

**Attachment A -
Summary of Test Results**

Table A.1 - Physical Properties and Dynamic Moduli

Specimen Identification						Specifications (prepared)				Physical Properties and Dynamic Moduli								
Specimen ID	Segment	Sample Top Depth (mbgs)	Wireline Top Depth (mbgs)	Rock Type	Test Type	Diameter (mm)	Length (mm)	Volume (cm ³)	As-Received Mass (g)	As-Received Bulk Density (g/cm ³)	Dry Bulk Density (g/cm ³)	Wet Bulk Density (g/cm ³)	Porosity (%)	P-wave Velocity (km/s)	S-wave Velocity (km/s)	Young's Modulus (GPa)	Shear Modulus (GPa)	Poisson's Ratio
1U	1	17.56	17.14	Sandy Dolostone	UCS	47.48	105.03	185.94	481.74	2.59	2.59	2.61	1.95	4.12	2.54	39.9	16.8	0.19
2T	1	17.67	17.25	Sandy Dolostone	TCS, Perm.	47.50	105.02	186.13	472.16	2.54	2.53	2.57	3.08	4.09	2.56	39.1	16.6	0.18
1B	1	17.78	17.36	Sandy Dolostone	BTS	47.47	35.26	62.40	157.78	2.53	2.53	2.56	3.12	--	--	--	--	--
3U	2	29.58	29.16	Sandstone	UCS	47.27	105.01	184.29	471.19	2.56	2.56	2.57	1.54	4.05	2.49	38.0	15.9	0.20
4T	2	29.70	29.29	Sandstone	TCS, Perm.	47.14	105.03	183.33	435.40	2.37	2.38	2.48	9.91	3.54	2.19	27.1	11.4	0.19
2B	2	29.82	29.41	Sandstone	BTS	47.20	35.20	61.59	142.36	2.31	2.31	2.44	12.42	--	--	--	--	--
3B	2	29.86	29.45	Sandstone	BTS	47.21	35.27	61.74	149.30	2.42	2.42	2.50	8.08	--	--	--	--	--
4B	3	34.66	34.25	Sandstone	BTS	47.24	35.24	61.77	164.38	2.66	2.66	2.67	1.02	--	--	--	--	--
5B	3	34.70	34.29	Sandstone	BTS	47.26	35.19	61.73	161.28	2.61	2.61	2.63	2.41	--	--	--	--	--
6B	3	34.75	34.34	Sandstone	BTS	47.23	34.97	61.27	158.17	2.58	2.57	2.61	4.55	--	--	--	--	--
7B	4	47.54	47.23	Sandstone	BTS	47.38	33.31	58.73	151.39	2.58	2.58	2.59	1.87	--	--	--	--	--
5U	4	47.60	47.29	Sandstone	UCS	47.38	105.01	185.14	480.79	2.60	2.59	2.61	1.85	3.56	2.16	29.2	12.1	0.21
8B	5	59.22	59.03	Sandstone	BTS	47.47	35.19	62.28	148.19	2.38	2.38	2.47	8.85	--	--	--	--	--
9B	5	59.26	59.08	Sandstone	BTS	47.40	35.16	62.04	149.14	2.40	2.40	2.49	8.40	--	--	--	--	--
6T	5	59.79	59.61	Sandstone	TCS, Perm.	47.38	104.95	185.06	444.75	2.40	2.40	2.49	8.59	3.63	2.24	28.7	12.0	0.19
