 0.025 m
Static Water Column Height: 10.79 m
Screen Length: 10.74 m
Well Radius: 0.048 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 2.883E-8 m/sec
y0 = 0.3392 m



330-01-BH2103 (SLUG IN)

Data Set: V:\...\330-01-BH2103_SlugIn_KGS.aqt
Date: 11/23/18 Time: 08:29:00

PROJECT INFORMATION

Company: Golder
Project: 1893802
Test Well: 330-01-BH2103
Test Date: 20/11/2018

AQUIFER DATA

Saturated Thickness: 10.79 m

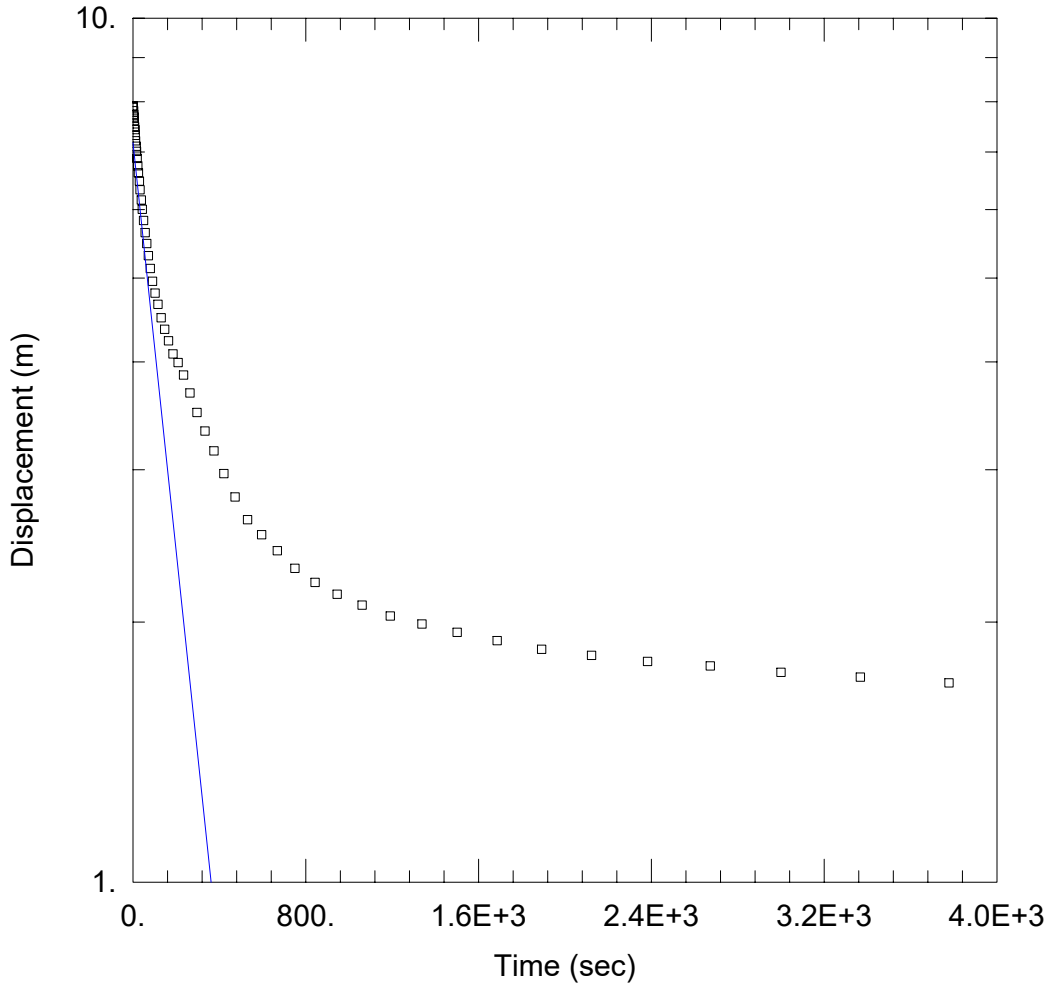
WELL DATA (330-01-BH2103)

Initial Displacement: 0.4 m
Total Well Penetration Depth: 10.74 m
Casing Radius: 0.025 m
Static Water Column Height: 10.79 m
Screen Length: 10.74 m
Well Radius: 0.048 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 2.438E-8 m/sec
Kz/Kr = 1.
Ss = 4.251E-5 m^{-1}



WELL TEST ANALYSIS

Data Set: V:\...\330-01-BH2203_Hvorslev_NMC_NMC.aqt
Date: 11/20/18 Time: 14:07:06

PROJECT INFORMATION

Company: Golder
Project: 1893802
Test Well: 330-01-BH2203
Test Date: 24/10/2018

AQUIFER DATA

Saturated Thickness: 7.903 m Anisotropy Ratio (Kz/Kr): 1.

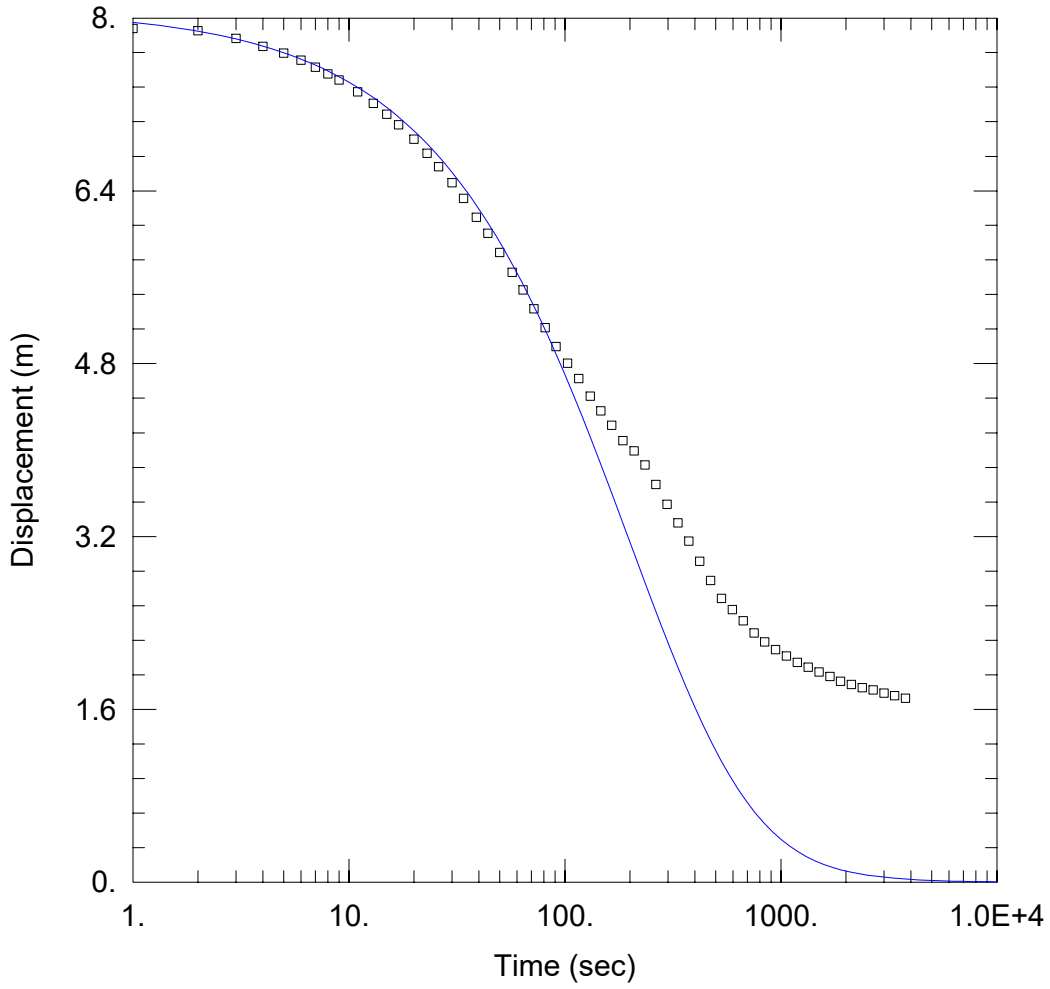
WELL DATA (330-01-BH2203)

Initial Displacement: 7.903 m
Total Well Penetration Depth: 12.2 m
Casing Radius: 0.025 m
Static Water Column Height: 0.1 m
Screen Length: 6.2 m
Well Radius: 0.048 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev

K = 1.525E-6 m/sec
y0 = 7.175 m



WELL TEST ANALYSIS

Data Set: V:\...\330-01-BH2203_KGS_NMC_NMC.aqt
Date: 11/20/18 Time: 14:09:54

PROJECT INFORMATION

Company: Golder
Project: 1893802
Test Well: 330-01-BH2203
Test Date: 24/10/2018

AQUIFER DATA

Saturated Thickness: 7.903 m

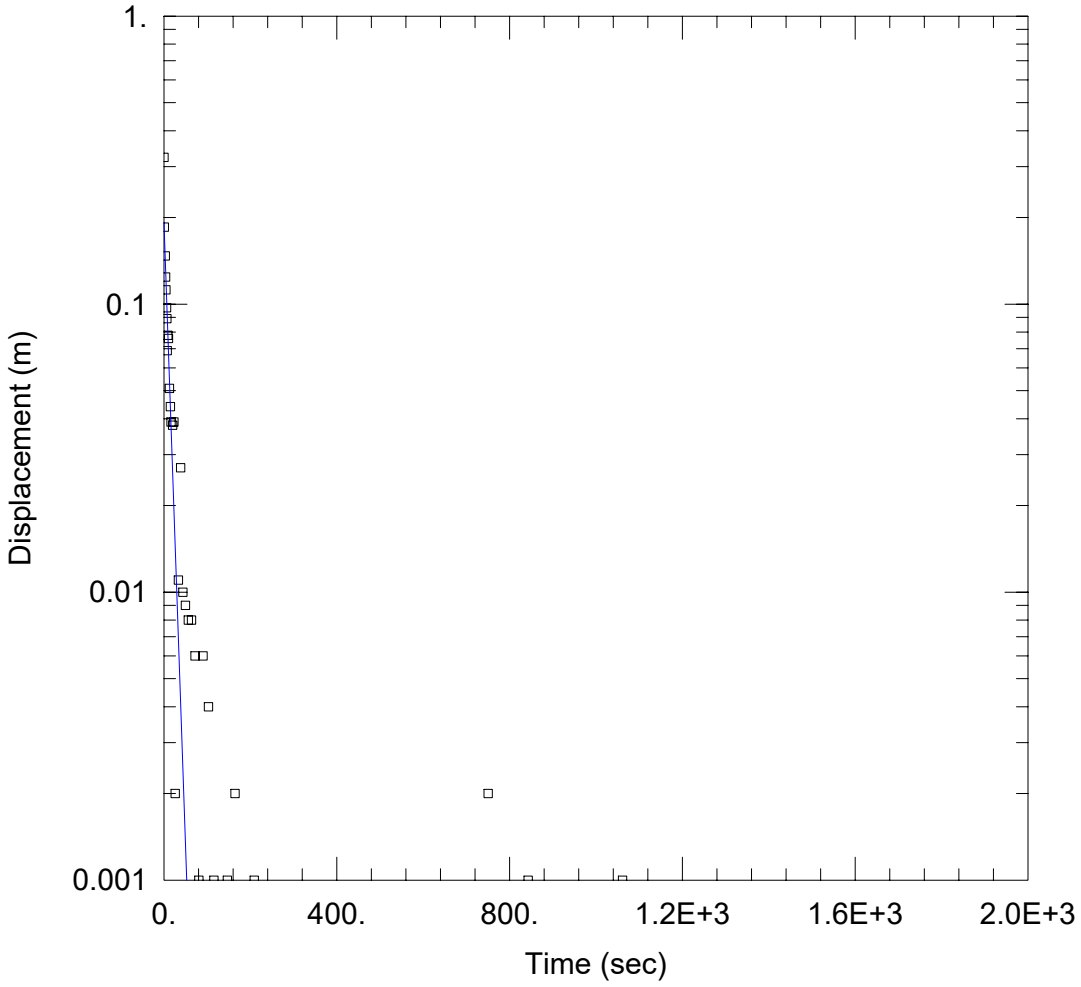
WELL DATA (330-01-BH2203)

Initial Displacement: 8.1 m
Total Well Penetration Depth: 12.2 m
Casing Radius: 0.025 m
Static Water Column Height: 0.1 m
Screen Length: 6.2 m
Well Radius: 0.048 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 1.285E-6 m/sec
Kz/Kr = 1.
Ss = 0.0002005 m^{-1}



330-01-BH2207_FHT

Data Set: V:\...\330-01-BH2207_Hvorslev_slug in_NMC_EB.aqt
Date: 11/20/18 Time: 14:14:40

PROJECT INFORMATION

Company: Golder
Project: 1893802
Test Well: 330-01-BH2207
Test Date: 25/10/2018

AQUIFER DATA

Saturated Thickness: 11.83 m Anisotropy Ratio (Kz/Kr): 1.

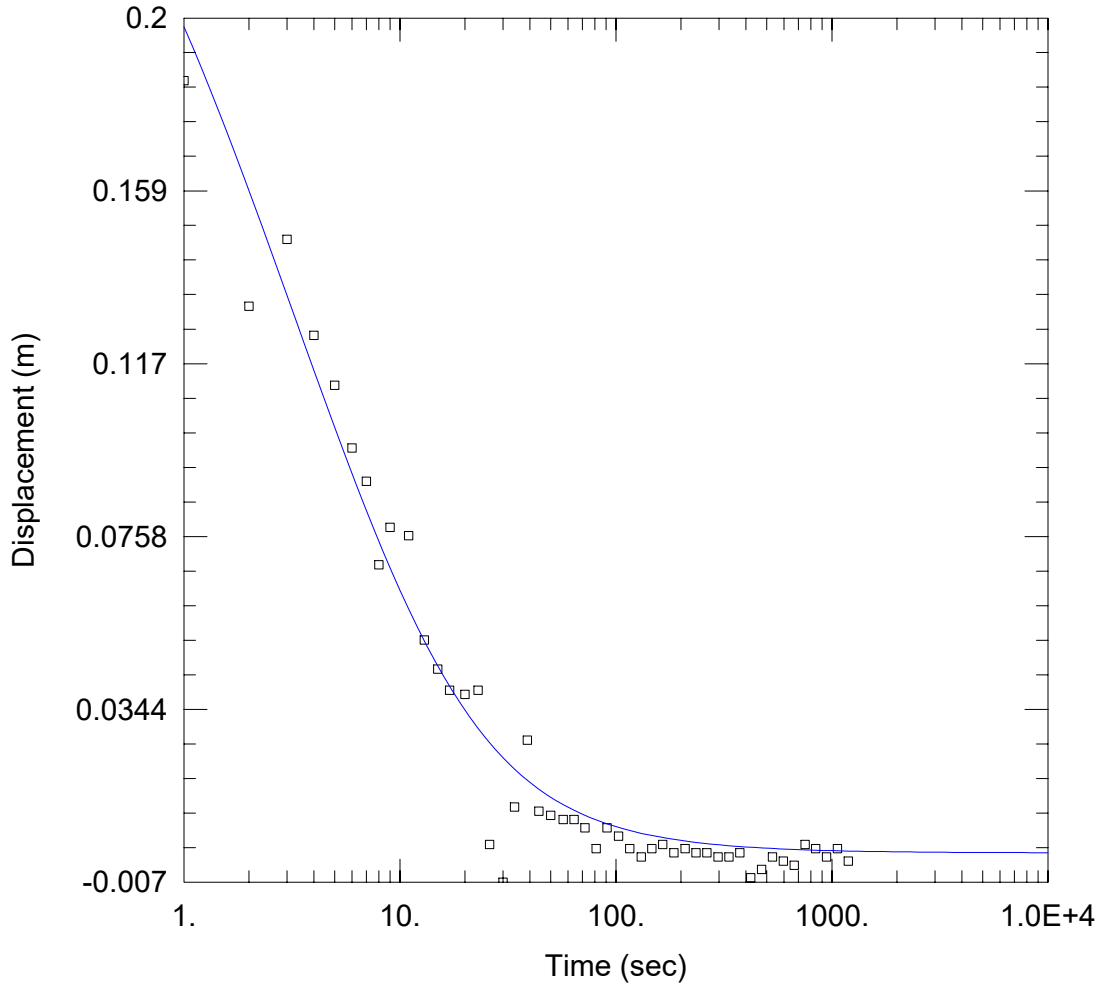
WELL DATA (330-01-BH2207)

Initial Displacement: 0.323 m Static Water Column Height: 11.83 m
Total Well Penetration Depth: 10.83 m Screen Length: 9. m
Casing Radius: 0.025 m Well Radius: 0.048 m

SOLUTION

Aquifer Model: Unconfined Solution Method: Hvorslev

K = 1.814E-5 m/sec y0 = 0.1917 m



330-01-BH2207_FHT

Data Set: V:\...\330-01-BH2207_KGS_slug in_NMC_EB.aqt
Date: 11/20/18 Time: 14:13:09

PROJECT INFORMATION

Company: Golder
Project: 1893802
Test Well: 330-01-BH2207
Test Date: 25/10/2018

AQUIFER DATA

Saturated Thickness: 11.83 m

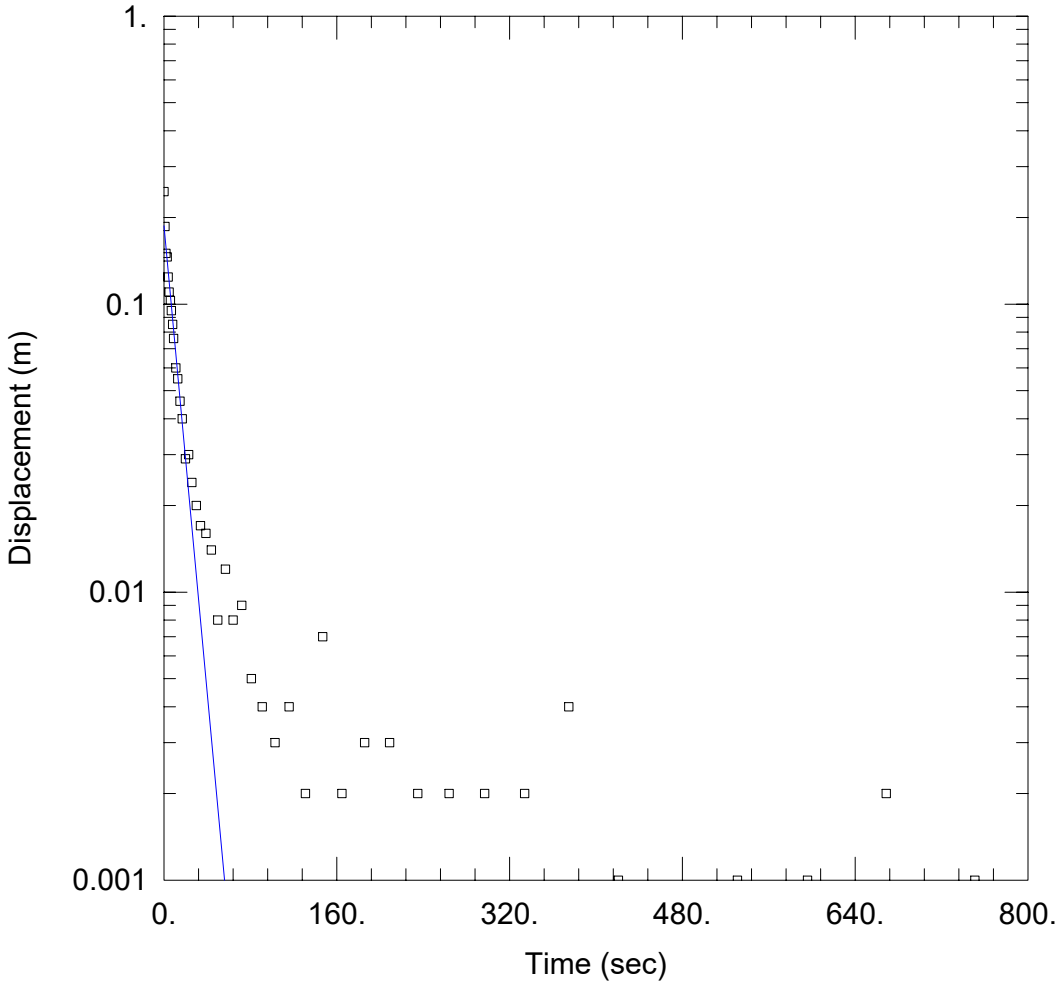
WELL DATA (330-01-BH2207)

Initial Displacement: 0.323 m
Total Well Penetration Depth: 10.83 m
Casing Radius: 0.025 m
Static Water Column Height: 11.83 m
Screen Length: 9. m
Well Radius: 0.048 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 9.376E-6 m/sec
Kz/Kr = 1.
Ss = 0.008103 m^{-1}



330-01-BH2207_RHT

Data Set: V:\...\330-01-BH2207_Hvorslev_slug out_NMC_EB.aqt
Date: 11/20/18 Time: 14:16:57

PROJECT INFORMATION

Company: Golder
Project: 1893802
Test Well: 330-01-BH2207
Test Date: 25/10/2018

AQUIFER DATA

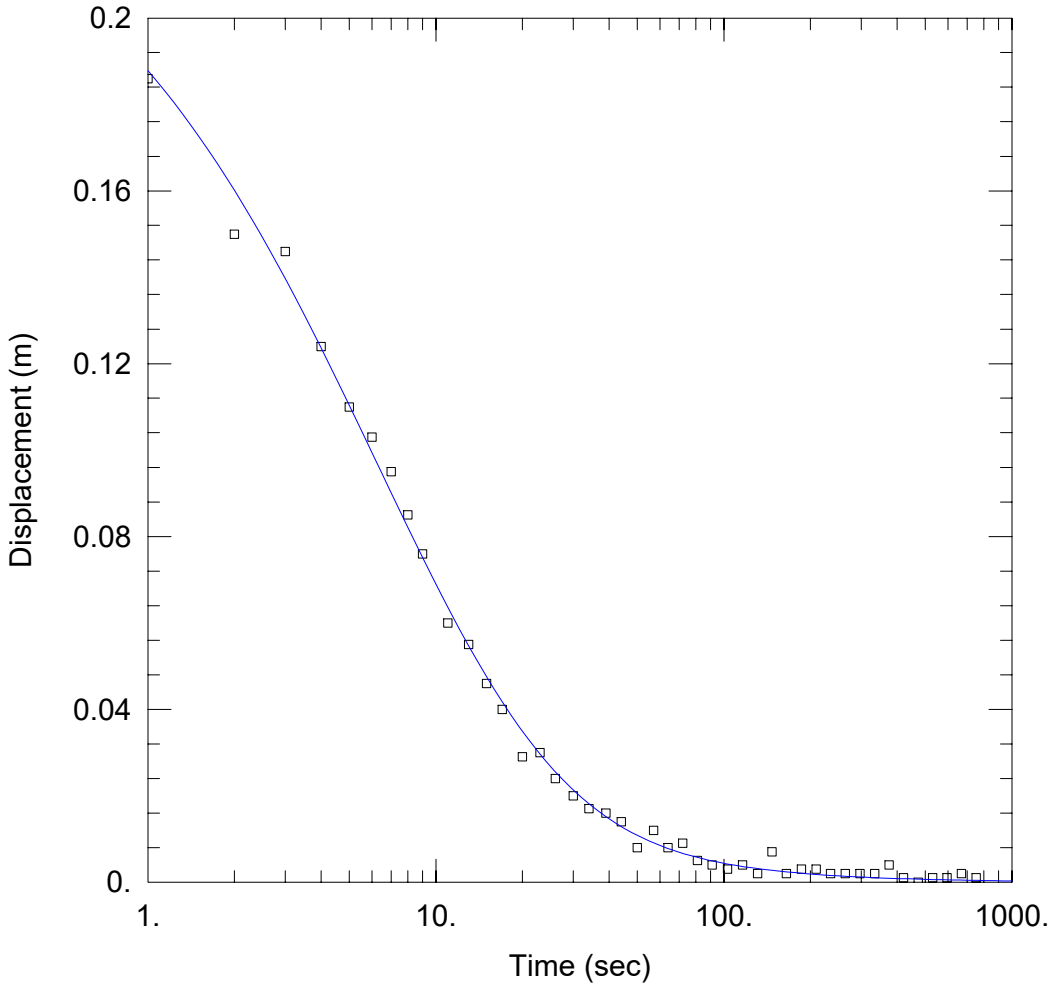
Saturated Thickness: 11.83 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (330-01-BH2207)

Initial Displacement: 0.246 m
Total Well Penetration Depth: 10.83 m
Casing Radius: 0.025 m
Static Water Column Height: 11.83 m
Screen Length: 9. m
Well Radius: 0.048 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 1.695E-5 m/sec
y0 = 0.1868 m



330-01-BH2207_RHT

Data Set: V:\...\330-01-BH2207_KGS_slug out_NMC_EB.aqt
Date: 11/20/18 Time: 14:18:27

PROJECT INFORMATION

Company: Golder
Project: 1893802
Test Well: 330-01-BH2207
Test Date: 25/10/2018

AQUIFER DATA

Saturated Thickness: 11.83 m

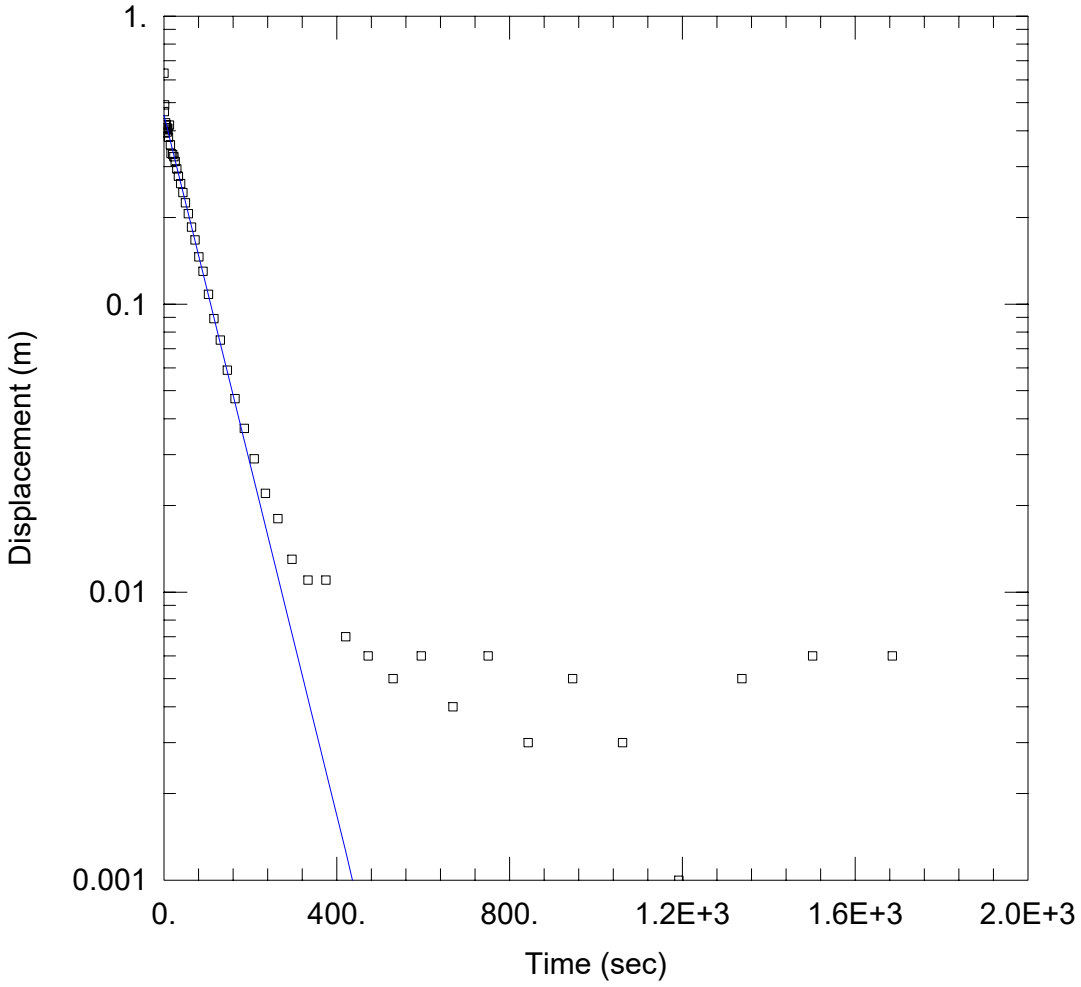
WELL DATA (330-01-BH2207)

Initial Displacement: 0.246 m
Total Well Penetration Depth: 10.83 m
Casing Radius: 0.025 m
Static Water Column Height: 11.83 m
Screen Length: 9. m
Well Radius: 0.048 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 1.067E-5 m/sec
Kz/Kr = 1.
Ss = 0.0009674 m^{-1}



330-01-BH2212_FHT

Data Set: V:\...\330-01-BH2212_Hvorslev_slug in_NMC_EB.aqt
Date: 11/20/18 Time: 14:25:45

PROJECT INFORMATION

Company: Golder
Project: 1893802
Test Well: 330-01-BH2212
Test Date: 23/10/2018

AQUIFER DATA

Saturated Thickness: 20.94 m Anisotropy Ratio (Kz/Kr): 1.

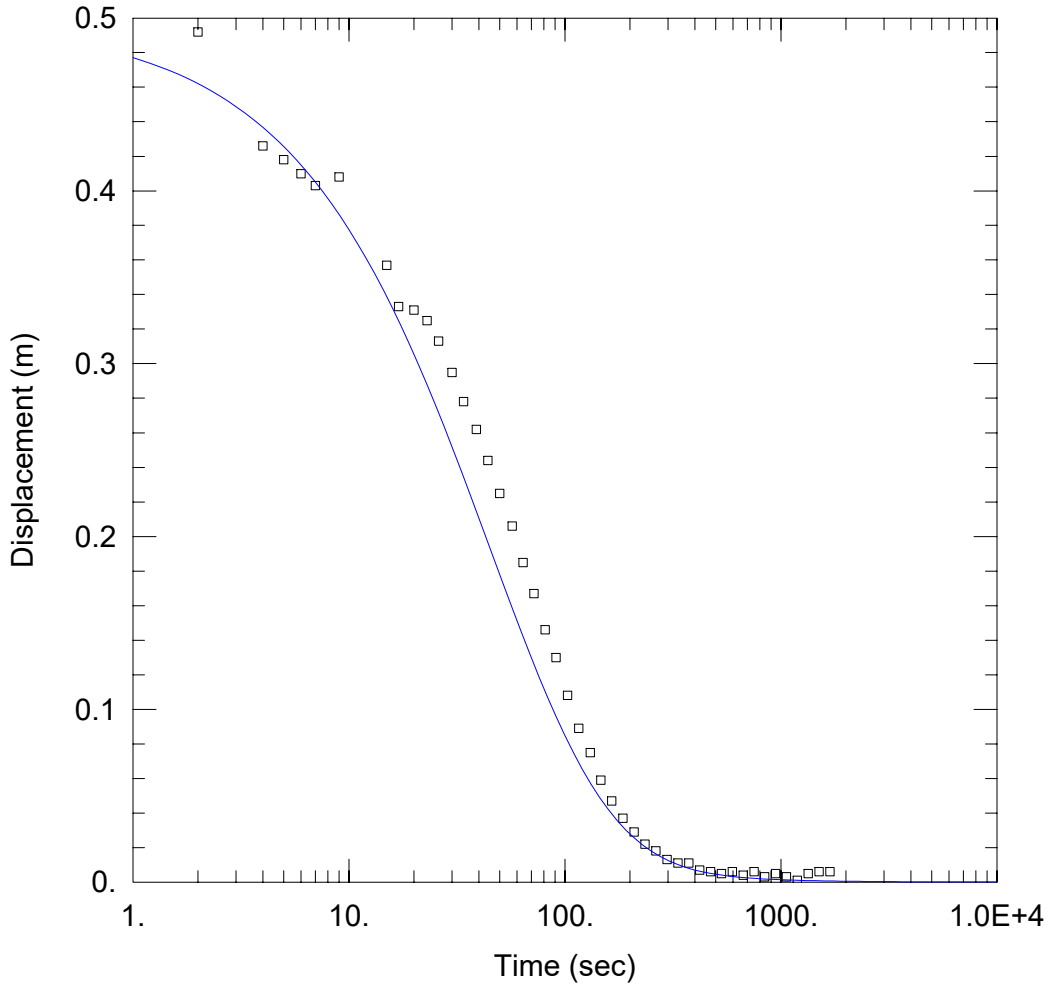
WELL DATA (330-01-BH2212)

Initial Displacement: 0.633 m
Total Well Penetration Depth: 20.94 m
Casing Radius: 0.025 m
Static Water Column Height: 20.94 m
Screen Length: 4. m
Well Radius: 0.048 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev

K = 5.593E-6 m/sec
y0 = 0.4528 m



WELL TEST ANALYSIS

Data Set: V:\...\330-01-BH2212_KGS_slug in_NMC_EB.aqt
Date: 11/20/18 Time: 14:26:48

PROJECT INFORMATION

Company: Golder
Project: 1893802
Test Well: 330-01-BH2212
Test Date: 23/10/2018

AQUIFER DATA

Saturated Thickness: 20.94 m

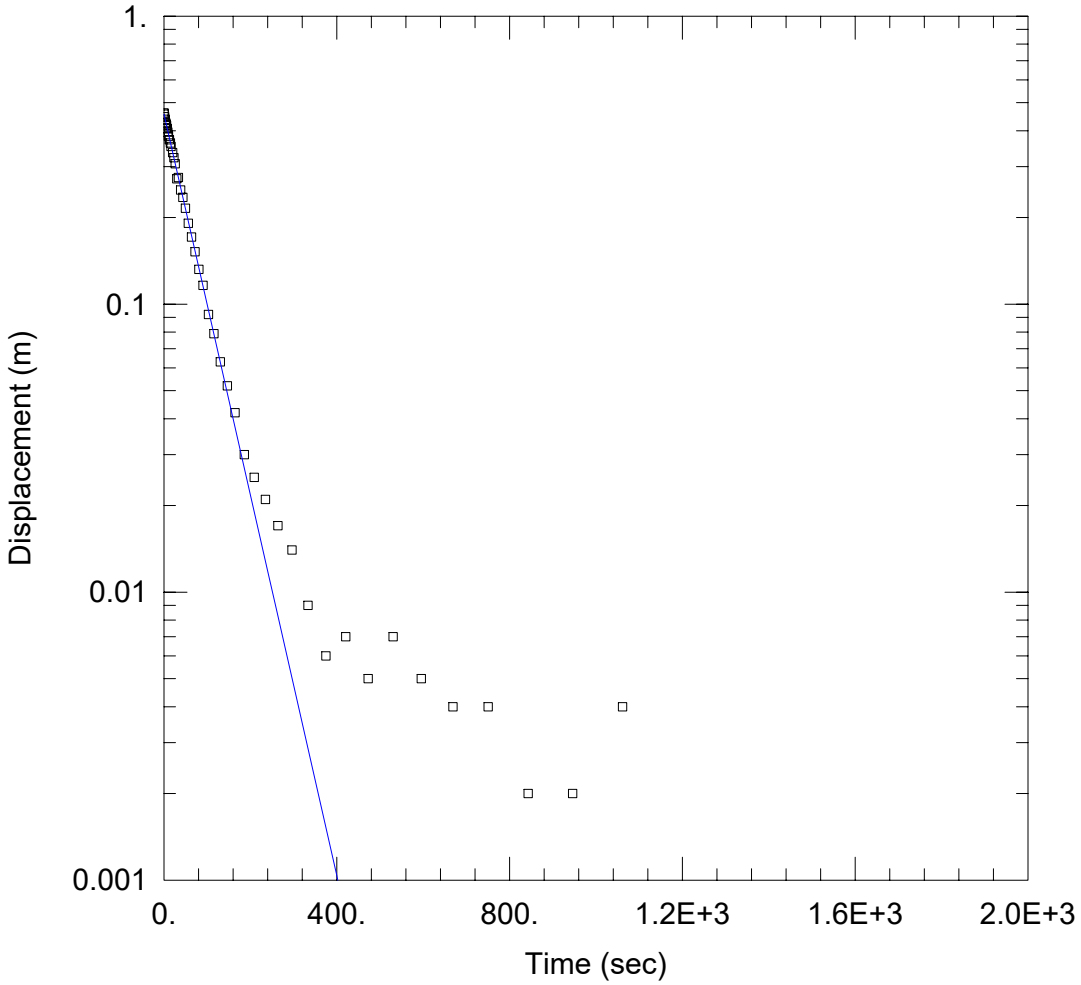
WELL DATA (330-01-BH2212)

Initial Displacement: 0.5 m
Total Well Penetration Depth: 20.94 m
Casing Radius: 0.025 m
Static Water Column Height: 20.94 m
Screen Length: 4. m
Well Radius: 0.048 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 5.71E-6 m/sec
Kz/Kr = 1.
Ss = 0.0001409 m^{-1}



330-01-BH2212_RHT

Data Set: V:\...\330-01-BH2212_Hvorslev_slug out_NMC_EB.aqt
Date: 11/20/18 Time: 14:28:44

PROJECT INFORMATION

Company: Golder
Project: 1893802
Test Well: 330-01-BH2212
Test Date: 23/10/2018

AQUIFER DATA

Saturated Thickness: 20.94 m Anisotropy Ratio (Kz/Kr): 1.

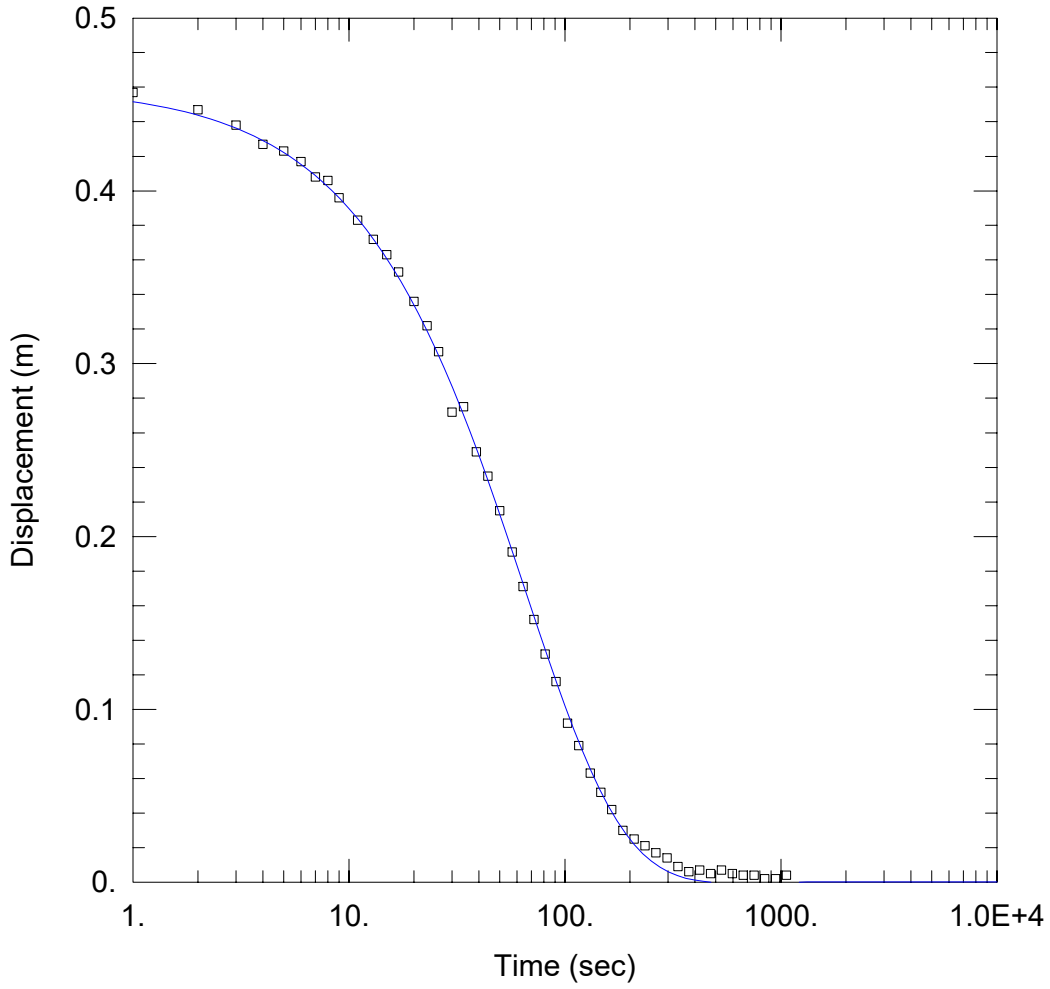
WELL DATA (330-01-BH2212)

Initial Displacement: 0.461 m
Total Well Penetration Depth: 20.94 m
Casing Radius: 0.025 m
Static Water Column Height: 20.94 m
Screen Length: 4. m
Well Radius: 0.048 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev

K = 6.081E-6 m/sec
y0 = 0.4561 m



330-01-BH2212_RHT

Data Set: V:\...\330-01-BH2212_KGS_slug out_NMC_EB.aqt
Date: 11/20/18 Time: 14:29:52

PROJECT INFORMATION

Company: Golder
Project: 1893802
Test Well: 330-01-BH2212
Test Date: 23/10/2018

AQUIFER DATA

Saturated Thickness: 20.94 m

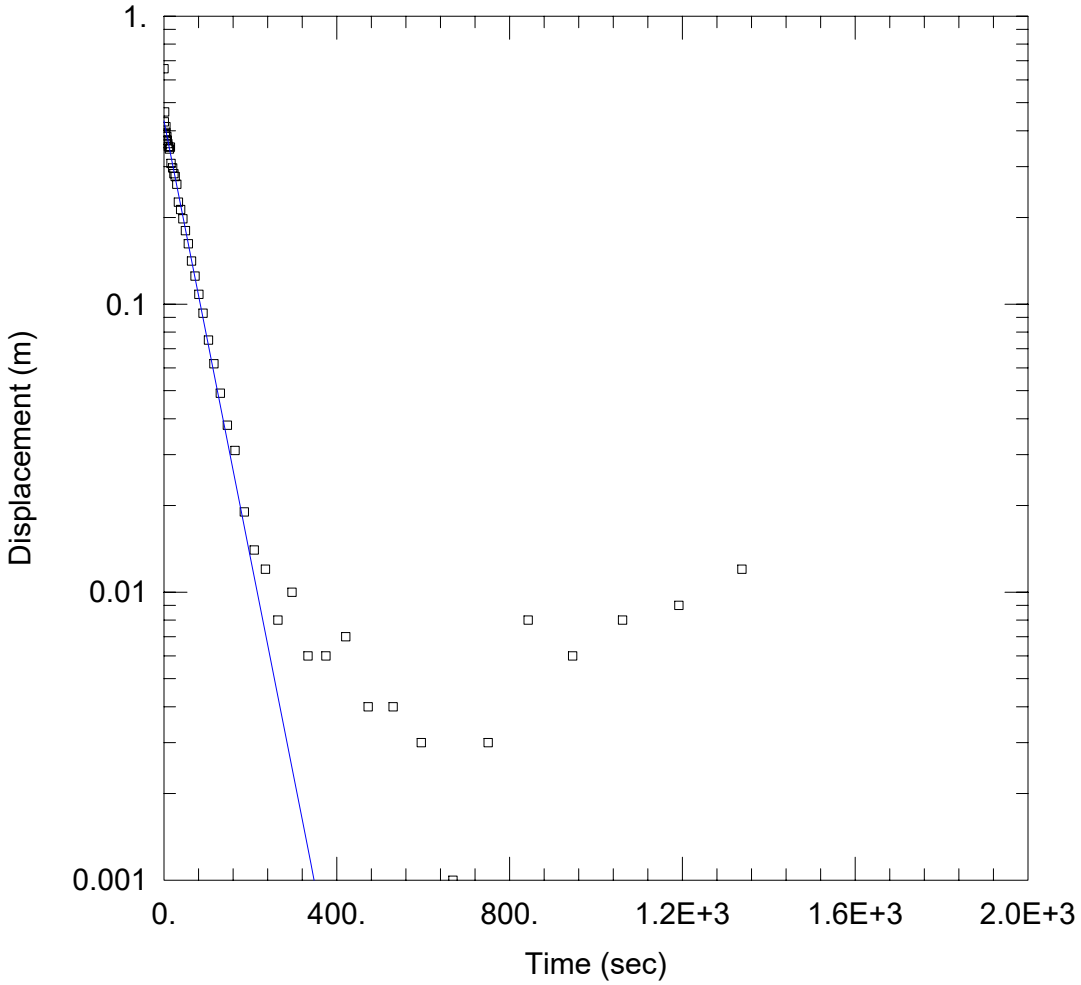
WELL DATA (330-01-BH2212)

Initial Displacement: 0.461 m
Total Well Penetration Depth: 20.94 m
Casing Radius: 0.025 m
Static Water Column Height: 20.94 m
Screen Length: 4. m
Well Radius: 0.048 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 5.543E-6 m/sec
Kz/Kr = 1.
Ss = 1.542E-6 m^{-1}



330-01-BH2216_FHT

Data Set: V:\...\330-01-BH2216_Hvorslev_slug in_NMC_EB.aqt
Date: 11/20/18 Time: 14:31:21

PROJECT INFORMATION

Company: Golder
Project: 1893802
Test Well: 330-01-BH2216
Test Date: 23/10/2018

AQUIFER DATA

Saturated Thickness: 22.55 m Anisotropy Ratio (Kz/Kr): 1.

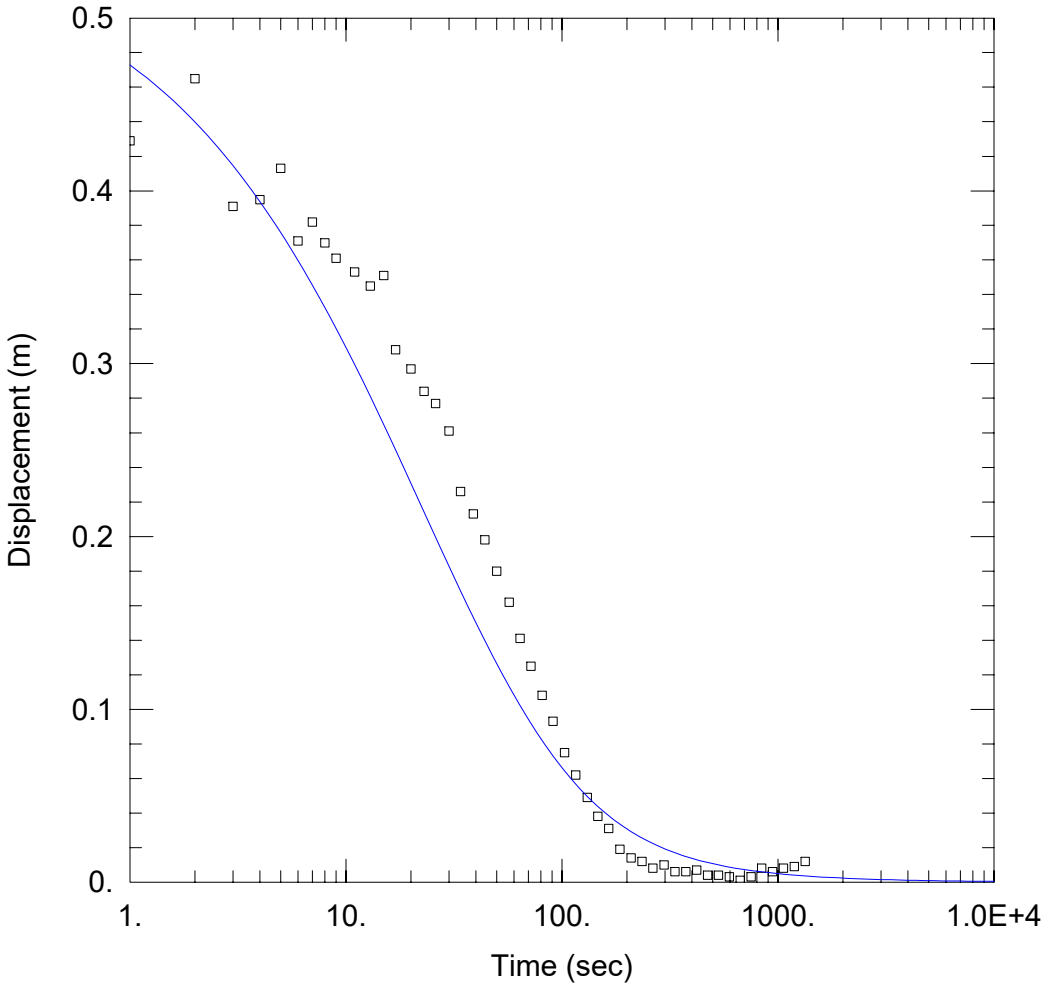
WELL DATA (330-01-BH2216)

Initial Displacement: 0.656 m
Total Well Penetration Depth: 24.55 m
Casing Radius: 0.025 m
Static Water Column Height: 22.55 m
Screen Length: 7. m
Well Radius: 0.048 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev

K = 4.422E-6 m/sec
y0 = 0.4324 m



WELL TEST ANALYSIS

Data Set: V:\...\330-01-BH2216_KGS_slug in_NMC_EB.aqt
Date: 11/20/18 Time: 14:33:32

PROJECT INFORMATION

Company: Golder
Project: 1893802
Test Well: 330-01-BH2216
Test Date: 23/10/2018

AQUIFER DATA

Saturated Thickness: 22.55 m

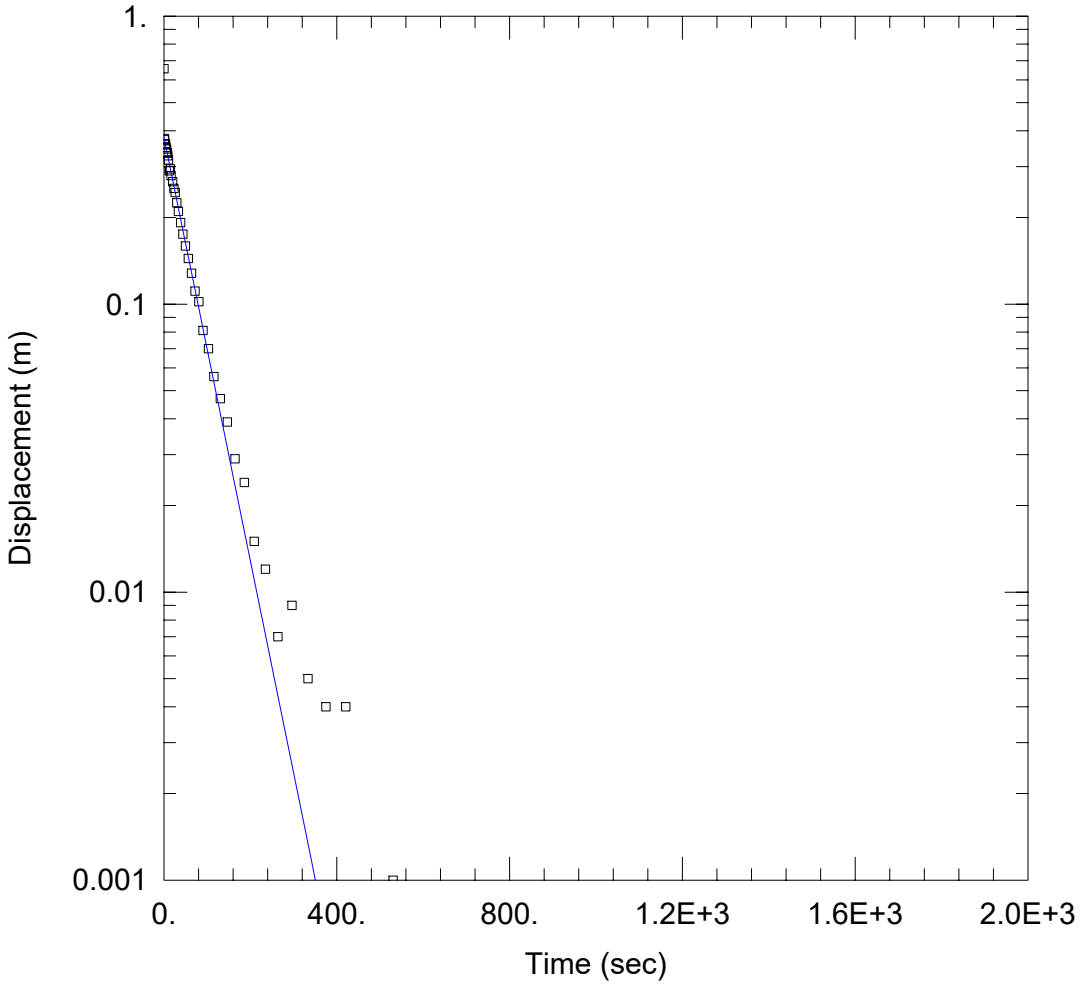
WELL DATA (330-01-BH2216)

Initial Displacement: 0.55 m
Total Well Penetration Depth: 22.55 m
Casing Radius: 0.025 m
Static Water Column Height: 22.55 m
Screen Length: 7. m
Well Radius: 0.048 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 2.564E-6 m/sec
Kz/Kr = 1.
Ss = 0.004435 m^{-1}



330-01-BH2216_RHT

Data Set: V:\...\330-01-BH2216_Hvorslev_slug out_NMC_EB.aqt
Date: 11/20/18 Time: 14:34:50

PROJECT INFORMATION

Company: Golder
Project: 1893802
Test Well: 330-01-BH2216
Test Date: 23/10/2018

AQUIFER DATA

Saturated Thickness: 22.55 m Anisotropy Ratio (Kz/Kr): 1.

