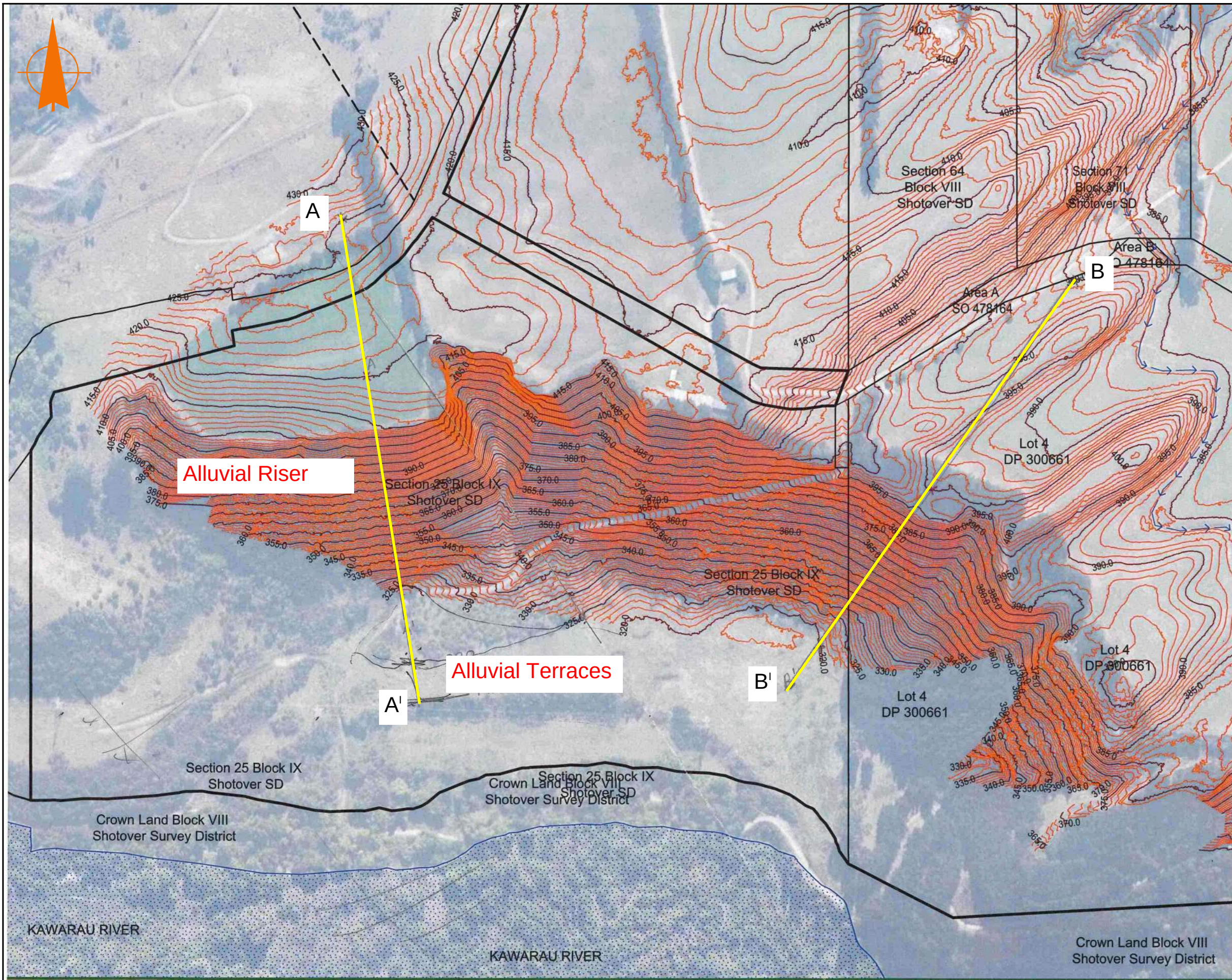


Appendix D

Geological Cross-Section & Slope Stability Analysis

1. Transect Line Map
2. Geological Cross-section and Slope Stability Outputs – Static, SLS, and ULS for Current Ground Model and Options 1 and 2.
3. Setback Zones Based on Slope Stability Outputs





LEGEND

Cross Section Transect Lines

NOTES

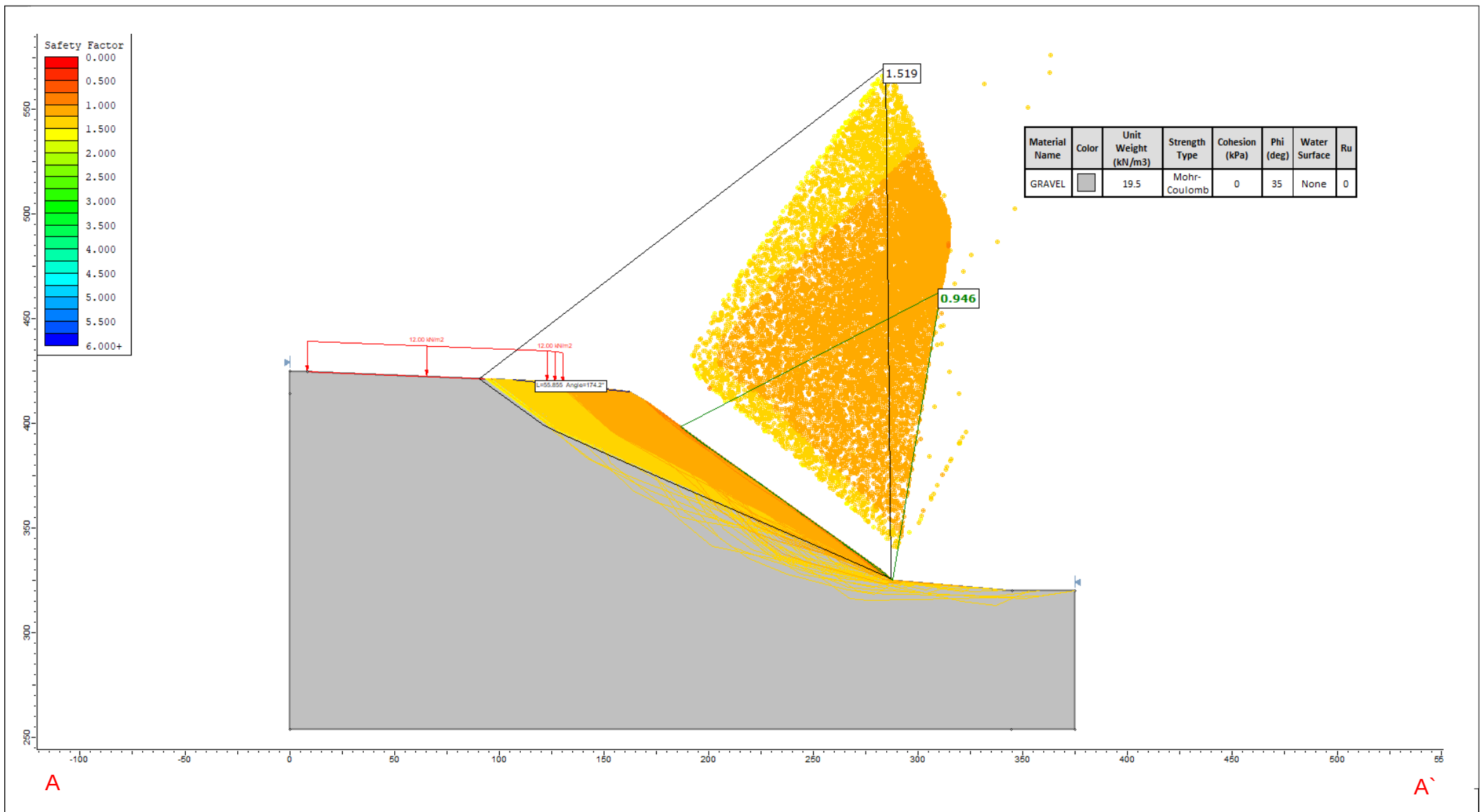
Location of Features and Ground Investigation points are approximate only.
Aerial Image & Site Boundary Sourced from Topographical plans provided by McKenzie and Co. titled "Doonholme Estate, 122 Morven Ferry Road, Arrow Junction, Queenstown" updated 19/01/26