10B	5	59.90	59.72	Sandstone	BTS	47.35	35.16	61.91	147.46	2.38	2.38	2.47	9.35	--	--	--	--	--
11B	5	59.94	59.76	Sandstone	BTS	47.33	35.08	61.72	147.81	2.39	2.39	2.48	8.86	--	--	--	--	--
66.71-U	6	66.71	66.72	pre-Cambrian	UCS	47.42	104.85	185.20	478.77	2.59	--	--	--	1.20	0.60	2.5	0.9	0.34
66.84-P	6	66.84	66.85	pre-Cambrian	Porosity	24.95 (plug)	* irreg.	--	--	--	--	--	--	--	--	--	--	--
66.99-U	6	66.99	66.99	pre-Cambrian	UCS	47.50	104.88	185.85	464.63	2.50	--	--	--	1.06	n/a	n/a	n/a	n/a
67.20-P	6	67.20	67.20	pre-Cambrian	Porosity	47.34	* irreg.	--	--	--	--	--	--	--	--	--	--	--
67.20-P2	6	67.20	67.20	pre-Cambrian	Porosity	47.34	* irreg.	--	--	--	--	--	--	--	--	--	--	--
70.94-U	7	70.94	70.94	pre-Cambrian	UCS	47.36	104.97	184.92	508.69	2.75	--	--	--	5.41	3.28	71.6	29.6	0.21
71.09-T	7	71.09	71.09	pre-Cambrian	TCS	47.34	104.98	184.81	501.55	2.71	2.71	2.72	0.18	5.15	3.00	60.7	24.4	0.24
71.20-U	7	71.20	71.20	pre-Cambrian	UCS	47.36	104.98	184.91	490.99	2.66	--	--	--	4.82	2.81	20.2	8.1	0.24
75.87-U	8	75.87	75.93	pre-Cambrian	UCS	47.34	104.97	184.74	474.81	2.57	--	--	--	2.88	1.66	17.7	7.0	0.25
75.98-P	8	75.98	76.04	pre-Cambrian	Porosity	24.95 (plug)	40.70	19.93	48.81	2.45	2.44	2.50	5.12	--	--	--	--	--
76.12-U	8	76.12	76.19	pre-Cambrian	UCS	47.37	104.95	184.93	473.09	2.56	--	--	--	2.61	1.54	15.0	6.1	0.23
76.23-T	8	76.23	76.3	pre-Cambrian	TCS	47.34	104.94	184.73	481.02	2.60	2.60	2.62	2.28	3.70	2.30	32.6	13.8	0.18
76.35-P	8	76.35	76.42	pre-Cambrian	Porosity	47.35	82.30	144.92	369.01	2.55	2.54	2.59	5.12	--	--	--	--	--
86.74-U	9	86.74	86.92	pre-Cambrian	UCS	47.35	105.00	184.92	498.58	2.70	--	--	--	5.30	3.22	67.6	28.0	0.21
86.85-T	9	86.85	87.03	pre-Cambrian	TCS	47.35	105.01	184.94	500.04	2.70	2.70	2.71	0.17	5.30	3.05	63.1	25.2	0.25
86.96-U	9	86.96	87.14	pre-Cambrian	UCS	47.35	104.99	184.87	498.83	2.70	--	--	--	5.10	2.98	59.5	24.0	0.24
87.07-T	9	87.07	87.25	pre-Cambrian	UCS	47.36	105.01	184.96	496.16	2.68	2.68	2.68	0.25	5.05	3.18	63.6	27.2	0.17