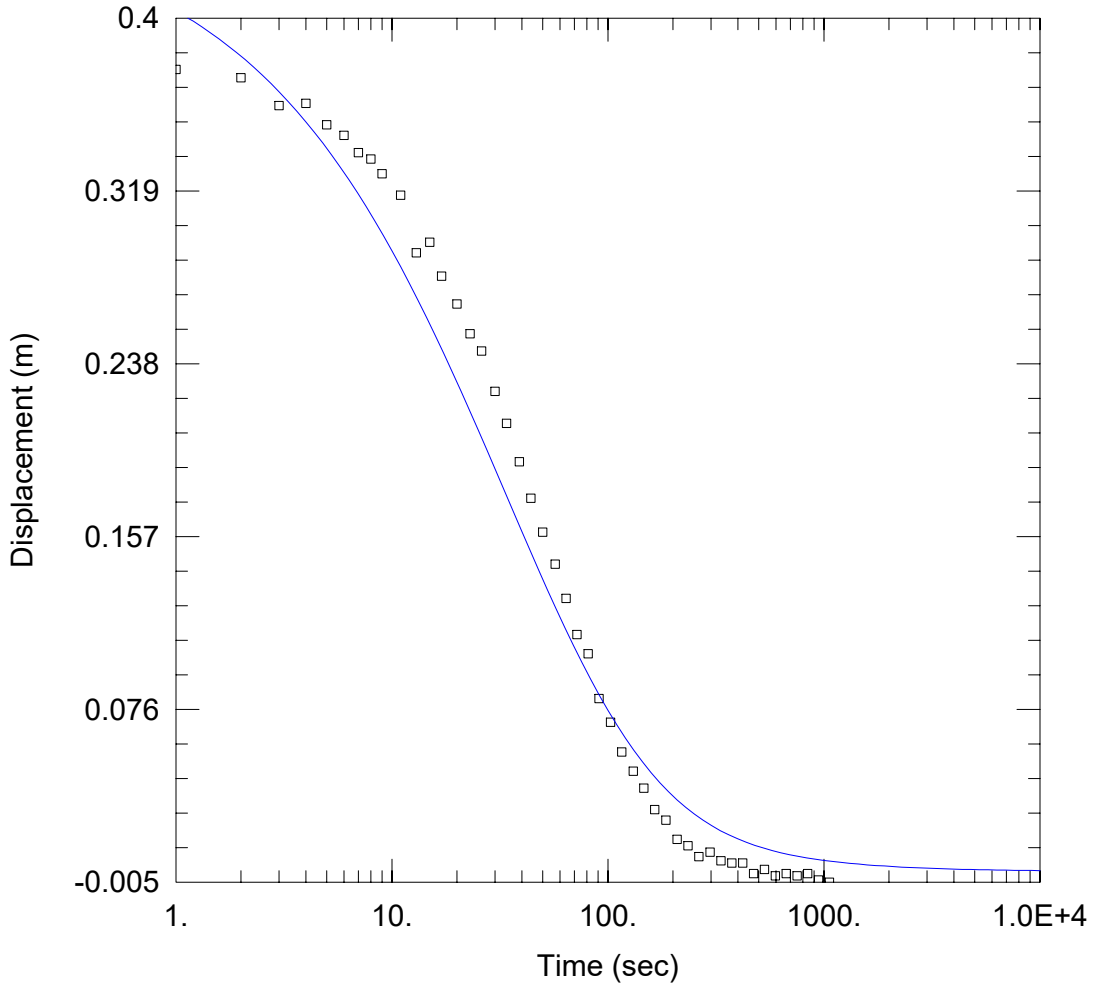
WELL DATA (330-01-BH2216)

Initial Displacement: 0.656 m
Total Well Penetration Depth: 22.55 m
Casing Radius: 0.025 m
Static Water Column Height: 22.55 m
Screen Length: 7. m
Well Radius: 0.048 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev

K = 4.29E-6 m/sec
y0 = 0.3788 m



330-01-BH2216_RHT

Data Set: V:\...\330-01-BH2216_KGS_slug out_NMC_EB.aqt
Date: 11/20/18 Time: 14:36:17

PROJECT INFORMATION

Company: Golder
Project: 1893802
Test Well: 330-01-BH2216
Test Date: 23/10/2018

AQUIFER DATA

Saturated Thickness: 22.55 m

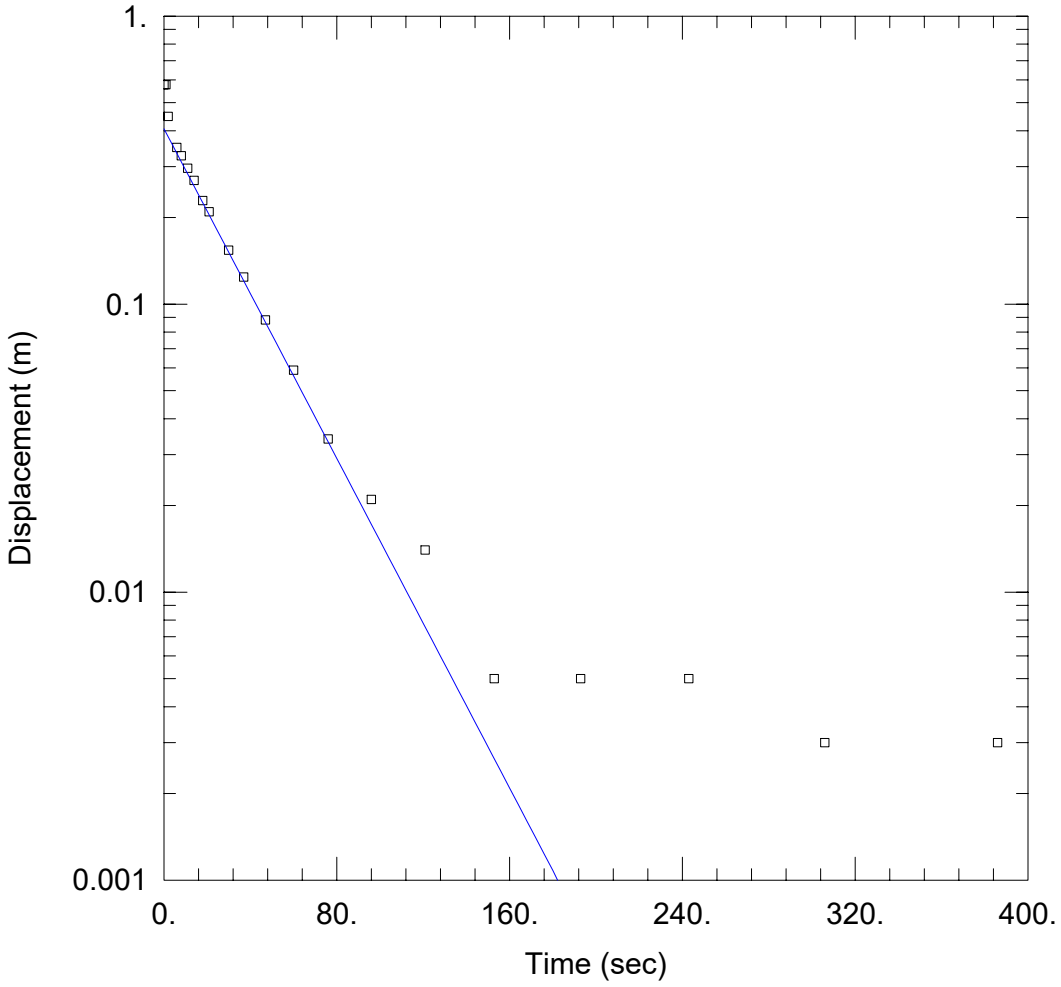
WELL DATA (330-01-BH2216)

Initial Displacement: 0.45 m
Total Well Penetration Depth: 22.55 m
Casing Radius: 0.025 m
Static Water Column Height: 22.55 m
Screen Length: 7. m
Well Radius: 0.048 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 2.043E-6 m/sec
Kz/Kr = 1.
Ss = 0.002722 m^{-1}



330-01-BH2224_FHT

Data Set: V:\...\330-01-BH2224_Hvorslev_Slug in_NMC_DB.aqt
Date: 11/20/18 Time: 14:42:29

PROJECT INFORMATION

Company: Golder
Project: 1893802
Test Well: 330-01-BH2224
Test Date: 29/10/2018

AQUIFER DATA

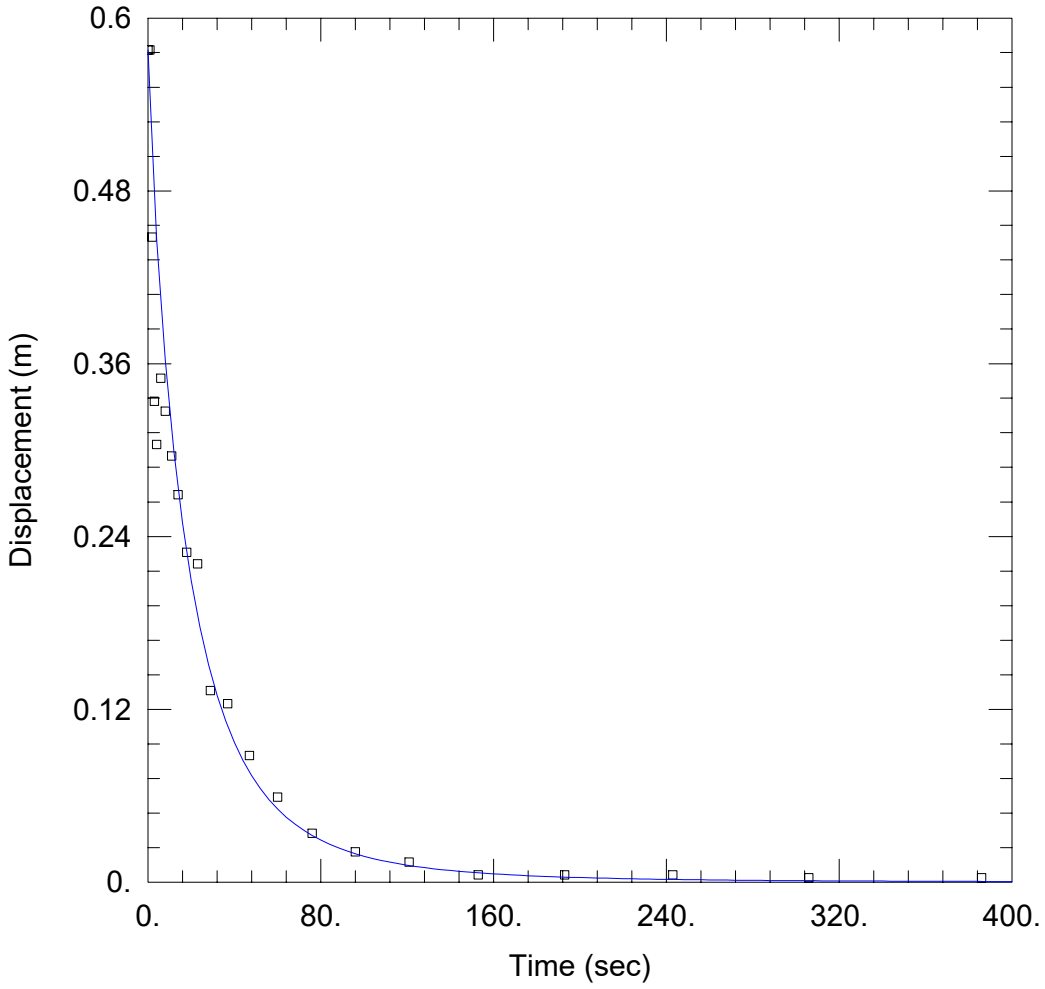
Saturated Thickness: 17.11 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (330-01-BH2224)

Initial Displacement: 0.578 m
Total Well Penetration Depth: 17.11 m
Casing Radius: 0.025 m
Static Water Column Height: 17.11 m
Screen Length: 13. m
Well Radius: 0.048 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 4.985E-6 m/sec
y0 = 0.4061 m



330-01-BH2224_FHT

Data Set: V:\...\330-01-BH2224_KGS_Slug in_DB.aqt
Date: 11/20/18 Time: 14:44:48

PROJECT INFORMATION

Company: Golder
Project: 1893802
Test Well: 330-01-BH2224
Test Date: 29/10/2018

AQUIFER DATA

Saturated Thickness: 17.11 m

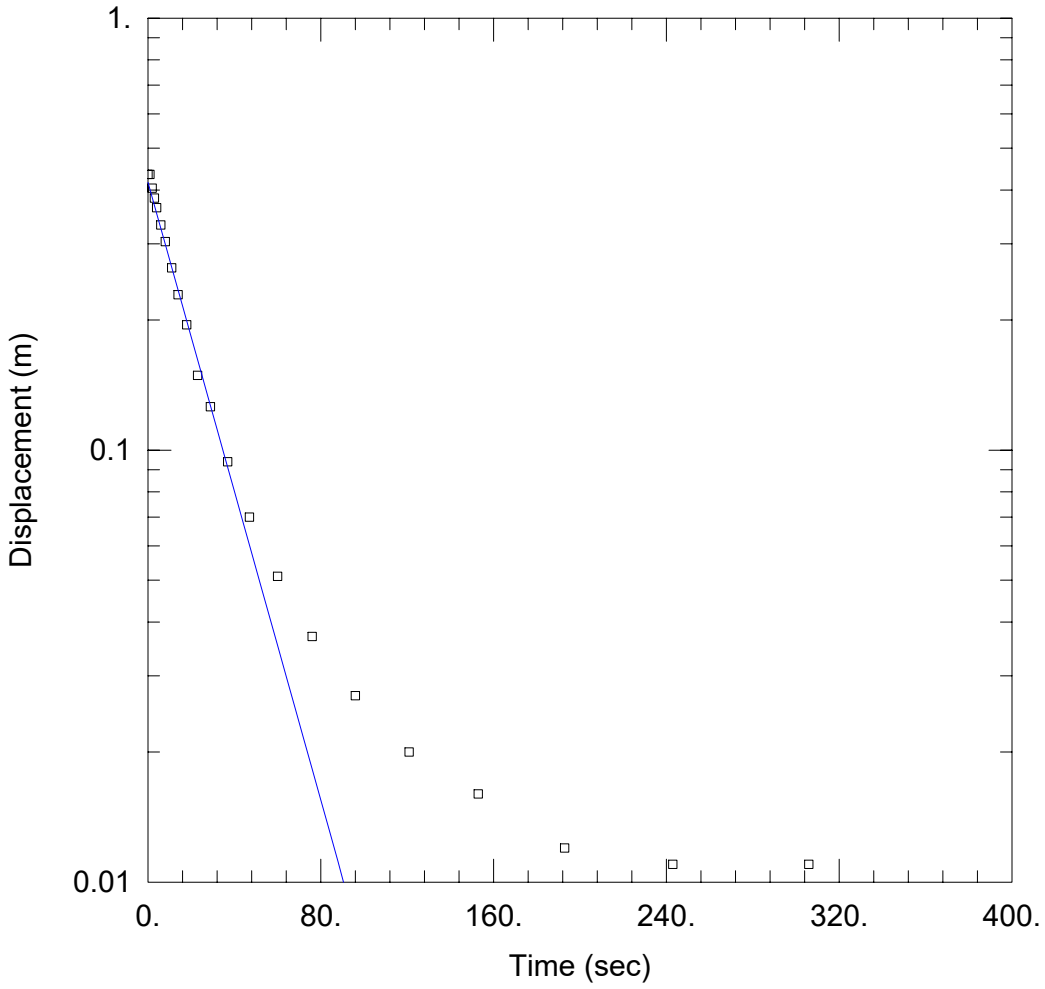
WELL DATA (330-01-BH2224)

Initial Displacement: 0.578 m
Total Well Penetration Depth: 17.11 m
Casing Radius: 0.025 m
Static Water Column Height: 17.11 m
Screen Length: 13. m
Well Radius: 0.048 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 5.493E-6 m/sec
Kz/Kr = 1.
Ss = 7.705E-6 m^{-1}



330-01-BH2224_RHT

Data Set: V:\...\330-01-BH2224_Hvorslev_Slug out_DB.aqt
Date: 11/20/18 Time: 14:45:56

PROJECT INFORMATION

Company: Golder
Project: 1893802
Test Well: 330-01-BH2224
Test Date: 29/10/2018

AQUIFER DATA

Saturated Thickness: 17.11 m Anisotropy Ratio (Kz/Kr): 1.

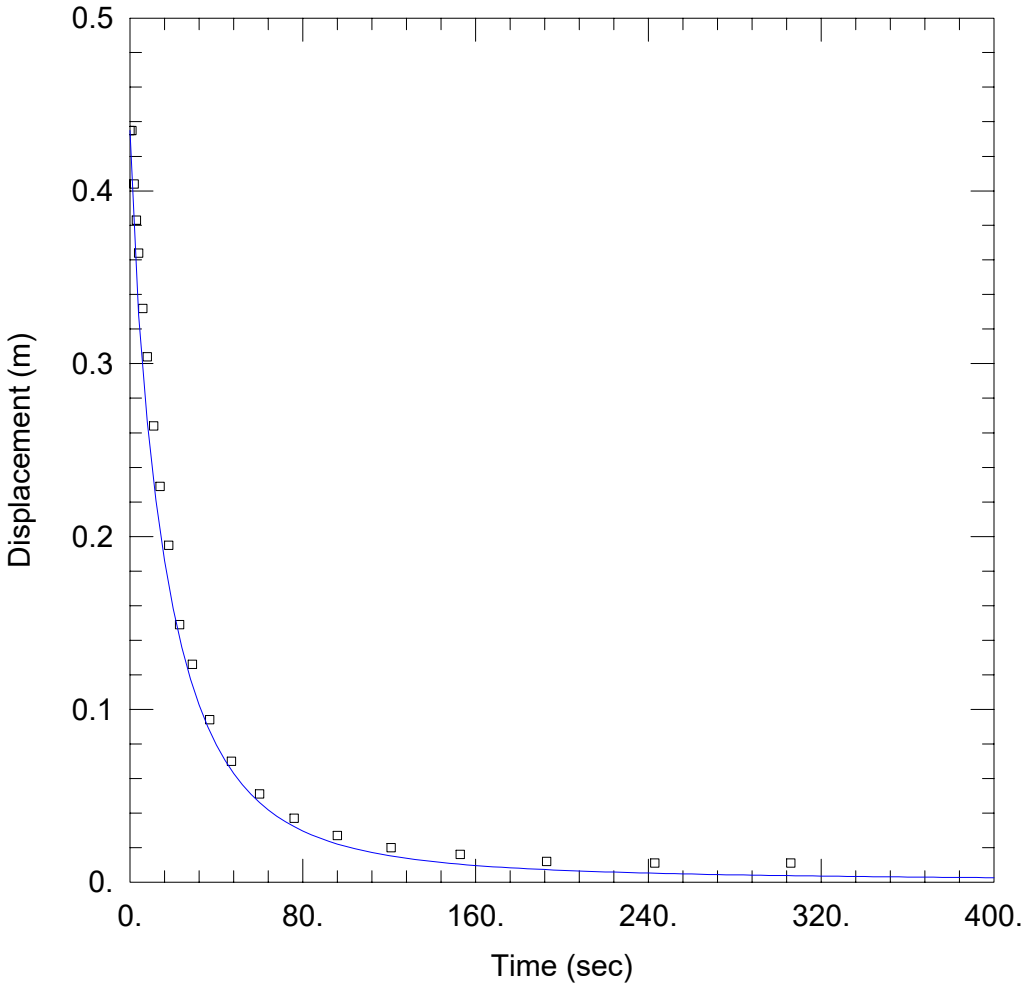
WELL DATA (330-01-BH2224)

Initial Displacement: 0.435 m
Total Well Penetration Depth: 17.11 m
Casing Radius: 0.025 m
Static Water Column Height: 17.11 m
Screen Length: 13. m
Well Radius: 0.048 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev

K = 6.224E-6 m/sec
y0 = 0.4162 m



330-01-BH2224_RHT

Data Set: V:\...\330-01-BH2224_KGS_Slug out_DB.aqt
Date: 11/20/18 Time: 14:46:53

PROJECT INFORMATION

Company: Golder
Project: 1893802
Test Well: 330-01-BH2224
Test Date: 29/10/2018

AQUIFER DATA

Saturated Thickness: 17.11 m

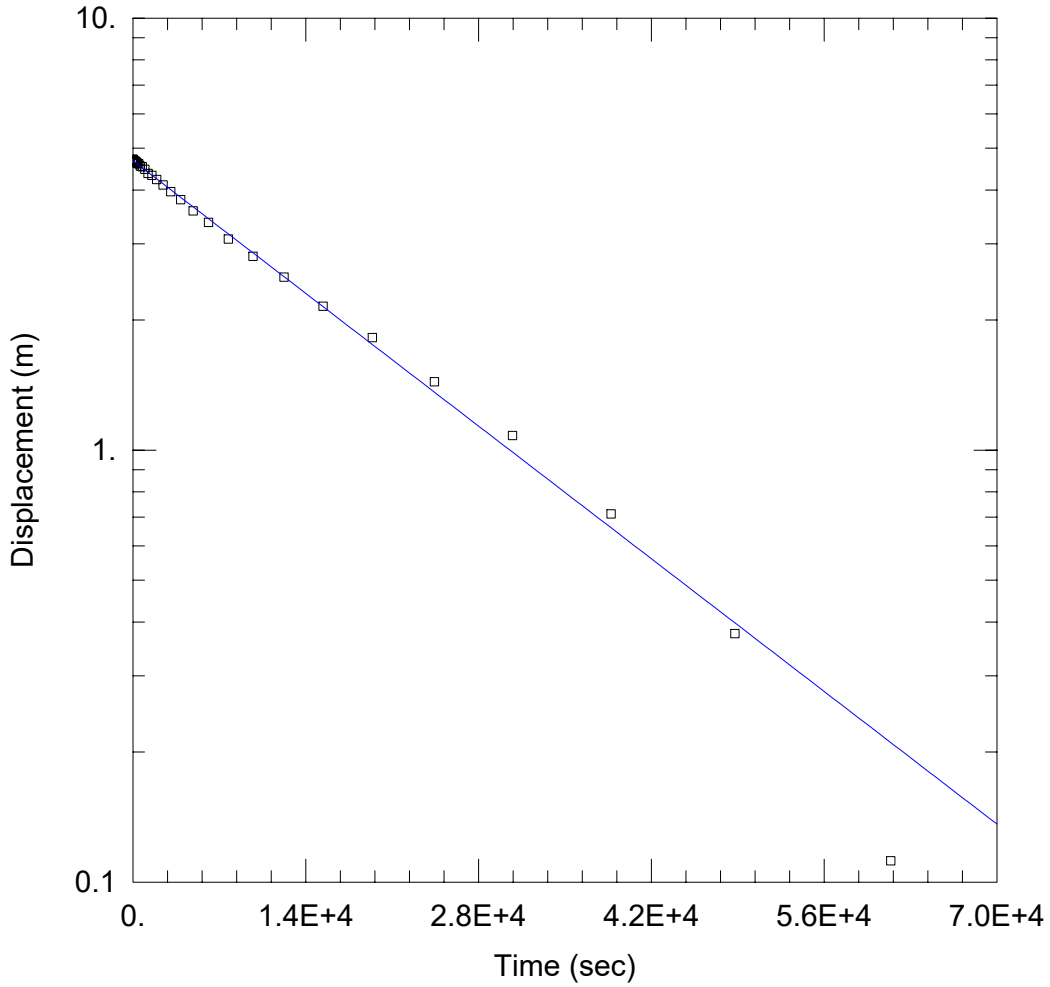
WELL DATA (330-01-BH2224)

Initial Displacement: 0.435 m
Total Well Penetration Depth: 17.11 m
Casing Radius: 0.025 m
Static Water Column Height: 17.11 m
Screen Length: 13. m
Well Radius: 0.048 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 4.3E-6 m/sec
Kz/Kr = 1.
Ss = 5.393E-5 m^{-1}



330-01-BH2303_FHT

Data Set: V:\...\330-01-BH2303_FHT_Hvorslev.aqt
Date: 11/20/18 Time: 14:48:28

PROJECT INFORMATION

Company: Golder
Project: 1893802
Test Well: 330-01-BH2303
Test Date: 31/10/2018

AQUIFER DATA

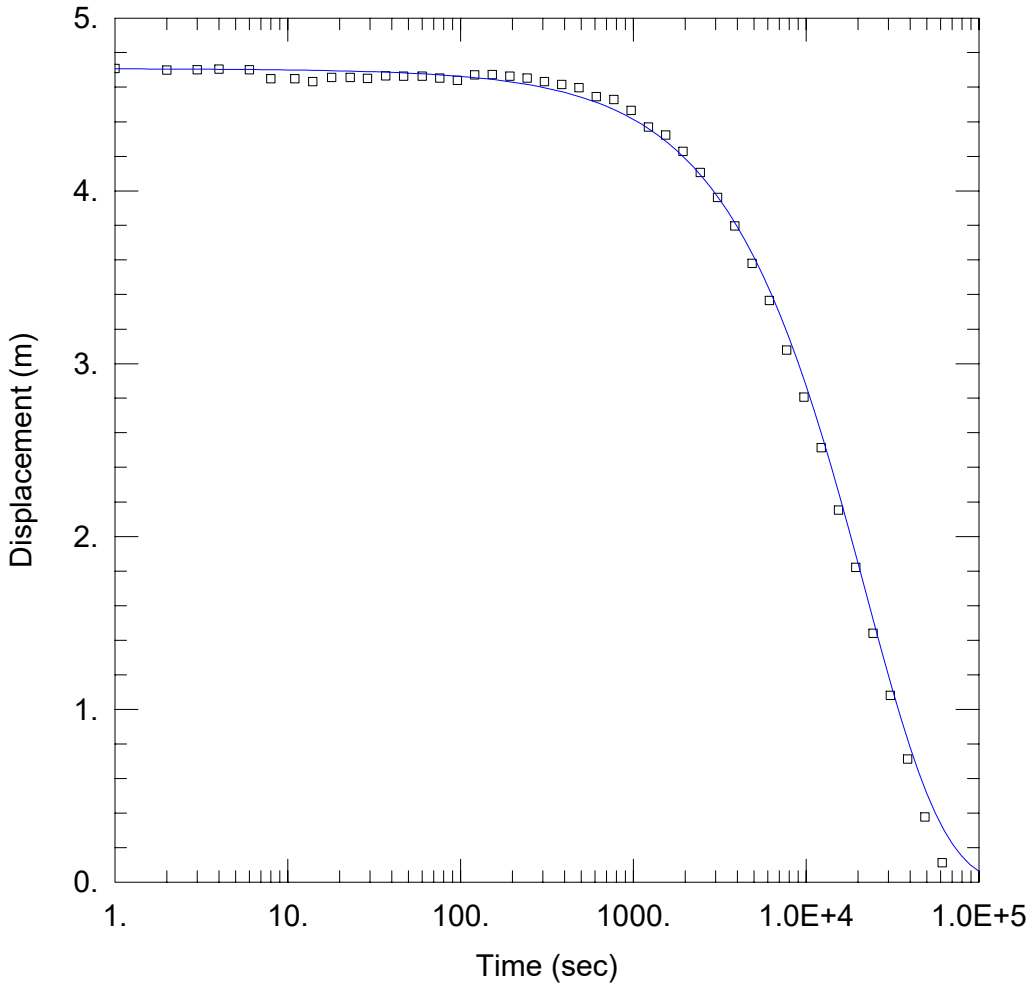
Saturated Thickness: 5.47 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (330-01-BH2303)

Initial Displacement: 4.708 m
Total Well Penetration Depth: 5.47 m
Casing Radius: 0.025 m
Static Water Column Height: 5.47 m
Screen Length: 5.47 m
Well Radius: 0.048 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 1.529E-8 m/sec
y0 = 4.676 m



330-01-BH2303_FHT

Data Set: V:\...\330-01-BH2303_FHT_KGS_NMC.aqt
Date: 11/20/18 Time: 14:49:54

PROJECT INFORMATION

Company: Golder
Project: 1893802
Test Well: 330-01-BH2303
Test Date: 31/10/2018

AQUIFER DATA

Saturated Thickness: 5.47 m

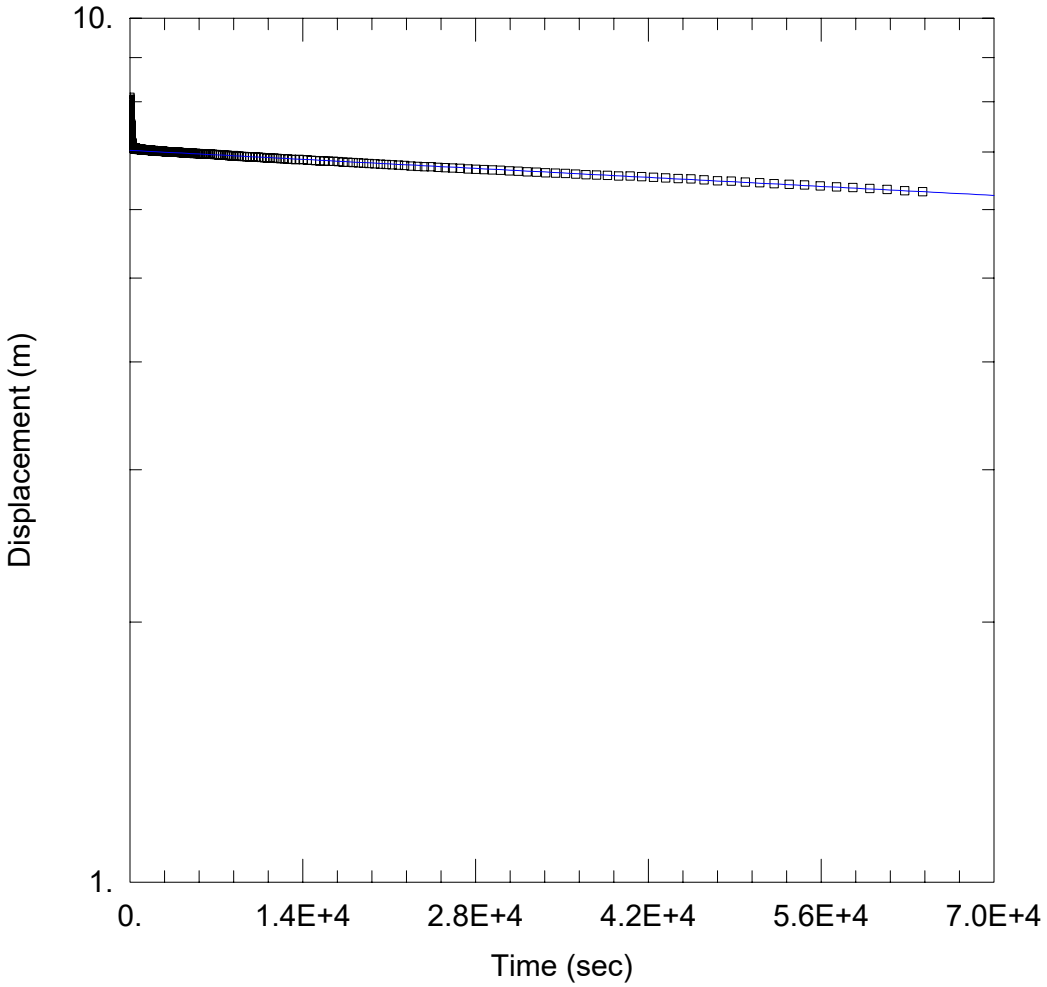
WELL DATA (330-01-BH2303)

Initial Displacement: 4.708 m
Total Well Penetration Depth: 5.47 m
Casing Radius: 0.025 m
Static Water Column Height: 5.47 m
Screen Length: 5.47 m
Well Radius: 0.048 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 1.065E-8 m/sec
Kz/Kr = 1.
Ss = 1.052E-5 m^{-1}



330-01-BH2306_FHT

Data Set: V:\...\330-01-BH2306_FHT_Hvorslev.aqt
Date: 03/19/19 Time: 12:26:49

PROJECT INFORMATION

Company: Golder
Project: 1893802
Test Well: 330-01-BH2306
Test Date: 25/02/2019

AQUIFER DATA

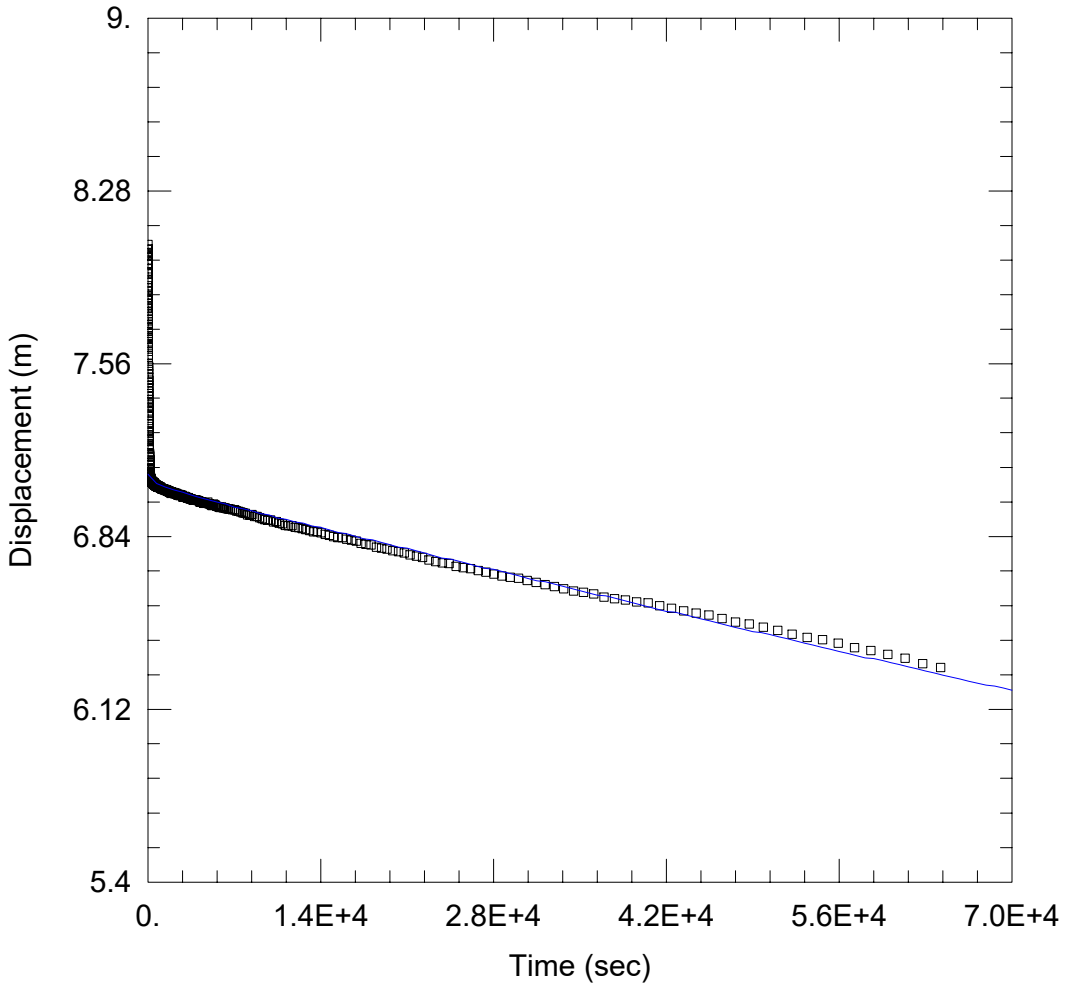
Saturated Thickness: 8.1 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (330-01-BH2306)

Initial Displacement: 8.1 m
Total Well Penetration Depth: 0.01 m
Casing Radius: 0.025 m
Static Water Column Height: 0.01 m
Screen Length: 0.01 m
Well Radius: 0.048 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 5.571E-9 m/sec
y0 = 7.029 m



330-01-BH2306_FHT

Data Set: V:\...\330-01-BH2306_FHT_KGS.aqt
Date: 03/19/19 Time: 12:27:21

PROJECT INFORMATION

Company: Golder
Project: 1893802
Test Well: 330-01-BH2306
Test Date: 25/02/2019

AQUIFER DATA

Saturated Thickness: 8.1 m

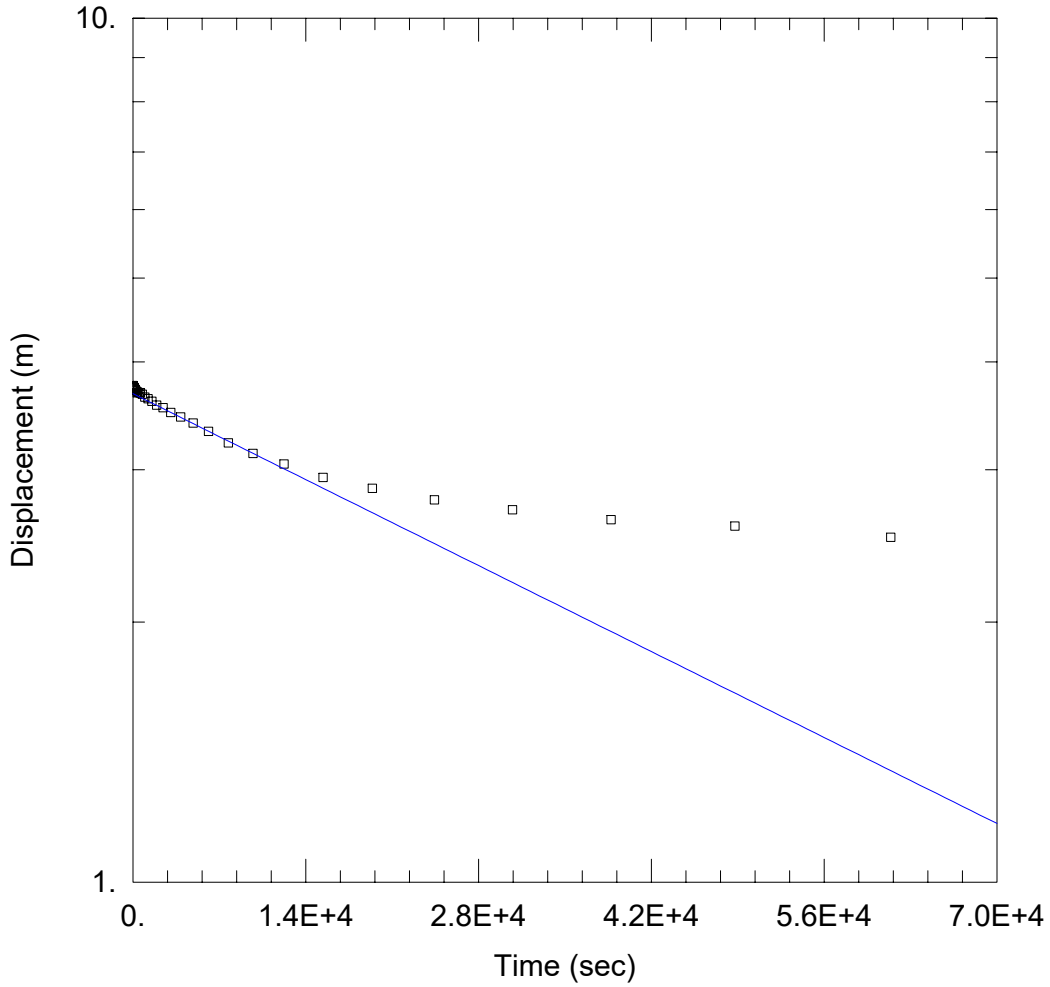
WELL DATA (330-01-BH2306)

Initial Displacement: 7.1 m
Total Well Penetration Depth: 0.01 m
Casing Radius: 0.025 m
Static Water Column Height: 0.01 m
Screen Length: 0.01 m
Well Radius: 0.048 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 4.944E-9 m/sec
Kz/Kr = 1.
Ss = 4.33E-7 m^{-1}



330-01-BH2503_FHT

Data Set: V:\...\330-01-BH2503_FHT_Hvorslev.aqt_DB.aqt
Date: 11/20/18 Time: 14:50:55

PROJECT INFORMATION

Company: Golder
Project: 1893802
Test Well: 330-01-BH2503

AQUIFER DATA

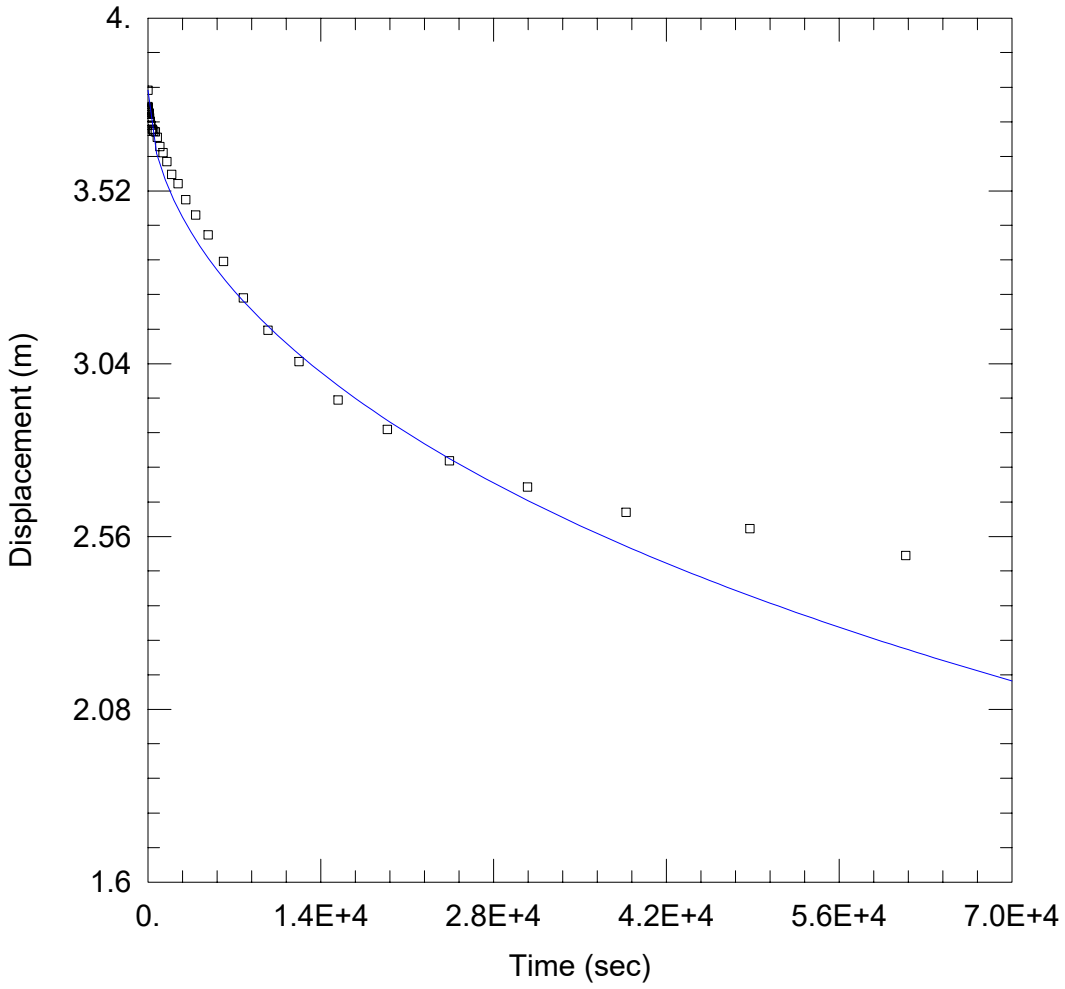
Saturated Thickness: 3.754 m Anisotropy Ratio (Kz/Kr): 1.