PROJECT: 2555087
CREATED BY: SSA
APPROVED BY: OB
DATE: January 2026

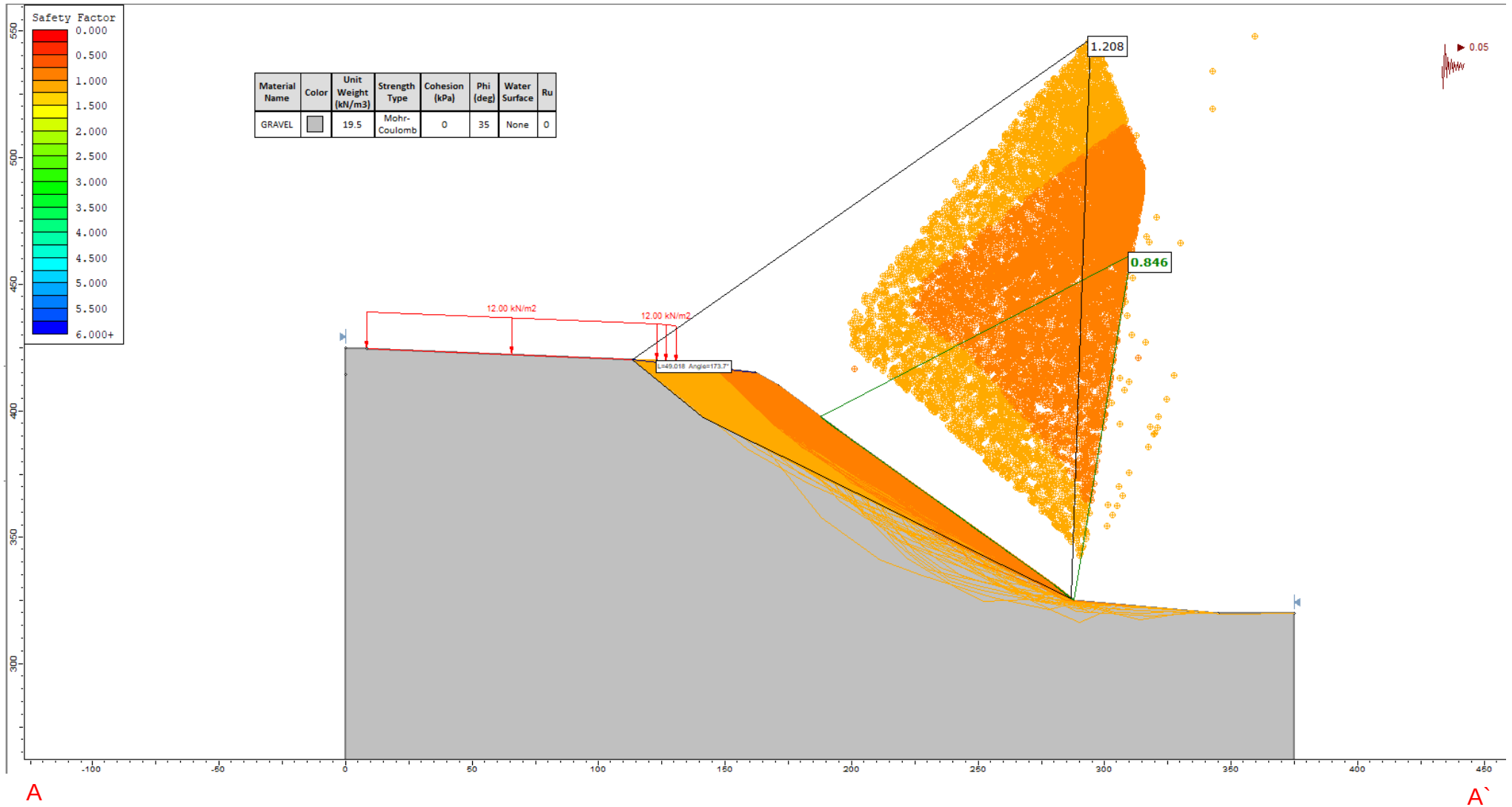
122 Morven Ferry Road,
Arrow Junction

**SLOPE STABILITY TRANSECT LINES
LOCATION PLAN**

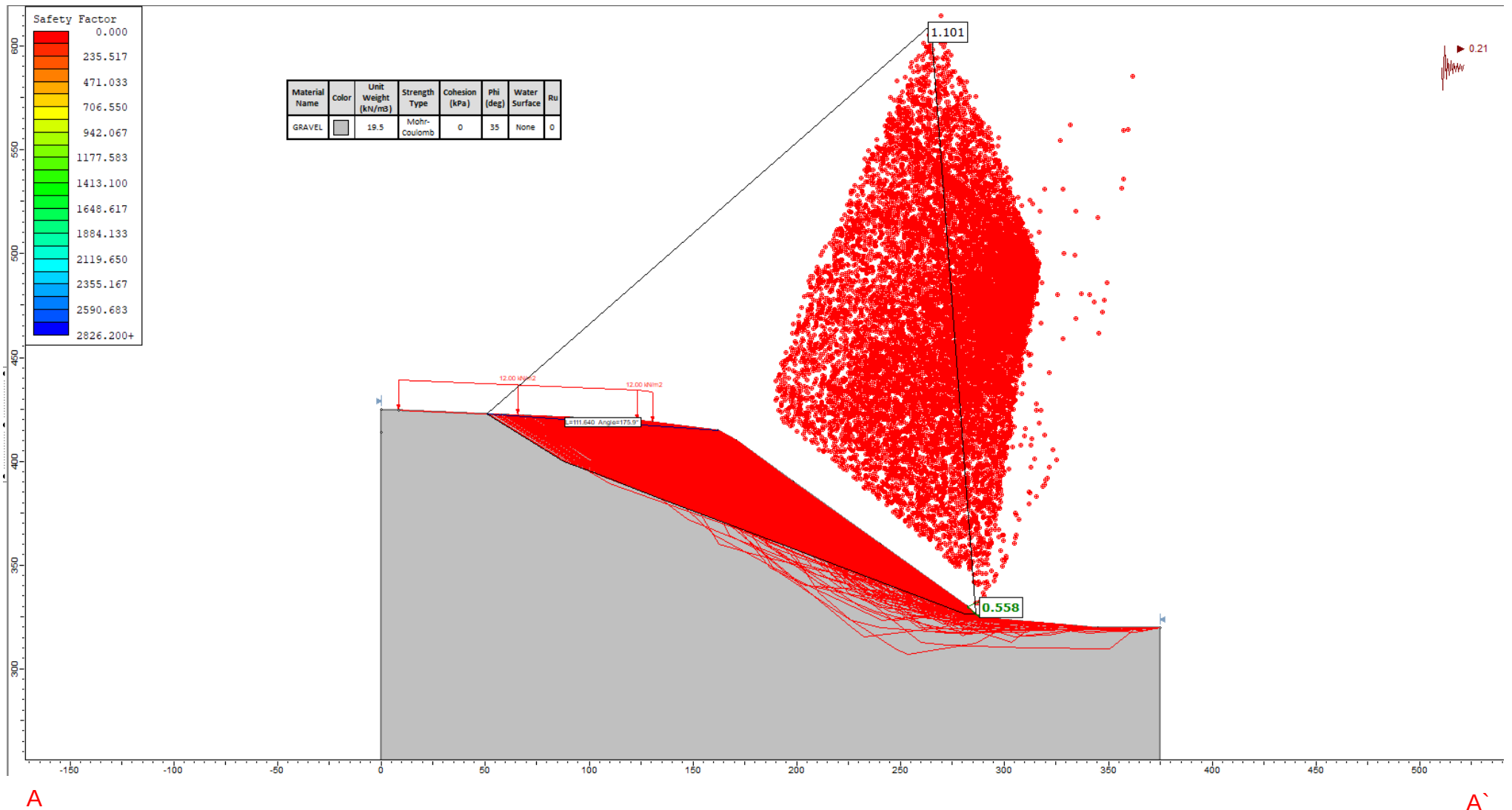




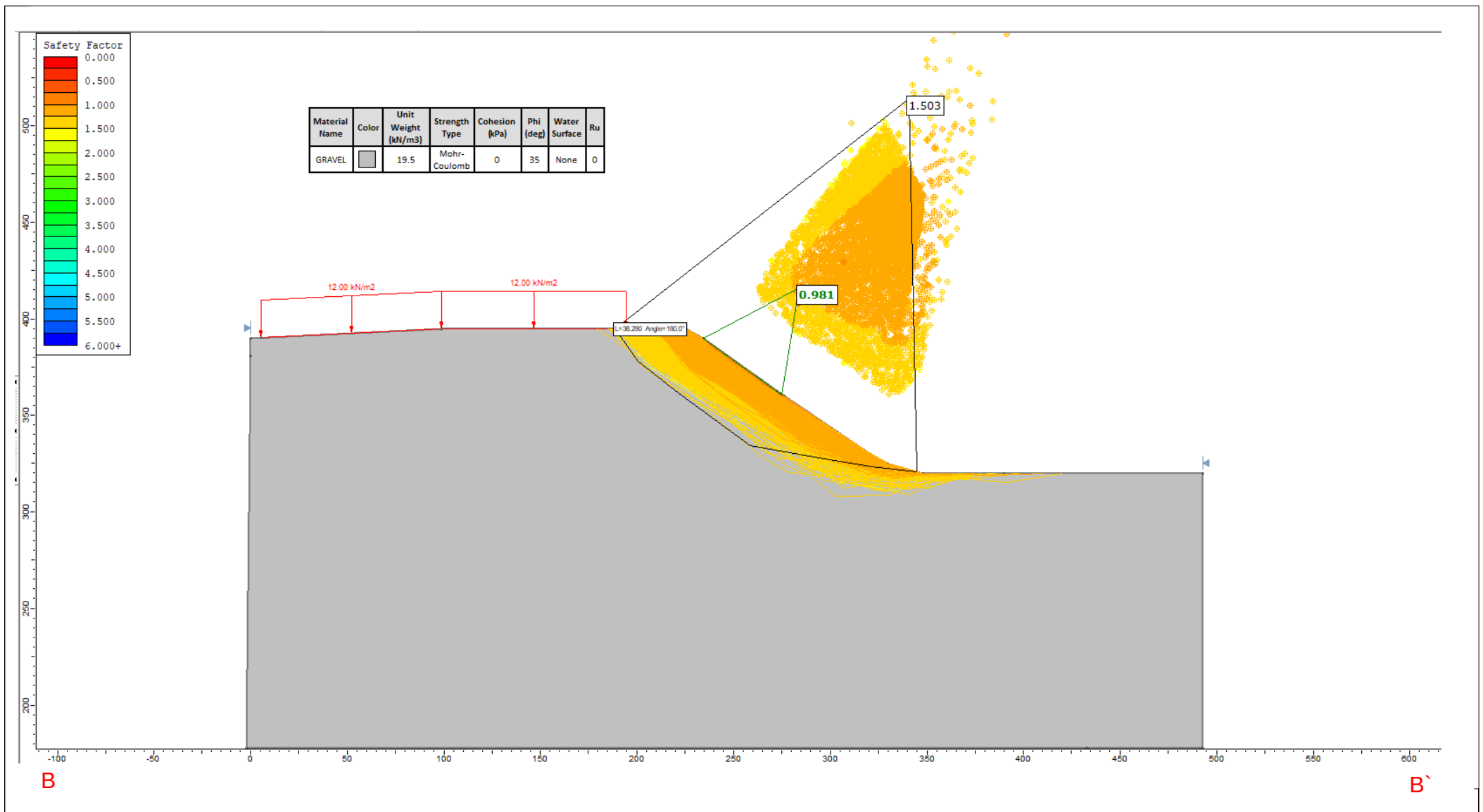
Project		122 Morven Ferry Road, Arrow Junction	
Group		Slope Stability Analysis	Scenario Static Case - Current Model