Table A.1 - Physical Properties and Dynamic Moduli

Specimen Identification						Specifications (prepared)				Physical Properties and Dynamic Moduli								
Specimen ID	Segment	Sample Top Depth (mbgs)	Wireline Top Depth (mbgs)	Rock Type	Test Type	Diameter (mm)	Length (mm)	Volume (cm ³)	As-Received Mass (g)	As-Received Bulk Density (g/cm ³)	Dry Bulk Density (g/cm ³)	Wet Bulk Density (g/cm ³)	Porosity (%)	P-wave Velocity (km/s)	S-wave Velocity (km/s)	Young's Modulus (GPa)	Shear Modulus (GPa)	Poisson's Ratio
93.92-U	10	93.92	94.09	pre-Cambrian	UCS	47.28	104.99	184.35	559.42	3.03	--	--	--	5.58	3.32	82.1	33.5	0.23
94.03-P	10	94.03	94.2	pre-Cambrian	Porosity	24.95 (plug)	40.87	20.01	59.45	2.97	2.97	2.97	0.55	--	--	--	--	--
94.07-P	10	94.07	94.24	pre-Cambrian	Porosity	47.29	77.61	136.32	416.11	3.05	3.05	3.05	0.12	--	--	--	--	--
99.01-P	11	99.01	99.19	pre-Cambrian	Porosity	47.32	105.00	184.66	500.23	2.71	2.71	2.71	0.18	--	--	--	--	--
99.17-U	11	99.17	99.35	pre-Cambrian	UCS	47.34	105.00	184.79	505.34	2.73	--	--	--	5.30	3.18	67.5	27.7	0.22
99.28-U	11	99.28	99.46	pre-Cambrian	UCS	47.31	105.00	184.55	516.13	2.80	--	--	--	5.59	3.32	75.7	30.9	0.23
109.01-U	12	109.01	109.22	pre-Cambrian	UCS	47.23	105.00	183.98	552.18	3.00	--	--	--	5.53	3.34	81.3	33.6	0.21
109.12-T	12	109.12	109.33	pre-Cambrian	TCS	47.24	105.00	184.03	551.03	2.99	2.99	2.99	0.17	5.59	3.39	83.1	34.4	0.21
109.23-T	12	109.23	109.44	pre-Cambrian	TCS	47.24	104.99	184.04	550.49	2.99	2.99	2.99	0.15	5.58	3.41	83.6	34.8	0.20

Notes:

mbgs = metres below ground surface

-- = not measured, no data

- Uniaxial Compression Strength (UCS), Triaxial Compression Strength (TCS), Brazilian Tensile Strength (BTS), Permeability (Perm.)

Table A.2 - Compression Test Results

Specimen and Test Data						Strength and Elastic Properties							Description of Failure Mode
Specimen ID	Sample Top Depth (mbgs)	Wireline Top Depth (mbgs)	Rocktype	Date Tested	Confinement (MPa)	Peak Strength (MPa)	Mechanical Gauges			Electrical Strain Gauges			
							Axial Strain at Peak (%)	Young's Modulus (GPa)	Poisson's Ratio	Axial Strain at Peak (%)	Young's Modulus (GPa)	Poisson's Ratio	
1U	17.56	17.14	Sandy Dolostone	21-Feb-19	0.0	152.4	0.406	48.7	--	0.297	61.5	0.23	massive/planar shear
2T	17.67	17.25	Sandy Dolostone	11-Mar-19	5.0	255.3	0.547	56.1	0.15	--	--	--	multiple shear, massive/crushing along horizontal plane in upper 1/3 of sample