WELL DATA (330-01-BH2503)

Initial Displacement: 3.754 m
Total Well Penetration Depth: 3.754 m
Casing Radius: 0.025 m
Static Water Column Height: 0.01 m
Screen Length: 3.754 m
Well Radius: 0.048 m

SOLUTION

Aquifer Model: Unconfined
Solution Method: Hvorslev
K = 7.217E-9 m/sec
y0 = 3.675 m



WELL TEST ANALYSIS

Data Set: V:\...\330-01-BH2503_FHT_KGS_DB.aqt
Date: 11/20/18 Time: 14:54:36

PROJECT INFORMATION

Company: Golder
Project: 1893802
Test Well: 330-01-BH2503

AQUIFER DATA

Saturated Thickness: 3.754 m

WELL DATA (330-01-BH2503)

Initial Displacement: 3.8 m
Total Well Penetration Depth: 3.754 m
Casing Radius: 0.025 m
Static Water Column Height: 0.01 m
Screen Length: 3.754 m
Well Radius: 0.048 m

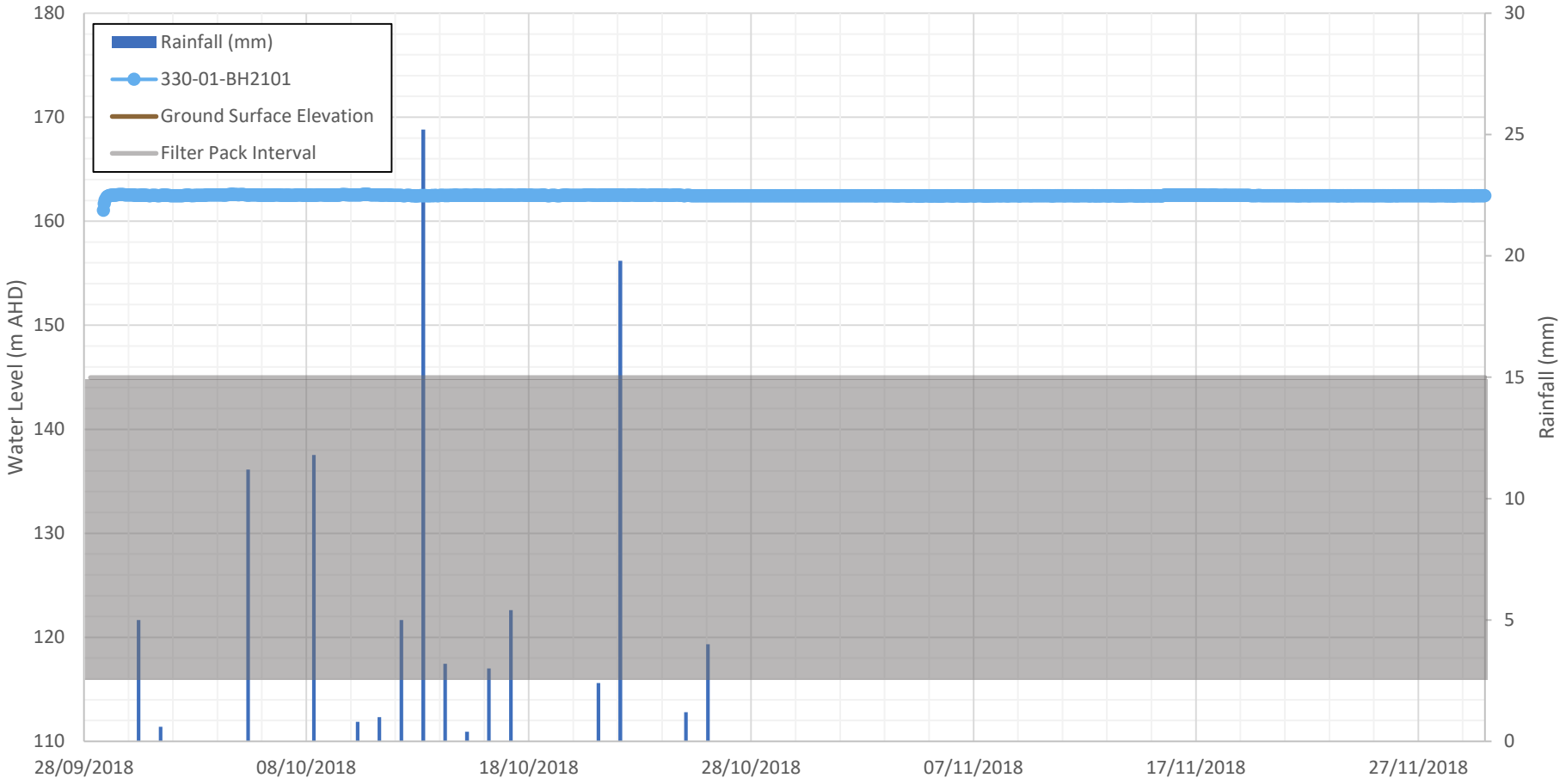
SOLUTION

Aquifer Model: Unconfined
Solution Method: KGS Model

Kr = 5.032E-10 m/sec
Kz/Kr = 0.9661
Ss = 0.01402 m^{-1}

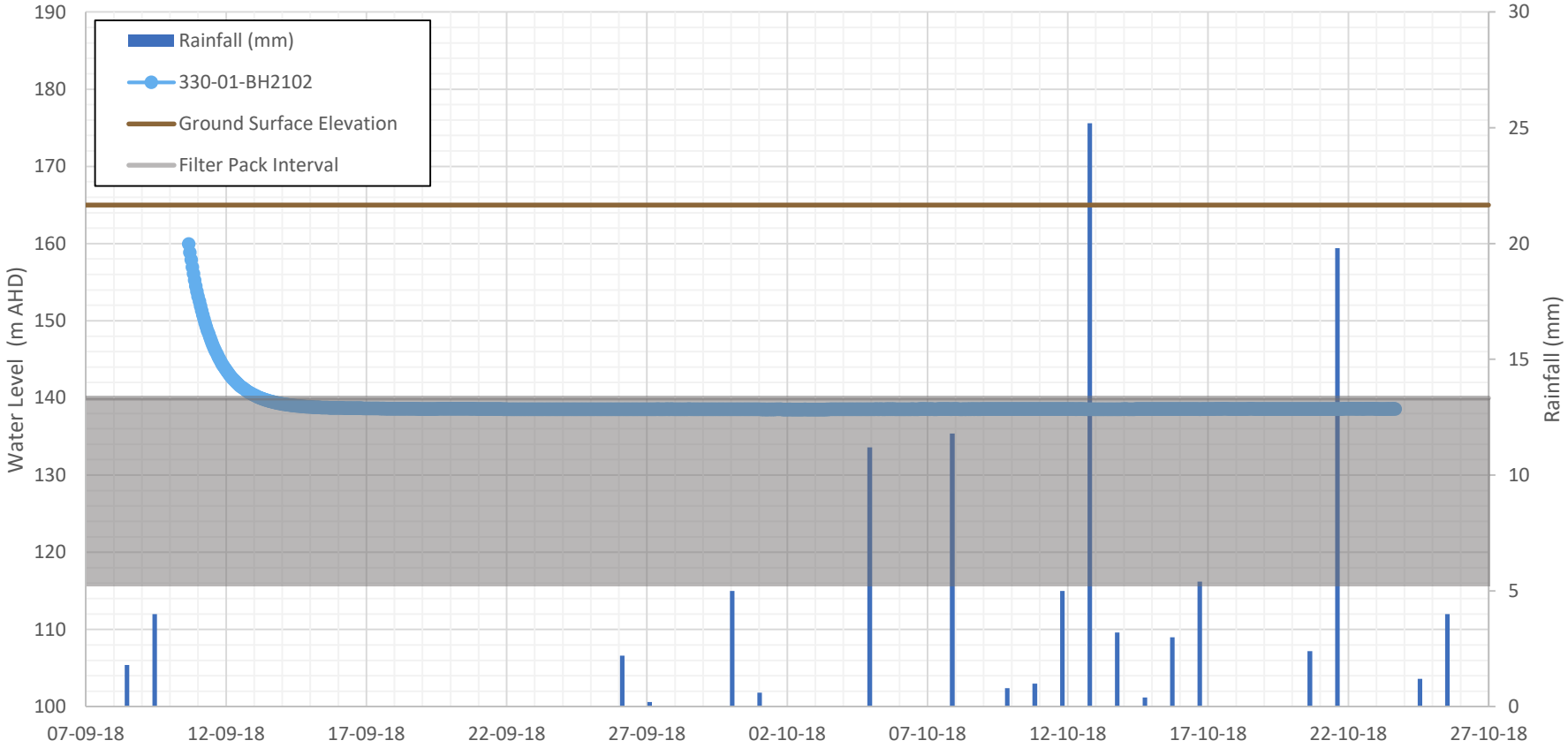
Appendix G
Hydrographs

HELIDON TO CALVERT ENVIRONMENTAL IMPACT STATEMENT



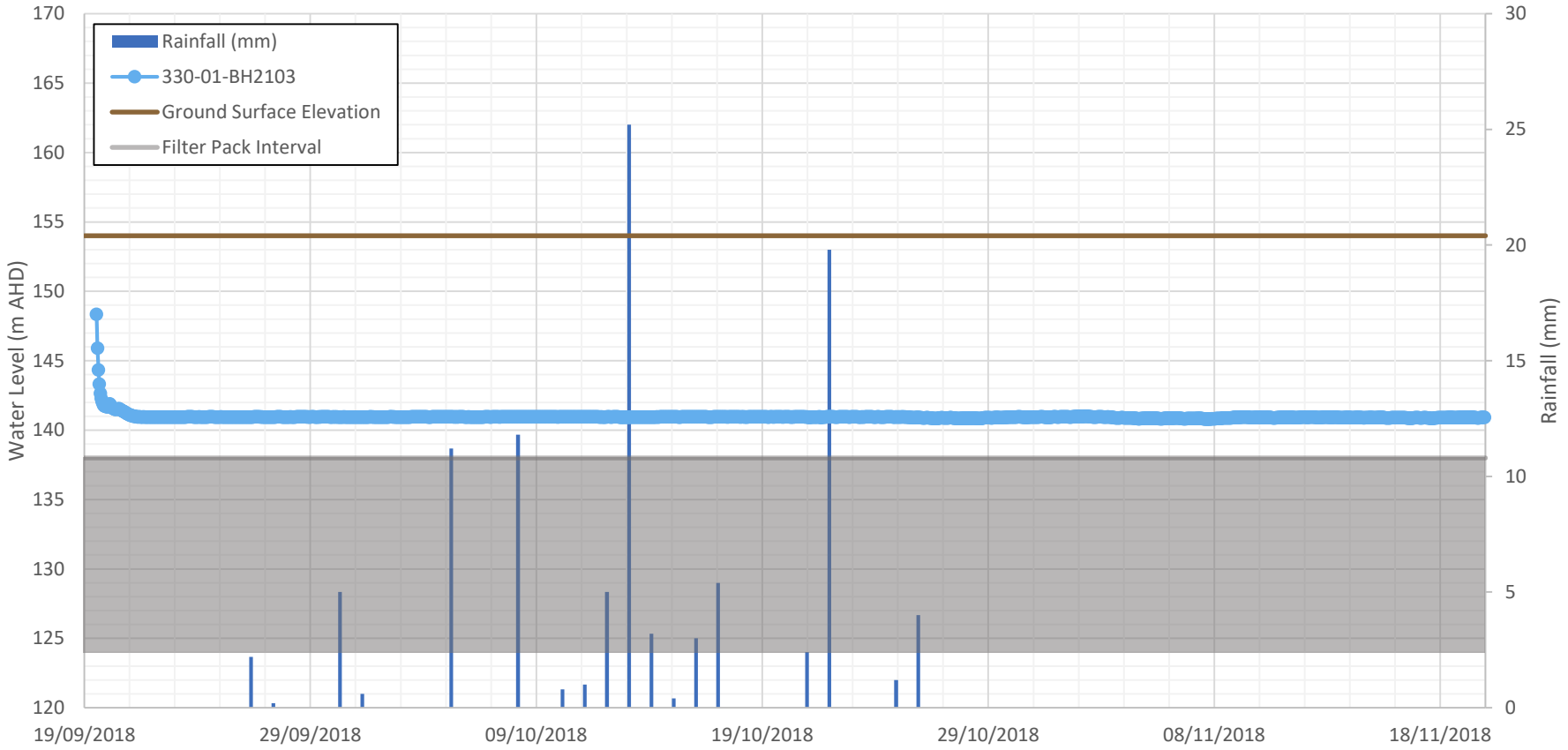
GOLDER

CLIENT	FFJV			PROJECT	Inland Rail – H2C		
DRAWN	SK	DATE	19/03/19	TITLE	330-01-BH2101 Hydrograph		
CHECKED	DB	DATE	19/03/19				
SCALE	Not to Scale			PROJECT No	1893802	FIGURE No G1.1	REV No 1 A4



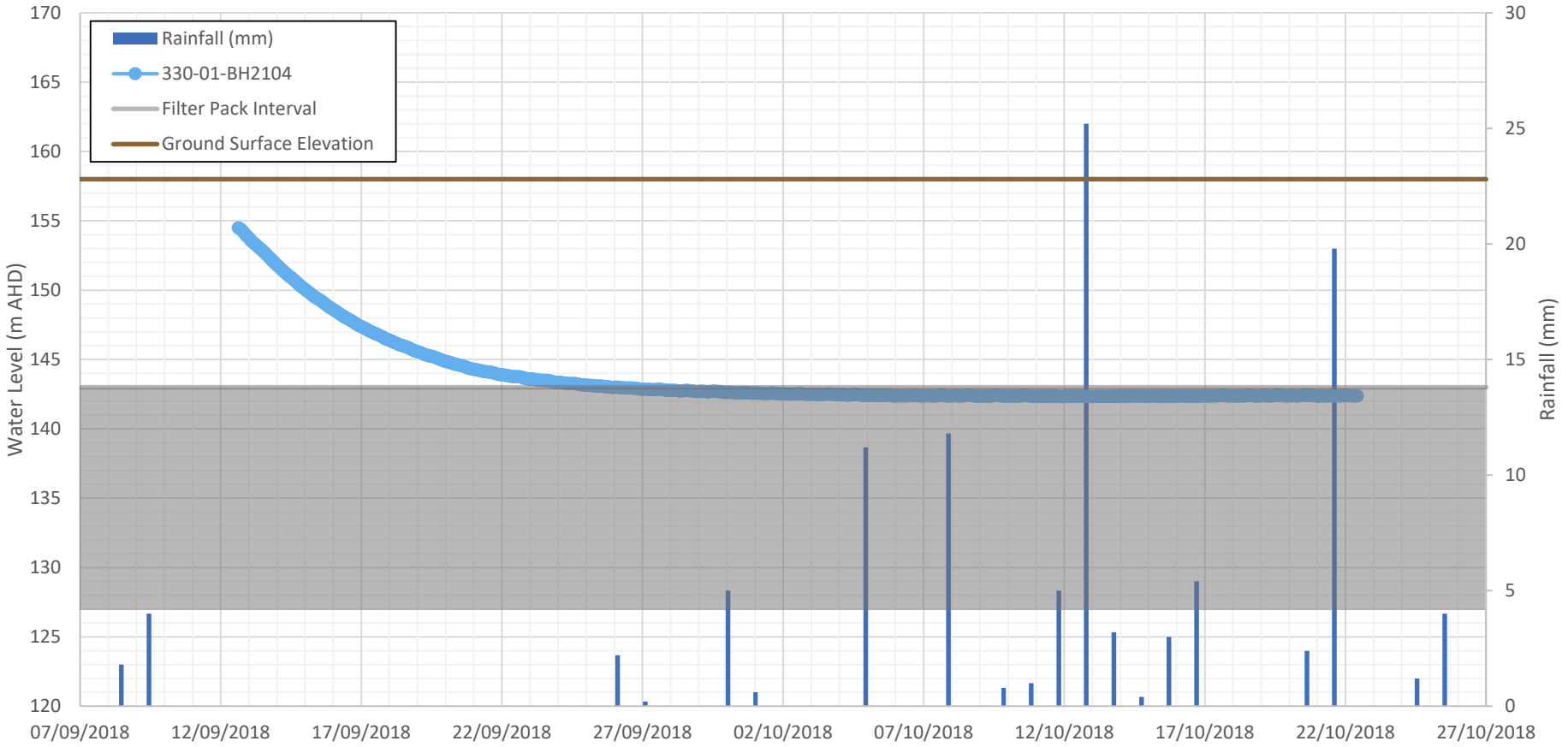
GOLDER

CLIENT	FFJV			PROJECT	Inland Rail – H2C		
DRAWN	SK	DATE	19/03/19	TITLE	330-01-BH2102 Hydrograph		
CHECKED	DB	DATE	19/03/19				
SCALE	Not to Scale			PROJECT No	1893802	FIGURE No G1.2	REV No 1 A4



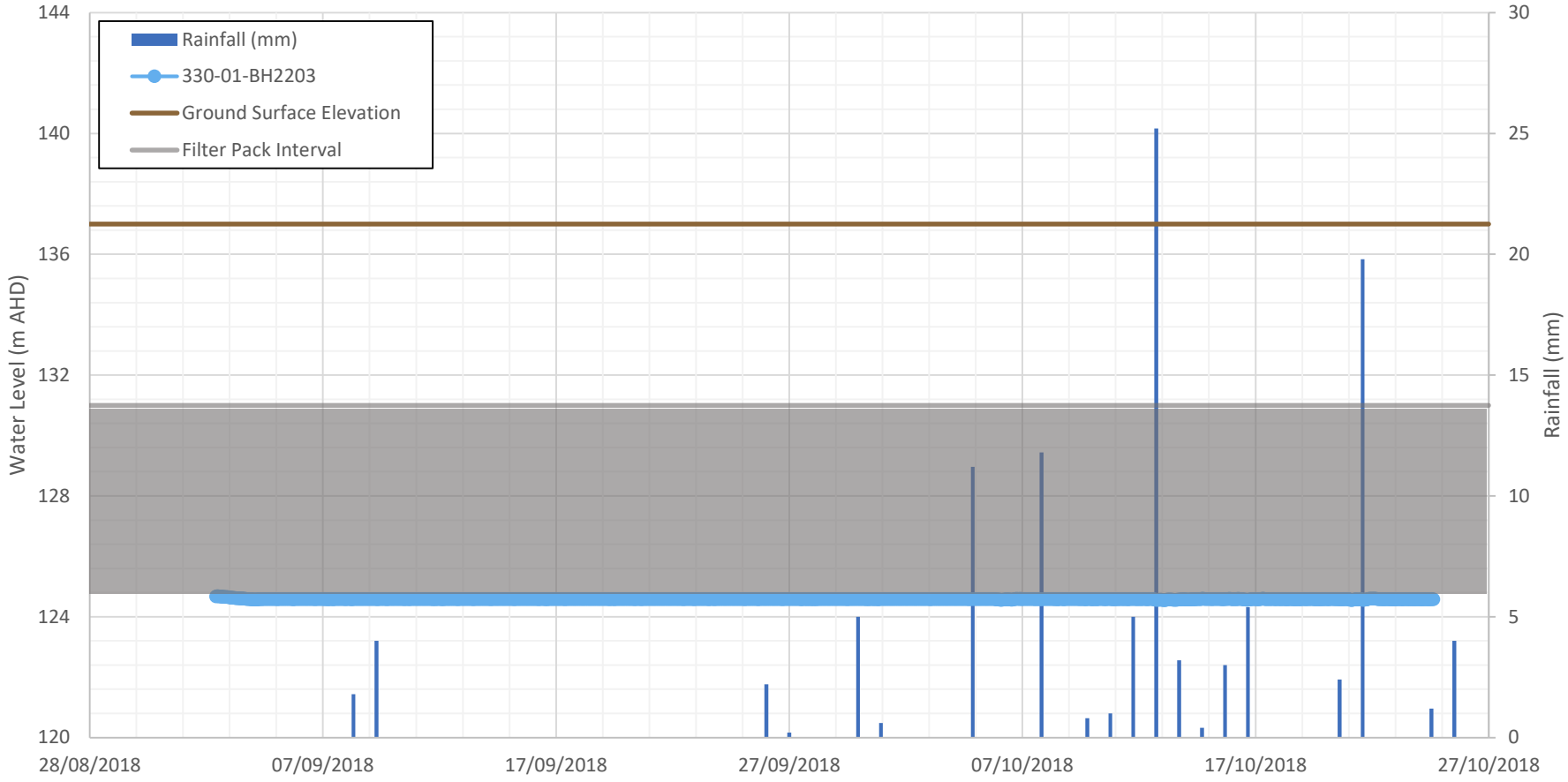
GOLDER

CLIENT	FFJV			PROJECT	Inland Rail – H2C	
DRAWN	SK	DATE	19/03/19	TITLE	330-01-BH2103 Hydrograph	
CHECKED	DB	DATE	19/03/19			
SCALE	Not to Scale			PROJECT No	1893802	FIGURE No G1.3 REV No 1 A4



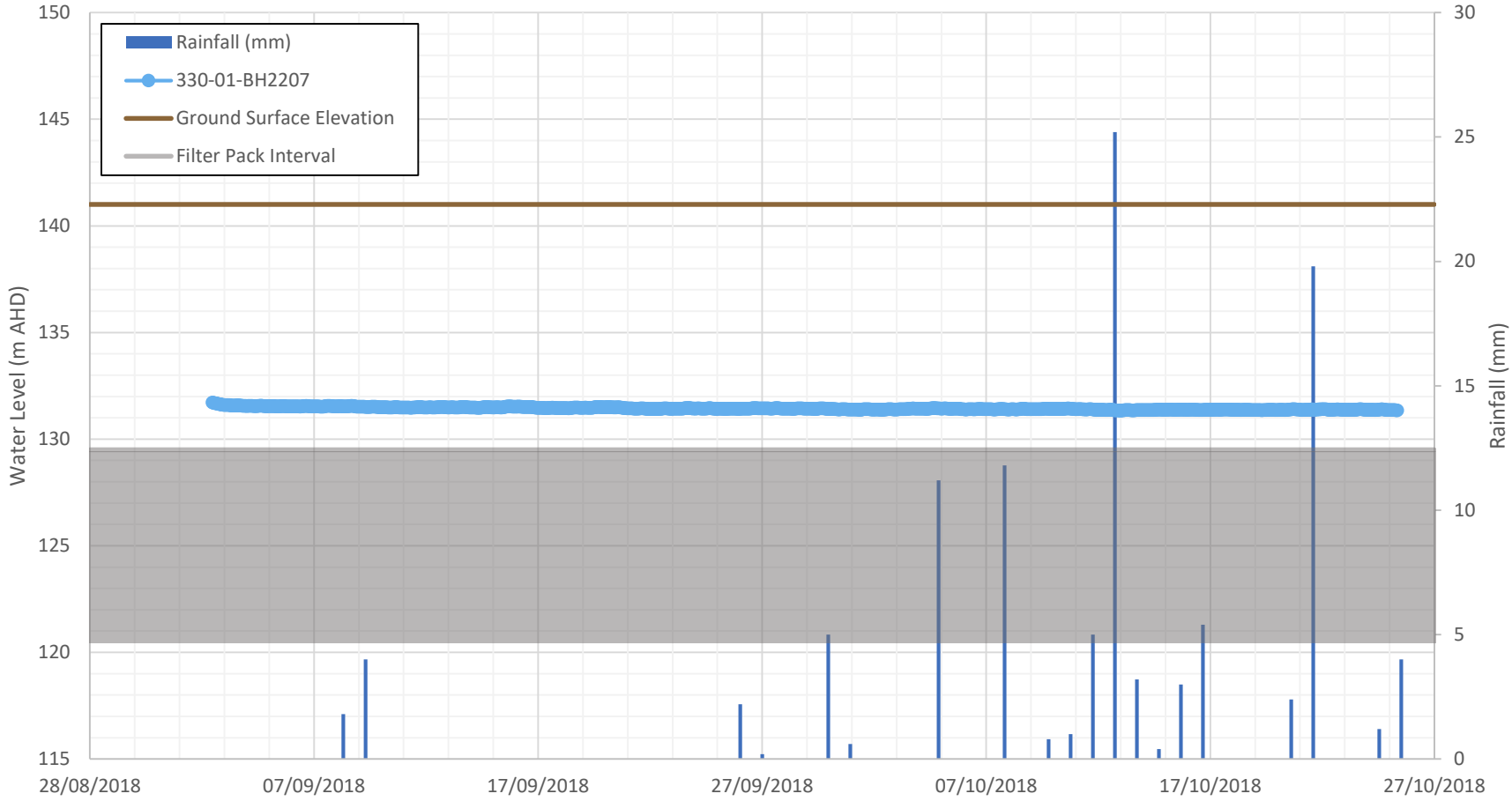
GOLDER

CLIENT	FFJV		PROJECT	Inland Rail – H2C	
DRAWN	SK	DATE 19/03/19	TITLE	330-01-BH2104 Hydrograph	
CHECKED	DB	DATE 19/03/19			
SCALE	Not to Scale		PROJECT No 1893802	FIGURE No G1.4	REV No 1 A4



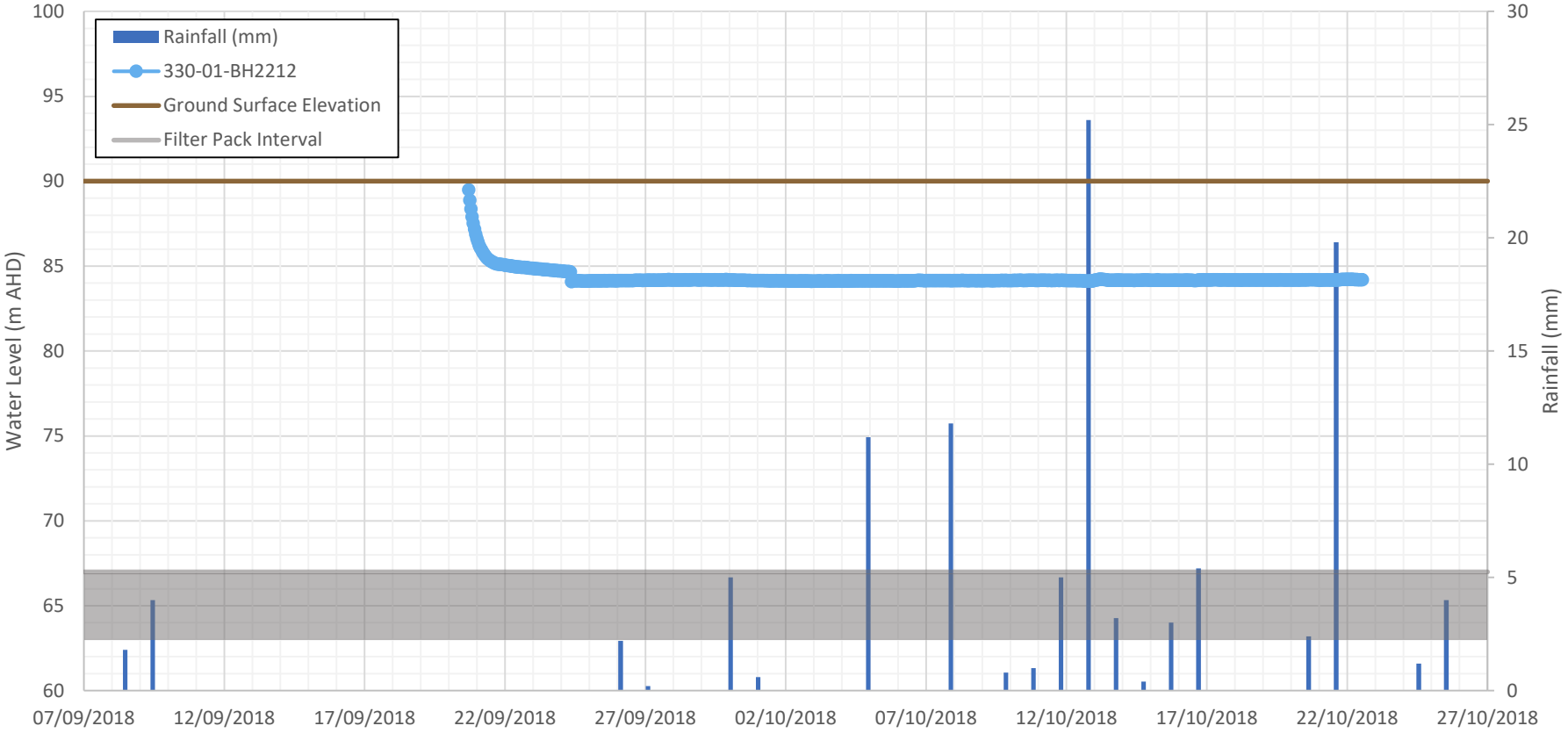
CLIENT	FFJV			PROJECT	Inland Rail – H2C		
DRAWN	SK	DATE	19/03/19	TITLE	330-01-BH2203 Hydrograph		
CHECKED	DB	DATE	19/03/19				
SCALE	Not to Scale			PROJECT No	1893802	FIGURE No G1.5	REV No 1 A4

GOLDER



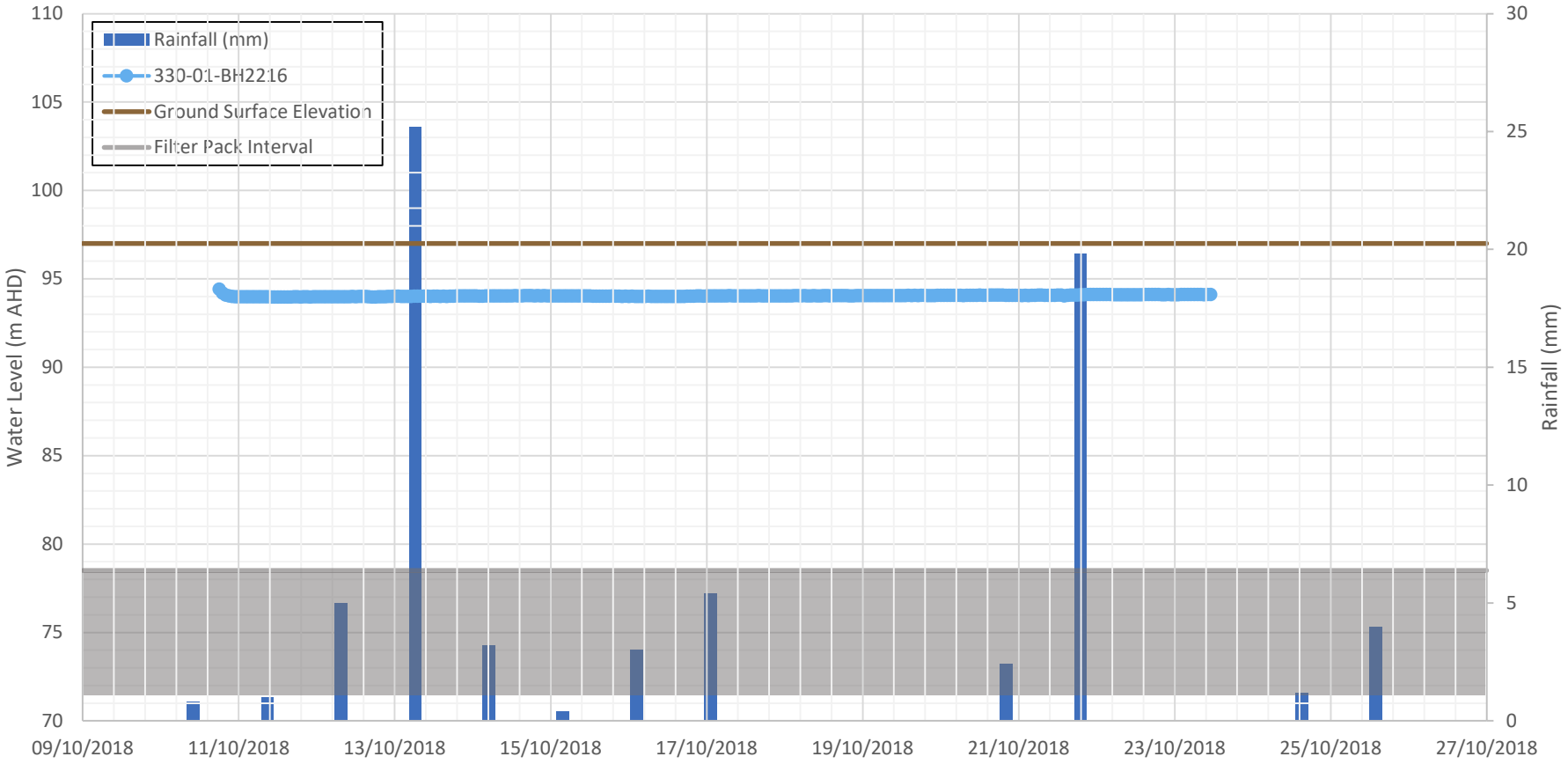
CLIENT	FFJV			PROJECT	Inland Rail – H2C		
DRAWN	SK	DATE	19/03/19	TITLE	330-01-BH2207 Hydrograph		
CHECKED	DB	DATE	19/03/19				
SCALE	Not to Scale			PROJECT No	1893802	FIGURE No G1.6	REV No 1 A4

GOLDER



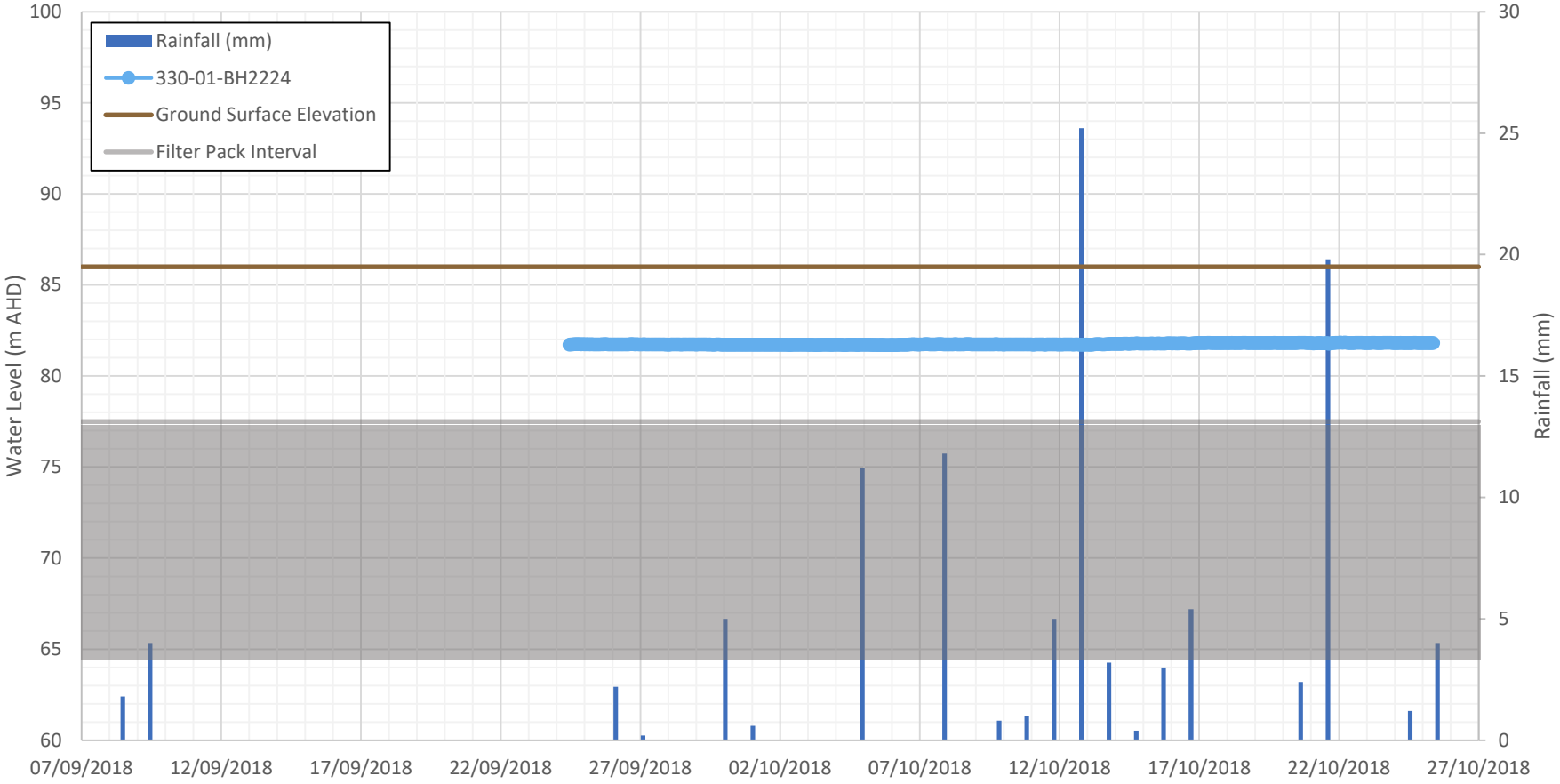
GOLDER

CLIENT	FFJV			PROJECT	Inland Rail – H2C	
DRAWN	SK	DATE	19/03/19	TITLE	330-01-BH2212 Hydrograph	
CHECKED	DB	DATE	19/03/19			
SCALE	Not to Scale			PROJECT No	1893802	FIGURE No G1.7 REV No 1 A4



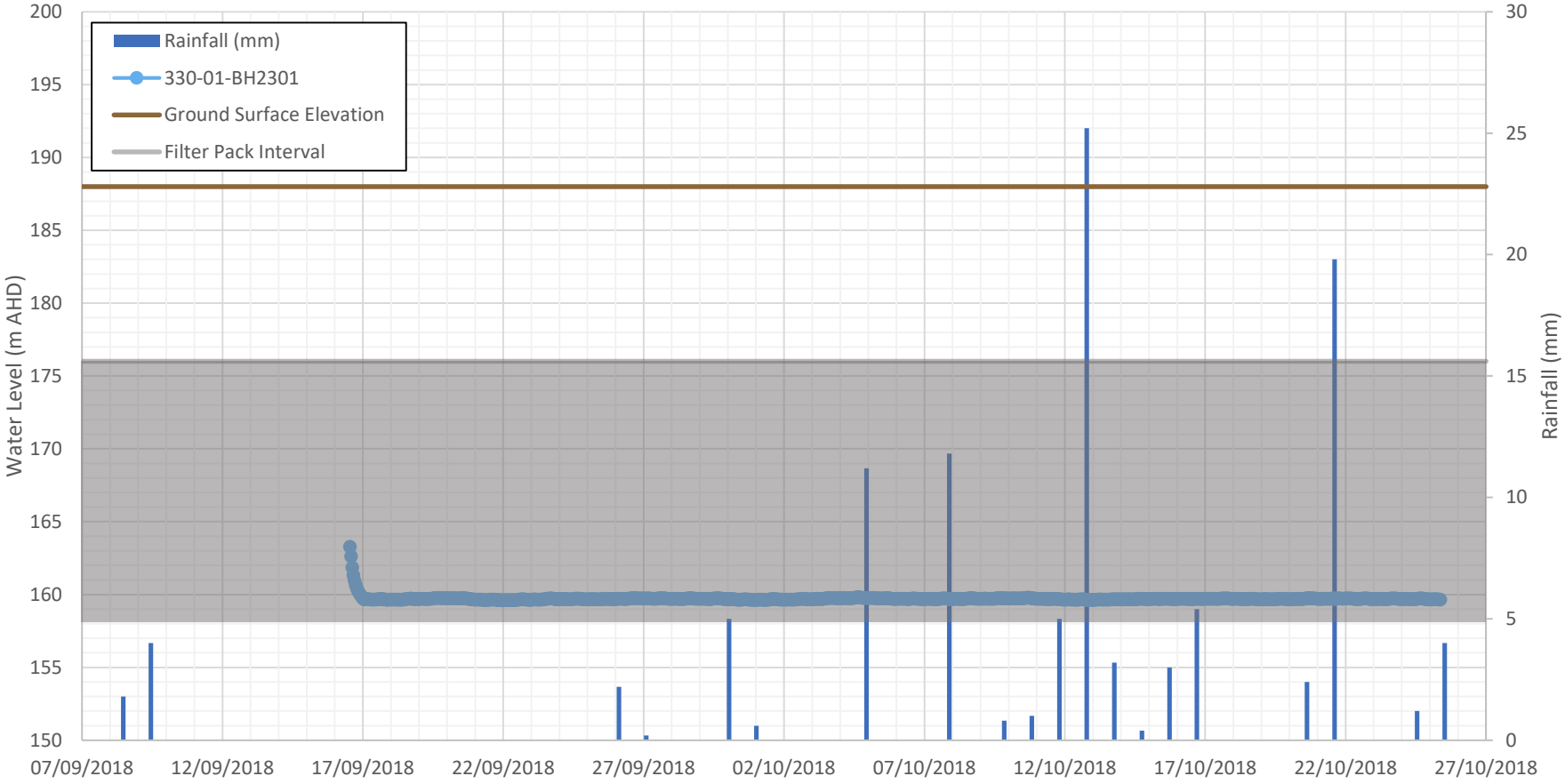
GOLDER

CLIENT	FFJV			PROJECT	Inland Rail – H2C
DRAWN	SK	DATE	19/03/19	TITLE	330-01-BH2216 Hydrograph
CHECKED	DB	DATE	19/03/19		
SCALE	Not to Scale			PROJECT No 1893802	FIGURE No G1.8 REV No 1 A4



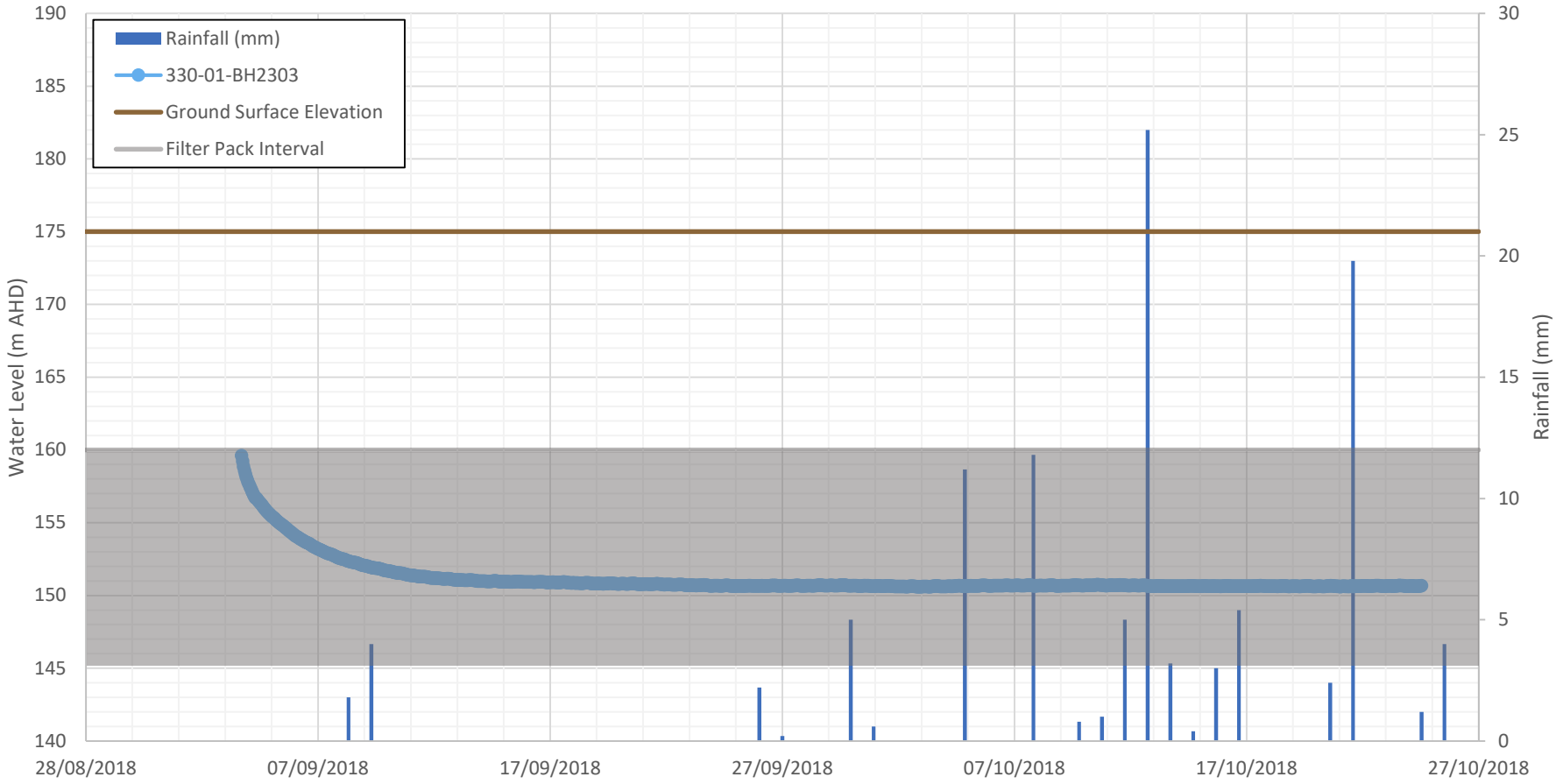
GOLDER

CLIENT	FFJV			PROJECT	Inland Rail – H2C	
DRAWN	SK	DATE	19/03/19	TITLE	330-01-BH2224 Hydrograph	
CHECKED	DB	DATE	19/03/19			
SCALE	Not to Scale			PROJECT No	1893802	FIGURE No G1.9 REV No 1 A4



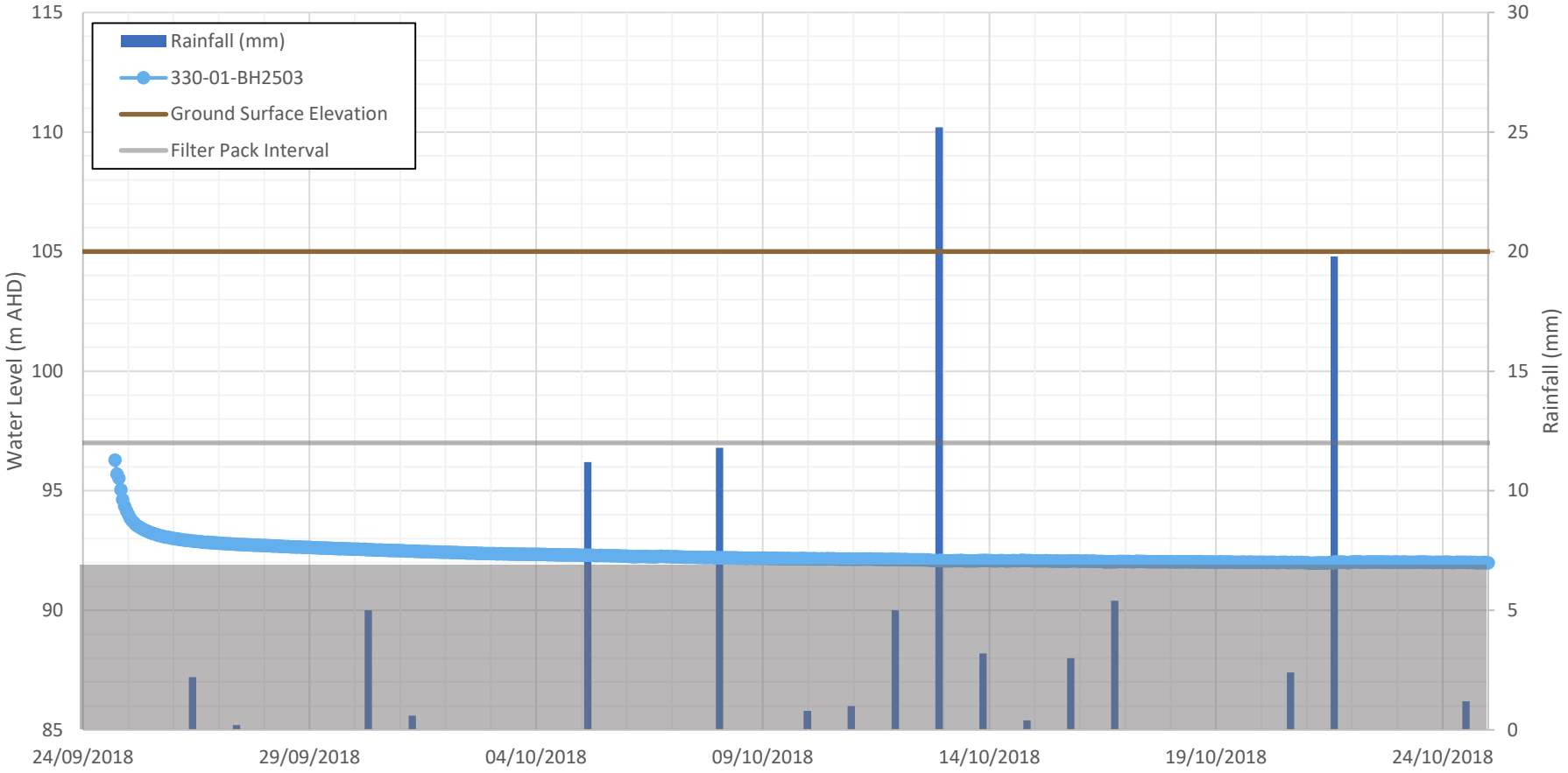
GOLDER

CLIENT	FFJV			PROJECT	Inland Rail – H2C		
DRAWN	SK	DATE	19/03/19	TITLE	330-01-BH2301 Hydrograph		
CHECKED	DB	DATE	19/03/19				
SCALE	Not to Scale			PROJECT No	1893802	FIGURE No G1.10	REV No 1 A4



GOLDER

CLIENT	FFJV			PROJECT	Inland Rail – H2C		
DRAWN	SK	DATE	19/03/19	TITLE	330-01-BH2303 Hydrograph		
CHECKED	DB	DATE	19/03/19				
SCALE	Not to Scale			PROJECT No	1893802	FIGURE No G1.11	REV No 1 A4



GOLDER

CLIENT	FFJV	PROJECT	Inland Rail – H2C
DRAWN	SK	DATE 19/03/19	TITLE 330-01-DH2503 Hydrograph
CHECKED	DB	DATE 19/03/19	
SCALE	Not to Scale	PROJECT No 1893802	FIGURE No G1.12 REV No 1 A4

Appendix H
Groundwater Laboratory Reports

HELIDON TO CALVERT ENVIRONMENTAL IMPACT STATEMENT

CHAIN OF CUSTODY

ALS Laboratory: please tick →

ADELAIDE 3/1 Burma Road Pooraka SA 5095 Ph: 08 8162 5130 E: adelaide@alsglobal.com

BRISBANE 2 Byth Street Stafford QLD 4053 Ph: 07 3243 7222 E: samples.brisbane@alsglobal.com

GLADSTONE 48 Callemondah Drive Gladstone QLD 4680 Ph: 07 4978 7944 E: gladstone@alsglobal.com

MACKAY 78 Harbour Road Mackay QLD 4740 Ph: 07 4944 0177 E: mackay@alsglobal.com

MELBOURNE 2-4 Westall Road Springvale VIC 3171 Ph: 03 8549 9600 E: samples.melbourne@alsglobal.com

MUDGEE 1/29 Sydney Road Mudgee NSW 2850 Ph: 02 6372 6735 E: mudgee.mail@alsglobal.com

NEWCASTLE 5/585 Maitland Road Mayfield West NSW 2304 Ph: 02 4014 2500 E: samples.newcastle@alsglobal.com

NOWRA 4/13 Geary Place North Nowra NSW 2541 Ph: 02 4423 2063 E: nowra@alsglobal.com

PERTH 10 Hod Way Malaga WA 6090 Ph: 08 9209 7655 E: samples.perth@alsglobal.com

SYDNEY 277-289 Woodpark Road Smithfield NSW 2164 Ph: 02 8784 8555 E: samples.sydney@alsglobal.com

TOWNSVILLE 14-15 Desma Court Bohle QLD 4818 Ph: 07 4796 0600 E: townsville.environmental@alsglobal.com

WOLLONGONG 1/19-21 Ralph Black Drive, Nth Wollongong NSW 2500 Ph: 02 4225 3125 E: wollongong@alsglobal.com

CLIENT: Golder Associates Pty Ltd	TURNAROUND REQUIREMENTS : (Standard TAT may be longer for some tests e.g. Ultra Trace Organics)	☑ Standard TAT (List due date): 48 hrs.	FOR LABORATORY USE ONLY (Circle)
OFFICE: Golder-Brisbane		☐ Non Standard or urgent TAT (List due date):	Custody Seal Intact? Yes No N/A
PROJECT: Inland Rail (P13) PROJECT NO.: 1893802	ALS QUOTE NO.:	COC SEQUENCE NUMBER (Circle)	Free ice / frozen ice bricks present upon receipt? Yes No N/A
ORDER NUMBER: PURCHASE ORDER NO.:	COUNTRY OF ORIGIN:	COC: 1 2 3 4 5 6 7	Random Sample Temperature on Receipt: °C
PROJECT MANAGER: Mitch McGinnis CONTACT PH:		OF: 1 2 3 4 5 6 7	Other comment:
SAMPLER: Rob Cupper SAMPLER MOBILE: 0448611113	RELINQUISHED BY:	RECEIVED BY:	RELINQUISHED BY: / RECEIVED BY:
COC Emailed to ALS? (YES / (NO) EDD FORMAT (or default):			
Email Reports to (will default to PM if no other addresses are listed): skumarapeli@golder.com.au	DATE/TIME:	DATE/TIME: 24/10/18 9:17	DATE/TIME: / DATE/TIME:
Email Invoice to (will default to PM if no other addresses are listed):			

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:

ALS USE ONLY	SAMPLE DETAILS MATRIX: Solid(S) Water(W)			CONTAINER INFORMATION		ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) When Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required).								Additional Information
LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE (refer to codes below)	TOTAL BOTTLES	Anions/cations Ca, Mg, Na, Cl, F SO4, Alkalinity, Hardness	EC, pH, TDS	Total/Dissolved As, B, Ba, Be, Cd, Cr Co, Cu, Cd, Mn, Fe	Ni, Pb, Se, V, Zn Hg	Nutrients Nitrate, Nitrite Ammonia	Reactive Phosphorus Total P/N, TKN	Sodium Adsorption Ratio		Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
1	330-01-BH2212	22/10/18 15:20	W	N, SP	4	✓	✓	✓	✓	✓	✓	✓		
2	330-01-BH 2216	29/10/18 13:40	W	N, SP	4	✓	✓	✓	✓	✓	✓	✓		
3	GW 789	23/10/18 13:50	W	N, SP	4	✓	✓	✓	✓	✓	✓	✓		
	~~330-01-BH2214~~													
4	330-01-BH 2104	23/10/18 16:00	W	N, SP	4	✓	✓	✓	✓	✓	✓	✓		
				TOTAL	16									

URGENT

H7

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP = Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F
Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag; LI = Lugols Iodine Preserved Bottles; STT = Sterile Sodium Thiosulfate Preserved Bottles.