Drawn By		SSA	Company Kirk Roberts Consulting
Date		30/01/2026, 10:00:40 am	Revision 01



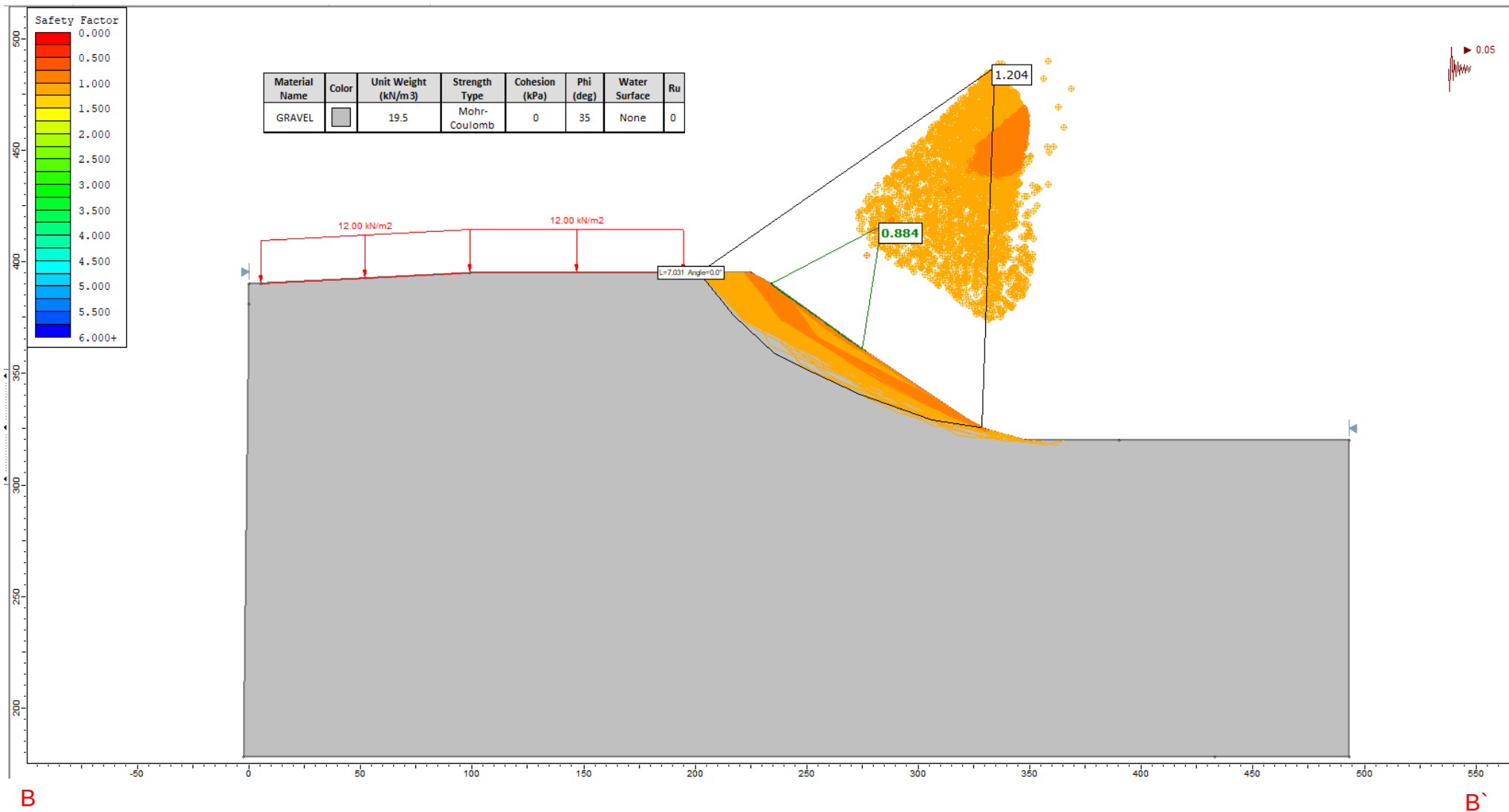
Project		122 Morven Ferry Road, Arrow Junction	
Group		Slope Stability Analysis	Scenario
Drawn By		SSA	Company
Date		30/01/2026, 10:00:40 am	Revision
			01
		SLS Case - Current Model	
		Kirk Roberts Consulting	