3U	29.58	29.16	Sandstone	21-Feb-19	0.0	156.2	0.341	57.2	--	0.244	64.5	0.36	massive shear
4T	29.70	29.29	Sandstone	11-Mar-19	5.0	139.6	0.705	26.0	nd	--	--	--	planar shear, FA = 65°
5U	47.60	47.29	Sandstone	21-Feb-19	0.0	194.7 ^a	0.448	62.0	--	0.354	68.3	0.16	massive shear, vertical splitting
6T	59.79	59.61	Sandstone	12-Mar-19	5.0	113.0	0.531	29.1	0.26	--	--	--	undulating shear, FA = 60°
66.71-U	66.71	66.72	pre-Cambrian	14-Feb-20	0.0	27.4 ^{a,b}	0.875	5.7	0.07	0.470	7.8	0.19	undulating shear, FA = 60° -- [hydrostone used to fill sample ends]
66.99-U	66.99	66.99	pre-Cambrian	14-Feb-20	0.0	10.6 ^{a,b}	1.73	0.7	0.30	0.895	1.3	nd	axial splitting -- [hydrostone used to fill sample ends & voids]
70.94-U	70.94	70.94	pre-Cambrian	14-Feb-20	0.0	201.4	0.318	72.8	0.19	0.236	76.7	0.23	axial splitting, multiple fractures
71.09-T	71.09	71.09	pre-Cambrian	12-Mar-20	5.0	290.8	0.471	72.9	0.20	--	--	--	massive shear (60°) and axial splitting
71.20-U	71.20	71.20	pre-Cambrian	14-Feb-20	0.0	155.0	0.305	57.8	0.13	0.364	50.1	0.23	axial splitting
75.87-U	75.87	75.93	pre-Cambrian	14-Feb-20	0.0	55.0	0.469	16.4	nd	0.418	17.9	0.19	undulating shear, FA = 60°
76.12-U	76.12	76.19	pre-Cambrian	14-Feb-20	0.0	48.9	0.539	12.6	0.09	0.562	11.3	0.17	undulating shear, FA = 65°
76.23-T	76.23	76.3	pre-Cambrian	12-Mar-20	10.0	135.1	0.533	31.4	0.22	--	--	--	undulating shear, FA = 63°
86.74-U	86.74	86.92	pre-Cambrian	14-Feb-20	0.0	231.7	0.362	73.4	0.13	0.365	68.3	0.28	massive shear, combination of axial splitting and planar shear (FA = 60°)
86.85-T	86.85	87.03	pre-Cambrian	13-Mar-20	10.0	299.9	0.494	72.9	0.21	--	--	--	planar shear, FA = 62°
86.96-U	86.96	87.14	pre-Cambrian	14-Feb-20	0.0	186.2	0.300	68.1	0.08	0.235	82.3	0.30	axial splitting
87.07-T	87.07	87.25	pre-Cambrian	13-Mar-20	5.0	273.4	0.489	67.3	0.19	--	--	--	conical shear
93.92-U	93.92	94.09	pre-Cambrian	14-Feb-20	0.0	137.9	0.224	75.1	0.12	0.204	78.9	0.27	wedge failure (55°), from top-middle
99.17-U	99.17	99.35	pre-Cambrian	14-Feb-20	0.0	206.2	0.325	71.2	0.11	0.292	73.3	0.28	axial splitting
99.28-U	99.28	99.46	pre-Cambrian	14-Feb-20	0.0	240.1	0.332	78.2	0.08	0.316	78.4	0.32	massive planar shear, FA = 60°
109.01-U	109.01	109.22	pre-Cambrian	17-Feb-20	0.0	140.9	0.237	72.6	0.15	0.218	73.6	0.45	planar shear, FA = 64°
109.12-T	109.12	109.33	pre-Cambrian	13-Mar-20	5.0	172.0	0.715	31.1	0.03	--	--	--	planar shear, FA = 65°
109.23-T	109.23	109.44	pre-Cambrian	13-Mar-20	10.0	195.7	0.372	69.5	0.14	--	--	--	planar shear, FA = 60°