Environmental Division Brisbane
Work Order Reference
EB1825628

Telephone : + 61-7-3243 7222

CHAIN OF CUSTODY

ALS Laboratory: please tick →

ADELAIDE 3/1 Burma Road Pooraka SA 5095 Ph: 08 8162 5130 E: adelaide@alsglobal.com

BRISBANE 2 Byth Street Stafford QLD 4053 Ph: 07 3243 7222 E: samples.brisbane@alsglobal.com

GLADSTONE 48 Callemondah Drive Gladstone QLD 4680 Ph: 07 4978 7944 E: gladstone@alsglobal.com

MACKAY 78 Harbour Road Mackay QLD 4740 Ph: 07 4944 0177 E: mackay@alsglobal.com

MELBOURNE 2-4 Westall Road Springvale VIC 3171 Ph: 03 8549 9600 E: samples.melbourne@alsglobal.com

MUDGEE 1/29 Sydney Road Mudgee NSW 2850 Ph: 02 6372 6735 E: mudgee.mail@alsglobal.com

NEWCASTLE 5/585 Maitland Road Mayfield West NSW 2304 Ph: 02 4014 2500 E: samples.newcastle@alsglobal.com

NOWRA 4/13 Geary Place North Nowra NSW 2541 Ph: 02 4423 2063 E: nowra@alsglobal.com

PERTH 10 Hod Way Malaga WA 6090 Ph: 08 9209 7655 E: samples.perth@alsglobal.com

SYDNEY 277-289 Woodpark Road Smithfield NSW 2164 Ph: 02 8784 8555 E: samples.sydney@alsglobal.com

TOWNSVILLE 14-15 Desma Court Bohle QLD 4818 Ph: 07 4796 0600 E: [illegible]

500

Environmental Division
Brisbane
Work Order Reference
EB1825910

Telephone : + 61-7-3243 7222

CLIENT: Golder Associates Pty Ltd	TURNAROUND REQUIREMENTS : (Standard TAT may be longer for some tests e.g., Ultra Trace Organics)	☐ Standard TAT (List due date):	FOR LI
OFFICE: Golder - Brisbane		☑ Non Standard or urgent TAT (List due date): 48 hrs	Custody
PROJECT: Inland Rail CP13 PROJECT NO. 1893802	ALS QUOTE NO.:	COC SEQUENCE NUMBER (Circle) COC: 1 2 3 4 5 6 7	Free Ice receipt? N/A
ORDER NUMBER: PURCHASE ORDER NO.:	COUNTRY OF ORIGIN:	OF: 1 2 3 4 5 6 7	Random N/A
PROJECT MANAGER: Mitch McGinnis CONTACT PH:			Other co
SAMPLER: Rob Cupper SAMPLER MOBILE: 0448611113	RELINQUISHED BY:	RECEIVED BY:	RELINQUISH
COC Emailed to ALS? (YES / NO) EDD FORMAT (or default):	DATE/TIME:	DATE/TIME: 26/10/18 9:05	DATE/TIME:
Email Reports to (will default to PM if no other addresses are listed): skumarapeli@golder.com.au			
Email Invoice to (will default to PM if no other addresses are listed):			

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:

ALS USE ONLY	SAMPLE DETAILS MATRIX: Solid(S) Water(W)			CONTAINER INFORMATION		ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) When Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required).								Additional Information
LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE (refer to codes below)	TOTAL BOTTLES	Anions/Cations Ca, Mg, Na, Cl, F SO4, Alkalinity, Hardness	EC, PH, TDS	(Total / Dissolved) As, B, Ba, Be, Ca, Cr, Co, Cu, Mn, Fe, Ni, Pb, Se, V, Zn, Hg	Nutrients Nitrites, Nitrate Ammonia	Reactive Phosphorus	Total PSN, TKN	Sodium Adsorption Ratio		Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
	330-01-BH 2102	24/10/18 12:00	W	N, SP	4	✓	✓	✓	✓	✓	✓	✓		
	330-01-BH 2303	25/10/18 7:30	W	N, SP	4	✓	✓	✓	✓	✓	✓	✓		
	330-01-BH 2207	25/10/18 9:45	W	N, SP	4	✓	✓	✓	✓	✓	✓	✓		
				TOTAL	12									

URGENT

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass;
Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag; LI = Lugols Iodine Preserved Bottles; STT = Sterile Sodium Thiosulfate Preserved Bottles.

CHAIN OF CUSTODY

ALS Laboratory: please tick →

ADELAIDE 3/1 Burma Road Pooraka SA 5095 Ph: 08 8162 5130 E: adelaide@alsglobal.com

BRISBANE 2 Byth Street Stafford QLD 4053 Ph: 07 3243 7222 E: samples.brisbane@alsglobal.com

GLADSTONE 46 Callemondah Drive Gladstone QLD 4680 Ph: 07 4978 7944 E: gladstone@alsglobal.com

MACKAY 78 Harbour Road Mackay QLD 4740 Ph: 07 4944 0177 E: mackay@alsglobal.com

MELBOURNE 2-4 Westall Road Springvale VIC 3171 Ph: 03 8549 9600 E: samples.melbourne@alsglobal.com

MUDGEE 1/29 Sydney Road Mudgee NSW 2850 Ph: 02 6372 6735 E: mudgee.mail@alsglobal.com

NEWCASTLE 5/585 Maitland Road Mayfield West NSW 2304 Ph: 02 4014 2500 E: samples.newcastle@alsglobal.com

NOWRA 4/13 Geary Place North Nowra NSW 2541 Ph: 02 4423 2063 E: nowra@alsglobal.com

PERTH 10 Hod Way Malaga WA 6090 Ph: 08 9209 7655 E: samples.perth@alsglobal.com

SYDNEY 277-289 Woodpark Road Smithfield NSW 2164 Ph: 02 8784 8555 E: samples.sydney@alsglobal.com

TOWNSVILLE 14-15 Desma Court Bohle QLD 4818 Ph: 07 4796 0600 E: townsville.environmental@alsglobal.com

WOLLONGONG 1/19-21 Ralph Black Drive, Nth Wollongong NSW 2500 Ph: 02 4225 3125 E: wollongong@alsglobal.com

URGENT

CLIENT: GOLDER ASSOCIATES	TURNAROUND REQUIREMENTS: (Standard TAT may be longer for some tests e.g., Ultra Trace Organics)	☐ Standard TAT (List due date):	FOR LABORATORY USE ONLY (Circle)
OFFICE: GOLDEN - BRISBANE		☑ Non Standard or urgent TAT (List due date): 48 hours	Custody Seal Intact? Yes No N/A
PROJECT: INLAND RAIL (P13) PROJECT NO.: 18938082	ALS QUOTE NO.:	COC SEQUENCE NUMBER (Circle)	Free Ice / frozen ice bricks present upon receipt? Yes No N/A
ORDER NUMBER: PURCHASE ORDER NO.:	COUNTRY OF ORIGIN:	COC: 1 2 3 4 5 6 7	Random Sample Temperature on Receipt: °C
PROJECT MANAGER: MITCH MCGINNIS CONTACT PH:		OF: 1 2 3 4 5 6 7	Other comment:
SAMPLER: ROB CUPPER SAMPLER MOBILE: 0448611113			
COC Emailed to ALS? (YES / NO) EDD FORMAT (or default):	RELINQUISHED BY:	RECEIVED BY: CHRIS PERRY	RELINQUISHED BY:
Email Reports to (will default to PM if no other addresses are listed): skunmarapeli@golder.com.au	DATE/TIME:	DATE/TIME: 26/10/18 1625	DATE/TIME:
Email Invoice to (will default to PM if no other addresses are listed):			RECEIVED BY: DATE/TIME:

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:

ALS USE ONLY	SAMPLE DETAILS MATRIX: Solid(S) Water(W)			CONTAINER INFORMATION		ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price)								Additional Information
						Where Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required).								
LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE (refer to codes below)	TOTAL BOTTLES	Anions / Cations Ca, Mg, Na, K, Cl, F, SO4, Alkalinity, Hardness	EC, pH, TDS	Total / Dissolved As, B, Ba, Be, Co	Cr, Cu, Mn, Fe, Ni	Pb, Se, V, Zn, Hg	Nutrients Nitrate, Nitrite, Ammonia	Reactive Phosphorus Total P, TKN	Sodium Adsorption Ratio	Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
1	330-01-BH22	26/10/18 10.00 am	W	NV, SP	4	✓	✓	✓	✓	✓	✓	✓	✓	
				TOTAL	4									

Environmental Division
Brisbane
Work Order Reference
EB1825981

Telephone : +61-7-3243 7222

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass;
Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag; LI = Lugols Iodine Preserved Bottles; STT = Sterile Sodium Thiosulfate Preserved Bottles.

CHAIN OF CUSTODY

ALS Laboratory: please tick →

ADELAIDE 3/1 Burma Road Pooraka SA 5095 Ph: 08 8162 5130 E: adelaide@alsglobal.com
BRISBANE 2 Byth Street Stafford QLD 4053 Ph: 07 3243 7222 E: samples.brisbane@alsglobal.com
GLADSTONE 48 Callemondah Drive Gladstone QLD 4680 Ph: 07 4978 7944 E: gladstone@alsglobal.com
MACKAY 78 Harbour Road Mackay QLD 4740 Ph: 07 4944 0177 E: mackay@alsglobal.com
MELBOURNE 2-4 Westall Road Springvale VIC 3171 Ph: 03 8549 9600 E: samples.melbourne@alsglobal.com
MUDGEE 1/29 Sydney Road Mudgee NSW 2850 Ph: 02 6372 6735 E: mudgee.mail@alsglobal.com
NEWCASTLE 5/585 Maitland Road Mayfield West NSW 2304 Ph: 02 4014 2500 E: samples.newcastle@alsglobal.com
NOWRA 4/13 Geary Place North Nowra NSW 2541 Ph: 02 4423 2063 E: nowra@alsglobal.com
PERTH 10 Hod Way Malaga WA 6090 Ph: 08 9209 7655 E: samples.perth@alsglobal.com
SYDNEY 277-289 Woodpark Road Smithfield NSW 2164 Ph: 02 8784 8555 E: samples.sydney@alsglobal.com
TOWNSVILLE 14-15 Desma Court Bohle QLD 4818 Ph: 07 4796 0600 E: townsville.environmental@alsglobal.com
WOLLONGONG 1/19-21 Ralph Black Drive, Nth Wollongong NSW 2500 Ph: 02 4225 3125 E: wollongong@alsglobal.com

CLIENT: GOLDER ASSOCIATES	TURNAROUND REQUIREMENTS: (Standard TAT may be longer for some tests e.g. Ultra Trace Organics)	☐ Standard TAT (List due date):	FOR LABORATORY USE ONLY (Circle)
OFFICE: GOLDER - BRISBANE		☑ Non Standard or urgent TAT (List due date): 48 hrs	Custody Seal Intact? Yes No N/A
PROJECT: INLAND RAIL (P13) PROJECT NO.: 1893862	ALS QUOTE NO.:	COC SEQUENCE NUMBER (Circle)	Free ice / frozen ice bricks present upon receipt? Yes No N/A
ORDER NUMBER: PURCHASE ORDER NO.:	COUNTRY OF ORIGIN:	COC: 1 2 3 4 5 6 7	Random Sample Temperature on Receipt °C
PROJECT MANAGER: Mitch McGinnis CONTACT PH:		OF: 1 2 3 4 5 6 7	Other comment:
SAMPLER: SUSANTHA KUMARAPELI SAMPLER MOBILE: 0410023462	RELINQUISHED BY: C. VINCENT	RECEIVED BY: KYLIE	RELINQUISHED BY:
COC Emailed to ALS? (YES / NO) EDD FORMAT (or default):	DATE/TIME: 22/11/18	DATE/TIME: 22/11/18 8:35	DATE/TIME:
Email Reports to (will default to PM if no other addresses are listed): skumarapeli@golder.com.au			RECEIVED BY:
Email Invoice to (will default to PM if no other addresses are listed):			DATE/TIME:

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:

ALS USE ONLY	SAMPLE DETAILS MATRIX: Solid(S) Water(W)			CONTAINER INFORMATION		ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) When Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required).						Additional Information
LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE (refer to codes below)	TOTAL BOTTLES	Anions/cations Ca, Mg, Na, K Cl, F, SO4, Alkalinity, Hardness	EC, pH, TDS	Total Dissolved As, B, Ba, Be, Cd, Cr, Co, Cu, Mn, Fe, Ni, Pb, Se, V, Zn, Hg	Nutrients Nitrate, Nitrite, Ammonia	Reactive Phosphorus	Total P&N, TKN	Sodium Adsorption Ratio	
1	330-01-BH2103	20/11/18	W	N, SP	4	✓	✓	✓	✓	✓	✓	✓	
				TOTAL	4								

Environmental Division
Brisbane
Work Order Reference
EB1828572

Telephone : +61-7-3243 7222

URGENT

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass;
Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag; LI = Lugols Iodine Preserved Bottles; STT = Sterile Sodium Thiosulfate Preserved Bottles.

CHAIN OF CUSTODY

ALS Laboratory: please tick →

ADELAIDE 3/1 Burma Road Pooraka SA 5095 Ph: 08 8162 5130 E: adelaide@alsglobal.com

BRISBANE 2 Byth Street Stafford QLD 4053 Ph: 07 3243 7222 E: samples.brisbane@alsglobal.com

GLADSTONE 46 Callemondah Drive Gladstone QLD 4680 Ph: 07 4978 7944 E: gladstone@alsglobal.com

MACKAY 78 Harbour Road Mackay QLD 4740 Ph: 07 4944 0177 E: mackay@alsglobal.com

MELBOURNE 2-4 Westall Road Springvale VIC 3171 Ph: 03 8549 9600 E: samples.melbourne@alsglobal.com

MUDGEE 1/29 Sydney Road Mudgee NSW 2850 Ph: 02 6372 6735 E: mudgee.mail@alsglobal.com

NEWCASTLE 5/585 Maitland Road Mayfield West NSW 2304 Ph: 02 4014 2500 E: samples.newcastle@alsglobal.com

NOWRA 4/13 Geary Place North Nowra NSW 2541 Ph: 02 4423 2063 E: nowra@alsglobal.com

PERTH 10 Hod Way Malaga WA 6090 Ph: 08 9209 7655 E: samples.perth@alsglobal.com

SYDNEY 277-289 Woodpark Road Smithfield NSW 2164 Ph: 02

TOV Ph: 07

WO Ph: 02

Environmental Division Brisbane

Work Order Reference

EB1830098

Telephone : + 61-7-3243 7222

CLIENT: GOLDER ASSOCIATES PTY LTD.	TURNAROUND REQUIREMENTS : (Standard TAT may be longer for some tests e.g., Ultra Trace Organics)	☑ Standard TAT (List due date): 48 hrs	FOR LABOR
OFFICE: GOLDER - BRISBANE		☐ Non Standard or urgent TAT (List due date):	Custody Seal I
PROJECT: INLAND RAIL (P13) PROJECT NO.: 1893802	ALS QUOTE NO.:	COC SEQUENCE NUMBER (Circle)	Free Ice / froze receipt?
ORDER NUMBER: PURCHASE ORDER NO.:	COUNTRY OF ORIGIN:	COC: 1 2 3 4 5 6 7	Random Samp
PROJECT MANAGER: MITCH McGINNIS . CONTACT PH:		OF: 1 2 3 4 5 6 7	Other comme
SAMPLER: HANNAH GROVES SAMPLER MOBILE: 0405 046 250	RELINQUISHED BY: H. GROVES	RECEIVED BY: DANE K	RELINQUISHED I
COC Emailed to ALS? (YES / NO) EDD FORMAT (or default):	DATE/TIME: 7/12/18	DATE/TIME: 7/12/18 1400	DATE/TIME:
Email Reports to (will default to PM if no other addresses are listed): SKUMARAPELI@GOLDER.COM.AU			
Email Invoice to (will default to PM if no other addresses are listed):			

COMMENTS/SPECIAL HANDLING/STORAGE OR DISPOSAL:

ALS USE ONLY	SAMPLE DETAILS MATRIX: Solid(S) Water(W)			CONTAINER INFORMATION		ANALYSIS REQUIRED including SUITES (NB. Suite Codes must be listed to attract suite price) When Metals are required, specify Total (unfiltered bottle required) or Dissolved (field filtered bottle required).								Additional Information
LAB ID	SAMPLE ID	DATE / TIME	MATRIX	TYPE & PRESERVATIVE (refer to codes below)	TOTAL BOTTLES	ANIONS/CATIONS Ca, Mg, Na, Cl, F, SO4, Alkalinity, Hardness	EC, pH, TDS	TOTAL DISSOLVED As, B, Ba, Be, Cd, Cr, Co, Cu, Mn, Fe,	Ni, Pb, Se, V, Zn, Hg	Nitrates Nitrate, Nitrite Ammonia	Reactive Phosphorus TOTAL P/N, TKN	SODIUM ADSORPTION RATIO		Comments on likely contaminant levels, dilutions, or samples requiring specific QC analysis etc.
	330-01-BH21d	7/12/18	W	N, SP	4	✓	✓	✓	✓	✓	✓	✓		
				TOTAL	4									

Water Container Codes: P = Unpreserved Plastic; N = Nitric Preserved Plastic; ORC = Nitric Preserved ORC; SH = Sodium Hydroxide/Cd Preserved; S = Sodium Hydroxide Preserved Plastic; AG = Amber Glass Unpreserved; AP - Airfreight Unpreserved Plastic
V = VOA Vial HCl Preserved; VB = VOA Vial Sodium Bisulphate Preserved; VS = VOA Vial Sulfuric Preserved; AV = Airfreight Unpreserved Vial SG = Sulfuric Preserved Amber Glass; H = HCl preserved Plastic; HS = HCl preserved Speciation bottle; SP = Sulfuric Preserved Plastic; F = Formaldehyde Preserved Glass;
Z = Zinc Acetate Preserved Bottle; E = EDTA Preserved Bottles; ST = Sterile Bottle; ASS = Plastic Bag for Acid Sulphate Soils; B = Unpreserved Bag; LI = Lugols Iodine Preserved Bottles; STT = Sterile Sodium Thiosulfate Preserved Bottles.

0 0.00 True

CERTIFICATE OF ANALYSIS

Work Order	: **EB1825628**	Page	: 1 of 5
Client	: **GOLDER ASSOCIATES**	Laboratory	: Environmental Division Brisbane
Contact	: MR MITCH McGINNIS	Contact	: Andrew Epps
Address	: 32 SHAND STREET BRISBANE QLD, AUSTRALIA 4053	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: +61 07 3721 5400	Telephone	: +61 7 3552 8639
Project	: 1893802 Inland Rail (P13)	Date Samples Received	: 24-Oct-2018 09:17
Order number	:	Date Analysis Commenced	: 24-Oct-2018
C-O-C number	: ----	Issue Date	: 26-Oct-2018 15:59
Sampler	: ROBERT CUPPER		
Site	: ----		
Quote number	: EN/002/18 National BQ		
No. of samples received	: 4		
No. of samples analysed	: 4		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	330-01-BH2212	330-01-BH2216	GW 789	330-01-BH22104	----
			Client sampling date / time	22-Oct-2018 15:20	23-Oct-2018 13:40	23-Oct-2018 13:50	23-Oct-2018 16:00	----
Compound	CAS Number	LOR	Unit	EB1825628-001	EB1825628-002	EB1825628-003	EB1825628-004	--------
				Result	Result	Result	Result	----
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**8.16**	**10.5**	**10.6**	**8.33**	----
EA006: Sodium Adsorption Ratio (SAR)								
^ Sodium Adsorption Ratio	----	0.01	-	**29.5**	**17.6**	**17.5**	**21.7**	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**5500**	**2530**	**2390**	**4260**	----
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	**2940**	**1180**	**1210**	**2390**	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	**24**	**24**	<1	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	**194**	**166**	**7**	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**601**	<1	<1	**549**	----
Total Alkalinity as CaCO3	----	1	mg/L	**601**	**218**	**190**	**556**	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	**77**	**41**	**39**	**98**	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	**1340**	**646**	**614**	**980**	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**38**	**25**	**26**	**48**	----
Magnesium	7439-95-4	1	mg/L	**42**	**15**	**15**	**36**	----
Sodium	7440-23-5	1	mg/L	**1110**	**451**	**453**	**817**	----
Potassium	7440-09-7	1	mg/L	**7**	**12**	**12**	**8**	----
ED093F: SAR and Hardness Calculations								
Total Hardness as CaCO3	----	1	mg/L	**268**	**124**	**127**	**268**	----
EG020F: Dissolved Metals by ICP-MS								
Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	<0.001	**0.008**	----
Boron	7440-42-8	0.05	mg/L	**0.06**	**0.06**	**0.06**	**0.10**	----
Barium	7440-39-3	0.001	mg/L	**0.096**	**0.279**	**0.283**	**0.199**	----
Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	<0.001	<0.001	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	----
Cobalt	7440-48-4	0.001	mg/L	**0.001**	<0.001	<0.001	**0.005**	----
Chromium	7440-47-3	0.001	mg/L	<0.001	**0.004**	**0.004**	<0.001	----
Copper	7440-50-8	0.001	mg/L	<0.001	**0.002**	**0.002**	**0.001**	----
Manganese	7439-96-5	0.001	mg/L	**0.096**	<0.001	<0.001	**0.072**	----
Nickel	7440-02-0	0.001	mg/L	**0.003**	**0.001**	<0.001	**0.008**	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	330-01-BH2212	330-01-BH2216	GW 789	330-01-BH22104	----
				Client sampling date / time	22-Oct-2018 15:20	23-Oct-2018 13:40	23-Oct-2018 13:50	23-Oct-2018 16:00	----
Compound	CAS Number	LOR	Unit		EB1825628-001	EB1825628-002	EB1825628-003	EB1825628-004	--------
					Result	Result	Result	Result	----
EG020F: Dissolved Metals by ICP-MS - Continued									
Lead	7439-92-1	0.001	mg/L		<0.001	<0.001	<0.001	<0.001	----
Selenium	7782-49-2	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	----
Vanadium	7440-62-2	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	----
Zinc	7440-66-6	0.005	mg/L		<0.005	<0.005	<0.005	**0.007**	----
Iron	7439-89-6	0.05	mg/L		<0.05	<0.05	<0.05	<0.05	----
EG020T: Total Metals by ICP-MS									
Arsenic	7440-38-2	0.001	mg/L		<0.001	**0.001**	<0.001	**0.015**	----
Boron	7440-42-8	0.05	mg/L		**0.06**	**0.08**	**0.08**	**0.12**	----
Barium	7440-39-3	0.001	mg/L		**0.125**	**0.440**	**0.504**	**0.379**	----
Beryllium	7440-41-7	0.001	mg/L		<0.001	<0.001	<0.001	**0.002**	----
Cadmium	7440-43-9	0.0001	mg/L		<0.0001	<0.0001	<0.0001	**0.0003**	----
Cobalt	7440-48-4	0.001	mg/L		**0.002**	**0.002**	**0.001**	**0.026**	----
Chromium	7440-47-3	0.001	mg/L		**0.003**	**0.005**	**0.005**	**0.012**	----
Copper	7440-50-8	0.001	mg/L		**0.002**	**0.004**	**0.004**	**0.045**	----
Manganese	7439-96-5	0.001	mg/L		**0.154**	**0.157**	**0.107**	**0.333**	----
Nickel	7440-02-0	0.001	mg/L		**0.006**	**0.002**	**0.002**	**0.027**	----
Lead	7439-92-1	0.001	mg/L		**0.002**	<0.001	<0.001	**0.039**	----
Selenium	7782-49-2	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	----
Vanadium	7440-62-2	0.01	mg/L		**0.01**	<0.01	<0.01	**0.03**	----
Zinc	7440-66-6	0.005	mg/L		<0.005	<0.005	<0.005	**0.145**	----
Iron	7439-89-6	0.05	mg/L		**1.55**	**0.87**	**0.48**	**25.6**	----
EG035F: Dissolved Mercury by FIMS									
Mercury	7439-97-6	0.0001	mg/L		<0.0001	<0.0001	<0.0001	<0.0001	----
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.0001	mg/L		<0.0001	<0.0001	<0.0001	<0.0001	----
EK040P: Fluoride by PC Titrator									
Fluoride	16984-48-8	0.1	mg/L		**0.5**	**0.7**	**0.7**	**0.7**	----
EK055G: Ammonia as N by Discrete Analyser									
Ammonia as N	7664-41-7	0.01	mg/L		**0.11**	**0.16**	**0.15**	**0.66**	----
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N	14797-65-0	0.01	mg/L		<0.01	**0.01**	**0.01**	**0.01**	----
EK058G: Nitrate as N by Discrete Analyser									
Nitrate as N	14797-55-8	0.01	mg/L		**0.48**	**0.26**	**0.27**	**0.01**	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	330-01-BH2212	330-01-BH2216	GW 789	330-01-BH22104	----
				Client sampling date / time	22-Oct-2018 15:20	23-Oct-2018 13:40	23-Oct-2018 13:50	23-Oct-2018 16:00	----
Compound	CAS Number	LOR	Unit		EB1825628-001	EB1825628-002	EB1825628-003	EB1825628-004	--------
					Result	Result	Result	Result	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser - Continued									
Nitrite + Nitrate as N	----	0.01	mg/L		**0.48**	**0.27**	**0.28**	**0.02**	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		**0.6**	**0.8**	**0.8**	**1.5**	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ Total Nitrogen as N	----	0.1	mg/L		**1.1**	**1.1**	**1.1**	**1.5**	----
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		**0.08**	**0.04**	**0.03**	**0.12**	----
EK071G: Reactive Phosphorus as P by discrete analyser									
Reactive Phosphorus as P	14265-44-2	0.01	mg/L		<0.01	<0.01	<0.01	<0.01	----
EN055: Ionic Balance									
Total Anions	----	0.01	meq/L		**51.4**	**23.4**	**21.9**	**40.8**	----
Total Cations	----	0.01	meq/L		**53.8**	**22.4**	**22.5**	**41.1**	----
Ionic Balance	----	0.01	%		**2.28**	**2.24**	**1.38**	**0.37**	----

0 0.00 True

CERTIFICATE OF ANALYSIS

Work Order	: **EB1825910**	Page	: 1 of 5
Client	: **GOLDER ASSOCIATES**	Laboratory	: Environmental Division Brisbane
Contact	: MR MITCH McGINNIS	Contact	: Andrew Epps
Address	: P O BOX 1734 MILTON QLD, AUSTRALIA 4064	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: +61 07 3721 5400	Telephone	: +61 7 3552 8639
Project	: 1893802	Date Samples Received	: 26-Oct-2018 09:05
Order number	: 1893802	Date Analysis Commenced	: 26-Oct-2018
C-O-C number	: ----	Issue Date	: 31-Oct-2018 08:13
Sampler	: ROBERT CUPPER		
Site	: ----		
Quote number	: EN/002/18 National BQ		
No. of samples received	: 3		
No. of samples analysed	: 3		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- It is recognised that EG020-T (Total Metals by ICP-MS) is less than EG020-F (Dissolved Metals by ICP-MS) for some samples. However, the difference is within experimental variation of the methods.
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	330-01-BH2102	330-01-BH2303	330-01-BH2207	----	----
			Client sampling date / time	24-Oct-2018 12:00	25-Oct-2018 07:30	25-Oct-2018 09:45	----	----
Compound	CAS Number	LOR	Unit	EB1825910-001	EB1825910-002	EB1825910-003	--------	--------
				Result	Result	Result	----	----
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**7.95**	**7.22**	**8.53**	----	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**4260**	**1720**	**1730**	----	----
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	**2340**	**999**	**955**	----	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	<1	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	**12**	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**457**	**385**	**116**	----	----
Total Alkalinity as CaCO3	----	1	mg/L	**457**	**385**	**128**	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	**97**	**20**	**50**	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	**1000**	**322**	**438**	----	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**40**	**118**	**33**	----	----
Magnesium	7439-95-4	1	mg/L	**24**	**60**	**33**	----	----
Sodium	7440-23-5	1	mg/L	**833**	**138**	**246**	----	----
Potassium	7440-09-7	1	mg/L	**8**	**10**	**28**	----	----
ED093F: SAR and Hardness Calculations								
Total Hardness as CaCO3	----	1	mg/L	**199**	**542**	**218**	----	----
^ Sodium Adsorption Ratio	----	0.01	-	**25.7**	**2.58**	**7.24**	----	----
EG020F: Dissolved Metals by ICP-MS								
Arsenic	7440-38-2	0.001	mg/L	**0.008**	**0.005**	**0.002**	----	----
Boron	7440-42-8	0.05	mg/L	**0.18**	**0.07**	**0.28**	----	----
Barium	7440-39-3	0.001	mg/L	**0.214**	**0.500**	**0.098**	----	----
Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	<0.001	----	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	<0.0001	----	----
Cobalt	7440-48-4	0.001	mg/L	<0.001	**0.022**	**0.003**	----	----
Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	**0.010**	----	----
Copper	7440-50-8	0.001	mg/L	<0.001	**0.001**	**0.008**	----	----
Manganese	7439-96-5	0.001	mg/L	**0.086**	**0.790**	**0.461**	----	----
Nickel	7440-02-0	0.001	mg/L	**0.001**	**0.022**	**0.013**	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	**0.004**	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	330-01-BH2102	330-01-BH2303	330-01-BH2207	----	----
				Client sampling date / time	24-Oct-2018 12:00	25-Oct-2018 07:30	25-Oct-2018 09:45	----	----
Compound	CAS Number	LOR	Unit		EB1825910-001	EB1825910-002	EB1825910-003	--------	--------
					Result	Result	Result	----	----
EG020F: Dissolved Metals by ICP-MS - Continued									
Selenium	7782-49-2	0.01	mg/L		<0.01	<0.01	<0.01	----	----
Vanadium	7440-62-2	0.01	mg/L		<0.01	<0.01	<0.01	----	----
Zinc	7440-66-6	0.005	mg/L		**0.006**	**0.014**	**0.008**	----	----
Iron	7439-89-6	0.05	mg/L		<0.05	**0.15**	**0.10**	----	----
EG020T: Total Metals by ICP-MS									
Arsenic	7440-38-2	0.001	mg/L		**0.011**	**0.005**	**0.002**	----	----
Boron	7440-42-8	0.05	mg/L		**0.18**	**0.05**	**0.26**	----	----
Barium	7440-39-3	0.001	mg/L		**0.275**	**0.468**	**0.136**	----	----
Beryllium	7440-41-7	0.001	mg/L		<0.001	<0.001	<0.001	----	----
Cadmium	7440-43-9	0.0001	mg/L		<0.0001	<0.0001	<0.0001	----	----
Cobalt	7440-48-4	0.001	mg/L		**0.008**	**0.021**	**0.004**	----	----
Chromium	7440-47-3	0.001	mg/L		**0.008**	<0.001	**0.021**	----	----
Copper	7440-50-8	0.001	mg/L		**0.015**	<0.001	**0.013**	----	----
Manganese	7439-96-5	0.001	mg/L		**0.296**	**0.693**	**0.482**	----	----
Nickel	7440-02-0	0.001	mg/L		**0.010**	**0.037**	**0.020**	----	----
Lead	7439-92-1	0.001	mg/L		**0.013**	<0.001	**0.026**	----	----
Selenium	7782-49-2	0.01	mg/L		<0.01	<0.01	<0.01	----	----
Vanadium	7440-62-2	0.01	mg/L		**0.02**	<0.01	<0.01	----	----
Zinc	7440-66-6	0.005	mg/L		**0.046**	**0.014**	**0.046**	----	----
Iron	7439-89-6	0.05	mg/L		**13.0**	**1.66**	**2.93**	----	----
EG035F: Dissolved Mercury by FIMS									
Mercury	7439-97-6	0.0001	mg/L		<0.0001	<0.0001	<0.0001	----	----
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.0001	mg/L		<0.0001	<0.0001	<0.0001	----	----
EK040P: Fluoride by PC Titrator									
Fluoride	16984-48-8	0.1	mg/L		**0.4**	**0.2**	**0.6**	----	----
EK055G: Ammonia as N by Discrete Analyser									
Ammonia as N	7664-41-7	0.01	mg/L		**0.89**	**0.15**	**0.25**	----	----
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N	14797-65-0	0.01	mg/L		<0.01	<0.01	**0.20**	----	----
EK058G: Nitrate as N by Discrete Analyser									
Nitrate as N	14797-55-8	0.01	mg/L		<0.01	<0.01	**0.22**	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N	----	0.01	mg/L		<0.01	<0.01	**0.42**	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	330-01-BH2102	330-01-BH2303	330-01-BH2207	----	----
				Client sampling date / time	24-Oct-2018 12:00	25-Oct-2018 07:30	25-Oct-2018 09:45	----	----
Compound	CAS Number	LOR	Unit		EB1825910-001	EB1825910-002	EB1825910-003	--------	--------
					Result	Result	Result	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		**2.3**	**0.4**	**1.4**	**----**	**----**
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ Total Nitrogen as N	----	0.1	mg/L		**2.3**	**0.4**	**1.8**	**----**	**----**
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		**0.22**	**0.04**	**0.09**	**----**	**----**
EK071G: Reactive Phosphorus as P by discrete analyser									
Reactive Phosphorus as P	14265-44-2	0.01	mg/L		<0.01	<0.01	<0.01	**----**	**----**
EN055: Ionic Balance									
Total Anions	----	0.01	meq/L		**39.4**	**17.2**	**16.0**	**----**	**----**
Total Cations	----	0.01	meq/L		**40.4**	**17.1**	**15.8**	**----**	**----**
Ionic Balance	----	0.01	%		**1.32**	**0.31**	**0.55**	**----**	**----**

0 0.00 True

CERTIFICATE OF ANALYSIS

Work Order	: **EB1825981**	Page	: 1 of 5
Client	: **GOLDER ASSOCIATES**	Laboratory	: Environmental Division Brisbane
Contact	: MR SUSANTHA KUMARAPELI	Contact	: Andrew Epps
Address	: P O BOX 1734 MILTON QLD, AUSTRALIA 4064	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: +61 07 3721 5400	Telephone	: +61 7 3552 8639
Project	: 1893802 Inland Rail (P13)	Date Samples Received	: 26-Oct-2018 16:25
Order number	: 1893802	Date Analysis Commenced	: 27-Oct-2018
C-O-C number	: ----	Issue Date	: 31-Oct-2018 09:13
Sampler	: ROB CUPPER		
Site	: ----		
Quote number	: EN/002/18 National BQ		
No. of samples received	: 1		
No. of samples analysed	: 1		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	330-01-BH2224	----	----	----	----
			Client sampling date / time	26-Oct-2018 10:00	----	----	----	----
Compound	CAS Number	LOR	Unit	EB1825981-001	--------	--------	--------	--------
				Result	----	----	----	----
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**9.66**	----	----	----	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**459**	----	----	----	----
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	**258**	----	----	----	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	----	----	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	**28**	----	----	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**31**	----	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L	**59**	----	----	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	**46**	----	----	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	**73**	----	----	----	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**11**	----	----	----	----
Magnesium	7439-95-4	1	mg/L	**2**	----	----	----	----
Sodium	7440-23-5	1	mg/L	**68**	----	----	----	----
Potassium	7440-09-7	1	mg/L	**16**	----	----	----	----
ED093F: SAR and Hardness Calculations								
Total Hardness as CaCO3	----	1	mg/L	**36**	----	----	----	----
^ **Sodium Adsorption Ratio**	----	0.01	-	**4.95**	----	----	----	----
EG020F: Dissolved Metals by ICP-MS								
Arsenic	7440-38-2	0.001	mg/L	**0.001**	----	----	----	----
Beryllium	7440-41-7	0.001	mg/L	<0.001	----	----	----	----
Barium	7440-39-3	0.001	mg/L	**0.029**	----	----	----	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	----	----	----	----
Chromium	7440-47-3	0.001	mg/L	**0.008**	----	----	----	----
Cobalt	7440-48-4	0.001	mg/L	<0.001	----	----	----	----
Copper	7440-50-8	0.001	mg/L	**0.003**	----	----	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	----	----	----	----
Manganese	7439-96-5	0.001	mg/L	**0.006**	----	----	----	----
Nickel	7440-02-0	0.001	mg/L	**0.002**	----	----	----	----
Selenium	7782-49-2	0.01	mg/L	<0.01	----	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	330-01-BH2224	----	----	----	----
				Client sampling date / time	26-Oct-2018 10:00	----	----	----	----
Compound	CAS Number	LOR	Unit		EB1825981-001	--------	--------	--------	--------
					Result	----	----	----	----
EG020F: Dissolved Metals by ICP-MS - Continued									
Vanadium	7440-62-2	0.01	mg/L		<0.01	----	----	----	----
Zinc	7440-66-6	0.005	mg/L		<0.005	----	----	----	----
Boron	7440-42-8	0.05	mg/L		**0.06**	----	----	----	----
Iron	7439-89-6	0.05	mg/L		<0.05	----	----	----	----
EG020T: Total Metals by ICP-MS									
Arsenic	7440-38-2	0.001	mg/L		**0.002**	----	----	----	----
Beryllium	7440-41-7	0.001	mg/L		<0.001	----	----	----	----
Barium	7440-39-3	0.001	mg/L		**0.047**	----	----	----	----
Cadmium	7440-43-9	0.0001	mg/L		<0.0001	----	----	----	----
Chromium	7440-47-3	0.001	mg/L		**0.010**	----	----	----	----
Cobalt	7440-48-4	0.001	mg/L		**0.001**	----	----	----	----
Copper	7440-50-8	0.001	mg/L		**0.003**	----	----	----	----
Lead	7439-92-1	0.001	mg/L		**0.003**	----	----	----	----
Manganese	7439-96-5	0.001	mg/L		**0.047**	----	----	----	----
Nickel	7440-02-0	0.001	mg/L		**0.003**	----	----	----	----
Selenium	7782-49-2	0.01	mg/L		<0.01	----	----	----	----
Vanadium	7440-62-2	0.01	mg/L		<0.01	----	----	----	----
Zinc	7440-66-6	0.005	mg/L		**0.012**	----	----	----	----
Boron	7440-42-8	0.05	mg/L		**0.07**	----	----	----	----
Iron	7439-89-6	0.05	mg/L		**0.96**	----	----	----	----
EG035F: Dissolved Mercury by FIMS									
Mercury	7439-97-6	0.0001	mg/L		<0.0001	----	----	----	----
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.0001	mg/L		<0.0001	----	----	----	----
EK040P: Fluoride by PC Titrator									
Fluoride	16984-48-8	0.1	mg/L		**0.8**	----	----	----	----
EK055G: Ammonia as N by Discrete Analyser									
Ammonia as N	7664-41-7	0.01	mg/L		**0.18**	----	----	----	----
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N	14797-65-0	0.01	mg/L		<0.01	----	----	----	----
EK058G: Nitrate as N by Discrete Analyser									
Nitrate as N	14797-55-8	0.01	mg/L		**0.14**	----	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N	----	0.01	mg/L		**0.14**	----	----	----	----

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)				Client sample ID	**330-01-BH2224**	----	----	----	----
				Client sampling date / time	26-Oct-2018 10:00	----	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*		**EB1825981-001**	--------	--------	--------	--------
					Result	----	----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		**0.9**	----	----	----	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ **Total Nitrogen as N**	----	0.1	mg/L		**1.0**	----	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		**0.02**	----	----	----	----
EK071G: Reactive Phosphorus as P by discrete analyser									
Reactive Phosphorus as P	14265-44-2	0.01	mg/L		<0.01	----	----	----	----
EN055: Ionic Balance									
Total Anions	----	0.01	meq/L		**4.20**	----	----	----	----
Total Cations	----	0.01	meq/L		**4.08**	----	----	----	----
Ionic Balance	----	0.01	%		**1.39**	----	----	----	----

0 0.00 True

ALS Environmental

CERTIFICATE OF ANALYSIS

Work Order	: **EB1828572**	Page	: 1 of 5
Client	: **GOLDER ASSOCIATES**	Laboratory	: Environmental Division Brisbane
Contact	: MR SUSANTHA KUMARAPELI	Contact	: Andrew Epps
Address	: P O BOX 1734 MILTON QLD, AUSTRALIA 4064	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: +61 07 3721 5400	Telephone	: +61 7 3552 8639
Project	: 1893802 INLAND RAIL (P13)	Date Samples Received	: 22-Nov-2018 08:35
Order number	:	Date Analysis Commenced	: 22-Nov-2018
C-O-C number	: ----	Issue Date	: 26-Nov-2018 14:42
Sampler	: SUSANTHA KUMARAPELI		
Site	: ----		
Quote number	: EN/002/18 National BQ		
No. of samples received	: 1		
No. of samples analysed	: 1		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- It is recognised that EG020-T (Total Metals by ICP-MS) is less than EG020-F (Dissolved Metals by ICP-MS) for sample EB1828572-001(330-01-BH2103). However, the difference is within experimental variation of the methods.
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	330-01-BH2103	----	----	----	----
			Client sampling date / time	20-Nov-2018 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit	EB1828572-001	--------	--------	--------	--------
				Result	----	----	----	----
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**8.18**	----	----	----	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**3810**	----	----	----	----
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	**2170**	----	----	----	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	----	----	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	----	----	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**875**	----	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L	**875**	----	----	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	**169**	----	----	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	**709**	----	----	----	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**50**	----	----	----	----
Magnesium	7439-95-4	1	mg/L	**51**	----	----	----	----
Sodium	7440-23-5	1	mg/L	**662**	----	----	----	----
Potassium	7440-09-7	1	mg/L	**8**	----	----	----	----
ED093F: SAR and Hardness Calculations								
Total Hardness as CaCO3	----	1	mg/L	**335**	----	----	----	----
^ **Sodium Adsorption Ratio**	----	0.01	-	**15.7**	----	----	----	----
EG020F: Dissolved Metals by ICP-MS								
Arsenic	7440-38-2	0.001	mg/L	**0.002**	----	----	----	----
Boron	7440-42-8	0.05	mg/L	**0.12**	----	----	----	----
Barium	7440-39-3	0.001	mg/L	**0.080**	----	----	----	----
Beryllium	7440-41-7	0.001	mg/L	<0.001	----	----	----	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	----	----	----	----
Cobalt	7440-48-4	0.001	mg/L	**0.002**	----	----	----	----
Chromium	7440-47-3	0.001	mg/L	<0.001	----	----	----	----
Copper	7440-50-8	0.001	mg/L	**0.003**	----	----	----	----
Manganese	7439-96-5	0.001	mg/L	**0.082**	----	----	----	----
Nickel	7440-02-0	0.001	mg/L	**0.003**	----	----	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	----	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	330-01-BH2103	----	----	----	----
				Client sampling date / time	20-Nov-2018 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit		EB1828572-001	--------	--------	--------	--------
					Result	----	----	----	----
EG020F: Dissolved Metals by ICP-MS - Continued									
Selenium	7782-49-2	0.01	mg/L		<0.01	----	----	----	----
Vanadium	7440-62-2	0.01	mg/L		<0.01	----	----	----	----
Zinc	7440-66-6	0.005	mg/L		**0.040**	----	----	----	----
EG020T: Total Metals by ICP-MS									
Arsenic	7440-38-2	0.001	mg/L		**0.003**	----	----	----	----
Boron	7440-42-8	0.05	mg/L		**0.12**	----	----	----	----
Barium	7440-39-3	0.001	mg/L		**0.105**	----	----	----	----
Beryllium	7440-41-7	0.001	mg/L		<0.001	----	----	----	----
Cadmium	7440-43-9	0.0001	mg/L		**0.0002**	----	----	----	----
Cobalt	7440-48-4	0.001	mg/L		**0.005**	----	----	----	----
Chromium	7440-47-3	0.001	mg/L		**0.003**	----	----	----	----
Copper	7440-50-8	0.001	mg/L		**0.016**	----	----	----	----
Manganese	7439-96-5	0.001	mg/L		**0.178**	----	----	----	----
Nickel	7440-02-0	0.001	mg/L		**0.006**	----	----	----	----
Lead	7439-92-1	0.001	mg/L		**0.007**	----	----	----	----
Selenium	7782-49-2	0.01	mg/L		<0.01	----	----	----	----
Vanadium	7440-62-2	0.01	mg/L		**0.01**	----	----	----	----
Zinc	7440-66-6	0.005	mg/L		**0.029**	----	----	----	----
EG035F: Dissolved Mercury by FIMS									
Mercury	7439-97-6	0.0001	mg/L		<0.0001	----	----	----	----
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.0001	mg/L		<0.0001	----	----	----	----
EK040P: Fluoride by PC Titrator									
Fluoride	16984-48-8	0.1	mg/L		**0.2**	----	----	----	----
EK055G: Ammonia as N by Discrete Analyser									
Ammonia as N	7664-41-7	0.01	mg/L		**0.23**	----	----	----	----
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N	14797-65-0	0.01	mg/L		<0.01	----	----	----	----
EK058G: Nitrate as N by Discrete Analyser									
Nitrate as N	14797-55-8	0.01	mg/L		**0.03**	----	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N	----	0.01	mg/L		**0.03**	----	----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		**12.0**	----	----	----	----

Analytical Results

Sub-Matrix: **WATER** (Matrix: **WATER**)				Client sample ID	**330-01-BH2103**	----	----	----	----
				Client sampling date / time	20-Nov-2018 00:00	----	----	----	----
Compound	*CAS Number*	*LOR*	*Unit*		**EB1828572-001**	--------	--------	--------	--------
					Result	----	----	----	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									
^ **Total Nitrogen as N**	----	0.1	mg/L		**12.0**	----	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		**0.12**	----	----	----	----
EK071G: Reactive Phosphorus as P by discrete analyser									
Reactive Phosphorus as P	14265-44-2	0.01	mg/L		<0.01	----	----	----	----
EN055: Ionic Balance									
Total Anions	----	0.01	meq/L		**41.0**	----	----	----	----
Total Cations	----	0.01	meq/L		**35.7**	----	----	----	----
Ionic Balance	----	0.01	%		**6.92**	----	----	----	----

0 0.00 True

CERTIFICATE OF ANALYSIS

Work Order	: **EB1830098**	Page	: 1 of 5
Client	: **GOLDER ASSOCIATES**	Laboratory	: Environmental Division Brisbane
Contact	: MR SUSANTHA KUMARAPELI	Contact	: Andrew Epps
Address	: P O BOX 1734 MILTON QLD, AUSTRALIA 4064	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: +61 07 3721 5400	Telephone	: +61 7 3552 8639
Project	: 1893802 INLAND RAIL (P13)	Date Samples Received	: 07-Dec-2018 19:20
Order number	:	Date Analysis Commenced	: 08-Dec-2018
C-O-C number	: ----	Issue Date	: 11-Dec-2018 16:35
Sampler	: HANNAH GROVES		
Site	: ----		
Quote number	: EN/002/18 National BQ		
No. of samples received	: 1		
No. of samples analysed	: 1		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Certificate of Analysis contains the following information:

- General Comments
- Analytical Results

Additional information pertinent to this report will be found in the following separate attachments: Quality Control Report, QA/QC Compliance Assessment to assist with Quality Review and Sample Receipt Notification.

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis.

Where the LOR of a reported result differs from standard LOR, this may be due to high moisture content, insufficient sample (reduced weight employed) or matrix interference.

When sampling time information is not provided by the client, sampling dates are shown without a time component. In these instances, the time component has been assumed by the laboratory for processing purposes.

Where a result is required to meet compliance limits the associated uncertainty must be considered. Refer to the ALS Contact for details.

Key : CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
^ = This result is computed from individual analyte detections at or above the level of reporting
ø = ALS is not NATA accredited for these tests.
~ = Indicates an estimated value.

- It is recognised that EG020-T (Total Metals by ICP-MS) is less than EG020-F (Dissolved Metals by ICP-MS) for sample EB1830098-001(330-01-BH2101). However, the difference is within experimental variation of the methods.
- Sodium Adsorption Ratio (where reported): Where results for Na, Ca or Mg are <LOR, a concentration at half the reported LOR is incorporated into the SAR calculation. This represents a conservative approach for Na relative to the assumption that <LOR = zero concentration and a conservative approach for Ca & Mg relative to the assumption that <LOR is equivalent to the LOR concentration.