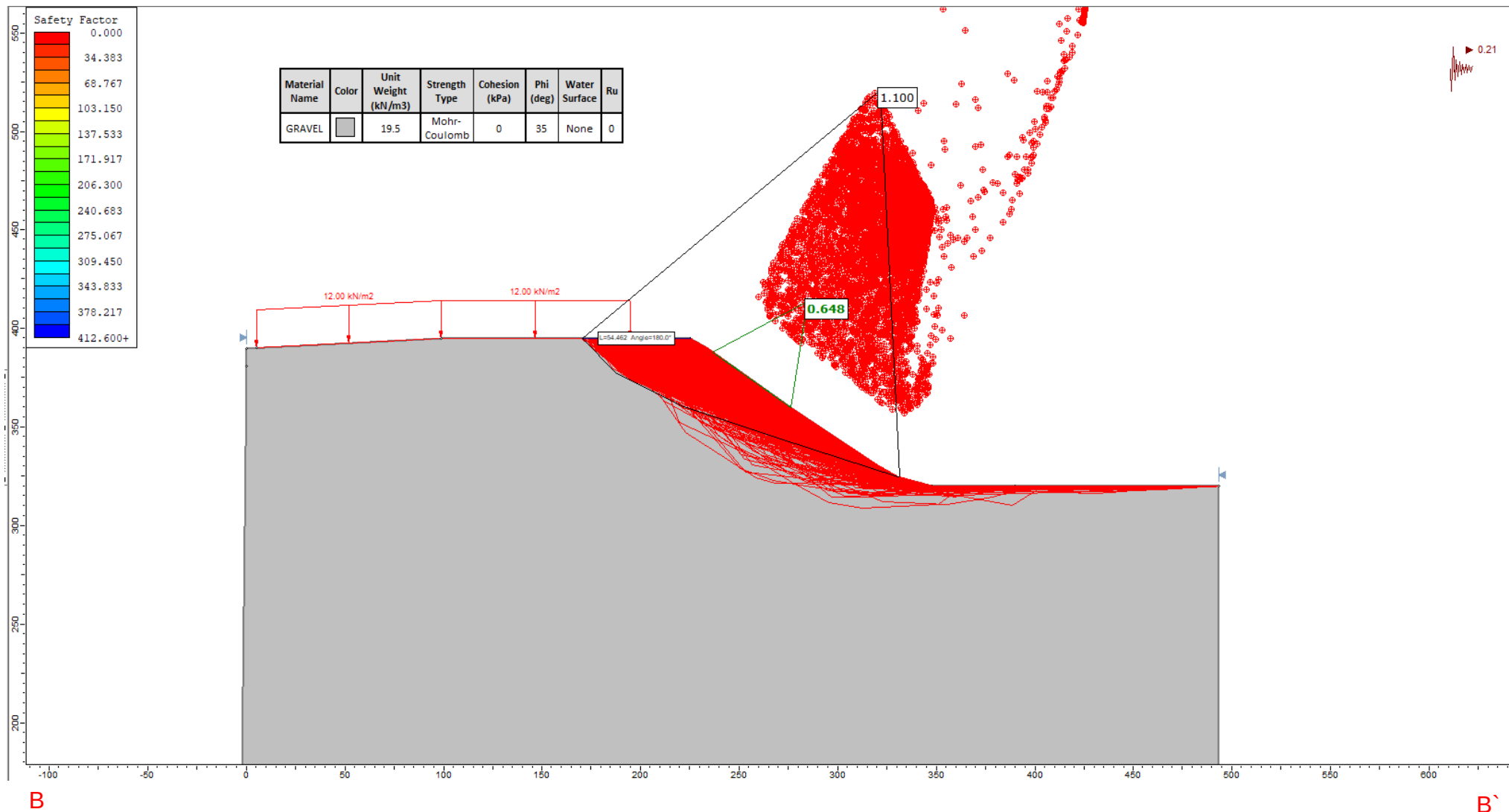
Project		122 Morven Ferry Road, Arrow Junction	
Group		Slope Stability Analysis	Scenario
Drawn By		SSA	Company
Date		30/01/2026, 10:00:40 am	Revision
			01
		ULS Case - Current Model	
		Kirk Roberts Consulting	



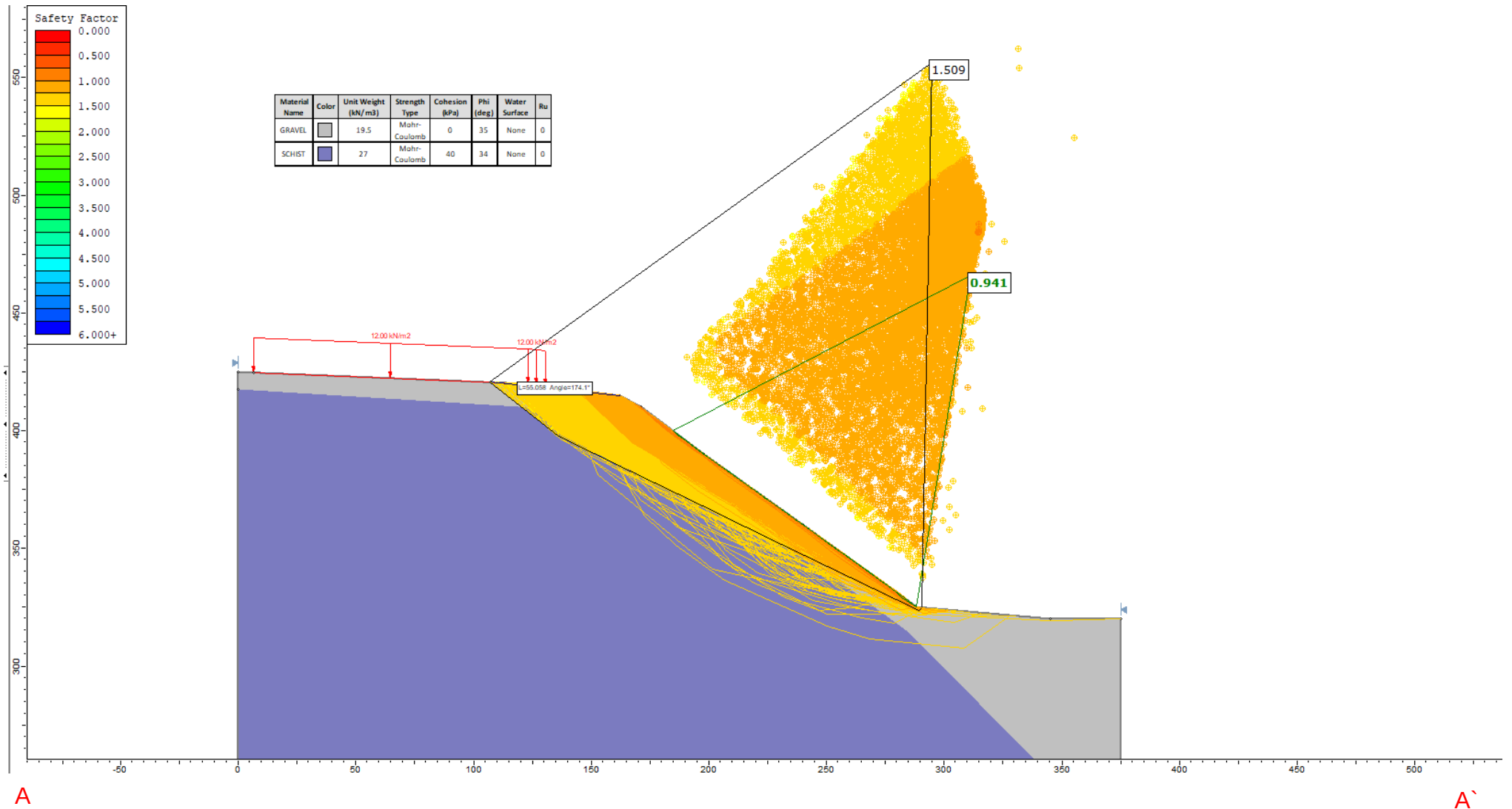
Project		122 Morven Ferry Road, Arrow Junction	
Group		Slope Stability Analysis	Scenario Static Case - Current Model
Drawn By		SSA	Company Kirk Roberts Consulting
Date		30/01/2026, 10:00:40 am	Revision 01