Notes:

- Testing completed in accordance with ASTM D7012 -14, using the MTS 815 load frame (axial displacement control @ 0.0007 mm/s)
- Elastic properties calculated b/w 45-55% of peak strength using electric strain gauges unless otherwise noted
- = not measured
- mbgs = metres below ground surface
- nd = could not be determined
- a = Peak strength identified as stress at initial sample damage and/or the onset of rapid decrease in volumetric strain
- b = Time to failure exceeded 15 minutes (as specified in ASTM D7012)

Table A.3 - Splitting Tensile (Brazilian) Test Results

Specimen and Test Data					Strength Properties		Description of Failure Mode
Specimen ID	Sample Top Depth (mbgs)	Wireline Top Depth (mbgs)	Rock Type	Date Tested	Maximum Applied Load, P _{Failure} (kN)	Splitting Tensile Strength, σ_t (MPa)	
1B	17.78	17.36	Sandy Dolostone	09-Oct-19	28.0	10.7	- diametral splitting
2B	29.82	29.41	Sandstone	09-Oct-19	10.6	4.0	- diametral splitting, minor crushing at ends
3B	29.86	29.45	Sandstone	09-Oct-19	22.7	8.7	- diametral splitting, minor crushing at ends
4B	34.66	34.25	Sandstone	09-Oct-19	24.0	9.2	- diametral splitting, minor crushing at ends
5B	34.70	34.29	Sandstone	09-Oct-19	27.0	10.3	- diametral splitting, multiple fractures
6B	34.75	34.34	Sandstone	09-Oct-19	22.5	8.4	- diametral splitting
7B	47.54	47.23	Sandstone	09-Oct-19	25.8	10.4	- diametral splitting, minor crushing at ends
8B	59.22	59.03	Sandstone	09-Oct-19	10.3	3.9	- diametral splitting
9B	59.26	59.08	Sandstone	09-Oct-19	11.5	4.4	- diametral splitting
10B	59.90	59.72	Sandstone	09-Oct-19	10.6	4.0	- diametral splitting, minor crushing at ends
11B	59.94	59.76	Sandstone	09-Oct-19	12.0	4.6	- diametral splitting
66.63-B	66.63	66.64	pre-Cambrian	11-Feb-20	14.8	5.7	- diametral splitting, weak sample, crumbling
66.67-B	66.67	66.68	pre-Cambrian	11-Feb-20	11.4	4.4	- off centre, 1/2 circle break, slabbing
66.88-B	66.88	66.89	pre-Cambrian	11-Feb-20	7.8	3.0	- diametral splitting, multiple fractures
71.05-B	71.05	71.05	pre-Cambrian	11-Feb-20	29.6	11.4	- diametral splitting
71.31-B	71.31	71.31	pre-Cambrian	12-Feb-20	24.5	9.4	- diametral splitting
76.04-B	76.04	76.1	pre-Cambrian	12-Feb-20	22.2	8.5	- diametral splitting
76.08-B	76.08	76.15	pre-Cambrian	13-Feb-20	23.1	8.9	- diametral splitting
86.66-B	86.66	86.84	pre-Cambrian	13-Feb-20	33.8	13.0	- diametral splitting
86.70-B	86.70	86.88	pre-Cambrian	13-Feb-20	33.1	12.7	- diametral splitting
93.81-B	93.81	93.98	pre-Cambrian	13-Feb-20	41.5	16.0	- diametral splitting, 1/2 circle break
93.85-B	93.85	94.02	pre-Cambrian	13-Feb-20	37.6	14.5	- diametral splitting, 1/2 circle break
99.13-B	99.13	99.31	pre-Cambrian	13-Feb-20	25.1	9.6	- diametral splitting
99.39-B	99.39	99.57	pre-Cambrian	13-Feb-20	33.5	12.9	- diametral splitting
108.98-B	108.97	109.18	pre-Cambrian	13-Feb-20	25.6	9.9	- diametral splitting, 1/2 circle break
109.34-B	109.34	109.55	pre-Cambrian	13-Feb-20	40.0	15.4	- diametral splitting

Notes:

mbgs = metres below ground surface

- Testing completed in accordance with ASTM D3967-16, using the MTS 815 load frame (axial load control @ 0.05 kN/s)

Table A.4 - Constant Head Permeability Test Results

Specimen and Test Data						Hydraulic Properties					
Specimen ID	Sample Top Depth (mbgs)	Wireline Top Depth (mbgs)	Date Tested	Axial Stress (MPa)	Confinement (MPa)	Pressure, P ₁ (MPa)	Time (s)	Flow Rate, Q (cm ³ /s)	Step Permeability (cm ²)	Step Conductivity (cm/s)	Average Conductivity (cm/s)
2T	17.67	17.26	08-Mar-19	9.9	5.0	1.0	2500	-1.7E-05	nd	nd	6E-11
						2.0	2900	1.1E-06	3.2E-16	3.1E-11	
						3.0	2500	3.0E+00	8.3E-16	8.1E-11	
4T	29.70	29.29	07-Mar-19	10.0	5.0	0.2	1700	6.9E-04	2.1E-12	2.0E-07	2E-07
						0.4	1700	1.3E-03	2.0E-12	2.0E-07	
						0.6	1000	2.0E-03	2.0E-12	1.9E-07	
6T	59.79	59.61	07-Mar-19	9.9	5.0	0.2	1300	5.6E-04	1.5E-12	1.5E-07	1E-07
						0.4	1200	9.1E-04	1.3E-12	1.3E-07	
						0.6	1100	1.3E-03	1.2E-12	1.2E-07	

Notes:

mbgs = metres below ground surface

nd = could not be determined, negligible flow

- Constant head permeability tests completed using the MTS 815 test system