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)			Client sample ID	330-01-BH2101	----	----	----	----
			Client sampling date / time	07-Dec-2018 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit	EB1830098-001	--------	--------	--------	--------
				Result	----	----	----	----
EA005P: pH by PC Titrator								
pH Value	----	0.01	pH Unit	**8.80**	----	----	----	----
EA010P: Conductivity by PC Titrator								
Electrical Conductivity @ 25°C	----	1	µS/cm	**2190**	----	----	----	----
EA015: Total Dissolved Solids dried at 180 ± 5 °C								
Total Dissolved Solids @180°C	----	10	mg/L	**1280**	----	----	----	----
ED037P: Alkalinity by PC Titrator								
Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	----	----	----	----
Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	**104**	----	----	----	----
Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	**670**	----	----	----	----
Total Alkalinity as CaCO3	----	1	mg/L	**774**	----	----	----	----
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA								
Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	**51**	----	----	----	----
ED045G: Chloride by Discrete Analyser								
Chloride	16887-00-6	1	mg/L	**209**	----	----	----	----
ED093F: Dissolved Major Cations								
Calcium	7440-70-2	1	mg/L	**9**	----	----	----	----
Magnesium	7439-95-4	1	mg/L	**5**	----	----	----	----
Sodium	7440-23-5	1	mg/L	**506**	----	----	----	----
Potassium	7440-09-7	1	mg/L	**3**	----	----	----	----
ED093F: SAR and Hardness Calculations								
^ **Sodium Adsorption Ratio**	----	0.01	-	**33.5**	----	----	----	----
EG020F: Dissolved Metals by ICP-MS								
Arsenic	7440-38-2	0.001	mg/L	**0.002**	----	----	----	----
Beryllium	7440-41-7	0.001	mg/L	<0.001	----	----	----	----
Barium	7440-39-3	0.001	mg/L	**0.196**	----	----	----	----
Cadmium	7440-43-9	0.0001	mg/L	<0.0001	----	----	----	----
Chromium	7440-47-3	0.001	mg/L	<0.001	----	----	----	----
Cobalt	7440-48-4	0.001	mg/L	<0.001	----	----	----	----
Copper	7440-50-8	0.001	mg/L	<0.001	----	----	----	----
Lead	7439-92-1	0.001	mg/L	<0.001	----	----	----	----
Manganese	7439-96-5	0.001	mg/L	**0.069**	----	----	----	----
Nickel	7440-02-0	0.001	mg/L	<0.001	----	----	----	----
Selenium	7782-49-2	0.01	mg/L	<0.01	----	----	----	----
Vanadium	7440-62-2	0.01	mg/L	<0.01	----	----	----	----

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	330-01-BH2101	----	----	----	----
				Client sampling date / time	07-Dec-2018 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit		EB1830098-001	--------	--------	--------	--------
					Result	----	----	----	----
EG020F: Dissolved Metals by ICP-MS - Continued									
Zinc	7440-66-6	0.005	mg/L		<0.005	----	----	----	----
Boron	7440-42-8	0.05	mg/L		**0.13**	----	----	----	----
Iron	7439-89-6	0.05	mg/L		**2.28**	----	----	----	----
EG020T: Total Metals by ICP-MS									
Arsenic	7440-38-2	0.001	mg/L		**0.004**	----	----	----	----
Beryllium	7440-41-7	0.001	mg/L		<0.001	----	----	----	----
Barium	7440-39-3	0.001	mg/L		**0.166**	----	----	----	----
Cadmium	7440-43-9	0.0001	mg/L		<0.0001	----	----	----	----
Chromium	7440-47-3	0.001	mg/L		**0.002**	----	----	----	----
Cobalt	7440-48-4	0.001	mg/L		<0.001	----	----	----	----
Copper	7440-50-8	0.001	mg/L		**0.002**	----	----	----	----
Lead	7439-92-1	0.001	mg/L		<0.001	----	----	----	----
Manganese	7439-96-5	0.001	mg/L		**0.078**	----	----	----	----
Nickel	7440-02-0	0.001	mg/L		**0.002**	----	----	----	----
Selenium	7782-49-2	0.01	mg/L		<0.01	----	----	----	----
Vanadium	7440-62-2	0.01	mg/L		<0.01	----	----	----	----
Zinc	7440-66-6	0.005	mg/L		**0.014**	----	----	----	----
Boron	7440-42-8	0.05	mg/L		**0.20**	----	----	----	----
Iron	7439-89-6	0.05	mg/L		**3.31**	----	----	----	----
EG035F: Dissolved Mercury by FIMS									
Mercury	7439-97-6	0.0001	mg/L		<0.0001	----	----	----	----
EG035T: Total Recoverable Mercury by FIMS									
Mercury	7439-97-6	0.0001	mg/L		<0.0001	----	----	----	----
EK055G: Ammonia as N by Discrete Analyser									
Ammonia as N	7664-41-7	0.01	mg/L		**0.97**	----	----	----	----
EK057G: Nitrite as N by Discrete Analyser									
Nitrite as N	14797-65-0	0.01	mg/L		<0.01	----	----	----	----
EK058G: Nitrate as N by Discrete Analyser									
Nitrate as N	14797-55-8	0.01	mg/L		**0.03**	----	----	----	----
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser									
Nitrite + Nitrate as N	----	0.01	mg/L		**0.03**	----	----	----	----
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser									
Total Kjeldahl Nitrogen as N	----	0.1	mg/L		**1.6**	----	----	----	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser									

Analytical Results

Sub-Matrix: WATER (Matrix: WATER)				Client sample ID	330-01-BH2101	----	----	----	----
				Client sampling date / time	07-Dec-2018 00:00	----	----	----	----
Compound	CAS Number	LOR	Unit		EB1830098-001	--------	--------	--------	--------
					Result	----	----	----	----
EK062G: Total Nitrogen as N (TKN + NOx) by Discrete Analyser - Continued									
^ **Total Nitrogen as N**	----	0.1	mg/L		**1.6**	----	----	----	----
EK067G: Total Phosphorus as P by Discrete Analyser									
Total Phosphorus as P	----	0.01	mg/L		**0.03**	----	----	----	----
EK071G: Reactive Phosphorus as P by discrete analyser									
Reactive Phosphorus as P	14265-44-2	0.01	mg/L		<0.01	----	----	----	----
EN055: Ionic Balance									
Total Anions	----	0.01	meq/L		**22.4**	----	----	----	----
Total Cations	----	0.01	meq/L		**22.9**	----	----	----	----
Ionic Balance	----	0.01	%		**1.16**	----	----	----	----

ALS Environmental

QUALITY CONTROL REPORT

Work Order	: **EB1825628**	Page	: 1 of 9
Client	: **GOLDER ASSOCIATES**	Laboratory	: Environmental Division Brisbane
Contact	: MR MITCH McGINNIS	Contact	: Andrew Epps
Address	: 32 SHAND STREET BRISBANE QLD, AUSTRALIA 4053	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: +61 07 3721 5400	Telephone	: +61 7 3552 8639
Project	: 1893802 Inland Rail (P13)	Date Samples Received	: 24-Oct-2018
Order number	:	Date Analysis Commenced	: 24-Oct-2018
C-O-C number	: ----	Issue Date	: 26-Oct-2018
Sampler	: ROBERT CUPPER		
Site	: ----		
Quote number	: EN/002/18 National BQ		
No. of samples received	: 4		
No. of samples analysed	: 4		

Accreditation No. 825
Accredited for compliance with
ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis. Where the LOR of a reported result differs from standard LOR, this may be due to high moisture

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EA005P: pH by PC Titrator (QC Lot: 1998976)									
EB1825421-001	Anonymous	EA005-P: pH Value	----	0.01	pH Unit	8.25	8.31	0.725	0% - 20%
EB1825628-001	330-01-BH2212	EA005-P: pH Value	----	0.01	pH Unit	8.16	8.19	0.367	0% - 20%
EA010P: Conductivity by PC Titrator (QC Lot: 1998975)									
EB1825421-001	Anonymous	EA010-P: Electrical Conductivity @ 25°C	----	1	µS/cm	3310	3300	0.307	0% - 20%
EB1825628-001	330-01-BH2212	EA010-P: Electrical Conductivity @ 25°C	----	1	µS/cm	5500	5480	0.369	0% - 20%
EA015: Total Dissolved Solids dried at 180 ± 5 °C (QC Lot: 1999654)									
EB1825537-001	Anonymous	EA015H: Total Dissolved Solids @180°C	----	10	mg/L	16	14	14.6	No Limit
EB1825568-007	Anonymous	EA015H: Total Dissolved Solids @180°C	----	10	mg/L	435	433	0.461	0% - 20%
EA015: Total Dissolved Solids dried at 180 ± 5 °C (QC Lot: 1999656)									
EB1825628-004	330-01-BH22104	EA015H: Total Dissolved Solids @180°C	----	10	mg/L	2390	2340	1.80	0% - 20%
ED037P: Alkalinity by PC Titrator (QC Lot: 1998974)									
EB1825421-001	Anonymous	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	4	115	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	203	194	4.08	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	203	198	2.19	0% - 20%
EB1825628-001	330-01-BH2212	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	601	609	1.44	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	601	609	1.44	0% - 20%
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QC Lot: 1999114)									
EB1825628-001	330-01-BH2212	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	77	77	0.00	0% - 20%
ED045G: Chloride by Discrete Analyser (QC Lot: 1999115)									
EB1825628-001	330-01-BH2212	ED045G: Chloride	16887-00-6	1	mg/L	1340	1360	0.843	0% - 20%

Sub-Matrix: **WATER**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Laboratory Duplicate (DUP) Report					
				LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
ED093F: Dissolved Major Cations (QC Lot: 2000478)									
EB1825699-003	Anonymous	ED093F: Calcium	7440-70-2	1	mg/L	37	37	0.00	0% - 20%
		ED093F: Magnesium	7439-95-4	1	mg/L	1	1	0.00	No Limit
		ED093F: Sodium	7440-23-5	1	mg/L	14	14	0.00	0% - 50%
		ED093F: Potassium	7440-09-7	1	mg/L	3	2	0.00	No Limit
EB1825618-001	Anonymous	ED093F: Calcium	7440-70-2	1	mg/L	36	36	0.00	0% - 20%
		ED093F: Magnesium	7439-95-4	1	mg/L	13	14	0.00	0% - 50%
		ED093F: Sodium	7440-23-5	1	mg/L	94	95	1.84	0% - 20%
		ED093F: Potassium	7440-09-7	1	mg/L	4	4	0.00	No Limit
EG020F: Dissolved Metals by ICP-MS (QC Lot: 2000480)									
EB1825699-003	Anonymous	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	0.001	0.001	0.00	No Limit
		EG020A-F: Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Barium	7440-39-3	0.001	mg/L	0.048	0.048	0.00	0% - 20%
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	0.009	0.010	11.9	0% - 50%
		EG020A-F: Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	0.003	0.003	0.00	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	0.001	<0.001	0.00	No Limit
		EG020A-F: Manganese	7439-96-5	0.001	mg/L	0.287	0.283	1.32	0% - 20%
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	0.006	0.006	0.00	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	11.2	11.0	1.48	0% - 20%
		EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-F: Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-F: Boron	7440-42-8	0.05	mg/L	<0.05	<0.05	0.00	No Limit
		EG020A-F: Iron	7439-89-6	0.05	mg/L	0.10	0.10	0.00	No Limit
EB1825618-001	Anonymous	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Barium	7440-39-3	0.001	mg/L	0.153	0.154	0.00	0% - 20%
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Cobalt	7440-48-4	0.001	mg/L	0.001	0.001	0.00	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	0.029	0.029	0.00	0% - 20%
		EG020A-F: Lead	7439-92-1	0.001	mg/L	0.003	0.003	0.00	No Limit
		EG020A-F: Manganese	7439-96-5	0.001	mg/L	0.108	0.110	1.56	0% - 20%
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	0.010	0.010	0.00	0% - 50%
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	0.041	0.040	0.00	No Limit
		EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-F: Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-F: Boron	7440-42-8	0.05	mg/L	<0.05	<0.05	0.00	No Limit
		EG020A-F: Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	0.00	No Limit
EG020T: Total Metals by ICP-MS (QC Lot: 2000492)									

Sub-Matrix: **WATER**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Laboratory Duplicate (DUP) Report					
				LOR	Unit	Original Result	Duplicate Result	RPD (%)	Recovery Limits (%)
EG020T: Total Metals by ICP-MS (QC Lot: 2000492) - continued									
EB1825618-001	Anonymous	EG020A-T: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
		EG020A-T: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Barium	7440-39-3	0.001	mg/L	0.172	0.181	4.75	0% - 20%
		EG020A-T: Chromium	7440-47-3	0.001	mg/L	0.002	0.002	0.00	No Limit
		EG020A-T: Cobalt	7440-48-4	0.001	mg/L	0.002	0.002	0.00	No Limit
		EG020A-T: Copper	7440-50-8	0.001	mg/L	0.040	0.041	0.00	0% - 20%
		EG020A-T: Lead	7439-92-1	0.001	mg/L	0.006	0.006	0.00	No Limit
		EG020A-T: Manganese	7439-96-5	0.001	mg/L	0.145	0.148	2.19	0% - 20%
		EG020A-T: Nickel	7440-02-0	0.001	mg/L	0.014	0.015	8.05	0% - 50%
		EG020A-T: Zinc	7440-66-6	0.005	mg/L	0.053	0.052	0.00	0% - 50%
		EG020A-T: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-T: Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-T: Boron	7440-42-8	0.05	mg/L	0.05	<0.05	0.00	No Limit
		EG020A-T: Iron	7439-89-6	0.05	mg/L	1.14	1.14	0.00	0% - 20%
EB1825675-002	Anonymous	EG020A-T: Cadmium	7440-43-9	0.0001	mg/L	<0.0005	<0.0005	0.00	No Limit
		EG020A-T: Arsenic	7440-38-2	0.001	mg/L	<0.005	<0.005	0.00	No Limit
		EG020A-T: Beryllium	7440-41-7	0.001	mg/L	<0.005	<0.005	0.00	No Limit
		EG020A-T: Barium	7440-39-3	0.001	mg/L	0.060	0.063	5.49	0% - 50%
		EG020A-T: Chromium	7440-47-3	0.001	mg/L	<0.005	<0.005	0.00	No Limit
		EG020A-T: Cobalt	7440-48-4	0.001	mg/L	0.009	0.009	0.00	No Limit
		EG020A-T: Copper	7440-50-8	0.001	mg/L	<0.005	<0.005	0.00	No Limit
		EG020A-T: Lead	7439-92-1	0.001	mg/L	<0.005	<0.005	0.00	No Limit
		EG020A-T: Manganese	7439-96-5	0.001	mg/L	10.0	10.4	3.24	0% - 20%
		EG020A-T: Nickel	7440-02-0	0.001	mg/L	0.007	0.008	0.00	No Limit
		EG020A-T: Zinc	7440-66-6	0.005	mg/L	0.287	0.296	3.26	0% - 50%
		EG020A-T: Selenium	7782-49-2	0.01	mg/L	<0.05	<0.05	0.00	No Limit
		EG020A-T: Vanadium	7440-62-2	0.01	mg/L	<0.05	<0.05	0.00	No Limit
		EG020A-T: Boron	7440-42-8	0.05	mg/L	1.43	1.49	4.57	0% - 20%
		EG020A-T: Iron	7439-89-6	0.05	mg/L	0.69	0.72	4.20	0% - 50%
EG035F: Dissolved Mercury by FIMS (QC Lot: 2000479)									
EB1825675-004	Anonymous	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EB1825618-001	Anonymous	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EG035T: Total Recoverable Mercury by FIMS (QC Lot: 2000491)									
EB1825618-001	Anonymous	EG035T: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EK040P: Fluoride by PC Titrator (QC Lot: 1998973)									
EB1825421-001	Anonymous	EK040P: Fluoride	16984-48-8	0.1	mg/L	<0.1	<0.1	0.00	No Limit
EB1825628-001	330-01-BH2212	EK040P: Fluoride	16984-48-8	0.1	mg/L	0.5	0.4	0.00	No Limit
EK055G: Ammonia as N by Discrete Analyser (QC Lot: 1999768)									

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EK055G: Ammonia as N by Discrete Analyser (QC Lot: 1999768) - continued									
EB1825283-001	Anonymous	EK055G: Ammonia as N	7664-41-7	0.01	mg/L	0.02	<0.01	80.7	No Limit
EB1825628-001	330-01-BH2212	EK055G: Ammonia as N	7664-41-7	0.01	mg/L	0.11	0.10	15.1	0% - 50%
EK057G: Nitrite as N by Discrete Analyser (QC Lot: 1999113)									
EB1825530-001	Anonymous	EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	0.00	No Limit
EB1825628-001	330-01-BH2212	EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	0.00	No Limit
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QC Lot: 1999769)									
EB1825283-001	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	<0.01	0.00	No Limit
EB1825628-001	330-01-BH2212	EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	0.48	0.49	3.08	0% - 20%
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QC Lot: 1999751)									
EB1825424-001	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	9.8	8.5	14.5	No Limit
EB1825602-005	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	8.6	8.4	2.23	0% - 20%
EK067G: Total Phosphorus as P by Discrete Analyser (QC Lot: 1999750)									
EB1825424-001	Anonymous	EK067G: Total Phosphorus as P	----	0.01	mg/L	2.10	1.85	12.6	0% - 20%
EB1825602-005	Anonymous	EK067G: Total Phosphorus as P	----	0.01	mg/L	0.80	0.80	0.00	0% - 20%
EK071G: Reactive Phosphorus as P by discrete analyser (QC Lot: 1999116)									
EB1825628-001	330-01-BH2212	EK071G: Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit

Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Spike (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **WATER**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EA005P: pH by PC Titrator (QCLot: 1998976)								
EA005-P: pH Value	----	----	pH Unit	----	4 pH Unit	100	98	102
				----	7 pH Unit	101	98	102
EA010P: Conductivity by PC Titrator (QCLot: 1998975)								
EA010-P: Electrical Conductivity @ 25°C	----	1	µS/cm	<1	220 µS/cm	103	91	107
				<1	12890 µS/cm	99.3	91	107
EA015: Total Dissolved Solids dried at 180 ± 5 °C (QCLot: 1999654)								
EA015H: Total Dissolved Solids @180°C	----	10	mg/L	<10	293 mg/L	101	88	112
				<10	2000 mg/L	100	88	112
EA015: Total Dissolved Solids dried at 180 ± 5 °C (QCLot: 1999656)								
EA015H: Total Dissolved Solids @180°C	----	10	mg/L	<10	293 mg/L	103	88	112
				<10	2000 mg/L	99.3	88	112
ED037P: Alkalinity by PC Titrator (QCLot: 1998974)								
ED037-P: Total Alkalinity as CaCO3	----	----	mg/L	----	50 mg/L	107	80	120
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 1999114)								
ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	25 mg/L	102	85	118
				<1	100 mg/L	96.4	85	118
ED045G: Chloride by Discrete Analyser (QCLot: 1999115)								
ED045G: Chloride	16887-00-6	1	mg/L	<1	10 mg/L	95.4	90	115
				<1	1000 mg/L	97.3	90	115
ED093F: Dissolved Major Cations (QCLot: 2000478)								
ED093F: Calcium	7440-70-2	1	mg/L	<1	----	----	----	----
ED093F: Magnesium	7439-95-4	1	mg/L	<1	----	----	----	----
ED093F: Sodium	7440-23-5	1	mg/L	<1	----	----	----	----
ED093F: Potassium	7440-09-7	1	mg/L	<1	----	----	----	----
EG020F: Dissolved Metals by ICP-MS (QCLot: 2000480)								
EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.1 mg/L	100	88	116
EG020A-F: Beryllium	7440-41-7	0.001	mg/L	<0.001	0.1 mg/L	96.9	81	117
EG020A-F: Barium	7440-39-3	0.001	mg/L	<0.001	0.5 mg/L	94.3	70	130
EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.1 mg/L	96.0	88	108
EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	0.1 mg/L	104	87	113
EG020A-F: Cobalt	7440-48-4	0.001	mg/L	<0.001	0.1 mg/L	103	86	112
EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	0.2 mg/L	104	88	114
EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	0.1 mg/L	101	89	110
EG020A-F: Manganese	7439-96-5	0.001	mg/L	<0.001	0.1 mg/L	102	89	120

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
				Result	Concentration	LCS	Low	High
EG020F: Dissolved Metals by ICP-MS (QCLot: 2000480) - continued								
EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	0.1 mg/L	102	89	113
EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	0.1 mg/L	101	83	112
EG020A-F: Vanadium	7440-62-2	0.01	mg/L	<0.01	0.1 mg/L	109	88	114
EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	0.2 mg/L	101	87	113
EG020A-F: Boron	7440-42-8	0.05	mg/L	<0.05	0.5 mg/L	107	81	125
EG020A-F: Iron	7439-89-6	0.05	mg/L	<0.05	0.5 mg/L	99.9	82	114
EG020T: Total Metals by ICP-MS (QCLot: 2000492)								
EG020A-T: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.1 mg/L	99.8	88	112
EG020A-T: Beryllium	7440-41-7	0.001	mg/L	<0.001	0.1 mg/L	98.4	81	119
EG020A-T: Barium	7440-39-3	0.001	mg/L	<0.001	0.5 mg/L	102	70	130
EG020A-T: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.1 mg/L	97.6	88	111
EG020A-T: Chromium	7440-47-3	0.001	mg/L	<0.001	0.1 mg/L	103	89	115
EG020A-T: Cobalt	7440-48-4	0.001	mg/L	<0.001	0.1 mg/L	102	89	115
EG020A-T: Copper	7440-50-8	0.001	mg/L	<0.001	0.2 mg/L	104	88	116
EG020A-T: Lead	7439-92-1	0.001	mg/L	<0.001	0.1 mg/L	97.8	89	112
EG020A-T: Manganese	7439-96-5	0.001	mg/L	<0.001	0.1 mg/L	102	88	114
EG020A-T: Nickel	7440-02-0	0.001	mg/L	<0.001	0.1 mg/L	105	88	116
EG020A-T: Selenium	7782-49-2	0.01	mg/L	<0.01	0.1 mg/L	97.0	79	111
EG020A-T: Vanadium	7440-62-2	0.01	mg/L	<0.01	0.1 mg/L	108	87	114
EG020A-T: Zinc	7440-66-6	0.005	mg/L	<0.005	0.2 mg/L	97.2	84	114
EG020A-T: Boron	7440-42-8	0.05	mg/L	<0.05	0.5 mg/L	121	82	128
EG020A-T: Iron	7439-89-6	0.05	mg/L	<0.05	0.5 mg/L	102	82	118
EG035F: Dissolved Mercury by FIMS (QCLot: 2000479)								
EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	0.01 mg/L	88.2	84	118
EG035T: Total Recoverable Mercury by FIMS (QCLot: 2000491)								
EG035T: Mercury	7439-97-6	0.0001	mg/L	<0.0001	0.01 mg/L	104	84	118
EK040P: Fluoride by PC Titrator (QCLot: 1998973)								
EK040P: Fluoride	16984-48-8	0.1	mg/L	<0.1	0.5 mg/L	102	80	117
EK055G: Ammonia as N by Discrete Analyser (QCLot: 1999768)								
EK055G: Ammonia as N	7664-41-7	0.01	mg/L	<0.01	0.5 mg/L	102	86	112
EK057G: Nitrite as N by Discrete Analyser (QCLot: 1999113)								
EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	0.5 mg/L	96.8	90	110
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 1999769)								
EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	0.5 mg/L	101	89	115
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 1999751)								
EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	<0.1	1 mg/L	93.6	70	111
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 1999750)								

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report: Result	Laboratory Control Spike (LCS) Report: Spike Concentration	Spike Recovery (%): LCS	Recovery Limits (%): Low	Recovery Limits (%): High
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 1999750) - continued								
EK067G: Total Phosphorus as P	----	0.01	mg/L	<0.01	0.442 mg/L	92.3	77	109
EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 1999116)								
EK071G: Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	0.5 mg/L	95.4	88	115

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **WATER**

Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Matrix Spike (MS) Report: Spike Concentration	SpikeRecovery(%): MS	Recovery Limits (%): Low	Recovery Limits (%): High
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 1999114)							
EB1825618-002	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	20 mg/L	70.3	70	130
ED045G: Chloride by Discrete Analyser (QCLot: 1999115)							
EB1825618-002	Anonymous	ED045G: Chloride	16887-00-6	400 mg/L	94.3	70	130
EG020F: Dissolved Metals by ICP-MS (QCLot: 2000480)							
EB1825628-001	330-01-BH2212	EG020A-F: Arsenic	7440-38-2	0.1 mg/L	107	70	130
		EG020A-F: Beryllium	7440-41-7	0.1 mg/L	99.1	70	130
		EG020A-F: Barium	7440-39-3	0.5 mg/L	99.0	70	130
		EG020A-F: Cadmium	7440-43-9	0.1 mg/L	98.7	70	130
		EG020A-F: Chromium	7440-47-3	0.1 mg/L	98.7	70	130
		EG020A-F: Cobalt	7440-48-4	0.1 mg/L	97.3	70	130
		EG020A-F: Copper	7440-50-8	0.2 mg/L	96.0	70	130
		EG020A-F: Lead	7439-92-1	0.1 mg/L	98.6	70	130
		EG020A-F: Manganese	7439-96-5	0.1 mg/L	95.7	70	130
		EG020A-F: Nickel	7440-02-0	0.1 mg/L	94.6	70	130
		EG020A-F: Selenium	7782-49-2	0.1 mg/L	105	70	130
		EG020A-F: Vanadium	7440-62-2	0.1 mg/L	105	70	130
		EG020A-F: Zinc	7440-66-6	0.2 mg/L	99.5	70	130
		EG020A-F: Boron	7440-42-8	0.5 mg/L	97.2	70	130
EG020T: Total Metals by ICP-MS (QCLot: 2000492)							
EB1825618-002	Anonymous	EG020A-T: Arsenic	7440-38-2	1 mg/L	91.4	70	130
		EG020A-T: Beryllium	7440-41-7	0.1 mg/L	90.9	70	130
		EG020A-T: Barium	7440-39-3	1 mg/L	99.7	70	130
		EG020A-T: Cadmium	7440-43-9	0.5 mg/L	99.3	70	130
		EG020A-T: Chromium	7440-47-3	1 mg/L	92.6	70	130
		EG020A-T: Cobalt	7440-48-4	1 mg/L	92.2	70	130
		EG020A-T: Copper	7440-50-8	1 mg/L	88.8	70	130

Sub-Matrix: **WATER**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EG020T: Total Metals by ICP-MS (QCLot: 2000492) - continued							
EB1825618-002	Anonymous	EG020A-T: Lead	7439-92-1	1 mg/L	94.0	70	130
		EG020A-T: Manganese	7439-96-5	1 mg/L	87.3	70	130
		EG020A-T: Nickel	7440-02-0	1 mg/L	93.6	70	130
		EG020A-T: Vanadium	7440-62-2	1 mg/L	94.7	70	130
		EG020A-T: Zinc	7440-66-6	1 mg/L	89.8	70	130
EG035F: Dissolved Mercury by FIMS (QCLot: 2000479)							
EB1825618-003	Anonymous	EG035F: Mercury	7439-97-6	0.01 mg/L	82.2	70	130
EG035T: Total Recoverable Mercury by FIMS (QCLot: 2000491)							
EB1825618-002	Anonymous	EG035T: Mercury	7439-97-6	0.01 mg/L	92.5	70	130
EK040P: Fluoride by PC Titrator (QCLot: 1998973)							
EB1825421-002	Anonymous	EK040P: Fluoride	16984-48-8	5 mg/L	92.6	70	130
EK055G: Ammonia as N by Discrete Analyser (QCLot: 1999768)							
EB1825319-001	Anonymous	EK055G: Ammonia as N	7664-41-7	0.4 mg/L	96.4	70	130
EK057G: Nitrite as N by Discrete Analyser (QCLot: 1999113)							
EB1825618-002	Anonymous	EK057G: Nitrite as N	14797-65-0	0.4 mg/L	95.6	70	130
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 1999769)							
EB1825319-001	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.4 mg/L	93.8	70	130
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 1999751)							
EB1825425-001	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	100 mg/L	109	70	130
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 1999750)							
EB1825425-001	Anonymous	EK067G: Total Phosphorus as P	----	20 mg/L	81.9	70	130
EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 1999116)							
EB1825618-002	Anonymous	EK071G: Reactive Phosphorus as P	14265-44-2	0.4 mg/L	97.2	70	130

ALS Environmental

QUALITY CONTROL REPORT

Work Order	: **EB1825910**	Page	: 1 of 9
Client	: **GOLDER ASSOCIATES**	Laboratory	: Environmental Division Brisbane
Contact	: MR MITCH McGINNIS	Contact	: Andrew Epps
Address	: P O BOX 1734 MILTON QLD, AUSTRALIA 4064	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: +61 07 3721 5400	Telephone	: +61 7 3552 8639
Project	: 1893802	Date Samples Received	: 26-Oct-2018
Order number	: 1893802	Date Analysis Commenced	: 26-Oct-2018
C-O-C number	: ----	Issue Date	: 31-Oct-2018
Sampler	: ROBERT CUPPER		
Site	: ----		
Quote number	: EN/002/18 National BQ		
No. of samples received	: 3		
No. of samples analysed	: 3		

ilac-MRA NATA
Accreditation No. 825
Accredited for compliance with ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis. Where the LOR of a reported result differs from standard LOR, this may be due to high moisture

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EA005P: pH by PC Titrator (QC Lot: 2004137)									
EB1825819-002	Anonymous	EA005-P: pH Value	----	0.01	pH Unit	7.54	7.41	1.74	0% - 20%
EB1825910-003	330-01-BH2307	EA005-P: pH Value	----	0.01	pH Unit	8.53	8.60	0.817	0% - 20%
EA010P: Conductivity by PC Titrator (QC Lot: 2004136)									
EB1825819-002	Anonymous	EA010-P: Electrical Conductivity @ 25°C	----	1	µS/cm	3210	3180	0.974	0% - 20%
EB1825910-003	330-01-BH2307	EA010-P: Electrical Conductivity @ 25°C	----	1	µS/cm	1730	1730	0.240	0% - 20%
EA015: Total Dissolved Solids dried at 180 ± 5 °C (QC Lot: 2004052)									
EB1825828-002	Anonymous	EA015H: Total Dissolved Solids @180°C	----	10	mg/L	5370	5240	2.49	0% - 20%
EB1825828-011	Anonymous	EA015H: Total Dissolved Solids @180°C	----	10	mg/L	13900	14000	0.687	0% - 20%
ED037P: Alkalinity by PC Titrator (QC Lot: 2004138)									
EB1825819-002	Anonymous	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	40	47	14.9	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	40	47	14.9	0% - 20%
EB1825910-003	330-01-BH2307	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	12	14	17.9	0% - 50%
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	116	112	3.56	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	128	126	1.36	0% - 20%
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QC Lot: 2004179)									
EB1825915-002	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	10	10	0.00	No Limit
EB1825875-001	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	45	45	0.00	0% - 20%
ED045G: Chloride by Discrete Analyser (QC Lot: 2004180)									
EB1825875-001	Anonymous	ED045G: Chloride	16887-00-6	1	mg/L	115	115	0.00	0% - 20%
ED093F: Dissolved Major Cations (QC Lot: 2005582)									
EB1825908-002	Anonymous	ED093F: Calcium	7440-70-2	1	mg/L	22	21	0.00	0% - 20%

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
ED093F: Dissolved Major Cations (QC Lot: 2005582) - continued									
EB1825908-002	Anonymous	ED093F: Magnesium	7439-95-4	1	mg/L	14	13	0.00	0% - 50%
		ED093F: Sodium	7440-23-5	1	mg/L	422	405	4.17	0% - 20%
		ED093F: Potassium	7440-09-7	1	mg/L	3	3	0.00	No Limit
EG020F: Dissolved Metals by ICP-MS (QC Lot: 2005581)									
EB1825492-001	Anonymous	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	0.0024	0.0024	0.00	0% - 20%
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Beryllium	7440-41-7	0.001	mg/L	0.004	0.004	0.00	No Limit
		EG020A-F: Barium	7440-39-3	0.001	mg/L	0.010	0.009	10.8	0% - 50%
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Cobalt	7440-48-4	0.001	mg/L	0.072	0.069	4.19	0% - 20%
		EG020A-F: Copper	7440-50-8	0.001	mg/L	0.001	0.002	65.2	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Manganese	7439-96-5	0.001	mg/L	3.55	3.52	0.891	0% - 20%
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	0.168	0.165	1.30	0% - 20%
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	0.708	0.700	1.21	0% - 20%
		EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-F: Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-F: Boron	7440-42-8	0.05	mg/L	0.96	0.95	0.00	0% - 50%
		EG020A-F: Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	0.00	No Limit
EB1825908-002	Anonymous	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	0.007	0.007	0.00	No Limit
		EG020A-F: Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Barium	7440-39-3	0.001	mg/L	0.045	0.043	4.36	0% - 20%
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Cobalt	7440-48-4	0.001	mg/L	0.003	0.003	0.00	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	0.005	0.004	0.00	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Manganese	7439-96-5	0.001	mg/L	0.069	0.067	3.58	0% - 20%
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	0.004	0.003	0.00	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	0.009	0.008	12.2	No Limit
		EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-F: Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-F: Boron	7440-42-8	0.05	mg/L	0.13	0.12	0.00	No Limit
		EG020A-F: Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	0.00	No Limit
EG020T: Total Metals by ICP-MS (QC Lot: 2005742)									
EB1825778-031	Anonymous	EG020A-T: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
		EG020A-T: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Barium	7440-39-3	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.00	No Limit

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EG020T: Total Metals by ICP-MS (QC Lot: 2005742) - continued									
EB1825778-031	Anonymous	EG020A-T: Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Manganese	7439-96-5	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	0.00	No Limit
		EG020A-T: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-T: Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-T: Boron	7440-42-8	0.05	mg/L	<0.05	<0.05	0.00	No Limit
		EG020A-T: Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	0.00	No Limit
EB1825822-001	Anonymous	EG020A-T: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
		EG020A-T: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Barium	7440-39-3	0.001	mg/L	0.009	0.009	0.00	No Limit
		EG020A-T: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Copper	7440-50-8	0.001	mg/L	0.005	0.005	0.00	No Limit
		EG020A-T: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Manganese	7439-96-5	0.001	mg/L	0.009	0.009	0.00	No Limit
		EG020A-T: Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Zinc	7440-66-6	0.005	mg/L	0.291	0.292	0.00	0% - 20%
		EG020A-T: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-T: Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-T: Boron	7440-42-8	0.05	mg/L	<0.05	<0.05	0.00	No Limit
		EG020A-T: Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	0.00	No Limit
EG035F: Dissolved Mercury by FIMS (QC Lot: 2005575)									
EB1825908-004	Anonymous	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EB1824322-003	Anonymous	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EG035T: Total Recoverable Mercury by FIMS (QC Lot: 2005740)									
EB1825778-031	Anonymous	EG035T: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EB1825910-002	330-01-BH2303	EG035T: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EK040P: Fluoride by PC Titrator (QC Lot: 2004139)									
EB1825819-002	Anonymous	EK040P: Fluoride	16984-48-8	0.1	mg/L	0.7	0.7	0.00	No Limit
EB1825910-003	330-01-BH2307	EK040P: Fluoride	16984-48-8	0.1	mg/L	0.6	0.6	0.00	No Limit
EK055G: Ammonia as N by Discrete Analyser (QC Lot: 2004188)									
EB1825908-001	Anonymous	EK055G: Ammonia as N	7664-41-7	0.01	mg/L	0.06	0.06	0.00	No Limit
EK057G: Nitrite as N by Discrete Analyser (QC Lot: 2004177)									
EB1825917-003	Anonymous	EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	0.00	No Limit
EB1825875-001	Anonymous	EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	0.00	No Limit

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QC Lot: 2004189)									
EB1825915-005	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	0.13	0.13	0.00	0% - 50%
EB1825908-001	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	<0.01	0.00	No Limit
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QC Lot: 2004477)									
EB1825611-001	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	117	114	2.52	0% - 20%
EB1825908-004	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	0.2	0.1	0.00	No Limit
EK067G: Total Phosphorus as P by Discrete Analyser (QC Lot: 2004478)									
EB1825611-001	Anonymous	EK067G: Total Phosphorus as P	----	0.01	mg/L	14.8	14.4	2.98	0% - 20%
EB1825908-004	Anonymous	EK067G: Total Phosphorus as P	----	0.01	mg/L	0.18	0.18	0.00	0% - 50%
EK071G: Reactive Phosphorus as P by discrete analyser (QC Lot: 2004178)									
EB1825852-002	Anonymous	EK071G: Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
EB1825917-003	Anonymous	EK071G: Reactive Phosphorus as P	14265-44-2	0.01	mg/L	0.03	0.02	0.00	No Limit

Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Spike (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **WATER**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EA005P: pH by PC Titrator (QCLot: 2004137)								
EA005-P: pH Value	----	----	pH Unit	----	4 pH Unit	100	98	102
				----	7 pH Unit	101	98	102
EA010P: Conductivity by PC Titrator (QCLot: 2004136)								
EA010-P: Electrical Conductivity @ 25°C	----	1	µS/cm	<1	2100 µS/cm	102	91	107
				<1	12890 µS/cm	101	91	107
EA015: Total Dissolved Solids dried at 180 ± 5 °C (QCLot: 2004052)								
EA015H: Total Dissolved Solids @180°C	----	10	mg/L	<10	293 mg/L	95.4	88	112
				<10	2000 mg/L	100	88	112
ED037P: Alkalinity by PC Titrator (QCLot: 2004138)								
ED037-P: Total Alkalinity as CaCO3	----	----	mg/L	----	50 mg/L	102	80	120
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 2004179)								
ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	25 mg/L	102	85	118
				<1	100 mg/L	87.3	85	118
ED045G: Chloride by Discrete Analyser (QCLot: 2004180)								
ED045G: Chloride	16887-00-6	1	mg/L	<1	10 mg/L	107	90	115
				<1	1000 mg/L	102	90	115
ED093F: Dissolved Major Cations (QCLot: 2005582)								
ED093F: Calcium	7440-70-2	1	mg/L	<1	----	----	----	----
ED093F: Magnesium	7439-95-4	1	mg/L	<1	----	----	----	----
ED093F: Sodium	7440-23-5	1	mg/L	# 2	----	----	----	----
ED093F: Potassium	7440-09-7	1	mg/L	<1	----	----	----	----
EG020F: Dissolved Metals by ICP-MS (QCLot: 2005581)								
EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.1 mg/L	97.7	88	116
EG020A-F: Beryllium	7440-41-7	0.001	mg/L	<0.001	0.1 mg/L	90.8	81	117
EG020A-F: Barium	7440-39-3	0.001	mg/L	<0.001	0.5 mg/L	97.9	70	130
EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.1 mg/L	96.2	88	108
EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	0.1 mg/L	101	87	113
EG020A-F: Cobalt	7440-48-4	0.001	mg/L	<0.001	0.1 mg/L	98.5	86	112
EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	0.2 mg/L	98.0	88	114
EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	0.1 mg/L	106	89	110
EG020A-F: Manganese	7439-96-5	0.001	mg/L	<0.001	0.1 mg/L	101	89	120
EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	0.1 mg/L	94.7	89	113
EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	0.1 mg/L	98.0	83	112
EG020A-F: Vanadium	7440-62-2	0.01	mg/L	<0.01	0.1 mg/L	112	88	114

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
				Result	Concentration	LCS	Low	High
EG020F: Dissolved Metals by ICP-MS (QCLot: 2005581) - continued								
EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	0.2 mg/L	98.1	87	113
EG020A-F: Boron	7440-42-8	0.05	mg/L	<0.05	0.5 mg/L	97.8	81	125
EG020A-F: Iron	7439-89-6	0.05	mg/L	<0.05	0.5 mg/L	95.0	82	114
EG020T: Total Metals by ICP-MS (QCLot: 2005742)								
EG020A-T: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.1 mg/L	100.0	88	112
EG020A-T: Beryllium	7440-41-7	0.001	mg/L	<0.001	0.1 mg/L	103	81	119
EG020A-T: Barium	7440-39-3	0.001	mg/L	<0.001	0.5 mg/L	90.4	70	130
EG020A-T: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.1 mg/L	95.9	88	111
EG020A-T: Chromium	7440-47-3	0.001	mg/L	<0.001	0.1 mg/L	108	89	115
EG020A-T: Cobalt	7440-48-4	0.001	mg/L	<0.001	0.1 mg/L	102	89	115
EG020A-T: Copper	7440-50-8	0.001	mg/L	<0.001	0.2 mg/L	101	88	116
EG020A-T: Lead	7439-92-1	0.001	mg/L	<0.001	0.1 mg/L	106	89	112
EG020A-T: Manganese	7439-96-5	0.001	mg/L	<0.001	0.1 mg/L	105	88	114
EG020A-T: Nickel	7440-02-0	0.001	mg/L	<0.001	0.1 mg/L	99.2	88	116
EG020A-T: Selenium	7782-49-2	0.01	mg/L	<0.01	0.1 mg/L	95.7	79	111
EG020A-T: Vanadium	7440-62-2	0.01	mg/L	<0.01	0.1 mg/L	107	87	114
EG020A-T: Zinc	7440-66-6	0.005	mg/L	<0.005	0.2 mg/L	95.1	84	114
EG020A-T: Boron	7440-42-8	0.05	mg/L	<0.05	0.5 mg/L	111	82	128
EG020A-T: Iron	7439-89-6	0.05	mg/L	<0.05	0.5 mg/L	100	82	118
EG035F: Dissolved Mercury by FIMS (QCLot: 2005575)								
EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	0.01 mg/L	87.2	84	118
EG035T: Total Recoverable Mercury by FIMS (QCLot: 2005740)								
EG035T: Mercury	7439-97-6	0.0001	mg/L	<0.0001	0.01 mg/L	86.6	84	118
EK040P: Fluoride by PC Titrator (QCLot: 2004139)								
EK040P: Fluoride	16984-48-8	0.1	mg/L	<0.1	5 mg/L	93.8	80	117
EK055G: Ammonia as N by Discrete Analyser (QCLot: 2004188)								
EK055G: Ammonia as N	7664-41-7	0.01	mg/L	<0.01	0.5 mg/L	107	86	112
EK057G: Nitrite as N by Discrete Analyser (QCLot: 2004177)								
EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	0.5 mg/L	97.0	90	110
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 2004189)								
EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	0.5 mg/L	100	89	115
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 2004477)								
EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	<0.1	1 mg/L	79.7	70	111
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 2004478)								
EK067G: Total Phosphorus as P	----	0.01	mg/L	<0.01	0.442 mg/L	93.4	77	109
EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 2004178)								
EK071G: Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	0.5 mg/L	90.5	88	115

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **WATER**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 2004179)							
EB1825908-001	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	20 mg/L	72.6	70	130
ED045G: Chloride by Discrete Analyser (QCLot: 2004180)							
EB1825908-001	Anonymous	ED045G: Chloride	16887-00-6	400 mg/L	91.3	70	130
EG020F: Dissolved Metals by ICP-MS (QCLot: 2005581)							
EB1825492-002	Anonymous	EG020A-F: Arsenic	7440-38-2	0.5 mg/L	99.9	70	130
		EG020A-F: Beryllium	7440-41-7	0.5 mg/L	91.0	70	130
		EG020A-F: Barium	7440-39-3	2.5 mg/L	96.4	70	130
		EG020A-F: Cadmium	7440-43-9	0.5 mg/L	94.4	70	130
		EG020A-F: Chromium	7440-47-3	0.5 mg/L	95.1	70	130
		EG020A-F: Cobalt	7440-48-4	0.5 mg/L	95.0	70	130
		EG020A-F: Copper	7440-50-8	1 mg/L	92.6	70	130
		EG020A-F: Lead	7439-92-1	0.5 mg/L	96.4	70	130
		EG020A-F: Manganese	7439-96-5	0.5 mg/L	85.2	70	130
		EG020A-F: Nickel	7440-02-0	0.5 mg/L	90.9	70	130
		EG020A-F: Selenium	7782-49-2	0.5 mg/L	96.6	70	130
		EG020A-F: Vanadium	7440-62-2	0.5 mg/L	98.1	70	130
		EG020A-F: Zinc	7440-66-6	1 mg/L	96.5	70	130
		EG020A-F: Boron	7440-42-8	2.5 mg/L	87.7	70	130
EG020T: Total Metals by ICP-MS (QCLot: 2005742)							
EB1825778-032	Anonymous	EG020A-T: Arsenic	7440-38-2	1 mg/L	103	70	130
		EG020A-T: Beryllium	7440-41-7	0.1 mg/L	102	70	130
		EG020A-T: Barium	7440-39-3	1 mg/L	92.7	70	130
		EG020A-T: Cadmium	7440-43-9	0.5 mg/L	98.8	70	130
		EG020A-T: Chromium	7440-47-3	1 mg/L	96.8	70	130
		EG020A-T: Cobalt	7440-48-4	1 mg/L	88.9	70	130
		EG020A-T: Copper	7440-50-8	1 mg/L	86.8	70	130
		EG020A-T: Lead	7439-92-1	1 mg/L	92.9	70	130
		EG020A-T: Manganese	7439-96-5	1 mg/L	90.5	70	130
		EG020A-T: Nickel	7440-02-0	1 mg/L	92.9	70	130
		EG020A-T: Vanadium	7440-62-2	1 mg/L	93.9	70	130
		EG020A-T: Zinc	7440-66-6	1 mg/L	96.1	70	130
EG035F: Dissolved Mercury by FIMS (QCLot: 2005575)							
EB1824322-004	Anonymous	EG035F: Mercury	7439-97-6	0.01 mg/L	72.0	70	130

Sub-Matrix: **WATER**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*Concentration*	*MS*	*Low*	*High*
EG035T: Total Recoverable Mercury by FIMS (QCLot: 2005740)							
EB1825778-032	Anonymous	EG035T: Mercury	7439-97-6	0.01 mg/L	91.3	70	130
EK040P: Fluoride by PC Titrator (QCLot: 2004139)							
EB1825819-004	Anonymous	EK040P: Fluoride	16984-48-8	5 mg/L	83.4	70	130
EK055G: Ammonia as N by Discrete Analyser (QCLot: 2004188)							
EB1825908-002	Anonymous	EK055G: Ammonia as N	7664-41-7	0.4 mg/L	82.4	70	130
EK057G: Nitrite as N by Discrete Analyser (QCLot: 2004177)							
EB1825908-001	Anonymous	EK057G: Nitrite as N	14797-65-0	0.4 mg/L	104	70	130
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 2004189)							
EB1825908-002	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.4 mg/L	95.2	70	130
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 2004477)							
EB1825763-001	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	5 mg/L	77.0	70	130
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 2004478)							
EB1825763-001	Anonymous	EK067G: Total Phosphorus as P	----	1 mg/L	# Not Determined	70	130
EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 2004178)							
EB1825908-001	Anonymous	EK071G: Reactive Phosphorus as P	14265-44-2	0.4 mg/L	103	70	130

ALS Environmental

QUALITY CONTROL REPORT

Work Order	: **EB1825981**	Page	: 1 of 8
Client	: **GOLDER ASSOCIATES**	Laboratory	: Environmental Division Brisbane
Contact	: MR SUSANTHA KUMARAPELI	Contact	: Andrew Epps
Address	: P O BOX 1734 MILTON QLD, AUSTRALIA 4064	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: +61 07 3721 5400	Telephone	: +61 7 3552 8639
Project	: 1893802 Inland Rail (P13)	Date Samples Received	: 26-Oct-2018
Order number	: 1893802	Date Analysis Commenced	: 27-Oct-2018
C-O-C number	: ----	Issue Date	: 31-Oct-2018
Sampler	: ROB CUPPER		
Site	: ----		
Quote number	: EN/002/18 National BQ		
No. of samples received	: 1		
No. of samples analysed	: 1		

ilac-MRA NATA
Accreditation No. 825
Accredited for compliance with ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis. Where the LOR of a reported result differs from standard LOR, this may be due to high moisture

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EA005P: pH by PC Titrator (QC Lot: 2005091)									
EB1825979-001	Anonymous	EA005-P: pH Value	----	0.01	pH Unit	7.89	7.91	0.253	0% - 20%
EA010P: Conductivity by PC Titrator (QC Lot: 2005092)									
EB1825979-001	Anonymous	EA010-P: Electrical Conductivity @ 25°C	----	1	µS/cm	782	780	0.256	0% - 20%
EA015: Total Dissolved Solids dried at 180 ± 5 °C (QC Lot: 2005707)									
EB1825905-001	Anonymous	EA015H: Total Dissolved Solids @180°C	----	10	mg/L	15700	15800	0.697	0% - 20%
EB1825997-015	Anonymous	EA015H: Total Dissolved Solids @180°C	----	10	mg/L	207	211	1.59	0% - 20%
ED037P: Alkalinity by PC Titrator (QC Lot: 2005090)									
EB1825979-001	Anonymous	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	180	187	3.55	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	180	187	3.55	0% - 20%
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QC Lot: 2005225)									
EB1825977-001	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	15	14	7.85	No Limit
EB1825979-001	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	40	40	0.00	0% - 20%
ED045G: Chloride by Discrete Analyser (QC Lot: 2005224)									
EB1825977-001	Anonymous	ED045G: Chloride	16887-00-6	1	mg/L	95	95	0.00	No Limit
EB1825979-001	Anonymous	ED045G: Chloride	16887-00-6	1	mg/L	110	109	1.54	0% - 20%
ED093F: Dissolved Major Cations (QC Lot: 2005582)									
EB1825908-002	Anonymous	ED093F: Calcium	7440-70-2	1	mg/L	22	21	0.00	0% - 20%
		ED093F: Magnesium	7439-95-4	1	mg/L	14	13	0.00	0% - 50%
		ED093F: Sodium	7440-23-5	1	mg/L	422	405	4.17	0% - 20%
		ED093F: Potassium	7440-09-7	1	mg/L	3	3	0.00	No Limit
EG020F: Dissolved Metals by ICP-MS (QC Lot: 2005583)									