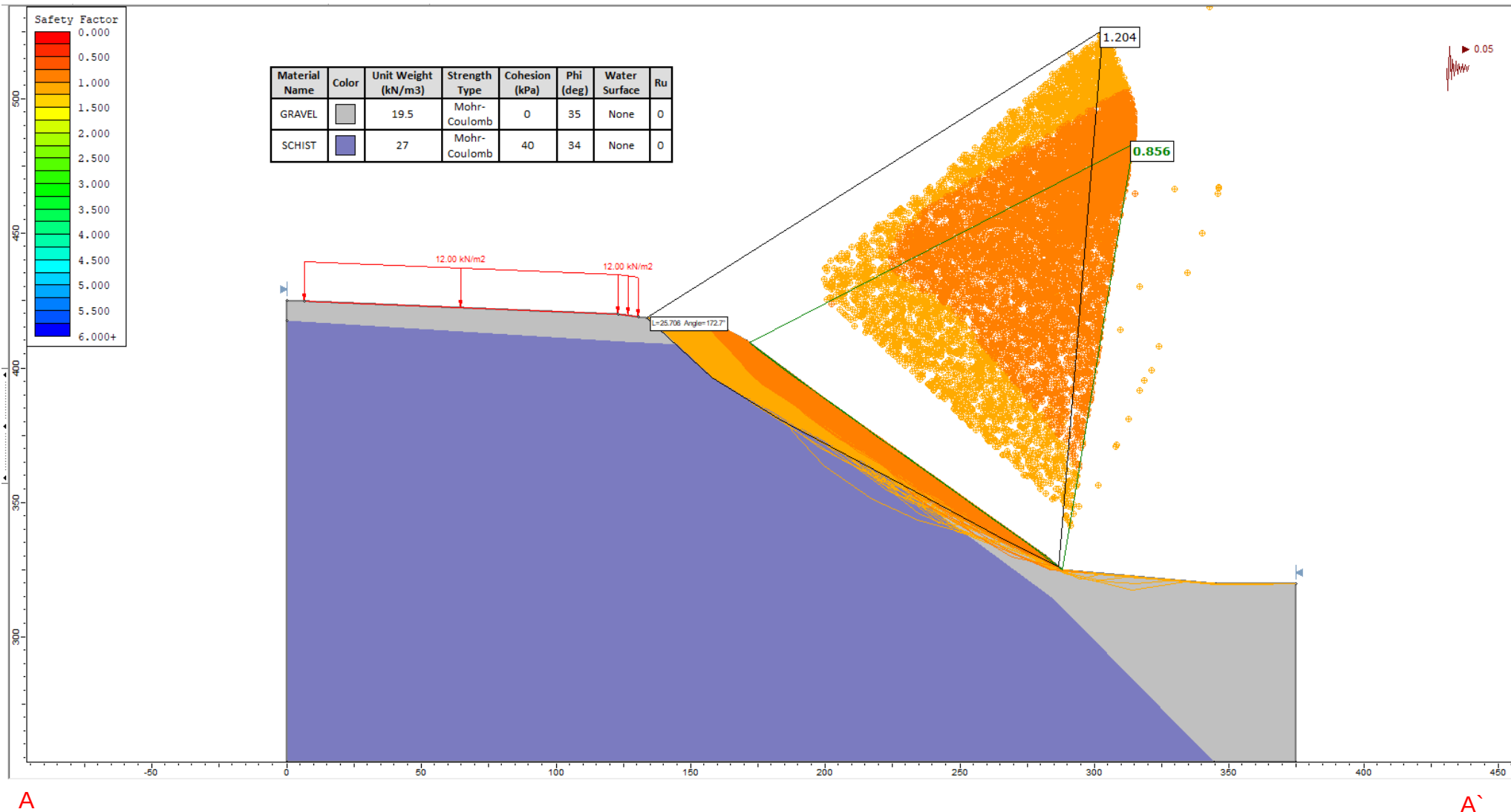
Project		122 Morven Ferry Road, Arrow Junction	
Group		Slope Stability Analysis	Scenario SLS Case - Current Model
Drawn By		SSA	Company Kirk Roberts Consulting
Date		30/01/2026, 10:00:40 am	Revision 01