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EG020F: Dissolved Metals by ICP-MS (QC Lot: 2005583) - continued									
EB1825911-002	Anonymous	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	0.002	0.002	0.00	No Limit
		EG020A-F: Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Barium	7440-39-3	0.001	mg/L	0.010	0.010	0.00	0% - 50%
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	0.002	0.001	0.00	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Manganese	7439-96-5	0.001	mg/L	0.007	0.006	0.00	No Limit
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	0.00	No Limit
		EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-F: Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-F: Boron	7440-42-8	0.05	mg/L	<0.05	<0.05	0.00	No Limit
		EG020A-F: Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	0.00	No Limit
EG020T: Total Metals by ICP-MS (QC Lot: 2005743)									
EB1825914-001	Anonymous	EG020A-T: Cadmium	7440-43-9	0.0001	mg/L	0.0001	<0.0001	0.00	No Limit
		EG020A-T: Arsenic	7440-38-2	0.001	mg/L	0.026	0.026	0.00	0% - 20%
		EG020A-T: Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Barium	7440-39-3	0.001	mg/L	0.009	0.009	0.00	No Limit
		EG020A-T: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Copper	7440-50-8	0.001	mg/L	0.009	0.009	0.00	No Limit
		EG020A-T: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Manganese	7439-96-5	0.001	mg/L	0.010	0.010	0.00	No Limit
		EG020A-T: Nickel	7440-02-0	0.001	mg/L	0.001	0.002	0.00	No Limit
		EG020A-T: Zinc	7440-66-6	0.005	mg/L	0.404	0.401	0.821	0% - 20%
		EG020A-T: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-T: Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-T: Boron	7440-42-8	0.05	mg/L	<0.05	<0.05	0.00	No Limit
		EG020A-T: Iron	7439-89-6	0.05	mg/L	0.06	<0.05	0.00	No Limit
EB1825932-004	Anonymous	EG020A-T: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
		EG020A-T: Arsenic	7440-38-2	0.001	mg/L	0.011	0.011	0.00	0% - 50%
		EG020A-T: Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Barium	7440-39-3	0.001	mg/L	0.403	0.406	0.724	0% - 20%
		EG020A-T: Chromium	7440-47-3	0.001	mg/L	0.012	0.012	0.00	0% - 50%
		EG020A-T: Cobalt	7440-48-4	0.001	mg/L	0.004	0.004	0.00	No Limit
		EG020A-T: Copper	7440-50-8	0.001	mg/L	0.002	0.002	0.00	No Limit
		EG020A-T: Lead	7439-92-1	0.001	mg/L	0.008	0.008	0.00	No Limit
		EG020A-T: Manganese	7439-96-5	0.001	mg/L	0.438	0.436	0.377	0% - 20%

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EG020T: Total Metals by ICP-MS (QC Lot: 2005743) - continued									
EB1825932-004	Anonymous	EG020A-T: Nickel	7440-02-0	0.001	mg/L	0.049	0.050	0.00	0% - 20%
		EG020A-T: Zinc	7440-66-6	0.005	mg/L	0.012	0.020	49.0	No Limit
		EG020A-T: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-T: Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-T: Boron	7440-42-8	0.05	mg/L	1.27	1.23	2.64	0% - 20%
		EG020A-T: Iron	7439-89-6	0.05	mg/L	1.96	1.96	0.00	0% - 20%
EG035F: Dissolved Mercury by FIMS (QC Lot: 2005584)									
EB1825979-001	Anonymous	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EG035T: Total Recoverable Mercury by FIMS (QC Lot: 2005741)									
EB1825932-006	Anonymous	EG035T: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EK040P: Fluoride by PC Titrator (QC Lot: 2005089)									
EB1825979-001	Anonymous	EK040P: Fluoride	16984-48-8	0.1	mg/L	0.3	0.3	0.00	No Limit
EK055G: Ammonia as N by Discrete Analyser (QC Lot: 2008325)									
EB1825979-001	Anonymous	EK055G: Ammonia as N	7664-41-7	0.01	mg/L	0.07	0.06	0.00	No Limit
EK057G: Nitrite as N by Discrete Analyser (QC Lot: 2005226)									
EB1825979-001	Anonymous	EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	0.00	No Limit
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QC Lot: 2008326)									
EB1825979-001	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	0.03	0.03	0.00	No Limit
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QC Lot: 2005437)									
EB1825827-003	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	0.7	0.7	0.00	No Limit
EB1825623-001	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	6.1	6.0	0.00	0% - 20%
EK067G: Total Phosphorus as P by Discrete Analyser (QC Lot: 2005439)									
EB1825827-008	Anonymous	EK067G: Total Phosphorus as P	----	0.01	mg/L	0.10	0.08	17.8	No Limit
EB1825827-003	Anonymous	EK067G: Total Phosphorus as P	----	0.01	mg/L	0.05	0.05	0.00	No Limit
EK071G: Reactive Phosphorus as P by discrete analyser (QC Lot: 2005227)									
EB1825979-001	Anonymous	EK071G: Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit

Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Spike (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **WATER**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EA005P: pH by PC Titrator (QCLot: 2005091)								
EA005-P: pH Value	----	----	pH Unit	----	4 pH Unit	100	98	102
				----	7 pH Unit	100	98	102
EA010P: Conductivity by PC Titrator (QCLot: 2005092)								
EA010-P: Electrical Conductivity @ 25°C	----	1	µS/cm	<1	4000 µS/cm	101	91	107
				<1	12890 µS/cm	96.2	91	107
EA015: Total Dissolved Solids dried at 180 ± 5 °C (QCLot: 2005707)								
EA015H: Total Dissolved Solids @180°C	----	10	mg/L	<10	293 mg/L	102	88	112
				<10	2000 mg/L	100	88	112
ED037P: Alkalinity by PC Titrator (QCLot: 2005090)								
ED037-P: Total Alkalinity as CaCO3	----	----	mg/L	----	200 mg/L	95.2	80	120
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 2005225)								
ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	25 mg/L	102	85	118
				<1	100 mg/L	106	85	118
ED045G: Chloride by Discrete Analyser (QCLot: 2005224)								
ED045G: Chloride	16887-00-6	1	mg/L	<1	10 mg/L	102	90	115
				<1	1000 mg/L	102	90	115
ED093F: Dissolved Major Cations (QCLot: 2005582)								
ED093F: Calcium	7440-70-2	1	mg/L	<1	----	----	----	----
ED093F: Magnesium	7439-95-4	1	mg/L	<1	----	----	----	----
ED093F: Sodium	7440-23-5	1	mg/L	# 2	----	----	----	----
ED093F: Potassium	7440-09-7	1	mg/L	<1	----	----	----	----
EG020F: Dissolved Metals by ICP-MS (QCLot: 2005583)								
EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.1 mg/L	98.5	88	116
EG020A-F: Beryllium	7440-41-7	0.001	mg/L	<0.001	0.1 mg/L	82.4	81	117
EG020A-F: Barium	7440-39-3	0.001	mg/L	<0.001	0.5 mg/L	98.5	70	130
EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.1 mg/L	96.2	88	108
EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	0.1 mg/L	103	87	113
EG020A-F: Cobalt	7440-48-4	0.001	mg/L	<0.001	0.1 mg/L	99.9	86	112
EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	0.2 mg/L	99.8	88	114
EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	0.1 mg/L	99.6	89	110
EG020A-F: Manganese	7439-96-5	0.001	mg/L	<0.001	0.1 mg/L	102	89	120
EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	0.1 mg/L	95.8	89	113
EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	0.1 mg/L	97.8	83	112
EG020A-F: Vanadium	7440-62-2	0.01	mg/L	<0.01	0.1 mg/L	111	88	114

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
				Result	Concentration	LCS	Low	High
EG020F: Dissolved Metals by ICP-MS (QCLot: 2005583) - continued								
EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	0.2 mg/L	98.0	87	113
EG020A-F: Boron	7440-42-8	0.05	mg/L	<0.05	0.5 mg/L	91.1	81	125
EG020A-F: Iron	7439-89-6	0.05	mg/L	<0.05	0.5 mg/L	99.0	82	114
EG020T: Total Metals by ICP-MS (QCLot: 2005743)								
EG020A-T: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.1 mg/L	98.8	88	112
EG020A-T: Beryllium	7440-41-7	0.001	mg/L	<0.001	0.1 mg/L	100	81	119
EG020A-T: Barium	7440-39-3	0.001	mg/L	<0.001	0.5 mg/L	92.9	70	130
EG020A-T: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.1 mg/L	95.6	88	111
EG020A-T: Chromium	7440-47-3	0.001	mg/L	<0.001	0.1 mg/L	106	89	115
EG020A-T: Cobalt	7440-48-4	0.001	mg/L	<0.001	0.1 mg/L	100	89	115
EG020A-T: Copper	7440-50-8	0.001	mg/L	<0.001	0.2 mg/L	99.2	88	116
EG020A-T: Lead	7439-92-1	0.001	mg/L	<0.001	0.1 mg/L	109	89	112
EG020A-T: Manganese	7439-96-5	0.001	mg/L	<0.001	0.1 mg/L	102	88	114
EG020A-T: Nickel	7440-02-0	0.001	mg/L	<0.001	0.1 mg/L	96.8	88	116
EG020A-T: Selenium	7782-49-2	0.01	mg/L	<0.01	0.1 mg/L	97.0	79	111
EG020A-T: Vanadium	7440-62-2	0.01	mg/L	<0.01	0.1 mg/L	104	87	114
EG020A-T: Zinc	7440-66-6	0.005	mg/L	<0.005	0.2 mg/L	93.4	84	114
EG020A-T: Boron	7440-42-8	0.05	mg/L	<0.05	0.5 mg/L	107	82	128
EG020A-T: Iron	7439-89-6	0.05	mg/L	<0.05	0.5 mg/L	99.0	82	118
EG035F: Dissolved Mercury by FIMS (QCLot: 2005584)								
EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	0.01 mg/L	92.9	84	118
EG035T: Total Recoverable Mercury by FIMS (QCLot: 2005741)								
EG035T: Mercury	7439-97-6	0.0001	mg/L	<0.0001	0.01 mg/L	92.3	84	118
EK040P: Fluoride by PC Titrator (QCLot: 2005089)								
EK040P: Fluoride	16984-48-8	0.1	mg/L	<0.1	10 mg/L	105	80	117
EK055G: Ammonia as N by Discrete Analyser (QCLot: 2008325)								
EK055G: Ammonia as N	7664-41-7	0.01	mg/L	<0.01	0.5 mg/L	98.6	86	112
EK057G: Nitrite as N by Discrete Analyser (QCLot: 2005226)								
EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	0.5 mg/L	94.9	90	110
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 2008326)								
EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	0.5 mg/L	101	89	115
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 2005437)								
EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	<0.1	10 mg/L	86.0	70	111
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 2005439)								
EK067G: Total Phosphorus as P	----	0.01	mg/L	<0.01	0.442 mg/L	94.7	77	109
EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 2005227)								
EK071G: Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	0.5 mg/L	92.1	88	115

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **WATER**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 2005225)							
EB1825981-001	330-01-BH2222	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	20 mg/L	97.9	70	130
ED045G: Chloride by Discrete Analyser (QCLot: 2005224)							
EB1825981-001	330-01-BH2222	ED045G: Chloride	16887-00-6	400 mg/L	96.8	70	130
EG020F: Dissolved Metals by ICP-MS (QCLot: 2005583)							
EB1825979-001	Anonymous	EG020A-F: Arsenic	7440-38-2	0.1 mg/L	104	70	130
		EG020A-F: Beryllium	7440-41-7	0.1 mg/L	91.3	70	130
		EG020A-F: Barium	7440-39-3	0.5 mg/L	102	70	130
		EG020A-F: Cadmium	7440-43-9	0.1 mg/L	100.0	70	130
		EG020A-F: Chromium	7440-47-3	0.1 mg/L	99.7	70	130
		EG020A-F: Cobalt	7440-48-4	0.1 mg/L	97.5	70	130
		EG020A-F: Copper	7440-50-8	0.2 mg/L	96.9	70	130
		EG020A-F: Lead	7439-92-1	0.1 mg/L	102	70	130
		EG020A-F: Manganese	7439-96-5	0.1 mg/L	95.7	70	130
		EG020A-F: Nickel	7440-02-0	0.1 mg/L	92.7	70	130
		EG020A-F: Selenium	7782-49-2	0.1 mg/L	101	70	130
		EG020A-F: Vanadium	7440-62-2	0.1 mg/L	102	70	130
		EG020A-F: Zinc	7440-66-6	0.2 mg/L	104	70	130
		EG020A-F: Boron	7440-42-8	0.5 mg/L	92.7	70	130
EG020T: Total Metals by ICP-MS (QCLot: 2005743)							
EB1825914-002	Anonymous	EG020A-T: Arsenic	7440-38-2	1 mg/L	102	70	130
		EG020A-T: Beryllium	7440-41-7	0.1 mg/L	101	70	130
		EG020A-T: Barium	7440-39-3	1 mg/L	92.1	70	130
		EG020A-T: Cadmium	7440-43-9	0.5 mg/L	98.8	70	130
		EG020A-T: Chromium	7440-47-3	1 mg/L	92.9	70	130
		EG020A-T: Cobalt	7440-48-4	1 mg/L	83.8	70	130
		EG020A-T: Copper	7440-50-8	1 mg/L	80.8	70	130
		EG020A-T: Lead	7439-92-1	1 mg/L	88.1	70	130
		EG020A-T: Manganese	7439-96-5	1 mg/L	87.2	70	130
		EG020A-T: Nickel	7440-02-0	1 mg/L	80.5	70	130
		EG020A-T: Vanadium	7440-62-2	1 mg/L	91.0	70	130
		EG020A-T: Zinc	7440-66-6	1 mg/L	78.9	70	130
EG035F: Dissolved Mercury by FIMS (QCLot: 2005584)							
EB1825981-001	330-01-BH2222	EG035F: Mercury	7439-97-6	0.01 mg/L	88.1	70	130

Sub-Matrix: **WATER**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EG035T: Total Recoverable Mercury by FIMS (QCLot: 2005741)							
EB1825932-007	Anonymous	EG035T: Mercury	7439-97-6	0.01 mg/L	87.9	70	130
EK040P: Fluoride by PC Titrator (QCLot: 2005089)							
EB1825981-001	330-01-BH2222	EK040P: Fluoride	16984-48-8	5 mg/L	88.0	70	130
EK055G: Ammonia as N by Discrete Analyser (QCLot: 2008325)							
EB1825981-001	330-01-BH2222	EK055G: Ammonia as N	7664-41-7	0.4 mg/L	114	70	130
EK057G: Nitrite as N by Discrete Analyser (QCLot: 2005226)							
EB1825981-001	330-01-BH2222	EK057G: Nitrite as N	14797-65-0	0.4 mg/L	106	70	130
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 2008326)							
EB1825981-001	330-01-BH2222	EK059G: Nitrite + Nitrate as N	----	0.4 mg/L	99.8	70	130
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 2005437)							
EB1824322-002	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	5 mg/L	110	70	130
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 2005439)							
EB1825824-011	Anonymous	EK067G: Total Phosphorus as P	----	1 mg/L	112	70	130
EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 2005227)							
EB1825981-001	330-01-BH2222	EK071G: Reactive Phosphorus as P	14265-44-2	0.4 mg/L	105	70	130

ALS Environmental

QUALITY CONTROL REPORT

Work Order	: **EB1828572**	Page	: 1 of 8
Client	: **GOLDER ASSOCIATES**	Laboratory	: Environmental Division Brisbane
Contact	: MR SUSANTHA KUMARAPELI	Contact	: Andrew Epps
Address	: P O BOX 1734 MILTON QLD, AUSTRALIA 4064	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: +61 07 3721 5400	Telephone	: +61 7 3552 8639
Project	: 1893802 INLAND RAIL (P13)	Date Samples Received	: 22-Nov-2018
Order number	:	Date Analysis Commenced	: 22-Nov-2018
C-O-C number	: ----	Issue Date	: 26-Nov-2018
Sampler	: SUSANTHA KUMARAPELI		
Site	: ----		
Quote number	: EN/002/18 National BQ		
No. of samples received	: 1		
No. of samples analysed	: 1		

ilac-MRA NATA
Accreditation No. 825
Accredited for compliance with ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis. Where the LOR of a reported result differs from standard LOR, this may be due to high moisture

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EA005P: pH by PC Titrator (QC Lot: 2051941)									
EB1828142-003	Anonymous	EA005-P: pH Value	----	0.01	pH Unit	7.68	7.74	0.778	0% - 20%
EB1828180-003	Anonymous	EA005-P: pH Value	----	0.01	pH Unit	7.57	7.64	0.920	0% - 20%
EA010P: Conductivity by PC Titrator (QC Lot: 2051943)									
EB1828142-003	Anonymous	EA010-P: Electrical Conductivity @ 25°C	----	1	µS/cm	404	404	0.00	0% - 20%
EB1828180-003	Anonymous	EA010-P: Electrical Conductivity @ 25°C	----	1	µS/cm	16800	16800	0.482	0% - 20%
EA015: Total Dissolved Solids dried at 180 ± 5 °C (QC Lot: 2052371)									
EB1828018-001	Anonymous	EA015H: Total Dissolved Solids @180°C	----	10	mg/L	1590	1580	0.883	0% - 20%
ED037P: Alkalinity by PC Titrator (QC Lot: 2051942)									
EB1828142-003	Anonymous	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	87	86	0.00	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	87	86	0.00	0% - 20%
EB1828180-003	Anonymous	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	637	642	0.699	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	637	642	0.699	0% - 20%
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QC Lot: 2051983)									
EB1828573-004	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	3	3	0.00	No Limit
EB1828285-001	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	108	109	1.44	No Limit
ED045G: Chloride by Discrete Analyser (QC Lot: 2051984)									
EB1828573-004	Anonymous	ED045G: Chloride	16887-00-6	1	mg/L	7	9	21.9	No Limit
EB1828285-001	Anonymous	ED045G: Chloride	16887-00-6	1	mg/L	76200	75800	0.476	0% - 20%
ED093F: Dissolved Major Cations (QC Lot: 2053078)									
EB1828548-001	Anonymous	ED093F: Calcium	7440-70-2	1	mg/L	6	6	0.00	No Limit

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
ED093F: Dissolved Major Cations (QC Lot: 2053078) - continued									
EB1828548-001	Anonymous	ED093F: Magnesium	7439-95-4	1	mg/L	3	3	0.00	No Limit
		ED093F: Sodium	7440-23-5	1	mg/L	257	259	0.827	0% - 20%
		ED093F: Potassium	7440-09-7	1	mg/L	12	12	0.00	0% - 50%
EG020F: Dissolved Metals by ICP-MS (QC Lot: 2053080)									
EB1828548-001	Anonymous	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	0.004	0.004	0.00	No Limit
		EG020A-F: Beryllium	7440-41-7	0.001	mg/L	0.002	0.001	0.00	No Limit
		EG020A-F: Barium	7440-39-3	0.001	mg/L	0.182	0.191	4.88	0% - 20%
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	0.008	0.007	0.00	No Limit
		EG020A-F: Cobalt	7440-48-4	0.001	mg/L	0.005	0.006	18.1	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	0.004	0.003	0.00	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	0.007	0.007	0.00	No Limit
		EG020A-F: Manganese	7439-96-5	0.001	mg/L	0.040	0.040	0.00	0% - 20%
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	0.008	0.006	26.0	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	0.054	0.050	7.93	0% - 50%
		EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-F: Vanadium	7440-62-2	0.01	mg/L	0.02	0.02	0.00	No Limit
		EG020A-F: Boron	7440-42-8	0.05	mg/L	0.40	0.40	0.00	No Limit
EG020T: Total Metals by ICP-MS (QC Lot: 2053085)									
EB1828168-001	Anonymous	EG020A-T: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
		EG020A-T: Arsenic	7440-38-2	0.001	mg/L	0.002	0.002	0.00	No Limit
		EG020A-T: Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Barium	7440-39-3	0.001	mg/L	0.113	0.114	1.47	0% - 20%
		EG020A-T: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Cobalt	7440-48-4	0.001	mg/L	0.003	0.003	0.00	No Limit
		EG020A-T: Copper	7440-50-8	0.001	mg/L	0.004	0.004	0.00	No Limit
		EG020A-T: Lead	7439-92-1	0.001	mg/L	0.001	<0.001	0.00	No Limit
		EG020A-T: Manganese	7439-96-5	0.001	mg/L	0.385	0.384	0.00	0% - 20%
		EG020A-T: Nickel	7440-02-0	0.001	mg/L	0.006	0.006	0.00	No Limit
		EG020A-T: Zinc	7440-66-6	0.005	mg/L	0.007	0.006	0.00	No Limit
		EG020A-T: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-T: Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-T: Boron	7440-42-8	0.05	mg/L	0.14	0.14	0.00	No Limit
EG035F: Dissolved Mercury by FIMS (QC Lot: 2053079)									
EB1828548-001	Anonymous	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EG035T: Total Recoverable Mercury by FIMS (QC Lot: 2053088)									
EB1828168-001	Anonymous	EG035T: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EK040P: Fluoride by PC Titrator (QC Lot: 2051944)									
EB1828142-003	Anonymous	EK040P: Fluoride	16984-48-8	0.1	mg/L	0.1	0.1	0.00	No Limit

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EK040P: Fluoride by PC Titrator (QC Lot: 2051944) - continued									
EB1828180-003	Anonymous	EK040P: Fluoride	16984-48-8	0.1	mg/L	0.2	0.2	0.00	No Limit
EK055G: Ammonia as N by Discrete Analyser (QC Lot: 2052027)									
EB1828540-001	Anonymous	EK055G: Ammonia as N	7664-41-7	0.01	mg/L	0.02	0.05	81.1	No Limit
EK057G: Nitrite as N by Discrete Analyser (QC Lot: 2051982)									
EB1828573-004	Anonymous	EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	0.00	No Limit
EB1828285-001	Anonymous	EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.10	<0.10	0.00	No Limit
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QC Lot: 2052026)									
EB1828540-001	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	0.06	0.07	0.00	No Limit
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QC Lot: 2052364)									
EB1828147-001	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	2.6	2.7	4.48	0% - 20%
EB1828540-001	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	0.6	0.5	0.00	No Limit
EK067G: Total Phosphorus as P by Discrete Analyser (QC Lot: 2052363)									
EB1828147-001	Anonymous	EK067G: Total Phosphorus as P	----	0.01	mg/L	0.38	0.37	0.00	0% - 20%
EB1828540-001	Anonymous	EK067G: Total Phosphorus as P	----	0.01	mg/L	<0.01	<0.01	0.00	No Limit
EK071G: Reactive Phosphorus as P by discrete analyser (QC Lot: 2051985)									
EB1827882-001	Anonymous	EK071G: Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit

Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Spike (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **WATER**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EA005P: pH by PC Titrator (QCLot: 2051941)								
EA005-P: pH Value	----	----	pH Unit	----	4 pH Unit	101	98	102
				----	7 pH Unit	100	98	102
EA010P: Conductivity by PC Titrator (QCLot: 2051943)								
EA010-P: Electrical Conductivity @ 25°C	----	1	µS/cm	<1	2100 µS/cm	96.6	91	107
				<1	24800 µS/cm	99.5	91	107
EA015: Total Dissolved Solids dried at 180 ± 5 °C (QCLot: 2052371)								
EA015H: Total Dissolved Solids @180°C	----	10	mg/L	<10	293 mg/L	99.6	88	112
				<10	2000 mg/L	99.8	88	112
ED037P: Alkalinity by PC Titrator (QCLot: 2051942)								
ED037-P: Total Alkalinity as CaCO3	----	----	mg/L	----	50 mg/L	103	80	120
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 2051983)								
ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	25 mg/L	103	85	118
				<1	100 mg/L	114	85	118
ED045G: Chloride by Discrete Analyser (QCLot: 2051984)								
ED045G: Chloride	16887-00-6	1	mg/L	<1	10 mg/L	102	90	115
				<1	1000 mg/L	106	90	115
ED093F: Dissolved Major Cations (QCLot: 2053078)								
ED093F: Calcium	7440-70-2	1	mg/L	<1	----	----	----	----
ED093F: Magnesium	7439-95-4	1	mg/L	<1	----	----	----	----
ED093F: Sodium	7440-23-5	1	mg/L	<1	----	----	----	----
ED093F: Potassium	7440-09-7	1	mg/L	<1	----	----	----	----
EG020F: Dissolved Metals by ICP-MS (QCLot: 2053080)								
EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.1 mg/L	97.1	88	116
EG020A-F: Beryllium	7440-41-7	0.001	mg/L	<0.001	0.1 mg/L	101	81	117
EG020A-F: Barium	7440-39-3	0.001	mg/L	<0.001	0.5 mg/L	95.1	70	130
EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.1 mg/L	91.0	88	108
EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	0.1 mg/L	91.8	87	113
EG020A-F: Cobalt	7440-48-4	0.001	mg/L	<0.001	0.1 mg/L	92.5	86	112
EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	0.2 mg/L	96.9	88	114
EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	0.1 mg/L	97.7	89	110
EG020A-F: Manganese	7439-96-5	0.001	mg/L	<0.001	0.1 mg/L	92.7	89	120
EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	0.1 mg/L	95.6	89	113
EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	0.1 mg/L	94.3	83	112
EG020A-F: Vanadium	7440-62-2	0.01	mg/L	<0.01	0.1 mg/L	95.7	88	114

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
				Result	Concentration	LCS	Low	High
EG020F: Dissolved Metals by ICP-MS (QCLot: 2053080) - continued								
EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	0.2 mg/L	96.7	87	113
EG020A-F: Boron	7440-42-8	0.05	mg/L	<0.05	0.5 mg/L	99.4	81	125
EG020T: Total Metals by ICP-MS (QCLot: 2053085)								
EG020A-T: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.1 mg/L	97.8	88	112
EG020A-T: Beryllium	7440-41-7	0.001	mg/L	<0.001	0.1 mg/L	92.7	81	119
EG020A-T: Barium	7440-39-3	0.001	mg/L	<0.001	0.5 mg/L	93.8	70	130
EG020A-T: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.1 mg/L	90.6	88	111
EG020A-T: Chromium	7440-47-3	0.001	mg/L	<0.001	0.1 mg/L	97.5	89	115
EG020A-T: Cobalt	7440-48-4	0.001	mg/L	<0.001	0.1 mg/L	98.3	89	115
EG020A-T: Copper	7440-50-8	0.001	mg/L	<0.001	0.2 mg/L	102	88	116
EG020A-T: Lead	7439-92-1	0.001	mg/L	<0.001	0.1 mg/L	97.4	89	112
EG020A-T: Manganese	7439-96-5	0.001	mg/L	<0.001	0.1 mg/L	104	88	114
EG020A-T: Nickel	7440-02-0	0.001	mg/L	<0.001	0.1 mg/L	98.1	88	116
EG020A-T: Selenium	7782-49-2	0.01	mg/L	<0.01	0.1 mg/L	94.4	79	111
EG020A-T: Vanadium	7440-62-2	0.01	mg/L	<0.01	0.1 mg/L	110	87	114
EG020A-T: Zinc	7440-66-6	0.005	mg/L	<0.005	0.2 mg/L	94.2	84	114
EG020A-T: Boron	7440-42-8	0.05	mg/L	<0.05	0.5 mg/L	96.6	82	128
EG035F: Dissolved Mercury by FIMS (QCLot: 2053079)								
EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	0.01 mg/L	90.3	84	118
EG035T: Total Recoverable Mercury by FIMS (QCLot: 2053088)								
EG035T: Mercury	7439-97-6	0.0001	mg/L	<0.0001	0.01 mg/L	89.5	84	118
EK040P: Fluoride by PC Titrator (QCLot: 2051944)								
EK040P: Fluoride	16984-48-8	0.1	mg/L	<0.1	5 mg/L	93.6	80	117
EK055G: Ammonia as N by Discrete Analyser (QCLot: 2052027)								
EK055G: Ammonia as N	7664-41-7	0.01	mg/L	<0.01	0.5 mg/L	95.7	86	112
EK057G: Nitrite as N by Discrete Analyser (QCLot: 2051982)								
EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	0.5 mg/L	100	90	110
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 2052026)								
EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	0.5 mg/L	102	89	115
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 2052364)								
EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	<0.1	1 mg/L	83.8	70	108
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 2052363)								
EK067G: Total Phosphorus as P	----	0.01	mg/L	<0.01	0.442 mg/L	93.4	79	105
EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 2051985)								
EK071G: Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	0.5 mg/L	97.9	88	115

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **WATER**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 2051983)							
EB1828285-001	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	400 mg/L	93.8	70	130
ED045G: Chloride by Discrete Analyser (QCLot: 2051984)							
EB1828285-001	Anonymous	ED045G: Chloride	16887-00-6	400 mg/L	# Not Determined	70	130
EG020F: Dissolved Metals by ICP-MS (QCLot: 2053080)							
EB1828572-001	330-01-BH2103	EG020A-F: Arsenic	7440-38-2	0.1 mg/L	99.1	70	130
		EG020A-F: Beryllium	7440-41-7	0.1 mg/L	94.5	70	130
		EG020A-F: Barium	7440-39-3	0.5 mg/L	100	70	130
		EG020A-F: Cadmium	7440-43-9	0.1 mg/L	91.1	70	130
		EG020A-F: Chromium	7440-47-3	0.1 mg/L	85.8	70	130
		EG020A-F: Cobalt	7440-48-4	0.1 mg/L	88.8	70	130
		EG020A-F: Copper	7440-50-8	0.2 mg/L	90.3	70	130
		EG020A-F: Lead	7439-92-1	0.1 mg/L	86.4	70	130
		EG020A-F: Manganese	7439-96-5	0.1 mg/L	87.3	70	130
		EG020A-F: Nickel	7440-02-0	0.1 mg/L	88.2	70	130
		EG020A-F: Selenium	7782-49-2	0.1 mg/L	98.9	70	130
		EG020A-F: Vanadium	7440-62-2	0.1 mg/L	94.2	70	130
		EG020A-F: Zinc	7440-66-6	0.2 mg/L	89.5	70	130
		EG020A-F: Boron	7440-42-8	0.5 mg/L	89.2	70	130
EG020T: Total Metals by ICP-MS (QCLot: 2053085)							
EB1828168-002	Anonymous	EG020A-T: Arsenic	7440-38-2	1 mg/L	88.2	70	130
		EG020A-T: Beryllium	7440-41-7	0.1 mg/L	90.8	70	130
		EG020A-T: Barium	7440-39-3	1 mg/L	90.4	70	130
		EG020A-T: Cadmium	7440-43-9	0.5 mg/L	93.3	70	130
		EG020A-T: Chromium	7440-47-3	1 mg/L	90.9	70	130
		EG020A-T: Cobalt	7440-48-4	1 mg/L	88.1	70	130
		EG020A-T: Copper	7440-50-8	1 mg/L	93.9	70	130
		EG020A-T: Lead	7439-92-1	1 mg/L	88.3	70	130
		EG020A-T: Manganese	7439-96-5	1 mg/L	89.9	70	130
		EG020A-T: Nickel	7440-02-0	1 mg/L	90.9	70	130
		EG020A-T: Vanadium	7440-62-2	1 mg/L	86.2	70	130
		EG020A-T: Zinc	7440-66-6	1 mg/L	88.0	70	130
EG035F: Dissolved Mercury by FIMS (QCLot: 2053079)							
EB1828572-001	330-01-BH2103	EG035F: Mercury	7439-97-6	0.01 mg/L	80.2	70	130

Sub-Matrix: **WATER**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
EG035T: Total Recoverable Mercury by FIMS (QCLot: 2053088)							
EB1828168-002	Anonymous	EG035T: Mercury	7439-97-6	0.01 mg/L	81.7	70	130
EK040P: Fluoride by PC Titrator (QCLot: 2051944)							
EB1828142-004	Anonymous	EK040P: Fluoride	16984-48-8	5 mg/L	90.4	70	130
EK055G: Ammonia as N by Discrete Analyser (QCLot: 2052027)							
EB1828548-001	Anonymous	EK055G: Ammonia as N	7664-41-7	0.4 mg/L	86.8	70	130
EK057G: Nitrite as N by Discrete Analyser (QCLot: 2051982)							
EB1828285-001	Anonymous	EK057G: Nitrite as N	14797-65-0	4 mg/L	94.4	70	130
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 2052026)							
EB1828548-001	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.4 mg/L	94.9	70	130
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 2052364)							
EB1828148-001	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	5 mg/L	96.1	70	130
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 2052363)							
EB1828148-001	Anonymous	EK067G: Total Phosphorus as P	----	1 mg/L	94.5	70	130
EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 2051985)							
EB1828285-001	Anonymous	EK071G: Reactive Phosphorus as P	14265-44-2	4 mg/L	98.1	70	130

ALS Environmental

QUALITY CONTROL REPORT

Work Order	: **EB1830098**	Page	: 1 of 9
Client	: **GOLDER ASSOCIATES**	Laboratory	: Environmental Division Brisbane
Contact	: MR SUSANTHA KUMARAPELI	Contact	: Andrew Epps
Address	: P O BOX 1734 MILTON QLD, AUSTRALIA 4064	Address	: 2 Byth Street Stafford QLD Australia 4053
Telephone	: +61 07 3721 5400	Telephone	: +61 7 3552 8639
Project	: 1893802 INLAND RAIL (P13)	Date Samples Received	: 07-Dec-2018
Order number	:	Date Analysis Commenced	: 08-Dec-2018
C-O-C number	: ----	Issue Date	: 11-Dec-2018
Sampler	: HANNAH GROVES		
Site	: ----		
Quote number	: EN/002/18 National BQ		
No. of samples received	: 1		
No. of samples analysed	: 1		

ilac-MRA NATA
Accreditation No. 825
Accredited for compliance with ISO/IEC 17025 - Testing

This report supersedes any previous report(s) with this reference. Results apply to the sample(s) as submitted. This document shall not be reproduced, except in full.

This Quality Control Report contains the following information:

- Laboratory Duplicate (DUP) Report; Relative Percentage Difference (RPD) and Acceptance Limits
- Method Blank (MB) and Laboratory Control Spike (LCS) Report; Recovery and Acceptance Limits
- Matrix Spike (MS) Report; Recovery and Acceptance Limits

Signatories

This document has been electronically signed by the authorized signatories below. Electronic signing is carried out in compliance with procedures specified in 21 CFR Part 11.

Signatories	*Position*	*Accreditation Category*
Kim McCabe	Senior Inorganic Chemist	Brisbane Inorganics, Stafford, QLD

General Comments

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the USEPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request.

Where moisture determination has been performed, results are reported on a dry weight basis.

Where a reported less than (<) result is higher than the LOR, this may be due to primary sample extract/digestate dilution and/or insufficient sample for analysis. Where the LOR of a reported result differs from standard LOR, this may be due to high moisture

Key : Anonymous = Refers to samples which are not specifically part of this work order but formed part of the QC process lot
CAS Number = CAS registry number from database maintained by Chemical Abstracts Services. The Chemical Abstracts Service is a division of the American Chemical Society.
LOR = Limit of reporting
RPD = Relative Percentage Difference
# = Indicates failed QC

Laboratory Duplicate (DUP) Report

The quality control term Laboratory Duplicate refers to a randomly selected intralaboratory split. Laboratory duplicates provide information regarding method precision and sample heterogeneity. The permitted ranges for the Relative Percent Deviation (RPD) of Laboratory Duplicates are specified in ALS Method QWI-EN/38 and are dependent on the magnitude of results in comparison to the level of reporting: Result < 10 times LOR: No Limit; Result between 10 and 20 times LOR: 0% - 50%; Result > 20 times LOR: 0% - 20%.

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EA005P: pH by PC Titrator (QC Lot: 2082923)									
EB1829787-001	Anonymous	EA005-P: pH Value	----	0.01	pH Unit	8.84	8.92	0.901	0% - 20%
EA010P: Conductivity by PC Titrator (QC Lot: 2082922)									
EB1829787-001	Anonymous	EA010-P: Electrical Conductivity @ 25°C	----	1	µS/cm	5280	5250	0.575	0% - 20%
EA015: Total Dissolved Solids dried at 180 ± 5 °C (QC Lot: 2083184)									
EB1830080-004	Anonymous	EA015H: Total Dissolved Solids @180°C	----	10	mg/L	5140	5220	1.54	0% - 20%
ED037P: Alkalinity by PC Titrator (QC Lot: 2082925)									
EB1830028-001	Anonymous	ED037-P: Hydroxide Alkalinity as CaCO3	DMO-210-001	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Carbonate Alkalinity as CaCO3	3812-32-6	1	mg/L	<1	<1	0.00	No Limit
		ED037-P: Bicarbonate Alkalinity as CaCO3	71-52-3	1	mg/L	161	167	3.96	0% - 20%
		ED037-P: Total Alkalinity as CaCO3	----	1	mg/L	161	167	3.96	0% - 20%
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QC Lot: 2083109)									
EB1830063-007	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	8	8	0.00	No Limit
EB1830002-001	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	100	100	0.00	0% - 20%
ED045G: Chloride by Discrete Analyser (QC Lot: 2083112)									
EB1830063-007	Anonymous	ED045G: Chloride	16887-00-6	1	mg/L	95	97	1.49	0% - 20%
EB1830002-001	Anonymous	ED045G: Chloride	16887-00-6	1	mg/L	900	901	0.00	0% - 20%
ED093F: Dissolved Major Cations (QC Lot: 2083837)									
EB1830099-001	Anonymous	ED093F: Calcium	7440-70-2	1	mg/L	83	84	0.00	0% - 20%
		ED093F: Magnesium	7439-95-4	1	mg/L	27	28	0.00	0% - 20%
		ED093F: Sodium	7440-23-5	1	mg/L	974	972	0.165	0% - 20%
		ED093F: Potassium	7440-09-7	1	mg/L	12	12	0.00	0% - 50%
EB1829556-001	Anonymous	ED093F: Calcium	7440-70-2	1	mg/L	87	86	1.52	0% - 20%
		ED093F: Magnesium	7439-95-4	1	mg/L	65	64	0.00	0% - 20%
		ED093F: Sodium	7440-23-5	1	mg/L	356	350	1.55	0% - 20%

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
ED093F: Dissolved Major Cations (QC Lot: 2083837) - continued									
EB1829556-001	Anonymous	ED093F: Potassium	7440-09-7	1	mg/L	3	3	0.00	No Limit
EG020F: Dissolved Metals by ICP-MS (QC Lot: 2083839)									
EB1829787-001	Anonymous	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	0.0002	0.0002	0.00	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	0.005	0.005	0.00	No Limit
		EG020A-F: Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Barium	7440-39-3	0.001	mg/L	0.260	0.265	1.92	0% - 20%
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Manganese	7439-96-5	0.001	mg/L	0.027	0.028	0.00	0% - 20%
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	0.057	0.057	0.00	0% - 20%
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	0.008	0.009	0.00	No Limit
		EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-F: Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-F: Boron	7440-42-8	0.05	mg/L	1.81	1.84	1.40	0% - 20%
		EG020A-F: Iron	7439-89-6	0.05	mg/L	0.15	0.16	9.41	No Limit
EB1829556-001	Anonymous	EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
		EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Barium	7440-39-3	0.001	mg/L	0.045	0.045	0.00	0% - 20%
		EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Manganese	7439-96-5	0.001	mg/L	0.006	0.006	0.00	No Limit
		EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	<0.005	0.00	No Limit
		EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-F: Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-F: Boron	7440-42-8	0.05	mg/L	0.26	0.26	0.00	No Limit
		EG020A-F: Iron	7439-89-6	0.05	mg/L	<0.05	<0.05	0.00	No Limit
EG020T: Total Metals by ICP-MS (QC Lot: 2083997)									
EB1830098-001	330-01-BH2101	EG020A-T: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
		EG020A-T: Arsenic	7440-38-2	0.001	mg/L	0.004	0.004	0.00	No Limit
		EG020A-T: Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Barium	7440-39-3	0.001	mg/L	0.166	0.162	2.30	0% - 20%
		EG020A-T: Chromium	7440-47-3	0.001	mg/L	0.002	0.002	0.00	No Limit
		EG020A-T: Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Copper	7440-50-8	0.001	mg/L	0.002	0.001	0.00	No Limit

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EG020T: Total Metals by ICP-MS (QC Lot: 2083997) - continued									
EB1830098-001	330-01-BH2101	EG020A-T: Lead	7439-92-1	0.001	mg/L	<0.001	0.001	0.00	No Limit
		EG020A-T: Manganese	7439-96-5	0.001	mg/L	0.078	0.076	2.83	0% - 20%
		EG020A-T: Nickel	7440-02-0	0.001	mg/L	0.002	0.002	0.00	No Limit
		EG020A-T: Zinc	7440-66-6	0.005	mg/L	0.014	0.014	0.00	No Limit
		EG020A-T: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-T: Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-T: Boron	7440-42-8	0.05	mg/L	0.20	0.13	42.2	No Limit
		EG020A-T: Iron	7439-89-6	0.05	mg/L	3.31	3.15	5.05	0% - 20%
EB1829787-001	Anonymous	EG020A-T: Cadmium	7440-43-9	0.0001	mg/L	0.0001	0.0002	0.00	No Limit
		EG020A-T: Arsenic	7440-38-2	0.001	mg/L	0.006	0.006	0.00	No Limit
		EG020A-T: Beryllium	7440-41-7	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Barium	7440-39-3	0.001	mg/L	0.287	0.292	1.56	0% - 20%
		EG020A-T: Chromium	7440-47-3	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Cobalt	7440-48-4	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Copper	7440-50-8	0.001	mg/L	0.003	0.003	0.00	No Limit
		EG020A-T: Lead	7439-92-1	0.001	mg/L	<0.001	<0.001	0.00	No Limit
		EG020A-T: Manganese	7439-96-5	0.001	mg/L	0.038	0.038	0.00	0% - 20%
		EG020A-T: Nickel	7440-02-0	0.001	mg/L	0.060	0.063	4.50	0% - 20%
		EG020A-T: Zinc	7440-66-6	0.005	mg/L	0.037	0.037	0.00	No Limit
		EG020A-T: Selenium	7782-49-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-T: Vanadium	7440-62-2	0.01	mg/L	<0.01	<0.01	0.00	No Limit
		EG020A-T: Boron	7440-42-8	0.05	mg/L	1.54	1.83	17.3	0% - 20%
		EG020A-T: Iron	7439-89-6	0.05	mg/L	2.62	2.68	2.08	0% - 20%
EG035F: Dissolved Mercury by FIMS (QC Lot: 2083838)									
EB1830022-001	Anonymous	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EB1829556-001	Anonymous	EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	<0.0001	0.00	No Limit
EG035T: Total Recoverable Mercury by FIMS (QC Lot: 2083995)									
EB1830028-001	Anonymous	EG035T: Mercury	7439-97-6	0.0001	mg/L	0.0705	0.0745	5.52	0% - 20%
EK055G: Ammonia as N by Discrete Analyser (QC Lot: 2083445)									
EB1830002-001	Anonymous	EK055G: Ammonia as N	7664-41-7	0.01	mg/L	2.04	1.98	2.79	0% - 20%
EK057G: Nitrite as N by Discrete Analyser (QC Lot: 2083111)									
EB1830063-007	Anonymous	EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	0.00	No Limit
EB1830002-001	Anonymous	EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	<0.01	0.00	No Limit
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QC Lot: 2083446)									
EB1830002-001	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	0.03	0.05	50.2	No Limit
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QC Lot: 2084226)									
EB1829364-001	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	2.7	2.8	0.00	0% - 20%
EB1830099-001	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	49.3	55.1	11.1	No Limit
EK067G: Total Phosphorus as P by Discrete Analyser (QC Lot: 2084225)									

Sub-Matrix: **WATER**

				Laboratory Duplicate (DUP) Report					
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*LOR*	*Unit*	*Original Result*	*Duplicate Result*	*RPD (%)*	*Recovery Limits (%)*
EK067G: Total Phosphorus as P by Discrete Analyser (QC Lot: 2084225) - continued									
EB1829364-001	Anonymous	EK067G: Total Phosphorus as P	----	0.01	mg/L	0.39	0.38	3.38	0% - 20%
EB1830099-001	Anonymous	EK067G: Total Phosphorus as P	----	0.01	mg/L	127	125	2.10	0% - 20%
EK071G: Reactive Phosphorus as P by discrete analyser (QC Lot: 2083110)									
EB1830002-001	Anonymous	EK071G: Reactive Phosphorus as P	14265-44-2	0.01	mg/L	0.05	0.05	0.00	No Limit

Method Blank (MB) and Laboratory Control Spike (LCS) Report

The quality control term Method / Laboratory Blank refers to an analyte free matrix to which all reagents are added in the same volumes or proportions as used in standard sample preparation. The purpose of this QC parameter is to monitor potential laboratory contamination. The quality control term Laboratory Control Spike (LCS) refers to a certified reference material, or a known interference free matrix spiked with target analytes. The purpose of this QC parameter is to monitor method precision and accuracy independent of sample matrix. Dynamic Recovery Limits are based on statistical evaluation of processed LCS.

Sub-Matrix: **WATER**

				Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
Method: Compound	CAS Number	LOR	Unit	Result	Concentration	LCS	Low	High
EA005P: pH by PC Titrator (QCLot: 2082923)								
EA005-P: pH Value	----	----	pH Unit	----	4 pH Unit	101	98	102
				----	7 pH Unit	100	98	102
EA010P: Conductivity by PC Titrator (QCLot: 2082922)								
EA010-P: Electrical Conductivity @ 25°C	----	1	µS/cm	<1	220 µS/cm	103	91	107
				<1	12890 µS/cm	98.9	91	107
EA015: Total Dissolved Solids dried at 180 ± 5 °C (QCLot: 2083184)								
EA015H: Total Dissolved Solids @180°C	----	10	mg/L	<10	293 mg/L	102	88	112
				<10	2000 mg/L	98.0	88	112
ED037P: Alkalinity by PC Titrator (QCLot: 2082925)								
ED037-P: Total Alkalinity as CaCO3	----	----	mg/L	----	50 mg/L	107	80	120
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 2083109)								
ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	1	mg/L	<1	25 mg/L	101	85	118
				<1	100 mg/L	95.5	85	118
ED045G: Chloride by Discrete Analyser (QCLot: 2083112)								
ED045G: Chloride	16887-00-6	1	mg/L	<1	10 mg/L	103	90	115
				<1	1000 mg/L	102	90	115
ED093F: Dissolved Major Cations (QCLot: 2083837)								
ED093F: Calcium	7440-70-2	1	mg/L	<1	----	----	----	----
ED093F: Magnesium	7439-95-4	1	mg/L	<1	----	----	----	----
ED093F: Sodium	7440-23-5	1	mg/L	<1	----	----	----	----
ED093F: Potassium	7440-09-7	1	mg/L	<1	----	----	----	----
EG020F: Dissolved Metals by ICP-MS (QCLot: 2083839)								
EG020A-F: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.1 mg/L	94.3	88	116
EG020A-F: Beryllium	7440-41-7	0.001	mg/L	<0.001	0.1 mg/L	96.1	81	117
EG020A-F: Barium	7440-39-3	0.001	mg/L	<0.001	0.5 mg/L	100	70	130
EG020A-F: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.1 mg/L	95.3	88	108
EG020A-F: Chromium	7440-47-3	0.001	mg/L	<0.001	0.1 mg/L	90.7	87	113
EG020A-F: Cobalt	7440-48-4	0.001	mg/L	<0.001	0.1 mg/L	95.5	86	112
EG020A-F: Copper	7440-50-8	0.001	mg/L	<0.001	0.2 mg/L	94.4	88	114
EG020A-F: Lead	7439-92-1	0.001	mg/L	<0.001	0.1 mg/L	93.4	89	110
EG020A-F: Manganese	7439-96-5	0.001	mg/L	<0.001	0.1 mg/L	93.1	89	120
EG020A-F: Nickel	7440-02-0	0.001	mg/L	<0.001	0.1 mg/L	93.5	89	113
EG020A-F: Selenium	7782-49-2	0.01	mg/L	<0.01	0.1 mg/L	87.1	83	112
EG020A-F: Vanadium	7440-62-2	0.01	mg/L	<0.01	0.1 mg/L	102	88	114

Sub-Matrix: **WATER**

Method: Compound	CAS Number	LOR	Unit	Method Blank (MB) Report	Laboratory Control Spike (LCS) Report			
					Spike	Spike Recovery (%)	Recovery Limits (%)	
				Result	Concentration	LCS	Low	High
EG020F: Dissolved Metals by ICP-MS (QCLot: 2083839) - continued								
EG020A-F: Zinc	7440-66-6	0.005	mg/L	<0.005	0.2 mg/L	92.3	87	113
EG020A-F: Boron	7440-42-8	0.05	mg/L	<0.05	0.5 mg/L	100	81	125
EG020A-F: Iron	7439-89-6	0.05	mg/L	<0.05	0.5 mg/L	95.3	82	114
EG020T: Total Metals by ICP-MS (QCLot: 2083997)								
EG020A-T: Arsenic	7440-38-2	0.001	mg/L	<0.001	0.1 mg/L	99.8	88	112
EG020A-T: Beryllium	7440-41-7	0.001	mg/L	<0.001	0.1 mg/L	87.4	81	119
EG020A-T: Barium	7440-39-3	0.001	mg/L	<0.001	0.5 mg/L	93.4	70	130
EG020A-T: Cadmium	7440-43-9	0.0001	mg/L	<0.0001	0.1 mg/L	91.0	88	111
EG020A-T: Chromium	7440-47-3	0.001	mg/L	<0.001	0.1 mg/L	99.9	89	115
EG020A-T: Cobalt	7440-48-4	0.001	mg/L	<0.001	0.1 mg/L	104	89	115
EG020A-T: Copper	7440-50-8	0.001	mg/L	<0.001	0.2 mg/L	106	88	116
EG020A-T: Lead	7439-92-1	0.001	mg/L	<0.001	0.1 mg/L	95.6	89	112
EG020A-T: Manganese	7439-96-5	0.001	mg/L	<0.001	0.1 mg/L	97.7	88	114
EG020A-T: Nickel	7440-02-0	0.001	mg/L	<0.001	0.1 mg/L	100	88	116
EG020A-T: Selenium	7782-49-2	0.01	mg/L	<0.01	0.1 mg/L	98.2	79	111
EG020A-T: Vanadium	7440-62-2	0.01	mg/L	<0.01	0.1 mg/L	102	87	114
EG020A-T: Zinc	7440-66-6	0.005	mg/L	<0.005	0.2 mg/L	104	84	114
EG020A-T: Boron	7440-42-8	0.05	mg/L	<0.05	0.5 mg/L	93.8	82	128
EG020A-T: Iron	7439-89-6	0.05	mg/L	<0.05	0.5 mg/L	96.3	82	118
EG035F: Dissolved Mercury by FIMS (QCLot: 2083838)								
EG035F: Mercury	7439-97-6	0.0001	mg/L	<0.0001	0.01 mg/L	99.3	84	118
EG035T: Total Recoverable Mercury by FIMS (QCLot: 2083995)								
EG035T: Mercury	7439-97-6	0.0001	mg/L	<0.0001	0.01 mg/L	97.6	84	118
EK055G: Ammonia as N by Discrete Analyser (QCLot: 2083445)								
EK055G: Ammonia as N	7664-41-7	0.01	mg/L	<0.01	0.5 mg/L	97.4	86	112
EK057G: Nitrite as N by Discrete Analyser (QCLot: 2083111)								
EK057G: Nitrite as N	14797-65-0	0.01	mg/L	<0.01	0.5 mg/L	101	90	110
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 2083446)								
EK059G: Nitrite + Nitrate as N	----	0.01	mg/L	<0.01	0.5 mg/L	108	89	115
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 2084226)								
EK061G: Total Kjeldahl Nitrogen as N	----	0.1	mg/L	<0.1	10 mg/L	95.1	70	108
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 2084225)								
EK067G: Total Phosphorus as P	----	0.01	mg/L	<0.01	4.42 mg/L	89.9	79	105
EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 2083110)								
EK071G: Reactive Phosphorus as P	14265-44-2	0.01	mg/L	<0.01	0.5 mg/L	96.3	88	115

Matrix Spike (MS) Report

The quality control term Matrix Spike (MS) refers to an intralaboratory split sample spiked with a representative set of target analytes. The purpose of this QC parameter is to monitor potential matrix effects on analyte recoveries. Static Recovery Limits as per laboratory Data Quality Objectives (DQOs). Ideal recovery ranges stated may be waived in the event of sample matrix interference.

Sub-Matrix: **WATER**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	Client sample ID	Method: Compound	CAS Number	Concentration	MS	Low	High
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA (QCLot: 2083109)							
EB1830002-004	Anonymous	ED041G: Sulfate as SO4 - Turbidimetric	14808-79-8	20 mg/L	112	70	130
ED045G: Chloride by Discrete Analyser (QCLot: 2083112)							
EB1830002-004	Anonymous	ED045G: Chloride	16887-00-6	400 mg/L	98.1	70	130
EG020F: Dissolved Metals by ICP-MS (QCLot: 2083839)							
EB1829556-003	Anonymous	EG020A-F: Arsenic	7440-38-2	0.1 mg/L	112	70	130
		EG020A-F: Beryllium	7440-41-7	0.1 mg/L	111	70	130
		EG020A-F: Barium	7440-39-3	0.5 mg/L	109	70	130
		EG020A-F: Cadmium	7440-43-9	0.1 mg/L	103	70	130
		EG020A-F: Chromium	7440-47-3	0.1 mg/L	93.7	70	130
		EG020A-F: Cobalt	7440-48-4	0.1 mg/L	95.0	70	130
		EG020A-F: Copper	7440-50-8	0.2 mg/L	90.3	70	130
		EG020A-F: Lead	7439-92-1	0.1 mg/L	102	70	130
		EG020A-F: Manganese	7439-96-5	0.1 mg/L	# Not Determined	70	130
		EG020A-F: Nickel	7440-02-0	0.1 mg/L	89.4	70	130
		EG020A-F: Selenium	7782-49-2	0.1 mg/L	116	70	130
		EG020A-F: Vanadium	7440-62-2	0.1 mg/L	100	70	130
		EG020A-F: Zinc	7440-66-6	0.2 mg/L	103	70	130
		EG020A-F: Boron	7440-42-8	0.5 mg/L	104	70	130
EG020T: Total Metals by ICP-MS (QCLot: 2083997)							
EB1829787-002	Anonymous	EG020A-T: Arsenic	7440-38-2	1 mg/L	98.6	70	130
		EG020A-T: Beryllium	7440-41-7	0.1 mg/L	83.5	70	130
		EG020A-T: Barium	7440-39-3	1 mg/L	98.3	70	130
		EG020A-T: Cadmium	7440-43-9	0.5 mg/L	89.8	70	130
		EG020A-T: Chromium	7440-47-3	1 mg/L	94.6	70	130
		EG020A-T: Cobalt	7440-48-4	1 mg/L	94.2	70	130
		EG020A-T: Copper	7440-50-8	1 mg/L	90.3	70	130
		EG020A-T: Lead	7439-92-1	1 mg/L	88.2	70	130
		EG020A-T: Manganese	7439-96-5	1 mg/L	88.0	70	130
		EG020A-T: Nickel	7440-02-0	1 mg/L	90.6	70	130
		EG020A-T: Vanadium	7440-62-2	1 mg/L	95.8	70	130
		EG020A-T: Zinc	7440-66-6	1 mg/L	96.5	70	130
EG035F: Dissolved Mercury by FIMS (QCLot: 2083838)							
EB1829556-002	Anonymous	EG035F: Mercury	7439-97-6	0.01 mg/L	87.2	70	130
EG035T: Total Recoverable Mercury by FIMS (QCLot: 2083995)							
EB1830098-001	330-01-BH2101	EG035T: Mercury	7439-97-6	0.01 mg/L	83.0	70	130

Sub-Matrix: **WATER**

				Matrix Spike (MS) Report			
				Spike	SpikeRecovery(%)	Recovery Limits (%)	
Laboratory sample ID	*Client sample ID*	*Method: Compound*	*CAS Number*	*Concentration*	*MS*	*Low*	*High*
EK055G: Ammonia as N by Discrete Analyser (QCLot: 2083445)							
EB1830002-004	Anonymous	EK055G: Ammonia as N	7664-41-7	0.4 mg/L	94.0	70	130
EK057G: Nitrite as N by Discrete Analyser (QCLot: 2083111)							
EB1830002-004	Anonymous	EK057G: Nitrite as N	14797-65-0	0.4 mg/L	107	70	130
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser (QCLot: 2083446)							
EB1830002-004	Anonymous	EK059G: Nitrite + Nitrate as N	----	0.4 mg/L	99.8	70	130
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser (QCLot: 2084226)							
EB1829364-002	Anonymous	EK061G: Total Kjeldahl Nitrogen as N	----	5 mg/L	108	70	130
EK067G: Total Phosphorus as P by Discrete Analyser (QCLot: 2084225)							
EB1829364-002	Anonymous	EK067G: Total Phosphorus as P	----	1 mg/L	107	70	130
EK071G: Reactive Phosphorus as P by discrete analyser (QCLot: 2083110)							
EB1830002-004	Anonymous	EK071G: Reactive Phosphorus as P	14265-44-2	0.4 mg/L	101	70	130

ALS Environmental

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **EB1825628**	Page	: 1 of 10
Client	: **GOLDER ASSOCIATES**	Laboratory	: Environmental Division Brisbane
Contact	: MR MITCH McGINNIS	Telephone	: +61 7 3552 8639
Project	: 1893802 Inland Rail (P13)	Date Samples Received	: 24-Oct-2018
Site	: ----	Issue Date	: 26-Oct-2018
Sampler	: ROBERT CUPPER	No. of samples received	: 4
Order number	:	No. of samples analysed	: 4

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **NO Duplicate outliers occur.**
- **NO Laboratory Control outliers occur.**
- **NO Matrix Spike outliers occur.**
- **For all regular sample matrices, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **Analysis Holding Time Outliers exist - please see following pages for full details.**

Outliers : Frequency of Quality Control Samples

- **NO Quality Control Sample Frequency Outliers exist.**

Outliers : Analysis Holding Time Compliance

Matrix: **WATER**

Method / Container / Client Sample ID(s)	Extraction / Preparation			Analysis		
	Date extracted	Due for extraction	Days overdue	Date analysed	Due for analysis	Days overdue
EA005P: pH by PC Titrator						
Clear Plastic Bottle - Natural						
330-01-BH2212	----	----	----	24-Oct-2018	22-Oct-2018	**2**
Clear Plastic Bottle - Natural						
330-01-BH2216, GW 789, 330-01-BH22104	----	----	----	24-Oct-2018	23-Oct-2018	**1**

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA005P: pH by PC Titrator							
Clear Plastic Bottle - Natural (EA005-P)							
330-01-BH2212	**22-Oct-2018**	**----**	----	----	**24-Oct-2018**	22-Oct-2018	×
Clear Plastic Bottle - Natural (EA005-P)							
330-01-BH2216, GW 789, 330-01-BH22104	**23-Oct-2018**	**----**	----	----	**24-Oct-2018**	23-Oct-2018	×
EA010P: Conductivity by PC Titrator							
Clear Plastic Bottle - Natural (EA010-P)							
330-01-BH2212	**22-Oct-2018**	**----**	----	----	**24-Oct-2018**	19-Nov-2018	✓
Clear Plastic Bottle - Natural (EA010-P)							
330-01-BH2216, GW 789, 330-01-BH22104	**23-Oct-2018**	**----**	----	----	**24-Oct-2018**	20-Nov-2018	✓
EA015: Total Dissolved Solids dried at 180 ± 5 °C							
Clear Plastic Bottle - Natural (EA015H)							
330-01-BH2212	**22-Oct-2018**	**----**	----	----	**24-Oct-2018**	29-Oct-2018	✓
Clear Plastic Bottle - Natural (EA015H)							
330-01-BH2216, GW 789, 330-01-BH22104	**23-Oct-2018**	**----**	----	----	**24-Oct-2018**	30-Oct-2018	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
ED037P: Alkalinity by PC Titrator							
Clear Plastic Bottle - Natural (ED037-P)							
330-01-BH2212	**22-Oct-2018**	**----**	----	----	**24-Oct-2018**	05-Nov-2018	✓
Clear Plastic Bottle - Natural (ED037-P)							
330-01-BH2216, GW 789, 330-01-BH22104	**23-Oct-2018**	**----**	----	----	**24-Oct-2018**	06-Nov-2018	✓
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA							
Clear Plastic Bottle - Natural (ED041G)							
330-01-BH2212	**22-Oct-2018**	**----**	----	----	**24-Oct-2018**	19-Nov-2018	✓
Clear Plastic Bottle - Natural (ED041G)							
330-01-BH2216, GW 789, 330-01-BH22104	**23-Oct-2018**	**----**	----	----	**24-Oct-2018**	20-Nov-2018	✓
ED045G: Chloride by Discrete Analyser							
Clear Plastic Bottle - Natural (ED045G)							
330-01-BH2212	**22-Oct-2018**	**----**	----	----	**24-Oct-2018**	19-Nov-2018	✓
Clear Plastic Bottle - Natural (ED045G)							
330-01-BH2216, GW 789, 330-01-BH22104	**23-Oct-2018**	**----**	----	----	**24-Oct-2018**	20-Nov-2018	✓
ED093F: Dissolved Major Cations							
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F)							
330-01-BH2212	**22-Oct-2018**	**----**	----	----	**25-Oct-2018**	19-Nov-2018	✓
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F)							
330-01-BH2216, GW 789, 330-01-BH22104	**23-Oct-2018**	**----**	----	----	**25-Oct-2018**	20-Nov-2018	✓
ED093F: SAR and Hardness Calculations							
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F)							
330-01-BH2212	**22-Oct-2018**	**----**	----	----	**25-Oct-2018**	19-Nov-2018	✓
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F)							
330-01-BH2216, GW 789, 330-01-BH22104	**23-Oct-2018**	**----**	----	----	**25-Oct-2018**	20-Nov-2018	✓
EG020F: Dissolved Metals by ICP-MS							
Clear Plastic Bottle - Nitric Acid; Filtered (EG020A-F)							
330-01-BH2212	**22-Oct-2018**	**----**	----	----	**25-Oct-2018**	20-Apr-2019	✓
Clear Plastic Bottle - Nitric Acid; Filtered (EG020A-F)							
330-01-BH2216, GW 789, 330-01-BH22104	**23-Oct-2018**	**----**	----	----	**25-Oct-2018**	21-Apr-2019	✓
EG020T: Total Metals by ICP-MS							
Clear Plastic Bottle - Nitric Acid; Unfiltered (EG020A-T)							
330-01-BH2212	**22-Oct-2018**	**25-Oct-2018**	20-Apr-2019	✓	**25-Oct-2018**	20-Apr-2019	✓
Clear Plastic Bottle - Nitric Acid; Unfiltered (EG020A-T)							
330-01-BH2216, GW 789, 330-01-BH22104	**23-Oct-2018**	**25-Oct-2018**	21-Apr-2019	✓	**25-Oct-2018**	21-Apr-2019	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EG035F: Dissolved Mercury by FIMS							
Clear Plastic Bottle - Nitric Acid; Filtered (EG035F)							
330-01-BH2212	**22-Oct-2018**	**----**	----	----	**25-Oct-2018**	19-Nov-2018	✓
Clear Plastic Bottle - Nitric Acid; Filtered (EG035F)							
330-01-BH2216, GW 789, 330-01-BH22104	**23-Oct-2018**	**----**	----	----	**25-Oct-2018**	20-Nov-2018	✓
EG035T: Total Recoverable Mercury by FIMS							
Clear Plastic Bottle - Nitric Acid; Unfiltered (EG035T)							
330-01-BH2212	**22-Oct-2018**	**----**	----	----	**26-Oct-2018**	19-Nov-2018	✓
Clear Plastic Bottle - Nitric Acid; Unfiltered (EG035T)							
330-01-BH2216, GW 789, 330-01-BH22104	**23-Oct-2018**	**----**	----	----	**26-Oct-2018**	20-Nov-2018	✓
EK040P: Fluoride by PC Titrator							
Clear Plastic Bottle - Natural (EK040P)							
330-01-BH2212	**22-Oct-2018**	**----**	----	----	**24-Oct-2018**	19-Nov-2018	✓
Clear Plastic Bottle - Natural (EK040P)							
330-01-BH2216, GW 789, 330-01-BH22104	**23-Oct-2018**	**----**	----	----	**24-Oct-2018**	20-Nov-2018	✓
EK055G: Ammonia as N by Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK055G)							
330-01-BH2212	**22-Oct-2018**	**----**	----	----	**25-Oct-2018**	19-Nov-2018	✓
Clear Plastic Bottle - Sulfuric Acid (EK055G)							
330-01-BH2216, GW 789, 330-01-BH22104	**23-Oct-2018**	**----**	----	----	**25-Oct-2018**	20-Nov-2018	✓
EK057G: Nitrite as N by Discrete Analyser							
Clear Plastic Bottle - Natural (EK057G)							
330-01-BH2212	**22-Oct-2018**	**----**	----	----	**24-Oct-2018**	24-Oct-2018	✓
Clear Plastic Bottle - Natural (EK057G)							
330-01-BH2216, GW 789, 330-01-BH22104	**23-Oct-2018**	**----**	----	----	**24-Oct-2018**	25-Oct-2018	✓
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK059G)							
330-01-BH2212	**22-Oct-2018**	**----**	----	----	**25-Oct-2018**	19-Nov-2018	✓
Clear Plastic Bottle - Sulfuric Acid (EK059G)							
330-01-BH2216, GW 789, 330-01-BH22104	**23-Oct-2018**	**----**	----	----	**25-Oct-2018**	20-Nov-2018	✓
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK061G)							
330-01-BH2212	**22-Oct-2018**	**25-Oct-2018**	19-Nov-2018	✓	**25-Oct-2018**	19-Nov-2018	✓
Clear Plastic Bottle - Sulfuric Acid (EK061G)							
330-01-BH2216, GW 789, 330-01-BH22104	**23-Oct-2018**	**25-Oct-2018**	20-Nov-2018	✓	**25-Oct-2018**	20-Nov-2018	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EK067G: Total Phosphorus as P by Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK067G)							
330-01-BH2212	**22-Oct-2018**	**25-Oct-2018**	19-Nov-2018	✓	**25-Oct-2018**	19-Nov-2018	✓
Clear Plastic Bottle - Sulfuric Acid (EK067G)							
330-01-BH2216, GW 789, 330-01-BH22104	**23-Oct-2018**	**25-Oct-2018**	20-Nov-2018	✓	**25-Oct-2018**	20-Nov-2018	✓
EK071G: Reactive Phosphorus as P by discrete analyser							
Clear Plastic Bottle - Natural (EK071G)							
330-01-BH2212	**22-Oct-2018**	**----**	----	----	**24-Oct-2018**	24-Oct-2018	✓
Clear Plastic Bottle - Natural (EK071G)							
330-01-BH2216, GW 789, 330-01-BH22104	**23-Oct-2018**	**----**	----	----	**24-Oct-2018**	25-Oct-2018	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **WATER**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Alkalinity by PC Titrator	ED037-P	2	18	**11.11**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Ammonia as N by Discrete analyser	EK055G	2	13	**15.38**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	1	8	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by PC Titrator	EA010-P	2	19	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	2	11	**18.18**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	2	18	**11.11**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	2	14	**14.29**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	2	14	**14.29**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	2	15	**13.33**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	2	16	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
pH by PC Titrator	EA005-P	2	19	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	9	**11.11**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	8	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Dissolved Solids (High Level)	EA015H	3	21	**14.29**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	2	19	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	8	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	2	12	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Alkalinity by PC Titrator	ED037-P	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Ammonia as N by Discrete analyser	EK055G	1	13	**7.69**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	2	8	**25.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by PC Titrator	EA010-P	2	19	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	11	**9.09**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	1	14	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	15	**6.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
pH by PC Titrator	EA005-P	2	19	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	9	**11.11**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	8	**25.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Dissolved Solids (High Level)	EA015H	4	21	**19.05**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	8	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Matrix: **WATER**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Method Blanks (MB)							
Ammonia as N by Discrete analyser	EK055G	1	13	**7.69**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	1	8	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by PC Titrator	EA010-P	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	11	**9.09**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	1	14	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	1	14	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	15	**6.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	9	**11.11**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	8	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Dissolved Solids (High Level)	EA015H	2	21	**9.52**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	8	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Ammonia as N by Discrete analyser	EK055G	1	13	**7.69**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	1	8	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	11	**9.09**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	1	14	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	15	**6.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	9	**11.11**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	8	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	8	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
pH by PC Titrator	EA005-P	WATER	In house: Referenced to APHA 4500 H+ B. This procedure determines pH of water samples by automated ISE. This method is compliant with NEPM (2013) Schedule B(3)
Sodium Adsorption Ratio	EA006	WATER	In house: Referenced to APHA 3120 Ca, Mg, Na. This method is compliant with NEPM (2013) Schedule B(3)
Conductivity by PC Titrator	EA010-P	WATER	In house: Referenced to APHA 2510 B. This procedure determines conductivity by automated ISE. This method is compliant with NEPM (2013) Schedule B(3)
Total Dissolved Solids (High Level)	EA015H	WATER	In house: Referenced to APHA 2540C. A gravimetric procedure that determines the amount of `filterable` residue in an aqueous sample. A well-mixed sample is filtered through a glass fibre filter (1.2um). The filtrate is evaporated to dryness and dried to constant weight at 180+/-5C. This method is compliant with NEPM (2013) Schedule B(3)
Alkalinity by PC Titrator	ED037-P	WATER	In house: Referenced to APHA 2320 B This procedure determines alkalinity by automated measurement (e.g. PC Titrate) using pH 4.5 for indicating the total alkalinity end-point. This method is compliant with NEPM (2013) Schedule B(3)
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	WATER	In house: Referenced to APHA 4500-SO4. Dissolved sulfate is determined in a 0.45um filtered sample. Sulfate ions are converted to a barium sulfate suspension in an acetic acid medium with barium chloride. Light absorbance of the BaSO4 suspension is measured by a photometer and the SO4-2 concentration is determined by comparison of the reading with a standard curve. This method is compliant with NEPM (2013) Schedule B(3)
Chloride by Discrete Analyser	ED045G	WATER	In house: Referenced to APHA 4500 Cl - G.The thiocyanate ion is liberated from mercuric thiocyanate through sequestration of mercury by the chloride ion to form non-ionised mercuric chloride.in the presence of ferric ions the librated thiocynate forms highly-coloured ferric thiocynate which is measured at 480 nm APHA 21st edition seal method 2 017-1-L april 2003
Major Cations - Dissolved	ED093F	WATER	In house: Referenced to APHA 3120 and 3125; USEPA SW 846 - 6010 and 6020; Cations are determined by either ICP-AES or ICP-MS techniques. This method is compliant with NEPM (2013) Schedule B(3) Sodium Adsorption Ratio is calculated from Ca, Mg and Na which determined by ALS in house method QWI-EN/ED093F. This method is compliant with NEPM (2013) Schedule B(3) Hardness parameters are calculated based on APHA 2340 B. This method is compliant with NEPM (2013) Schedule B(3)
Dissolved Metals by ICP-MS - Suite A	EG020A-F	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. Samples are 0.45µm filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Total Metals by ICP-MS - Suite A	EG020A-T	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.

Analytical Methods	Method	Matrix	Method Descriptions
Dissolved Mercury by FIMS	EG035F	WATER	In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) Samples are 0.45µm filtered prior to analysis. FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the filtered sample. The ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
Total Mercury by FIMS	EG035T	WATER	In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the unfiltered sample. The ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
Fluoride by PC Titrator	EK040P	WATER	In house: Referenced to APHA 4500-F C: CDTA is added to the sample to provide a uniform ionic strength background, adjust pH, and break up complexes. Fluoride concentration is determined by either manual or automatic ISE measurement. This method is compliant with NEPM (2013) Schedule B(3)
Ammonia as N by Discrete analyser	EK055G	WATER	In house: Referenced to APHA 4500-NH3 G Ammonia is determined by direct colorimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Nitrite as N by Discrete Analyser	EK057G	WATER	In house: Referenced to APHA 4500-NO2- B. Nitrite is determined by direct colourimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Nitrate as N by Discrete Analyser	EK058G	WATER	In house: Referenced to APHA 4500-NO3- F. Nitrate is reduced to nitrite by way of a chemical reduction followed by quantification by Discrete Analyser. Nitrite is determined seperately by direct colourimetry and result for Nitrate calculated as the difference between the two results. This method is compliant with NEPM (2013) Schedule B(3)
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	WATER	In house: Referenced to APHA 4500-NO3- F. Combined oxidised Nitrogen (NO2+NO3) is determined by Chemical Reduction and direct colourimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	WATER	In house: Referenced to APHA 4500-Norg D (In house). An aliquot of sample is digested using a high temperature Kjeldahl digestion to convert nitrogenous compounds to ammonia. Ammonia is determined colorimetrically by discrete analyser. This method is compliant with NEPM (2013) Schedule B(3)
Total Nitrogen as N (TKN + Nox) By Discrete Analyser	EK062G	WATER	In house: Referenced to APHA 4500-Norg / 4500-NO3-. This method is compliant with NEPM (2013) Schedule B(3)
Total Phosphorus as P By Discrete Analyser	EK067G	WATER	In house: Referenced to APHA 4500-P H, Jirka et al (1976), Zhang et al (2006). This procedure involves sulphuric acid digestion of a sample aliquot to break phosphorus down to orthophosphate. The orthophosphate reacts with ammonium molybdate and antimony potassium tartrate to form a complex which is then reduced and its concentration measured at 880nm using discrete analyser. This method is compliant with NEPM (2013) Schedule B(3)
Reactive Phosphorus as P-By Discrete Analyser	EK071G	WATER	In house: Referenced to APHA 4500-P F Ammonium molybdate and potassium antimonyl tartrate reacts in acid medium with othophosphate to form a heteropoly acid -phosphomolybdic acid - which is reduced to intensely coloured molybdenum blue by ascorbic acid. Quantification is by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Ionic Balance by PCT DA and Turbi SO4 DA	EN055 - PG	WATER	In house: Referenced to APHA 1030F. This method is compliant with NEPM (2013) Schedule B(3)

Preparation Methods	Method	Matrix	Method Descriptions

Preparation Methods	Method	Matrix	Method Descriptions
TKN/TP Digestion	EK061/EK067	WATER	In house: Referenced to APHA 4500 Norg - D; APHA 4500 P - H. This method is compliant with NEPM (2013) Schedule B(3)
Digestion for Total Recoverable Metals	EN25	WATER	In house: Referenced to USEPA SW846-3005. Method 3005 is a Nitric/Hydrochloric acid digestion procedure used to prepare surface and ground water samples for analysis by ICPAES or ICPMS. This method is compliant with NEPM (2013) Schedule B(3)

ALS Environmental

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **EB1825910**	Page	: 1 of 10
Client	: **GOLDER ASSOCIATES**	Laboratory	: Environmental Division Brisbane
Contact	: MR MITCH McGINNIS	Telephone	: +61 7 3552 8639
Project	: 1893802	Date Samples Received	: 26-Oct-2018
Site	: ----	Issue Date	: 31-Oct-2018
Sampler	: ROBERT CUPPER	No. of samples received	: 3
Order number	: 1893802	No. of samples analysed	: 3

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Duplicate outliers occur.**
- **NO Laboratory Control outliers occur.**
- **Method Blank value outliers exist - please see following pages for full details.**
- **Matrix Spike outliers exist - please see following pages for full details.**
- **For all regular sample matrices, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **Analysis Holding Time Outliers exist - please see following pages for full details.**

Outliers : Frequency of Quality Control Samples

- **NO Quality Control Sample Frequency Outliers exist.**

Outliers : Quality Control Samples

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: **WATER**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
Method Blank (MB) Values							
ED093F: Dissolved Major Cations	QC-MRG3-2005584002--	--	**Sodium**	7440-23-5	2 mg/L	1 mg/L	**Blank result exceeds permitted value**
Matrix Spike (MS) Recoveries							
EK067G: Total Phosphorus as P by Discrete Analyser	EB1825763--001	Anonymous	**Total Phosphorus as P**	----	Not Determined	----	**MS recovery not determined, background level greater than or equal to 4x spike level.**

Outliers : Analysis Holding Time Compliance

Matrix: **WATER**

Method / Container / Client Sample ID(s)	Extraction / Preparation			Analysis		
	Date extracted	Due for extraction	Days overdue	Date analysed	Due for analysis	Days overdue
EA005P: pH by PC Titrator						
Clear Plastic Bottle - Natural						
330-01-BH2102	----	----	----	26-Oct-2018	24-Oct-2018	**2**
Clear Plastic Bottle - Natural						
330-01-BH2303, 330-01-BH2307	----	----	----	26-Oct-2018	25-Oct-2018	**1**

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA005P: pH by PC Titrator							
Clear Plastic Bottle - Natural (EA005-P)							
330-01-BH2102	**24-Oct-2018**	**----**	----	----	**26-Oct-2018**	24-Oct-2018	×
Clear Plastic Bottle - Natural (EA005-P)							
330-01-BH2303, 330-01-BH2307	**25-Oct-2018**	**----**	----	----	**26-Oct-2018**	25-Oct-2018	×
EA010P: Conductivity by PC Titrator							
Clear Plastic Bottle - Natural (EA010-P)							
330-01-BH2102	**24-Oct-2018**	**----**	----	----	**26-Oct-2018**	21-Nov-2018	✓
Clear Plastic Bottle - Natural (EA010-P)							
330-01-BH2303, 330-01-BH2307	**25-Oct-2018**	**----**	----	----	**26-Oct-2018**	22-Nov-2018	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EA015: Total Dissolved Solids dried at 180 ± 5 °C							
Clear Plastic Bottle - Natural (EA015H)							
330-01-BH2102	**24-Oct-2018**	----	----	----	**29-Oct-2018**	31-Oct-2018	✓
Clear Plastic Bottle - Natural (EA015H)							
330-01-BH2303, 330-01-BH2307	**25-Oct-2018**	----	----	----	**29-Oct-2018**	01-Nov-2018	✓
ED037P: Alkalinity by PC Titrator							
Clear Plastic Bottle - Natural (ED037-P)							
330-01-BH2102	**24-Oct-2018**	----	----	----	**26-Oct-2018**	07-Nov-2018	✓
Clear Plastic Bottle - Natural (ED037-P)							
330-01-BH2303, 330-01-BH2307	**25-Oct-2018**	----	----	----	**26-Oct-2018**	08-Nov-2018	✓
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA							
Clear Plastic Bottle - Natural (ED041G)							
330-01-BH2102	**24-Oct-2018**	----	----	----	**26-Oct-2018**	21-Nov-2018	✓
Clear Plastic Bottle - Natural (ED041G)							
330-01-BH2303, 330-01-BH2307	**25-Oct-2018**	----	----	----	**26-Oct-2018**	22-Nov-2018	✓
ED045G: Chloride by Discrete Analyser							
Clear Plastic Bottle - Natural (ED045G)							
330-01-BH2102	**24-Oct-2018**	----	----	----	**26-Oct-2018**	21-Nov-2018	✓
Clear Plastic Bottle - Natural (ED045G)							
330-01-BH2303, 330-01-BH2307	**25-Oct-2018**	----	----	----	**26-Oct-2018**	22-Nov-2018	✓
ED093F: Dissolved Major Cations							
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F)							
330-01-BH2102	**24-Oct-2018**	----	----	----	**29-Oct-2018**	21-Nov-2018	✓
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F)							
330-01-BH2303, 330-01-BH2307	**25-Oct-2018**	----	----	----	**29-Oct-2018**	22-Nov-2018	✓
ED093F: SAR and Hardness Calculations							
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F)							
330-01-BH2102	**24-Oct-2018**	----	----	----	**29-Oct-2018**	21-Nov-2018	✓
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F)							
330-01-BH2303, 330-01-BH2307	**25-Oct-2018**	----	----	----	**29-Oct-2018**	22-Nov-2018	✓
EG020F: Dissolved Metals by ICP-MS							
Clear Plastic Bottle - Nitric Acid; Filtered (EG020A-F)							
330-01-BH2102	**24-Oct-2018**	----	----	----	**29-Oct-2018**	22-Apr-2019	✓
Clear Plastic Bottle - Nitric Acid; Filtered (EG020A-F)							
330-01-BH2303, 330-01-BH2307	**25-Oct-2018**	----	----	----	**29-Oct-2018**	23-Apr-2019	✓
EG020T: Total Metals by ICP-MS							
Clear Plastic Bottle - Nitric Acid; Unfiltered (EG020A-T)							
330-01-BH2102	**24-Oct-2018**	**29-Oct-2018**	22-Apr-2019	✓	**29-Oct-2018**	22-Apr-2019	✓
Clear Plastic Bottle - Nitric Acid; Unfiltered (EG020A-T)							
330-01-BH2303, 330-01-BH2307	**25-Oct-2018**	**29-Oct-2018**	23-Apr-2019	✓	**29-Oct-2018**	23-Apr-2019	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EG035F: Dissolved Mercury by FIMS							
Clear Plastic Bottle - Nitric Acid; Filtered (EG035F)							
330-01-BH2102	**24-Oct-2018**	**----**	----	----	**29-Oct-2018**	21-Nov-2018	✓
Clear Plastic Bottle - Nitric Acid; Filtered (EG035F)							
330-01-BH2303, 330-01-BH2307	**25-Oct-2018**	**----**	----	----	**29-Oct-2018**	22-Nov-2018	✓
EG035T: Total Recoverable Mercury by FIMS							
Clear Plastic Bottle - Nitric Acid; Unfiltered (EG035T)							
330-01-BH2102	**24-Oct-2018**	**----**	----	----	**29-Oct-2018**	21-Nov-2018	✓
Clear Plastic Bottle - Nitric Acid; Unfiltered (EG035T)							
330-01-BH2303, 330-01-BH2307	**25-Oct-2018**	**----**	----	----	**29-Oct-2018**	22-Nov-2018	✓
EK040P: Fluoride by PC Titrator							
Clear Plastic Bottle - Natural (EK040P)							
330-01-BH2102	**24-Oct-2018**	**----**	----	----	**26-Oct-2018**	21-Nov-2018	✓
Clear Plastic Bottle - Natural (EK040P)							
330-01-BH2303, 330-01-BH2307	**25-Oct-2018**	**----**	----	----	**26-Oct-2018**	22-Nov-2018	✓
EK055G: Ammonia as N by Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK055G)							
330-01-BH2102	**24-Oct-2018**	**----**	----	----	**26-Oct-2018**	21-Nov-2018	✓
Clear Plastic Bottle - Sulfuric Acid (EK055G)							
330-01-BH2303, 330-01-BH2307	**25-Oct-2018**	**----**	----	----	**26-Oct-2018**	22-Nov-2018	✓
EK057G: Nitrite as N by Discrete Analyser							
Clear Plastic Bottle - Natural (EK057G)							
330-01-BH2102	**24-Oct-2018**	**----**	----	----	**26-Oct-2018**	26-Oct-2018	✓
Clear Plastic Bottle - Natural (EK057G)							
330-01-BH2303, 330-01-BH2307	**25-Oct-2018**	**----**	----	----	**26-Oct-2018**	27-Oct-2018	✓
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK059G)							
330-01-BH2102	**24-Oct-2018**	**----**	----	----	**26-Oct-2018**	21-Nov-2018	✓
Clear Plastic Bottle - Sulfuric Acid (EK059G)							
330-01-BH2303, 330-01-BH2307	**25-Oct-2018**	**----**	----	----	**26-Oct-2018**	22-Nov-2018	✓
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK061G)							
330-01-BH2102	**24-Oct-2018**	**28-Oct-2018**	21-Nov-2018	✓	**28-Oct-2018**	21-Nov-2018	✓
Clear Plastic Bottle - Sulfuric Acid (EK061G)							
330-01-BH2303, 330-01-BH2307	**25-Oct-2018**	**28-Oct-2018**	22-Nov-2018	✓	**28-Oct-2018**	22-Nov-2018	✓
EK067G: Total Phosphorus as P by Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK067G)							
330-01-BH2102	**24-Oct-2018**	**28-Oct-2018**	21-Nov-2018	✓	**28-Oct-2018**	21-Nov-2018	✓
Clear Plastic Bottle - Sulfuric Acid (EK067G)							
330-01-BH2303, 330-01-BH2307	**25-Oct-2018**	**28-Oct-2018**	22-Nov-2018	✓	**28-Oct-2018**	22-Nov-2018	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EK071G: Reactive Phosphorus as P by discrete analyser							
Clear Plastic Bottle - Natural (EK071G)							
330-01-BH2102	**24-Oct-2018**	**----**	----	----	**26-Oct-2018**	26-Oct-2018	✓
Clear Plastic Bottle - Natural (EK071G)							
330-01-BH2303, 330-01-BH2307	**25-Oct-2018**	**----**	----	----	**26-Oct-2018**	27-Oct-2018	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **WATER**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Alkalinity by PC Titrator	ED037-P	2	19	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Ammonia as N by Discrete analyser	EK055G	1	10	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	1	9	**11.11**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by PC Titrator	EA010-P	2	17	**11.76**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	2	11	**18.18**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	1	8	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	2	10	**20.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	2	12	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
pH by PC Titrator	EA005-P	2	17	**11.76**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	2	11	**18.18**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	13	**15.38**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Dissolved Solids (High Level)	EA015H	2	17	**11.76**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	2	19	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Alkalinity by PC Titrator	ED037-P	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Ammonia as N by Discrete analyser	EK055G	1	10	**10.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	2	9	**22.22**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by PC Titrator	EA010-P	2	17	**11.76**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	1	11	**9.09**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	10	**10.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
pH by PC Titrator	EA005-P	2	17	**11.76**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	11	**9.09**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	13	**15.38**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Dissolved Solids (High Level)	EA015H	2	17	**11.76**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Matrix: **WATER**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Method Blanks (MB)							
Ammonia as N by Discrete analyser	EK055G	1	10	**10.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	1	9	**11.11**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by PC Titrator	EA010-P	1	17	**5.88**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	1	11	**9.09**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	1	8	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	10	**10.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	11	**9.09**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	13	**7.69**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Dissolved Solids (High Level)	EA015H	1	17	**5.88**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Ammonia as N by Discrete analyser	EK055G	1	10	**10.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	1	9	**11.11**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	1	11	**9.09**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	10	**10.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	12	**8.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	11	**9.09**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	13	**7.69**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
pH by PC Titrator	EA005-P	WATER	In house: Referenced to APHA 4500 H+ B. This procedure determines pH of water samples by automated ISE. This method is compliant with NEPM (2013) Schedule B(3)
Conductivity by PC Titrator	EA010-P	WATER	In house: Referenced to APHA 2510 B. This procedure determines conductivity by automated ISE. This method is compliant with NEPM (2013) Schedule B(3)
Total Dissolved Solids (High Level)	EA015H	WATER	In house: Referenced to APHA 2540C. A gravimetric procedure that determines the amount of `filterable` residue in an aqueous sample. A well-mixed sample is filtered through a glass fibre filter (1.2um). The filtrate is evaporated to dryness and dried to constant weight at 180+/-5C. This method is compliant with NEPM (2013) Schedule B(3)
Alkalinity by PC Titrator	ED037-P	WATER	In house: Referenced to APHA 2320 B This procedure determines alkalinity by automated measurement (e.g. PC Titrate) using pH 4.5 for indicating the total alkalinity end-point. This method is compliant with NEPM (2013) Schedule B(3)
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	WATER	In house: Referenced to APHA 4500-SO4. Dissolved sulfate is determined in a 0.45um filtered sample. Sulfate ions are converted to a barium sulfate suspension in an acetic acid medium with barium chloride. Light absorbance of the BaSO4 suspension is measured by a photometer and the SO4-2 concentration is determined by comparison of the reading with a standard curve. This method is compliant with NEPM (2013) Schedule B(3)
Chloride by Discrete Analyser	ED045G	WATER	In house: Referenced to APHA 4500 Cl - G.The thiocyanate ion is liberated from mercuric thiocyanate through sequestration of mercury by the chloride ion to form non-ionised mercuric chloride.in the presence of ferric ions the librated thiocynate forms highly-coloured ferric thiocynate which is measured at 480 nm APHA 21st edition seal method 2 017-1-L april 2003
Major Cations - Dissolved	ED093F	WATER	In house: Referenced to APHA 3120 and 3125; USEPA SW 846 - 6010 and 6020; Cations are determined by either ICP-AES or ICP-MS techniques. This method is compliant with NEPM (2013) Schedule B(3) Sodium Adsorption Ratio is calculated from Ca, Mg and Na which determined by ALS in house method QWI-EN/ED093F. This method is compliant with NEPM (2013) Schedule B(3) Hardness parameters are calculated based on APHA 2340 B. This method is compliant with NEPM (2013) Schedule B(3)
Dissolved Metals by ICP-MS - Suite A	EG020A-F	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. Samples are 0.45µm filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Total Metals by ICP-MS - Suite A	EG020A-T	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.

Analytical Methods	Method	Matrix	Method Descriptions
Dissolved Mercury by FIMS	EG035F	WATER	In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) Samples are 0.45µm filtered prior to analysis. FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the filtered sample. The ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
Total Mercury by FIMS	EG035T	WATER	In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the unfiltered sample. The ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
Fluoride by PC Titrator	EK040P	WATER	In house: Referenced to APHA 4500-F C: CDTA is added to the sample to provide a uniform ionic strength background, adjust pH, and break up complexes. Fluoride concentration is determined by either manual or automatic ISE measurement. This method is compliant with NEPM (2013) Schedule B(3)
Ammonia as N by Discrete analyser	EK055G	WATER	In house: Referenced to APHA 4500-NH3 G Ammonia is determined by direct colorimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Nitrite as N by Discrete Analyser	EK057G	WATER	In house: Referenced to APHA 4500-NO2- B. Nitrite is determined by direct colourimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Nitrate as N by Discrete Analyser	EK058G	WATER	In house: Referenced to APHA 4500-NO3- F. Nitrate is reduced to nitrite by way of a chemical reduction followed by quantification by Discrete Analyser. Nitrite is determined seperately by direct colourimetry and result for Nitrate calculated as the difference between the two results. This method is compliant with NEPM (2013) Schedule B(3)
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	WATER	In house: Referenced to APHA 4500-NO3- F. Combined oxidised Nitrogen (NO2+NO3) is determined by Chemical Reduction and direct colourimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	WATER	In house: Referenced to APHA 4500-Norg D (In house). An aliquot of sample is digested using a high temperature Kjeldahl digestion to convert nitrogenous compounds to ammonia. Ammonia is determined colorimetrically by discrete analyser. This method is compliant with NEPM (2013) Schedule B(3)
Total Nitrogen as N (TKN + Nox) By Discrete Analyser	EK062G	WATER	In house: Referenced to APHA 4500-Norg / 4500-NO3-. This method is compliant with NEPM (2013) Schedule B(3)
Total Phosphorus as P By Discrete Analyser	EK067G	WATER	In house: Referenced to APHA 4500-P H, Jirka et al (1976), Zhang et al (2006). This procedure involves sulphuric acid digestion of a sample aliquot to break phosphorus down to orthophosphate. The orthophosphate reacts with ammonium molybdate and antimony potassium tartrate to form a complex which is then reduced and its concentration measured at 880nm using discrete analyser. This method is compliant with NEPM (2013) Schedule B(3)
Reactive Phosphorus as P-By Discrete Analyser	EK071G	WATER	In house: Referenced to APHA 4500-P F Ammonium molybdate and potassium antimonyl tartrate reacts in acid medium with othophosphate to form a heteropoly acid -phosphomolybdic acid - which is reduced to intensely coloured molybdenum blue by ascorbic acid. Quantification is by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Ionic Balance by PCT DA and Turbi SO4 DA	EN055 - PG	WATER	In house: Referenced to APHA 1030F. This method is compliant with NEPM (2013) Schedule B(3)

Preparation Methods	Method	Matrix	Method Descriptions

Preparation Methods	Method	Matrix	Method Descriptions
TKN/TP Digestion	EK061/EK067	WATER	In house: Referenced to APHA 4500 Norg - D; APHA 4500 P - H. This method is compliant with NEPM (2013) Schedule B(3)
Digestion for Total Recoverable Metals	EN25	WATER	In house: Referenced to USEPA SW846-3005. Method 3005 is a Nitric/Hydrochloric acid digestion procedure used to prepare surface and ground water samples for analysis by ICPAES or ICPMS. This method is compliant with NEPM (2013) Schedule B(3)

ALS Environmental

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **EB1825981**	Page	: 1 of 9
Client	: **GOLDER ASSOCIATES**	Laboratory	: Environmental Division Brisbane
Contact	: MR SUSANTHA KUMARAPELI	Telephone	: +61 7 3552 8639
Project	: 1893802 Inland Rail (P13)	Date Samples Received	: 26-Oct-2018
Site	: ----	Issue Date	: 31-Oct-2018
Sampler	: ROB CUPPER	No. of samples received	: 1
Order number	: 1893802	No. of samples analysed	: 1

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Duplicate outliers occur.**
- **NO Laboratory Control outliers occur.**
- **NO Matrix Spike outliers occur.**
- **Method Blank value outliers exist - please see following pages for full details.**
- **For all regular sample matrices, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **Analysis Holding Time Outliers exist - please see following pages for full details.**

Outliers : Frequency of Quality Control Samples

- **NO Quality Control Sample Frequency Outliers exist.**

Outliers : Quality Control Samples

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: **WATER**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
Method Blank (MB) Values							
ED093F: Dissolved Major Cations	QC-MRG3-2005584002	--	**Sodium**	7440-23-5	2 mg/L	1 mg/L	**Blank result exceeds permitted value**

Outliers : Analysis Holding Time Compliance

Matrix: **WATER**

Method / Container / Client Sample ID(s)	Extraction / Preparation: Date extracted	Extraction / Preparation: Due for extraction	Extraction / Preparation: Days overdue	Analysis: Date analysed	Analysis: Due for analysis	Analysis: Days overdue
EA005P: pH by PC Titrator						
Clear Plastic Bottle - Natural						
330-01-BH2222	----	----	----	27-Oct-2018	26-Oct-2018	**1**

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation: Date extracted	Extraction / Preparation: Due for extraction	Extraction / Preparation: Evaluation	Analysis: Date analysed	Analysis: Due for analysis	Analysis: Evaluation
EA005P: pH by PC Titrator							
Clear Plastic Bottle - Natural (EA005-P)							
330-01-BH2222	**26-Oct-2018**	**----**	----	----	**27-Oct-2018**	26-Oct-2018	×
EA010P: Conductivity by PC Titrator							
Clear Plastic Bottle - Natural (EA010-P)							
330-01-BH2222	**26-Oct-2018**	**----**	----	----	**27-Oct-2018**	23-Nov-2018	✓
EA015: Total Dissolved Solids dried at 180 ± 5 °C							
Clear Plastic Bottle - Natural (EA015H)							
330-01-BH2222	**26-Oct-2018**	**----**	----	----	**29-Oct-2018**	02-Nov-2018	✓
ED037P: Alkalinity by PC Titrator							
Clear Plastic Bottle - Natural (ED037-P)							
330-01-BH2222	**26-Oct-2018**	**----**	----	----	**27-Oct-2018**	09-Nov-2018	✓
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA							
Clear Plastic Bottle - Natural (ED041G)							
330-01-BH2222	**26-Oct-2018**	**----**	----	----	**27-Oct-2018**	23-Nov-2018	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
ED045G: Chloride by Discrete Analyser							
Clear Plastic Bottle - Natural (ED045G)							
330-01-BH2222	**26-Oct-2018**	**----**	----	----	**27-Oct-2018**	23-Nov-2018	✓
ED093F: Dissolved Major Cations							
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F)							
330-01-BH2222	**26-Oct-2018**	**----**	----	----	**29-Oct-2018**	23-Nov-2018	✓
ED093F: SAR and Hardness Calculations							
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F)							
330-01-BH2222	**26-Oct-2018**	**----**	----	----	**29-Oct-2018**	23-Nov-2018	✓
EG020F: Dissolved Metals by ICP-MS							
Clear Plastic Bottle - Nitric Acid; Filtered (EG020A-F)							
330-01-BH2222	**26-Oct-2018**	**----**	----	----	**29-Oct-2018**	24-Apr-2019	✓
EG020T: Total Metals by ICP-MS							
Clear Plastic Bottle - Nitric Acid; Unfiltered (EG020A-T)							
330-01-BH2222	**26-Oct-2018**	**29-Oct-2018**	24-Apr-2019	✓	**29-Oct-2018**	24-Apr-2019	✓
EG035F: Dissolved Mercury by FIMS							
Clear Plastic Bottle - Nitric Acid; Filtered (EG035F)							
330-01-BH2222	**26-Oct-2018**	**----**	----	----	**29-Oct-2018**	23-Nov-2018	✓
EG035T: Total Recoverable Mercury by FIMS							
Clear Plastic Bottle - Nitric Acid; Unfiltered (EG035T)							
330-01-BH2222	**26-Oct-2018**	**----**	----	----	**29-Oct-2018**	23-Nov-2018	✓
EK040P: Fluoride by PC Titrator							
Clear Plastic Bottle - Natural (EK040P)							
330-01-BH2222	**26-Oct-2018**	**----**	----	----	**27-Oct-2018**	23-Nov-2018	✓
EK055G: Ammonia as N by Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK055G)							
330-01-BH2222	**26-Oct-2018**	**----**	----	----	**30-Oct-2018**	23-Nov-2018	✓
EK057G: Nitrite as N by Discrete Analyser							
Clear Plastic Bottle - Natural (EK057G)							
330-01-BH2222	**26-Oct-2018**	**----**	----	----	**27-Oct-2018**	28-Oct-2018	✓
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK059G)							
330-01-BH2222	**26-Oct-2018**	**----**	----	----	**30-Oct-2018**	23-Nov-2018	✓
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK061G)							
330-01-BH2222	**26-Oct-2018**	**29-Oct-2018**	23-Nov-2018	✓	**29-Oct-2018**	23-Nov-2018	✓
EK067G: Total Phosphorus as P by Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK067G)							
330-01-BH2222	**26-Oct-2018**	**29-Oct-2018**	23-Nov-2018	✓	**29-Oct-2018**	23-Nov-2018	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EK071G: Reactive Phosphorus as P by discrete analyser							
Clear Plastic Bottle - Natural (EK071G)							
330-01-BH2222	**26-Oct-2018**	**----**	----	----	**27-Oct-2018**	28-Oct-2018	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **WATER**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Alkalinity by PC Titrator	ED037-P	1	2	**50.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Ammonia as N by Discrete analyser	EK055G	1	5	**20.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	2	17	**11.76**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by PC Titrator	EA010-P	1	2	**50.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	2	**50.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	7	**14.29**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	1	2	**50.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	1	8	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	5	**20.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	2	**50.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
pH by PC Titrator	EA005-P	1	2	**50.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	2	**50.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	19	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Dissolved Solids (High Level)	EA015H	2	11	**18.18**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	2	18	**11.11**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	8	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	2	19	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	2	13	**15.38**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Alkalinity by PC Titrator	ED037-P	1	2	**50.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Ammonia as N by Discrete analyser	EK055G	1	5	**20.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	2	17	**11.76**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by PC Titrator	EA010-P	2	2	**100.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	2	**50.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	7	**14.29**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	1	2	**50.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	5	**20.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	2	**50.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
pH by PC Titrator	EA005-P	2	2	**100.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	2	**50.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	19	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Dissolved Solids (High Level)	EA015H	2	11	**18.18**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	8	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	13	**7.69**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Matrix: **WATER**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Method Blanks (MB)							
Ammonia as N by Discrete analyser	EK055G	1	5	**20.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	1	17	**5.88**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by PC Titrator	EA010-P	1	2	**50.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	2	**50.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	7	**14.29**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	1	2	**50.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	1	8	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	5	**20.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	2	**50.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	2	**50.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Dissolved Solids (High Level)	EA015H	1	11	**9.09**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	8	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	13	**7.69**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Ammonia as N by Discrete analyser	EK055G	1	5	**20.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	1	17	**5.88**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	2	**50.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	7	**14.29**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	1	2	**50.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	5	**20.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	2	**50.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	2	**50.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	8	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	13	**7.69**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
pH by PC Titrator	EA005-P	WATER	In house: Referenced to APHA 4500 H+ B. This procedure determines pH of water samples by automated ISE. This method is compliant with NEPM (2013) Schedule B(3)
Conductivity by PC Titrator	EA010-P	WATER	In house: Referenced to APHA 2510 B. This procedure determines conductivity by automated ISE. This method is compliant with NEPM (2013) Schedule B(3)
Total Dissolved Solids (High Level)	EA015H	WATER	In house: Referenced to APHA 2540C. A gravimetric procedure that determines the amount of `filterable` residue in an aqueous sample. A well-mixed sample is filtered through a glass fibre filter (1.2um). The filtrate is evaporated to dryness and dried to constant weight at 180+/-5C. This method is compliant with NEPM (2013) Schedule B(3)
Alkalinity by PC Titrator	ED037-P	WATER	In house: Referenced to APHA 2320 B This procedure determines alkalinity by automated measurement (e.g. PC Titrate) using pH 4.5 for indicating the total alkalinity end-point. This method is compliant with NEPM (2013) Schedule B(3)
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	WATER	In house: Referenced to APHA 4500-SO4. Dissolved sulfate is determined in a 0.45um filtered sample. Sulfate ions are converted to a barium sulfate suspension in an acetic acid medium with barium chloride. Light absorbance of the BaSO4 suspension is measured by a photometer and the SO4-2 concentration is determined by comparison of the reading with a standard curve. This method is compliant with NEPM (2013) Schedule B(3)
Chloride by Discrete Analyser	ED045G	WATER	In house: Referenced to APHA 4500 Cl - G.The thiocyanate ion is liberated from mercuric thiocyanate through sequestration of mercury by the chloride ion to form non-ionised mercuric chloride.in the presence of ferric ions the librated thiocynate forms highly-coloured ferric thiocynate which is measured at 480 nm APHA 21st edition seal method 2 017-1-L april 2003
Major Cations - Dissolved	ED093F	WATER	In house: Referenced to APHA 3120 and 3125; USEPA SW 846 - 6010 and 6020; Cations are determined by either ICP-AES or ICP-MS techniques. This method is compliant with NEPM (2013) Schedule B(3) Sodium Adsorption Ratio is calculated from Ca, Mg and Na which determined by ALS in house method QWI-EN/ED093F. This method is compliant with NEPM (2013) Schedule B(3) Hardness parameters are calculated based on APHA 2340 B. This method is compliant with NEPM (2013) Schedule B(3)
Dissolved Metals by ICP-MS - Suite A	EG020A-F	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. Samples are 0.45µm filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Total Metals by ICP-MS - Suite A	EG020A-T	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.