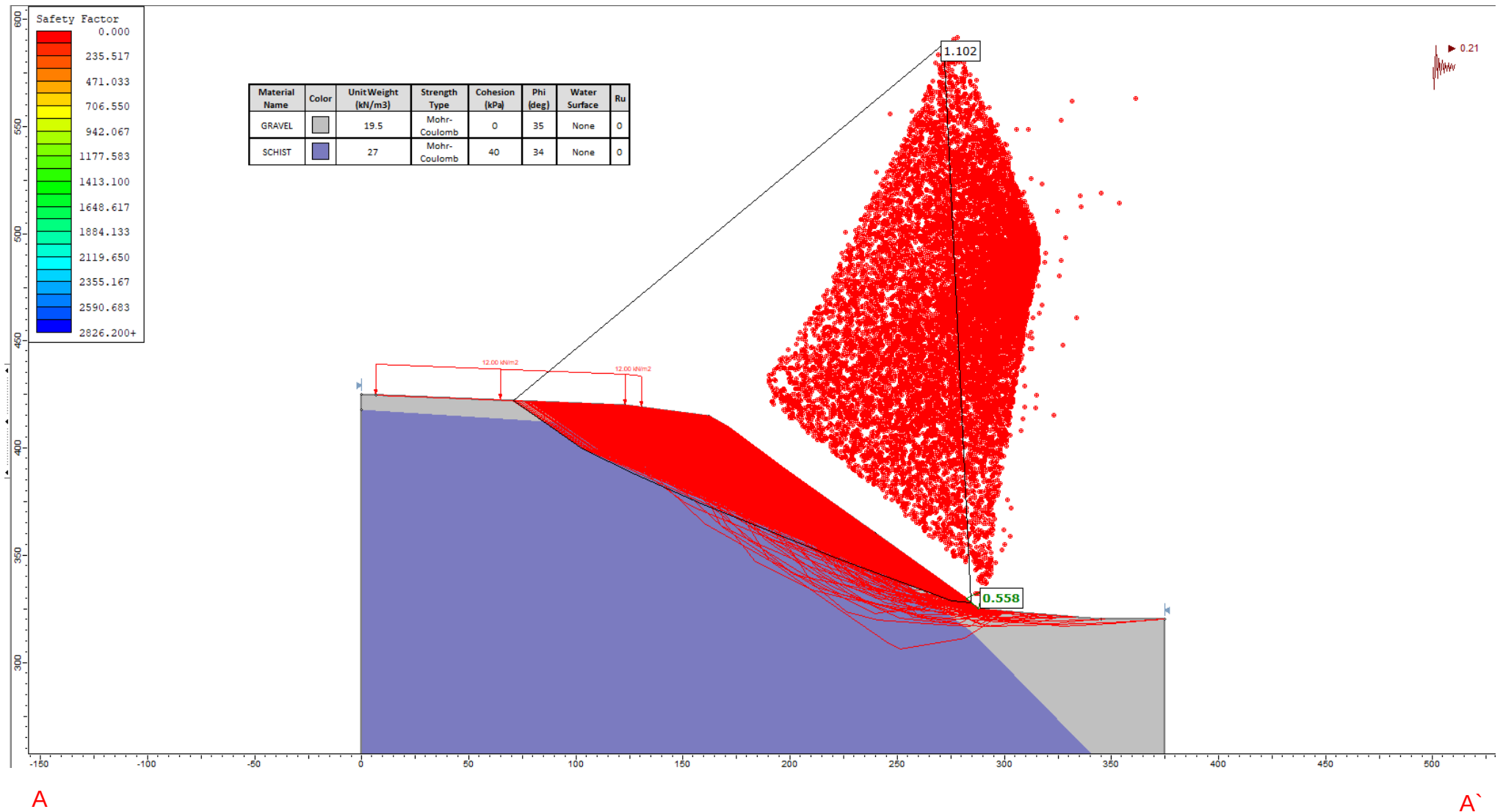
Project				122 Morven Ferry Road, Arrow Junction	
Group		Slope Stability Analysis		Scenario	ULS Case - Current Model
Drawn By		SSA		Company	Kirk Roberts Consulting
Date		30/01/2026, 10:00:40 am		Revision	01



Project		122 Morven Ferry Road, Arrow Junction	
Group		Slope Stability Analysis	Scenar Static Case - Potential Option 1
Drawn By		SSA	Company Kirk Roberts Consulting
Date		30/01/2026, 10:00:40 am	Revision 01



Project		122 Morven Ferry Road, Arrow Junction	
Group		Slope Stability Analysis	Scenario
Drawn By		SSA	Company
Date		30/01/2026, 10:00:40 am	Revision
			01
		SLS Case - Potential Option 1	
		Kirk Roberts Consulting	