Analytical Methods	Method	Matrix	Method Descriptions
Dissolved Mercury by FIMS	EG035F	WATER	In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) Samples are 0.45µm filtered prior to analysis. FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the filtered sample. The ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
Total Mercury by FIMS	EG035T	WATER	In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the unfiltered sample. The ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
Fluoride by PC Titrator	EK040P	WATER	In house: Referenced to APHA 4500-F C: CDTA is added to the sample to provide a uniform ionic strength background, adjust pH, and break up complexes. Fluoride concentration is determined by either manual or automatic ISE measurement. This method is compliant with NEPM (2013) Schedule B(3)
Ammonia as N by Discrete analyser	EK055G	WATER	In house: Referenced to APHA 4500-NH3 G Ammonia is determined by direct colorimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Nitrite as N by Discrete Analyser	EK057G	WATER	In house: Referenced to APHA 4500-NO2- B. Nitrite is determined by direct colourimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Nitrate as N by Discrete Analyser	EK058G	WATER	In house: Referenced to APHA 4500-NO3- F. Nitrate is reduced to nitrite by way of a chemical reduction followed by quantification by Discrete Analyser. Nitrite is determined seperately by direct colourimetry and result for Nitrate calculated as the difference between the two results. This method is compliant with NEPM (2013) Schedule B(3)
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	WATER	In house: Referenced to APHA 4500-NO3- F. Combined oxidised Nitrogen (NO2+NO3) is determined by Chemical Reduction and direct colourimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	WATER	In house: Referenced to APHA 4500-Norg D (In house). An aliquot of sample is digested using a high temperature Kjeldahl digestion to convert nitrogenous compounds to ammonia. Ammonia is determined colorimetrically by discrete analyser. This method is compliant with NEPM (2013) Schedule B(3)
Total Nitrogen as N (TKN + Nox) By Discrete Analyser	EK062G	WATER	In house: Referenced to APHA 4500-Norg / 4500-NO3-. This method is compliant with NEPM (2013) Schedule B(3)
Total Phosphorus as P By Discrete Analyser	EK067G	WATER	In house: Referenced to APHA 4500-P H, Jirka et al (1976), Zhang et al (2006). This procedure involves sulphuric acid digestion of a sample aliquot to break phosphorus down to orthophosphate. The orthophosphate reacts with ammonium molybdate and antimony potassium tartrate to form a complex which is then reduced and its concentration measured at 880nm using discrete analyser. This method is compliant with NEPM (2013) Schedule B(3)
Reactive Phosphorus as P-By Discrete Analyser	EK071G	WATER	In house: Referenced to APHA 4500-P F Ammonium molybdate and potassium antimonyl tartrate reacts in acid medium with othophosphate to form a heteropoly acid -phosphomolybdic acid - which is reduced to intensely coloured molybdenum blue by ascorbic acid. Quantification is by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Ionic Balance by PCT DA and Turbi SO4 DA	EN055 - PG	WATER	In house: Referenced to APHA 1030F. This method is compliant with NEPM (2013) Schedule B(3)

Preparation Methods	Method	Matrix	Method Descriptions

Preparation Methods	Method	Matrix	Method Descriptions
TKN/TP Digestion	EK061/EK067	WATER	In house: Referenced to APHA 4500 Norg - D; APHA 4500 P - H. This method is compliant with NEPM (2013) Schedule B(3)
Digestion for Total Recoverable Metals	EN25	WATER	In house: Referenced to USEPA SW846-3005. Method 3005 is a Nitric/Hydrochloric acid digestion procedure used to prepare surface and ground water samples for analysis by ICPAES or ICPMS. This method is compliant with NEPM (2013) Schedule B(3)

ALS Environmental

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **EB1828572**	Page	: 1 of 9
Client	: **GOLDER ASSOCIATES**	Laboratory	: Environmental Division Brisbane
Contact	: MR SUSANTHA KUMARAPELI	Telephone	: +61 7 3552 8639
Project	: 1893802 INLAND RAIL (P13)	Date Samples Received	: 22-Nov-2018
Site	: ----	Issue Date	: 26-Nov-2018
Sampler	: SUSANTHA KUMARAPELI	No. of samples received	: 1
Order number	:	No. of samples analysed	: 1

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **NO Duplicate outliers occur.**
- **NO Laboratory Control outliers occur.**
- **Matrix Spike outliers exist - please see following pages for full details.**
- **For all regular sample matrices, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **Analysis Holding Time Outliers exist - please see following pages for full details.**

Outliers : Frequency of Quality Control Samples

- **NO Quality Control Sample Frequency Outliers exist.**

Outliers : Quality Control Samples

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: **WATER**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
Matrix Spike (MS) Recoveries							
ED045G: Chloride by Discrete Analyser	EB1828285--001	Anonymous	**Chloride**	16887-00-6	Not Determined	----	**MS recovery not determined, background level greater than or equal to 4x spike level.**

Outliers : Analysis Holding Time Compliance

Matrix: **WATER**

Method / Container / Client Sample ID(s)	Extraction / Preparation: Date extracted	Extraction / Preparation: Due for extraction	Extraction / Preparation: Days overdue	Analysis: Date analysed	Analysis: Due for analysis	Analysis: Days overdue
EA005P: pH by PC Titrator						
Clear Plastic Bottle - Natural						
330-01-BH2103	----	----	----	22-Nov-2018	20-Nov-2018	**2**

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation: Date extracted	Extraction / Preparation: Due for extraction	Extraction / Preparation: Evaluation	Analysis: Date analysed	Analysis: Due for analysis	Analysis: Evaluation
EA005P: pH by PC Titrator							
Clear Plastic Bottle - Natural (EA005-P)							
330-01-BH2103	**20-Nov-2018**	**----**	----	----	**22-Nov-2018**	20-Nov-2018	×
EA010P: Conductivity by PC Titrator							
Clear Plastic Bottle - Natural (EA010-P)							
330-01-BH2103	**20-Nov-2018**	**----**	----	----	**22-Nov-2018**	18-Dec-2018	✓
EA015: Total Dissolved Solids dried at 180 ± 5 °C							
Clear Plastic Bottle - Natural (EA015H)							
330-01-BH2103	**20-Nov-2018**	**----**	----	----	**22-Nov-2018**	27-Nov-2018	✓
ED037P: Alkalinity by PC Titrator							
Clear Plastic Bottle - Natural (ED037-P)							
330-01-BH2103	**20-Nov-2018**	**----**	----	----	**22-Nov-2018**	04-Dec-2018	✓
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA							
Clear Plastic Bottle - Natural (ED041G)							
330-01-BH2103	**20-Nov-2018**	**----**	----	----	**22-Nov-2018**	18-Dec-2018	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
ED045G: Chloride by Discrete Analyser							
Clear Plastic Bottle - Natural (ED045G)							
330-01-BH2103	**20-Nov-2018**	**----**	----	----	**22-Nov-2018**	18-Dec-2018	✓
ED093F: Dissolved Major Cations							
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F)							
330-01-BH2103	**20-Nov-2018**	**----**	----	----	**23-Nov-2018**	18-Dec-2018	✓
ED093F: SAR and Hardness Calculations							
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F)							
330-01-BH2103	**20-Nov-2018**	**----**	----	----	**23-Nov-2018**	18-Dec-2018	✓
EG020F: Dissolved Metals by ICP-MS							
Clear Plastic Bottle - Nitric Acid; Filtered (EG020A-F)							
330-01-BH2103	**20-Nov-2018**	**----**	----	----	**23-Nov-2018**	19-May-2019	✓
EG020T: Total Metals by ICP-MS							
Clear Plastic Bottle - Nitric Acid; Unfiltered (EG020A-T)							
330-01-BH2103	**20-Nov-2018**	**23-Nov-2018**	19-May-2019	✓	**23-Nov-2018**	19-May-2019	✓
EG035F: Dissolved Mercury by FIMS							
Clear Plastic Bottle - Nitric Acid; Filtered (EG035F)							
330-01-BH2103	**20-Nov-2018**	**----**	----	----	**23-Nov-2018**	18-Dec-2018	✓
EG035T: Total Recoverable Mercury by FIMS							
Clear Plastic Bottle - Nitric Acid; Unfiltered (EG035T)							
330-01-BH2103	**20-Nov-2018**	**----**	----	----	**23-Nov-2018**	18-Dec-2018	✓
EK040P: Fluoride by PC Titrator							
Clear Plastic Bottle - Natural (EK040P)							
330-01-BH2103	**20-Nov-2018**	**----**	----	----	**22-Nov-2018**	18-Dec-2018	✓
EK055G: Ammonia as N by Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK055G)							
330-01-BH2103	**20-Nov-2018**	**----**	----	----	**22-Nov-2018**	18-Dec-2018	✓
EK057G: Nitrite as N by Discrete Analyser							
Clear Plastic Bottle - Natural (EK057G)							
330-01-BH2103	**20-Nov-2018**	**----**	----	----	**22-Nov-2018**	22-Nov-2018	✓
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK059G)							
330-01-BH2103	**20-Nov-2018**	**----**	----	----	**22-Nov-2018**	18-Dec-2018	✓
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK061G)							
330-01-BH2103	**20-Nov-2018**	**23-Nov-2018**	18-Dec-2018	✓	**23-Nov-2018**	18-Dec-2018	✓
EK067G: Total Phosphorus as P by Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK067G)							
330-01-BH2103	**20-Nov-2018**	**23-Nov-2018**	18-Dec-2018	✓	**23-Nov-2018**	18-Dec-2018	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
EK071G: Reactive Phosphorus as P by discrete analyser							
Clear Plastic Bottle - Natural (EK071G)							
330-01-BH2103	**20-Nov-2018**	**----**	----	----	**22-Nov-2018**	22-Nov-2018	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **WATER**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Alkalinity by PC Titrator	ED037-P	2	18	**11.11**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Ammonia as N by Discrete analyser	EK055G	1	3	**33.33**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	2	16	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by PC Titrator	EA010-P	2	14	**14.29**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	2	**50.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	2	**50.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	2	13	**15.38**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	1	7	**14.29**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	3	**33.33**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	2	16	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
pH by PC Titrator	EA005-P	2	18	**11.11**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	7	**14.29**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	15	**13.33**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Dissolved Solids (High Level)	EA015H	1	8	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	2	18	**11.11**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	7	**14.29**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	7	**14.29**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	2	19	**10.53**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Alkalinity by PC Titrator	ED037-P	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Ammonia as N by Discrete analyser	EK055G	1	3	**33.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	2	16	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by PC Titrator	EA010-P	2	14	**14.29**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	2	**50.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	2	**50.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	1	13	**7.69**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	3	**33.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
pH by PC Titrator	EA005-P	2	18	**11.11**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	7	**14.29**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	15	**13.33**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Dissolved Solids (High Level)	EA015H	2	8	**25.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	7	**14.29**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	7	**14.29**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Matrix: **WATER**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Method Blanks (MB)							
Ammonia as N by Discrete analyser	EK055G	1	3	**33.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by PC Titrator	EA010-P	1	14	**7.14**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	2	**50.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	2	**50.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	1	13	**7.69**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	1	7	**14.29**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	3	**33.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	7	**14.29**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	15	**6.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Dissolved Solids (High Level)	EA015H	1	8	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	7	**14.29**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	7	**14.29**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Ammonia as N by Discrete analyser	EK055G	1	3	**33.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	2	**50.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	2	**50.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Fluoride by PC Titrator	EK040P	1	13	**7.69**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	3	**33.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	7	**14.29**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	15	**6.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	7	**14.29**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	7	**14.29**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	19	**5.26**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
pH by PC Titrator	EA005-P	WATER	In house: Referenced to APHA 4500 H+ B. This procedure determines pH of water samples by automated ISE. This method is compliant with NEPM (2013) Schedule B(3)
Conductivity by PC Titrator	EA010-P	WATER	In house: Referenced to APHA 2510 B. This procedure determines conductivity by automated ISE. This method is compliant with NEPM (2013) Schedule B(3)
Total Dissolved Solids (High Level)	EA015H	WATER	In house: Referenced to APHA 2540C. A gravimetric procedure that determines the amount of `filterable` residue in an aqueous sample. A well-mixed sample is filtered through a glass fibre filter (1.2um). The filtrate is evaporated to dryness and dried to constant weight at 180+/-5C. This method is compliant with NEPM (2013) Schedule B(3)
Alkalinity by PC Titrator	ED037-P	WATER	In house: Referenced to APHA 2320 B This procedure determines alkalinity by automated measurement (e.g. PC Titrate) using pH 4.5 for indicating the total alkalinity end-point. This method is compliant with NEPM (2013) Schedule B(3)
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	WATER	In house: Referenced to APHA 4500-SO4. Dissolved sulfate is determined in a 0.45um filtered sample. Sulfate ions are converted to a barium sulfate suspension in an acetic acid medium with barium chloride. Light absorbance of the BaSO4 suspension is measured by a photometer and the SO4-2 concentration is determined by comparison of the reading with a standard curve. This method is compliant with NEPM (2013) Schedule B(3)
Chloride by Discrete Analyser	ED045G	WATER	In house: Referenced to APHA 4500 Cl - G.The thiocyanate ion is liberated from mercuric thiocyanate through sequestration of mercury by the chloride ion to form non-ionised mercuric chloride.in the presence of ferric ions the librated thiocynate forms highly-coloured ferric thiocynate which is measured at 480 nm APHA 21st edition seal method 2 017-1-L april 2003
Major Cations - Dissolved	ED093F	WATER	In house: Referenced to APHA 3120 and 3125; USEPA SW 846 - 6010 and 6020; Cations are determined by either ICP-AES or ICP-MS techniques. This method is compliant with NEPM (2013) Schedule B(3) Sodium Adsorption Ratio is calculated from Ca, Mg and Na which determined by ALS in house method QWI-EN/ED093F. This method is compliant with NEPM (2013) Schedule B(3) Hardness parameters are calculated based on APHA 2340 B. This method is compliant with NEPM (2013) Schedule B(3)
Dissolved Metals by ICP-MS - Suite A	EG020A-F	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. Samples are 0.45µm filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Total Metals by ICP-MS - Suite A	EG020A-T	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.

Analytical Methods	Method	Matrix	Method Descriptions
Dissolved Mercury by FIMS	EG035F	WATER	In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) Samples are 0.45µm filtered prior to analysis. FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the filtered sample. The ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
Total Mercury by FIMS	EG035T	WATER	In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the unfiltered sample. The ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
Fluoride by PC Titrator	EK040P	WATER	In house: Referenced to APHA 4500-F C: CDTA is added to the sample to provide a uniform ionic strength background, adjust pH, and break up complexes. Fluoride concentration is determined by either manual or automatic ISE measurement. This method is compliant with NEPM (2013) Schedule B(3)
Ammonia as N by Discrete analyser	EK055G	WATER	In house: Referenced to APHA 4500-NH3 G Ammonia is determined by direct colorimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Nitrite as N by Discrete Analyser	EK057G	WATER	In house: Referenced to APHA 4500-NO2- B. Nitrite is determined by direct colourimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Nitrate as N by Discrete Analyser	EK058G	WATER	In house: Referenced to APHA 4500-NO3- F. Nitrate is reduced to nitrite by way of a chemical reduction followed by quantification by Discrete Analyser. Nitrite is determined seperately by direct colourimetry and result for Nitrate calculated as the difference between the two results. This method is compliant with NEPM (2013) Schedule B(3)
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	WATER	In house: Referenced to APHA 4500-NO3- F. Combined oxidised Nitrogen (NO2+NO3) is determined by Chemical Reduction and direct colourimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	WATER	In house: Referenced to APHA 4500-Norg D (In house). An aliquot of sample is digested using a high temperature Kjeldahl digestion to convert nitrogenous compounds to ammonia. Ammonia is determined colorimetrically by discrete analyser. This method is compliant with NEPM (2013) Schedule B(3)
Total Nitrogen as N (TKN + Nox) By Discrete Analyser	EK062G	WATER	In house: Referenced to APHA 4500-Norg / 4500-NO3-. This method is compliant with NEPM (2013) Schedule B(3)
Total Phosphorus as P By Discrete Analyser	EK067G	WATER	In house: Referenced to APHA 4500-P H, Jirka et al (1976), Zhang et al (2006). This procedure involves sulphuric acid digestion of a sample aliquot to break phosphorus down to orthophosphate. The orthophosphate reacts with ammonium molybdate and antimony potassium tartrate to form a complex which is then reduced and its concentration measured at 880nm using discrete analyser. This method is compliant with NEPM (2013) Schedule B(3)
Reactive Phosphorus as P-By Discrete Analyser	EK071G	WATER	In house: Referenced to APHA 4500-P F Ammonium molybdate and potassium antimonyl tartrate reacts in acid medium with othophosphate to form a heteropoly acid -phosphomolybdic acid - which is reduced to intensely coloured molybdenum blue by ascorbic acid. Quantification is by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Ionic Balance by PCT DA and Turbi SO4 DA	EN055 - PG	WATER	In house: Referenced to APHA 1030F. This method is compliant with NEPM (2013) Schedule B(3)

Preparation Methods	Method	Matrix	Method Descriptions

Preparation Methods	Method	Matrix	Method Descriptions
TKN/TP Digestion	EK061/EK067	WATER	In house: Referenced to APHA 4500 Norg - D; APHA 4500 P - H. This method is compliant with NEPM (2013) Schedule B(3)
Digestion for Total Recoverable Metals	EN25	WATER	In house: Referenced to USEPA SW846-3005. Method 3005 is a Nitric/Hydrochloric acid digestion procedure used to prepare surface and ground water samples for analysis by ICPAES or ICPMS. This method is compliant with NEPM (2013) Schedule B(3)

ALS Environmental

QA/QC Compliance Assessment to assist with Quality Review

Work Order	: **EB1830098**	Page	: 1 of 8
Client	: **GOLDER ASSOCIATES**	Laboratory	: Environmental Division Brisbane
Contact	: MR SUSANTHA KUMARAPELI	Telephone	: +61 7 3552 8639
Project	: 1893802 INLAND RAIL (P13)	Date Samples Received	: 07-Dec-2018
Site	: ----	Issue Date	: 11-Dec-2018
Sampler	: HANNAH GROVES	No. of samples received	: 1
Order number	:	No. of samples analysed	: 1

This report is automatically generated by the ALS LIMS through interpretation of the ALS Quality Control Report and several Quality Assurance parameters measured by ALS. This automated reporting highlights any non-conformances, facilitates faster and more accurate data validation and is designed to assist internal expert and external Auditor review. Many components of this report contribute to the overall DQO assessment and reporting for guideline compliance.

Brief method summaries and references are also provided to assist in traceability.

Summary of Outliers

Outliers : Quality Control Samples

This report highlights outliers flagged in the Quality Control (QC) Report.

- **NO Method Blank value outliers occur.**
- **NO Duplicate outliers occur.**
- **NO Laboratory Control outliers occur.**
- **Matrix Spike outliers exist - please see following pages for full details.**
- **For all regular sample matrices, NO surrogate recovery outliers occur.**

Outliers : Analysis Holding Time Compliance

- **Analysis Holding Time Outliers exist - please see following pages for full details.**

Outliers : Frequency of Quality Control Samples

- **NO Quality Control Sample Frequency Outliers exist.**

Outliers : Quality Control Samples

Duplicates, Method Blanks, Laboratory Control Samples and Matrix Spikes

Matrix: **WATER**

Compound Group Name	Laboratory Sample ID	Client Sample ID	Analyte	CAS Number	Data	Limits	Comment
Matrix Spike (MS) Recoveries							
EG020F: Dissolved Metals by ICP-MS	EB1829556--003	Anonymous	**Manganese**	7439-96-5	Not Determined	----	**MS recovery not determined, background level greater than or equal to 4x spike level.**

Outliers : Analysis Holding Time Compliance

Matrix: **WATER**

Method / Container / Client Sample ID(s)	Extraction / Preparation: Date extracted	Extraction / Preparation: Due for extraction	Extraction / Preparation: Days overdue	Analysis: Date analysed	Analysis: Due for analysis	Analysis: Days overdue
EA005P: pH by PC Titrator						
Clear Plastic Bottle - Natural						
330-01-BH2101	----	----	----	10-Dec-2018	08-Dec-2018	**2**

Analysis Holding Time Compliance

If samples are identified below as having been analysed or extracted outside of recommended holding times, this should be taken into consideration when interpreting results.

This report summarizes extraction / preparation and analysis times and compares each with ALS recommended holding times (referencing USEPA SW 846, APHA, AS and NEPM) based on the sample container provided. Dates reported represent first date of extraction or analysis and preclude subsequent dilutions and reruns. A listing of breaches (if any) is provided herein.

Holding time for leachate methods (e.g. TCLP) vary according to the analytes reported. Assessment compares the leach date with the shortest analyte holding time for the equivalent soil method. These are: organics 14 days, mercury 28 days & other metals 180 days. A recorded breach does not guarantee a breach for all non-volatile parameters.

Holding times for ***VOC in soils*** vary according to analytes of interest. Vinyl Chloride and Styrene holding time is 7 days; others 14 days. A recorded breach does not guarantee a breach for all VOC analytes and should be verified in case the reported breach is a false positive or Vinyl Chloride and Styrene are not key analytes of interest/concern.

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation: Date extracted	Extraction / Preparation: Due for extraction	Extraction / Preparation: Evaluation	Analysis: Date analysed	Analysis: Due for analysis	Analysis: Evaluation
EA005P: pH by PC Titrator							
Clear Plastic Bottle - Natural (EA005-P)							
330-01-BH2101	**07-Dec-2018**	**----**	----	----	**10-Dec-2018**	08-Dec-2018	×
EA010P: Conductivity by PC Titrator							
Clear Plastic Bottle - Natural (EA010-P)							
330-01-BH2101	**07-Dec-2018**	**----**	----	----	**10-Dec-2018**	04-Jan-2019	✓
EA015: Total Dissolved Solids dried at 180 ± 5 °C							
Clear Plastic Bottle - Natural (EA015H)							
330-01-BH2101	**07-Dec-2018**	**----**	----	----	**08-Dec-2018**	14-Dec-2018	✓
ED037P: Alkalinity by PC Titrator							
Clear Plastic Bottle - Natural (ED037-P)							
330-01-BH2101	**07-Dec-2018**	**----**	----	----	**10-Dec-2018**	21-Dec-2018	✓
ED041G: Sulfate (Turbidimetric) as SO4 2- by DA							
Clear Plastic Bottle - Natural (ED041G)							
330-01-BH2101	**07-Dec-2018**	**----**	----	----	**08-Dec-2018**	04-Jan-2019	✓

Matrix: **WATER**

Evaluation: × = Holding time breach ; ✓ = Within holding time.

Method / Container / Client Sample ID(s)	Sample Date	Extraction / Preparation			Analysis		
		Date extracted	Due for extraction	Evaluation	Date analysed	Due for analysis	Evaluation
ED045G: Chloride by Discrete Analyser							
Clear Plastic Bottle - Natural (ED045G)							
330-01-BH2101	**07-Dec-2018**	**----**	----	----	**08-Dec-2018**	04-Jan-2019	✓
ED093F: Dissolved Major Cations							
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F)							
330-01-BH2101	**07-Dec-2018**	**----**	----	----	**10-Dec-2018**	04-Jan-2019	✓
ED093F: SAR and Hardness Calculations							
Clear Plastic Bottle - Nitric Acid; Filtered (ED093F)							
330-01-BH2101	**07-Dec-2018**	**----**	----	----	**10-Dec-2018**	04-Jan-2019	✓
EG020F: Dissolved Metals by ICP-MS							
Clear Plastic Bottle - Nitric Acid; Filtered (EG020A-F)							
330-01-BH2101	**07-Dec-2018**	**----**	----	----	**10-Dec-2018**	05-Jun-2019	✓
EG020T: Total Metals by ICP-MS							
Clear Plastic Bottle - Nitric Acid; Unfiltered (EG020A-T)							
330-01-BH2101	**07-Dec-2018**	**10-Dec-2018**	05-Jun-2019	✓	**10-Dec-2018**	05-Jun-2019	✓
EG035F: Dissolved Mercury by FIMS							
Clear Plastic Bottle - Nitric Acid; Filtered (EG035F)							
330-01-BH2101	**07-Dec-2018**	**----**	----	----	**10-Dec-2018**	04-Jan-2019	✓
EG035T: Total Recoverable Mercury by FIMS							
Clear Plastic Bottle - Nitric Acid; Unfiltered (EG035T)							
330-01-BH2101	**07-Dec-2018**	**----**	----	----	**10-Dec-2018**	04-Jan-2019	✓
EK055G: Ammonia as N by Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK055G)							
330-01-BH2101	**07-Dec-2018**	**----**	----	----	**10-Dec-2018**	04-Jan-2019	✓
EK057G: Nitrite as N by Discrete Analyser							
Clear Plastic Bottle - Natural (EK057G)							
330-01-BH2101	**07-Dec-2018**	**----**	----	----	**08-Dec-2018**	09-Dec-2018	✓
EK059G: Nitrite plus Nitrate as N (NOx) by Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK059G)							
330-01-BH2101	**07-Dec-2018**	**----**	----	----	**10-Dec-2018**	04-Jan-2019	✓
EK061G: Total Kjeldahl Nitrogen By Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK061G)							
330-01-BH2101	**07-Dec-2018**	**10-Dec-2018**	04-Jan-2019	✓	**10-Dec-2018**	04-Jan-2019	✓
EK067G: Total Phosphorus as P by Discrete Analyser							
Clear Plastic Bottle - Sulfuric Acid (EK067G)							
330-01-BH2101	**07-Dec-2018**	**10-Dec-2018**	04-Jan-2019	✓	**10-Dec-2018**	04-Jan-2019	✓
EK071G: Reactive Phosphorus as P by discrete analyser							
Clear Plastic Bottle - Natural (EK071G)							
330-01-BH2101	**07-Dec-2018**	**----**	----	----	**08-Dec-2018**	09-Dec-2018	✓

Quality Control Parameter Frequency Compliance

The following report summarises the frequency of laboratory QC samples analysed within the analytical lot(s) in which the submitted sample(s) was(were) processed. Actual rate should be greater than or equal to the expected rate. A listing of breaches is provided in the Summary of Outliers.

Matrix: **WATER**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Laboratory Duplicates (DUP)							
Alkalinity by PC Titrator	ED037-P	1	3	**33.33**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Ammonia as N by Discrete analyser	EK055G	1	3	**33.33**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	2	15	**13.33**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by PC Titrator	EA010-P	1	8	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	2	16	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	2	20	**10.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	2	11	**18.18**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	9	**11.11**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	2	15	**13.33**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
pH by PC Titrator	EA005-P	1	8	**12.50**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	6	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	15	**13.33**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Dissolved Solids (High Level)	EA015H	1	6	**16.67**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	2	13	**15.38**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	3	**33.33**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	2	11	**18.18**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	2	18	**11.11**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Laboratory Control Samples (LCS)							
Alkalinity by PC Titrator	ED037-P	1	3	**33.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Ammonia as N by Discrete analyser	EK055G	1	3	**33.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	2	15	**13.33**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by PC Titrator	EA010-P	2	8	**25.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	9	**11.11**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	15	**6.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
pH by PC Titrator	EA005-P	2	8	**25.00**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	6	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	2	15	**13.33**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Dissolved Solids (High Level)	EA015H	2	6	**33.33**	**10.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	13	**7.69**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	3	**33.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	11	**9.09**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Method Blanks (MB)							
Ammonia as N by Discrete analyser	EK055G	1	3	**33.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Matrix: **WATER**

Evaluation: × = Quality Control frequency not within specification ; ✓ = Quality Control frequency within specification.

Quality Control Sample Type		Count		Rate (%)			Quality Control Specification
Analytical Methods	*Method*	*QC*	*Regular*	***Actual***	***Expected***	*Evaluation*	
Method Blanks (MB) - Continued							
Chloride by Discrete Analyser	ED045G	1	15	**6.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Conductivity by PC Titrator	EA010-P	1	8	**12.50**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Major Cations - Dissolved	ED093F	1	11	**9.09**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	9	**11.11**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	15	**6.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	6	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	15	**6.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Dissolved Solids (High Level)	EA015H	1	6	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	13	**7.69**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	3	**33.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	11	**9.09**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Matrix Spikes (MS)							
Ammonia as N by Discrete analyser	EK055G	1	3	**33.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Chloride by Discrete Analyser	ED045G	1	15	**6.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Mercury by FIMS	EG035F	1	16	**6.25**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Dissolved Metals by ICP-MS - Suite A	EG020A-F	1	20	**5.00**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	1	9	**11.11**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Nitrite as N by Discrete Analyser	EK057G	1	15	**6.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Reactive Phosphorus as P-By Discrete Analyser	EK071G	1	6	**16.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	1	15	**6.67**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	1	13	**7.69**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Mercury by FIMS	EG035T	1	3	**33.33**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Metals by ICP-MS - Suite A	EG020A-T	1	11	**9.09**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard
Total Phosphorus as P By Discrete Analyser	EK067G	1	18	**5.56**	**5.00**	✓	NEPM 2013 B3 & ALS QC Standard

Brief Method Summaries

The analytical procedures used by the Environmental Division have been developed from established internationally recognized procedures such as those published by the US EPA, APHA, AS and NEPM. In house developed procedures are employed in the absence of documented standards or by client request. The following report provides brief descriptions of the analytical procedures employed for results reported in the Certificate of Analysis. Sources from which ALS methods have been developed are provided within the Method Descriptions.

Analytical Methods	Method	Matrix	Method Descriptions
pH by PC Titrator	EA005-P	WATER	In house: Referenced to APHA 4500 H+ B. This procedure determines pH of water samples by automated ISE. This method is compliant with NEPM (2013) Schedule B(3)
Conductivity by PC Titrator	EA010-P	WATER	In house: Referenced to APHA 2510 B. This procedure determines conductivity by automated ISE. This method is compliant with NEPM (2013) Schedule B(3)
Total Dissolved Solids (High Level)	EA015H	WATER	In house: Referenced to APHA 2540C. A gravimetric procedure that determines the amount of `filterable` residue in an aqueous sample. A well-mixed sample is filtered through a glass fibre filter (1.2um). The filtrate is evaporated to dryness and dried to constant weight at 180+/-5C. This method is compliant with NEPM (2013) Schedule B(3)
Alkalinity by PC Titrator	ED037-P	WATER	In house: Referenced to APHA 2320 B This procedure determines alkalinity by automated measurement (e.g. PC Titrate) using pH 4.5 for indicating the total alkalinity end-point. This method is compliant with NEPM (2013) Schedule B(3)
Sulfate (Turbidimetric) as SO4 2- by Discrete Analyser	ED041G	WATER	In house: Referenced to APHA 4500-SO4. Dissolved sulfate is determined in a 0.45um filtered sample. Sulfate ions are converted to a barium sulfate suspension in an acetic acid medium with barium chloride. Light absorbance of the BaSO4 suspension is measured by a photometer and the SO4-2 concentration is determined by comparison of the reading with a standard curve. This method is compliant with NEPM (2013) Schedule B(3)
Chloride by Discrete Analyser	ED045G	WATER	In house: Referenced to APHA 4500 Cl - G.The thiocyanate ion is liberated from mercuric thiocyanate through sequestration of mercury by the chloride ion to form non-ionised mercuric chloride.in the presence of ferric ions the librated thiocynate forms highly-coloured ferric thiocynate which is measured at 480 nm APHA 21st edition seal method 2 017-1-L april 2003
Major Cations - Dissolved	ED093F	WATER	In house: Referenced to APHA 3120 and 3125; USEPA SW 846 - 6010 and 6020; Cations are determined by either ICP-AES or ICP-MS techniques. This method is compliant with NEPM (2013) Schedule B(3) Sodium Adsorption Ratio is calculated from Ca, Mg and Na which determined by ALS in house method QWI-EN/ED093F. This method is compliant with NEPM (2013) Schedule B(3) Hardness parameters are calculated based on APHA 2340 B. This method is compliant with NEPM (2013) Schedule B(3)
Dissolved Metals by ICP-MS - Suite A	EG020A-F	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. Samples are 0.45µm filtered prior to analysis. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.
Total Metals by ICP-MS - Suite A	EG020A-T	WATER	In house: Referenced to APHA 3125; USEPA SW846 - 6020, ALS QWI-EN/EG020. The ICPMS technique utilizes a highly efficient argon plasma to ionize selected elements. Ions are then passed into a high vacuum mass spectrometer, which separates the analytes based on their distinct mass to charge ratios prior to their measurement by a discrete dynode ion detector.

Analytical Methods	Method	Matrix	Method Descriptions
Dissolved Mercury by FIMS	EG035F	WATER	In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) Samples are 0.45µm filtered prior to analysis. FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the filtered sample. The ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
Total Mercury by FIMS	EG035T	WATER	In house: Referenced to AS 3550, APHA 3112 Hg - B (Flow-injection (SnCl2)(Cold Vapour generation) AAS) FIM-AAS is an automated flameless atomic absorption technique. A bromate/bromide reagent is used to oxidise any organic mercury compounds in the unfiltered sample. The ionic mercury is reduced online to atomic mercury vapour by SnCl2 which is then purged into a heated quartz cell. Quantification is by comparing absorbance against a calibration curve. This method is compliant with NEPM (2013) Schedule B(3)
Ammonia as N by Discrete analyser	EK055G	WATER	In house: Referenced to APHA 4500-NH3 G Ammonia is determined by direct colorimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Nitrite as N by Discrete Analyser	EK057G	WATER	In house: Referenced to APHA 4500-NO2- B. Nitrite is determined by direct colourimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Nitrate as N by Discrete Analyser	EK058G	WATER	In house: Referenced to APHA 4500-NO3- F. Nitrate is reduced to nitrite by way of a chemical reduction followed by quantification by Discrete Analyser. Nitrite is determined seperately by direct colourimetry and result for Nitrate calculated as the difference between the two results. This method is compliant with NEPM (2013) Schedule B(3)
Nitrite and Nitrate as N (NOx) by Discrete Analyser	EK059G	WATER	In house: Referenced to APHA 4500-NO3- F. Combined oxidised Nitrogen (NO2+NO3) is determined by Chemical Reduction and direct colourimetry by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Total Kjeldahl Nitrogen as N By Discrete Analyser	EK061G	WATER	In house: Referenced to APHA 4500-Norg D (In house). An aliquot of sample is digested using a high temperature Kjeldahl digestion to convert nitrogenous compounds to ammonia. Ammonia is determined colorimetrically by discrete analyser. This method is compliant with NEPM (2013) Schedule B(3)
Total Nitrogen as N (TKN + Nox) By Discrete Analyser	EK062G	WATER	In house: Referenced to APHA 4500-Norg / 4500-NO3-. This method is compliant with NEPM (2013) Schedule B(3)
Total Phosphorus as P By Discrete Analyser	EK067G	WATER	In house: Referenced to APHA 4500-P H, Jirka et al (1976), Zhang et al (2006). This procedure involves sulphuric acid digestion of a sample aliquot to break phosphorus down to orthophosphate. The orthophosphate reacts with ammonium molybdate and antimony potassium tartrate to form a complex which is then reduced and its concentration measured at 880nm using discrete analyser. This method is compliant with NEPM (2013) Schedule B(3)
Reactive Phosphorus as P-By Discrete Analyser	EK071G	WATER	In house: Referenced to APHA 4500-P F Ammonium molybdate and potassium antimonyl tartrate reacts in acid medium with othophosphate to form a heteropoly acid -phosphomolybdic acid - which is reduced to intensely coloured molybdenum blue by ascorbic acid. Quantification is by Discrete Analyser. This method is compliant with NEPM (2013) Schedule B(3)
Ionic Balance by PCT DA and Turbi SO4 DA	EN055 - PG	WATER	In house: Referenced to APHA 1030F. This method is compliant with NEPM (2013) Schedule B(3)

Preparation Methods	Method	Matrix	Method Descriptions
TKN/TP Digestion	EK061/EK067	WATER	In house: Referenced to APHA 4500 Norg - D; APHA 4500 P - H. This method is compliant with NEPM (2013) Schedule B(3)

Preparation Methods	Method	Matrix	Method Descriptions
Digestion for Total Recoverable Metals	EN25	WATER	In house: Referenced to USEPA SW846-3005. Method 3005 is a Nitric/Hydrochloric acid digestion procedure used to prepare surface and ground water samples for analysis by ICPAES or ICPMS. This method is compliant with NEPM (2013) Schedule B(3)

GOLDER

		Heavy Metals																																	
		Arsenic	Arsenic (Filtered)	Barium	Barium (Filtered)	Beryllium	Beryllium (Filtered)	Boron	Boron (Filtered)	Cadmium	Cadmium (Filtered)	Chromium	Chromium (Filtered)	Cobalt	Cobalt (Filtered)	Copper	Copper (Filtered)	Iron	Iron (Filtered)	Lead	Lead (Filtered)	Manganese	Manganese (Filtered)	Mercury	Mercury (Filtered)	Nickel	Nickel (Filtered)	Selenium	Selenium (Filtered)	Vanadium	Vanadium (Filtered)	Zinc	Zinc (Filtered)
		mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L
EQL		0.001	0.001	0.001	0.001	0.001	0.001	0.05	0.05	0.0001	0.0001	0.001	0.001	0.001	0.001	0.001	0.001	0.05	0.05	0.001	0.001	0.001	0.001	0.0001	0.0001	0.001	0.001	0.01	0.01	0.01	0.01	0.005	0.005
Borehole ID	**Sampled Date**																																		
330-01-BH2101	7/12/2018	0.004	0.002	0.166	0.196	<0.001	<0.001	0.2	0.13	<0.0001	<0.0001	0.002	<0.001	<0.001	<0.001	0.002	<0.001	3.31	2.28	<0.001	<0.001	0.078	0.069	<0.0001	<0.0001	0.002	<0.001	<0.01	<0.01	<0.01	<0.01	0.014	<0.005
330-01-BH2102	24/10/2018	0.011	0.008	0.275	0.214	<0.001	<0.001	0.18	0.18	<0.0001	<0.0001	0.008	<0.001	0.008	<0.001	0.015	<0.001	13	<0.05	0.013	<0.001	0.296	0.086	<0.0001	<0.0001	0.01	0.001	<0.01	<0.01	0.02	<0.01	0.046	0.006
330-01-BH2103	20/11/2018	0.003	0.002	0.105	0.08	<0.001	<0.001	0.12	0.12	0.0002	<0.0001	0.003	<0.001	0.005	0.002	0.016	0.003	-	-	0.007	<0.001	0.178	0.082	<0.0001	<0.0001	0.006	0.003	<0.01	<0.01	0.01	<0.01	0.029	0.04
330-01-BH2104	23/10/2018	0.015	0.008	0.379	0.199	0.002	<0.001	0.12	0.1	0.0003	<0.0001	0.012	<0.001	0.026	0.005	0.045	0.001	25.6	<0.05	0.039	<0.001	0.333	0.072	<0.0001	<0.0001	0.027	0.008	<0.01	<0.01	0.03	<0.01	0.145	0.007
330-01-BH2207	25/10/2018	0.002	0.002	0.136	0.098	<0.001	<0.001	0.26	0.28	<0.0001	<0.0001	0.021	0.01	0.004	0.003	0.013	0.008	2.93	0.1	0.026	0.004	0.482	0.461	<0.0001	<0.0001	0.02	0.013	<0.01	<0.01	<0.01	<0.01	0.046	0.008
330-01-BH2212	22/10/2018	<0.001	<0.001	0.125	0.096	<0.001	<0.001	0.06	0.06	<0.0001	<0.0001	0.003	<0.001	0.002	0.001	0.002	<0.001	1.55	<0.05	0.002	<0.001	0.154	0.096	<0.0001	<0.0001	0.006	0.003	<0.01	<0.01	0.01	<0.01	<0.005	<0.005
330-01-BH2216	23/10/2018	0.001	<0.001	0.44	0.279	<0.001	<0.001	0.08	0.06	<0.0001	<0.0001	0.005	0.004	0.002	<0.001	0.004	0.002	0.87	<0.05	<0.001	<0.001	0.157	<0.001	<0.0001	<0.0001	0.002	0.001	<0.01	<0.01	<0.01	<0.01	<0.005	<0.005
330-01-BH2224	26/10/2018	0.002	0.001	0.047	0.029	<0.001	<0.001	0.07	0.06	<0.0001	<0.0001	0.01	0.008	0.001	<0.001	0.003	0.003	0.96	<0.05	0.003	<0.001	0.047	0.006	<0.0001	<0.0001	0.003	0.002	<0.01	<0.01	<0.01	<0.01	0.012	<0.005
330-01-BH2303	25/10/2018	0.005	0.005	0.468	0.5	<0.001	<0.001	0.05	0.07	<0.0001	<0.0001	<0.001	<0.001	0.021	0.022	<0.001	0.001	1.66	0.15	<0.001	<0.001	0.693	0.79	<0.0001	<0.0001	0.037	0.022	<0.01	<0.01	<0.01	<0.01	0.014	0.014

GOLDER

		Other		Sample Quality Parameters																											
		Sodium Absorption Ratio	Sodium Absorption Ratio (Filtered)	Electrical Conductivity @ 25°C	pH (Lab)	Total Dissolved Solids @180°C	Sodium (Filtered)	Potassium (Filtered)	Calcium (Filtered)	Magnesium (Filtered)	Chloride	Sulphate (as SO4) (Filtered)	Bicarbonate Alkalinity (as CaCO3)	Carbonate Alkalinity (as CaCO3)	Hydroxide Alkalinity (as CaCO3)	Total Alkalinity (as CaCO3)	Nitrate (as N)	Nitrite (as N)	Nitrogen (Total Oxidised)	Ammonia (as N)	Total Kjeldahl Nitrogen (as N)	Nitrogen (Total)	Fluoride	Reactive Phosphorus (as P)	Total Phosphorus (as P)	Total Anions	Total Cations	Ionic Balance (Lab)	Hardness (as CaCO3) (Filtered)
		-	-	uS/cm	pH_Units	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	mg/L	meq/L	meq/L	%	mg/L
EQL		0.01		1	0.01	10					1		1	1	1	1	0.01	0.01	0.01	0.01	0.1	0.1	0.1	0.01	0.01	0.01	0.01	0.01	
Borehole ID	**Sampled Date**																														
330-01-BH2101	7/12/2018	-	33.5	2190	8.8	1280	506	3	9	5	209	51	670	104	<1	774	0.03	<0.01	0.03	0.97	1.6	1.6	-	<0.01	0.03	22.4	22.9	1.16	-
330-01-BH2102	24/10/2018	-	25.7	4260	7.95	2340	833	8	40	24	1000	97	457	<1	<1	457	<0.01	<0.01	<0.01	0.89	2.3	2.3	0.4	<0.01	0.22	39.4	40.4	1.32	199
330-01-BH2103	20/11/2018	-	15.7	3810	8.18	2170	662	8	50	51	709	169	875	<1	<1	875	0.03	<0.01	0.03	0.23	12	12	0.2	<0.01	0.12	41	35.7	6.92	335
330-01-BH2104	23/10/2018	21.7	-	4260	8.33	2390	817	8	48	36	980	98	549	7	<1	556	0.01	0.01	0.02	0.66	1.5	1.5	0.7	<0.01	0.12	40.8	41.1	0.37	268
330-01-BH2207	25/10/2018	-	7.24	1730	8.53	955	246	28	33	33	438	50	116	12	<1	128	0.22	0.2	0.42	0.25	1.4	1.8	0.6	<0.01	0.09	16	15.8	0.55	218
330-01-BH2212	22/10/2018	29.5	-	5500	8.16	2940	1110	7	38	42	1340	77	601	<1	<1	601	0.48	<0.01	0.48	0.11	0.6	1.1	0.5	<0.01	0.08	51.4	53.8	2.28	268
330-01-BH2216	23/10/2018	17.6	-	2530	10.5	1180	451	12	25	15	646	41	<1	194	24	218	0.26	0.01	0.27	0.16	0.8	1.1	0.7	<0.01	0.04	23.4	22.4	2.24	124
330-01-BH2224	26/10/2018	-	4.95	459	9.66	258	68	16	11	2	73	46	31	28	<1	59	0.14	<0.01	0.14	0.18	0.9	1	0.8	<0.01	0.02	4.2	4.08	1.39	36
330-01-BH2303	25/10/2018	-	2.58	1720	7.22	999	138	10	118	60	322	20	385	<1	<1	385	<0.01	<0.01	<0.01	0.15	0.4	0.4	0.2	<0.01	0.04	17.2	17.1	0.31	542

Appendix I
Important Information Relating to this Report

HELIDON TO CALVERT ENVIRONMENTAL IMPACT STATEMENT

The document ("Report") to which this page is attached and which this page forms a part of, has been issued by Golder Associates Pty Ltd ("Golder") subject to the important limitations and other qualifications set out below.

This Report constitutes or is part of services ("Services") provided by Golder to its client ("Client") under and subject to a contract between Golder and its Client ("Contract"). The contents of this page are not intended to and do not alter Golder's obligations (including any limits on those obligations) to its Client under the Contract.

This Report is provided for use solely by Golder's Client and persons acting on the Client's behalf, such as its professional advisers. Golder is responsible only to its Client for this Report. Golder has no responsibility to any other person who relies or makes decisions based upon this Report or who makes any other use of this Report. Golder accepts no responsibility for any loss or damage suffered by any person other than its Client as a result of any reliance upon any part of this Report, decisions made based upon this Report or any other use of it.

This Report has been prepared in the context of the circumstances and purposes referred to in, or derived from, the Contract and Golder accepts no responsibility for use of the Report, in whole or in part, in any other context or circumstance or for any other purpose.

The scope of Golder's Services and the period of time they relate to are determined by the Contract and are subject to restrictions and limitations set out in the Contract. If a service or other work is not expressly referred to in this Report, do not assume that it has been provided or performed. If a matter is not addressed in this Report, do not assume that any determination has been made by Golder in regards to it.

At any location relevant to the Services conditions may exist which were not detected by Golder, in particular due to the specific scope of the investigation Golder has been engaged to undertake. Conditions can only be verified at the exact location of any tests undertaken. Variations in conditions may occur between tested locations and there may be conditions which have not been revealed by the investigation and which have not therefore been taken into account in this Report.

Golder accepts no responsibility for and makes no representation as to the accuracy or completeness of the information provided to it by or on behalf of the Client or sourced from any third party. Golder has assumed that such information is correct unless otherwise stated and no responsibility is accepted by Golder for incomplete or inaccurate data supplied by its Client or any other person for whom Golder is not responsible. Golder has not taken account of matters that may have existed when the Report was prepared but which were only later disclosed to Golder.

Having regard to the matters referred to in the previous paragraphs on this page in particular, carrying out the Services has allowed Golder to form no more than an opinion as to the actual conditions at any relevant location. That opinion is necessarily constrained by the extent of the information collected by Golder or otherwise made available to Golder. Further, the passage of time may affect the accuracy, applicability or usefulness of the opinions, assessments or other information in this Report. This Report is based upon the information and other circumstances that existed and were known to Golder when the Services were performed and this Report was prepared. Golder has not considered the effect of any possible future developments including physical changes to any relevant location or changes to any laws or regulations relevant to such location.

Where permitted by the Contract, Golder may have retained subconsultants affiliated with Golder to provide some or all of the Services. However, it is Golder which remains solely responsible for the Services and there is no legal recourse against any of Golder's affiliated companies or the employees, officers or directors of any of them.

By date, or revision, the Report supersedes any prior report or other document issued by Golder dealing with any matter that is addressed in the Report.

Any uncertainty as to the extent to which this Report can be used or relied upon in any respect should be referred to Golder for clarification