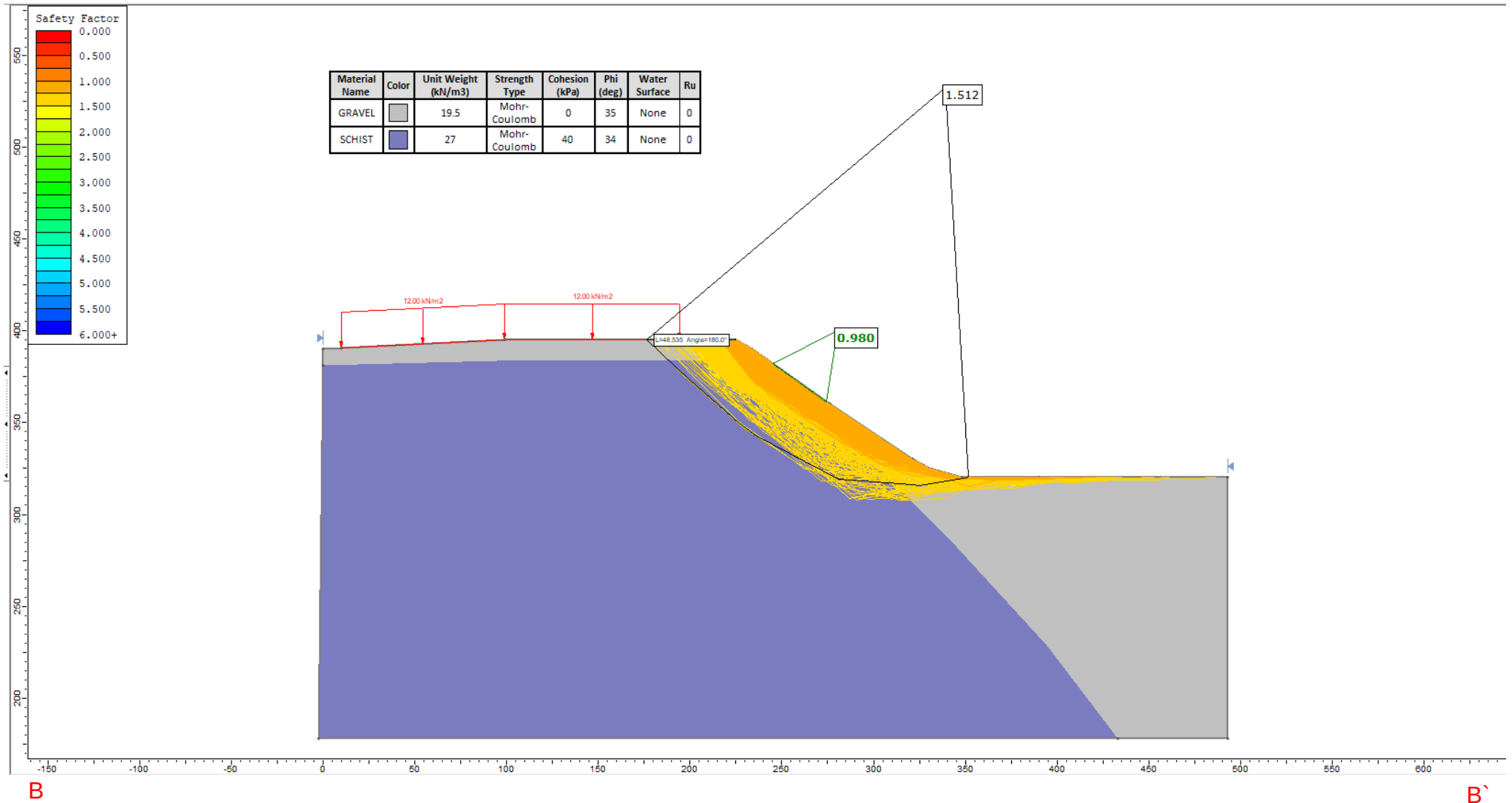


A

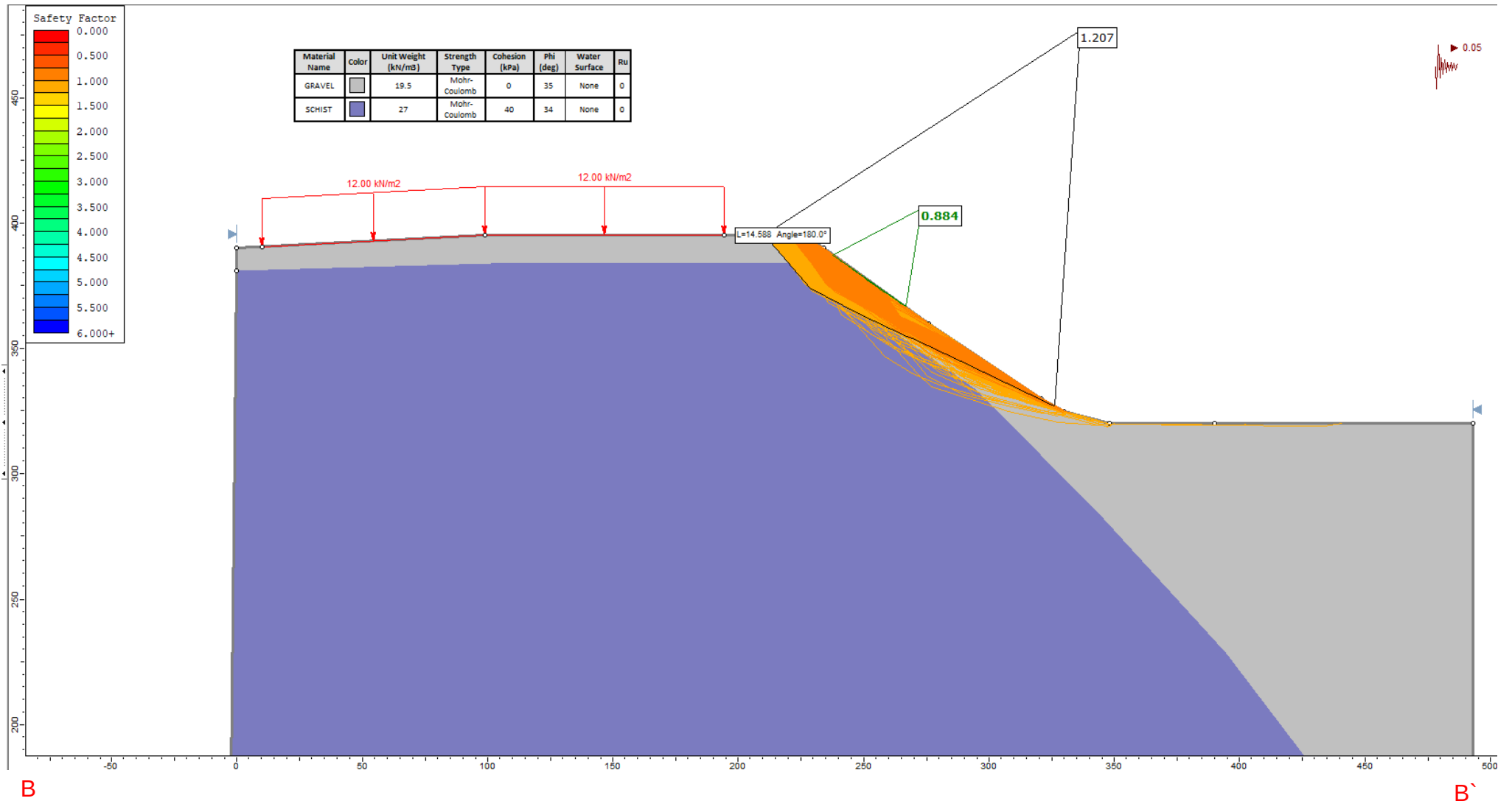
A'



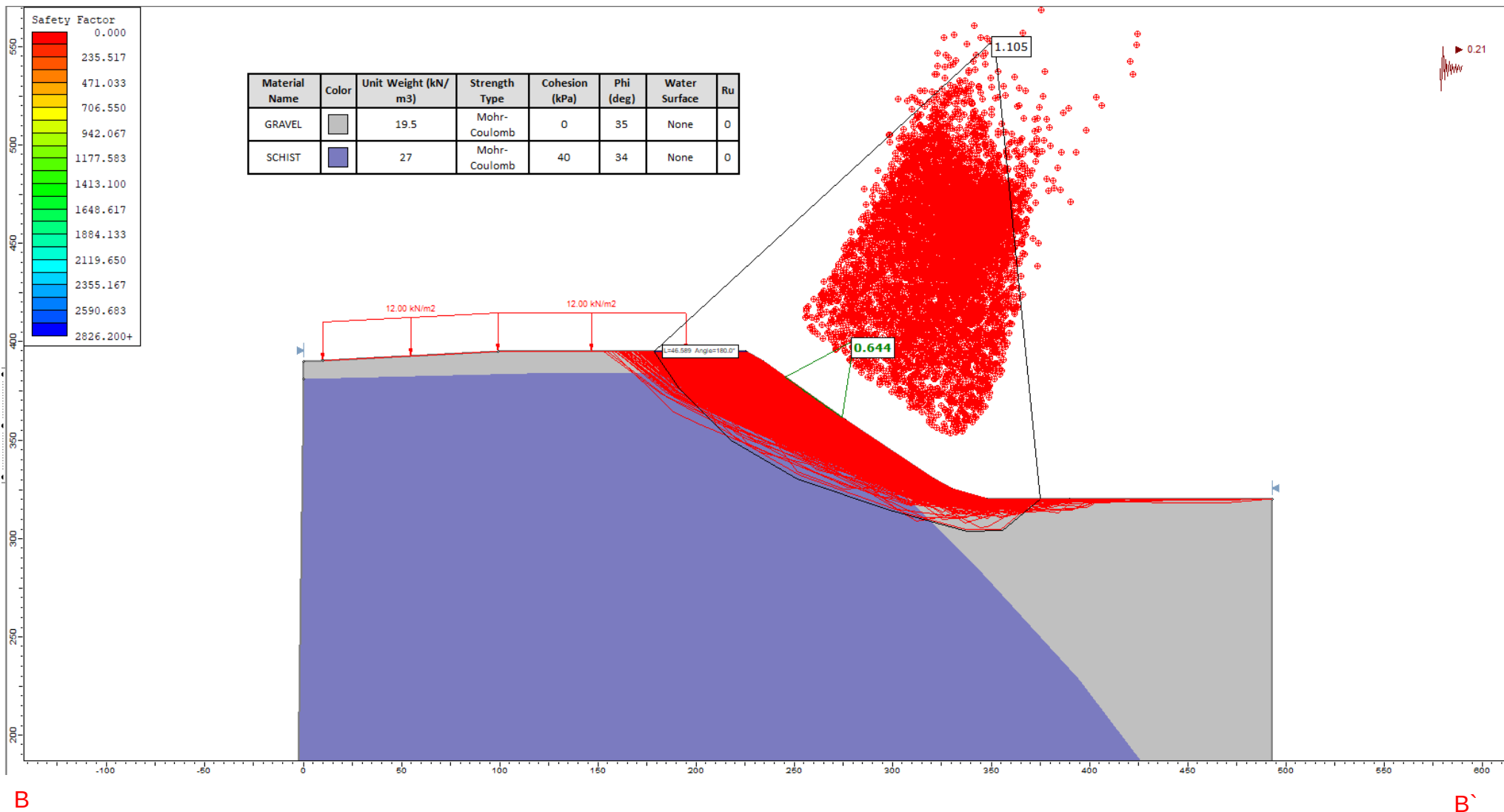
Project		122 Morven Ferry Road, Arrow Junction	
Group		Slope Stability Analysis	Scenario
Drawn By		SSA	Company
Date		30/01/2026, 10:00:40 am	Revision
			01
		ULS Case - Potential Option 1	
		Kirk Roberts Consulting	



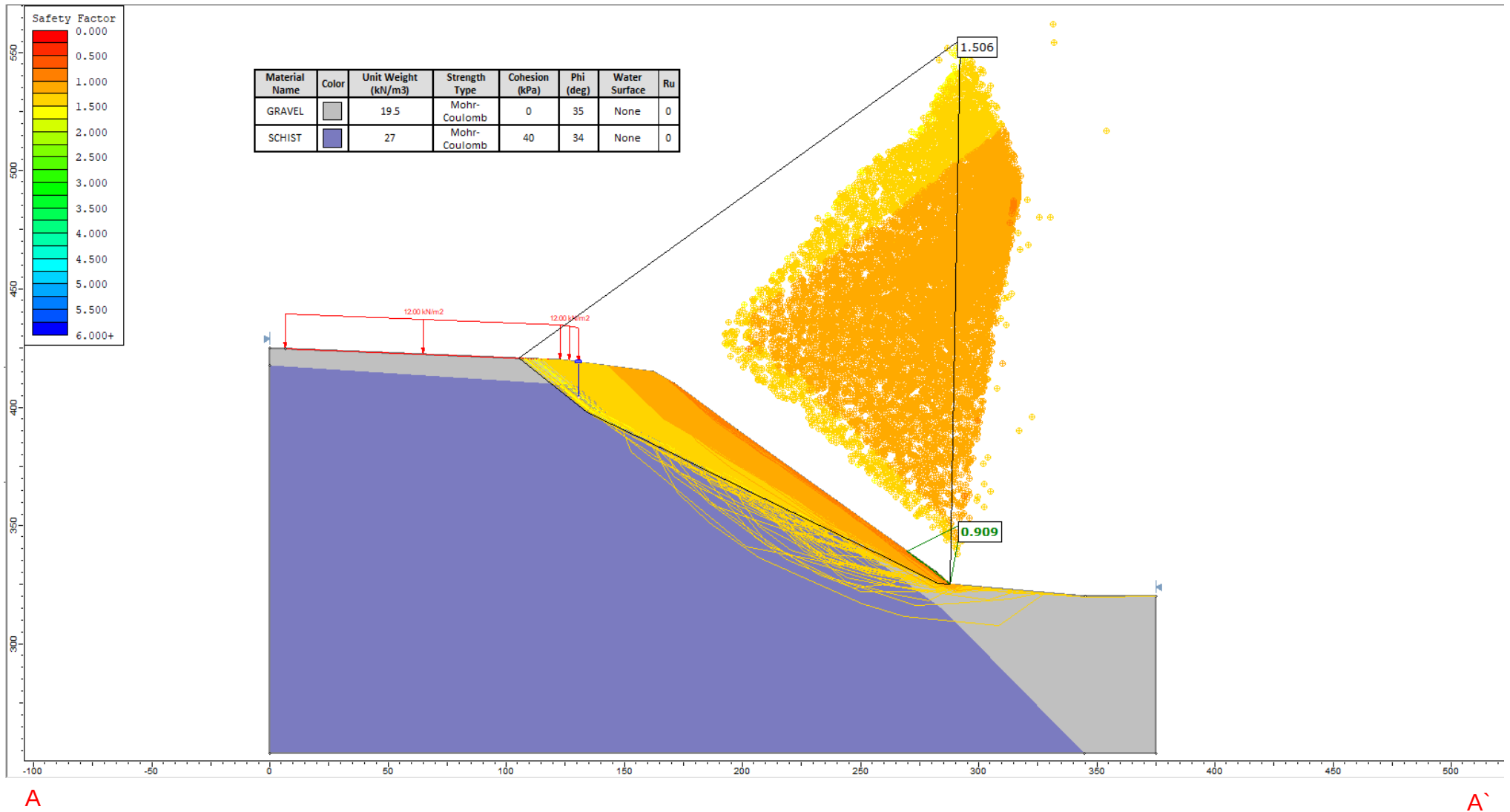
Project		122 Morven Ferry Road, Arrow Junction	
Group		Slope Stability Analysis	Scenar Static Case - Potential Option 1
Drawn By		SSA	Company Kirk Roberts Consulting
Date		30/01/2026, 10:00:40 am	Revision 01



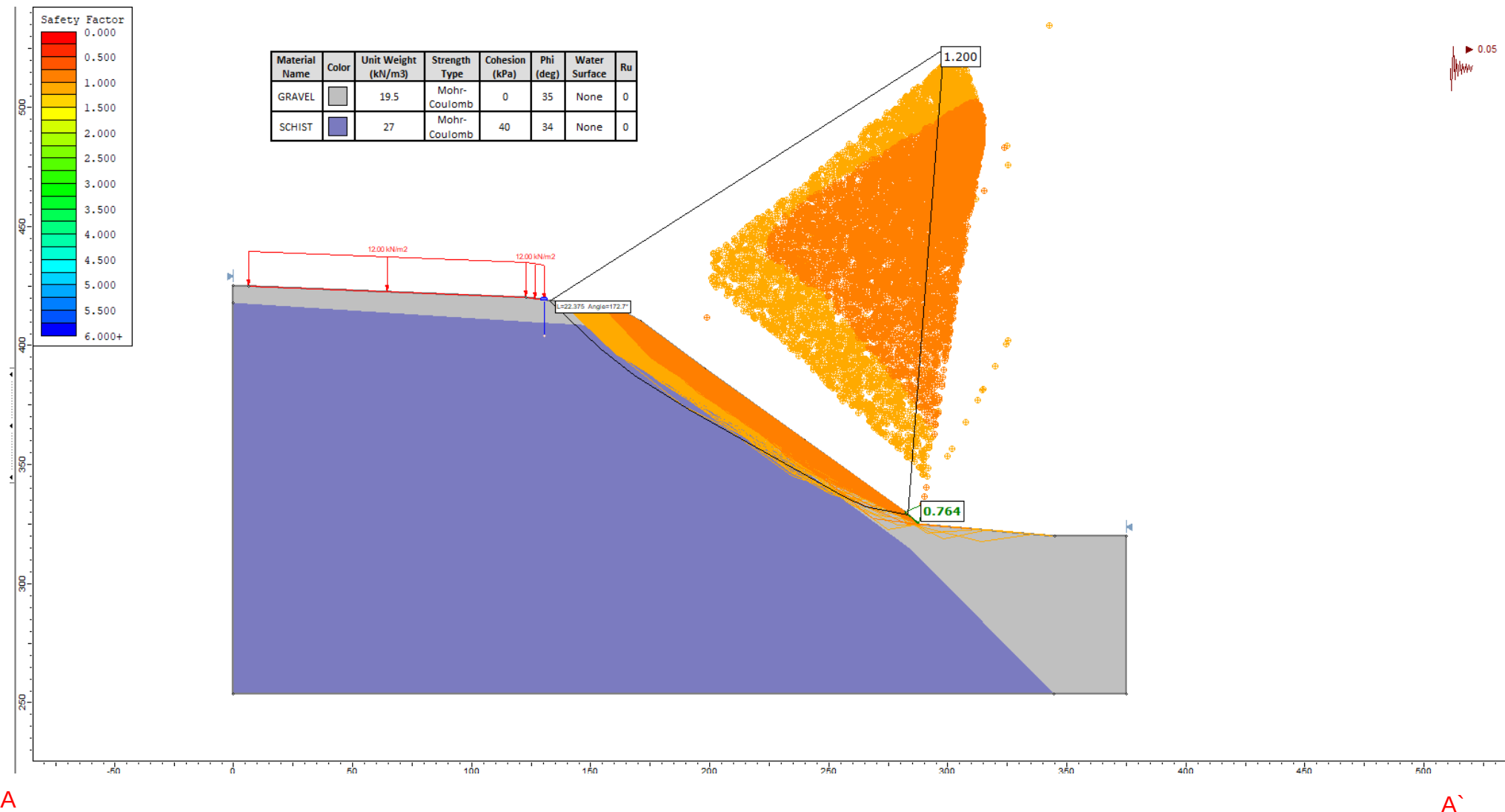
Project		122 Morven Ferry Road, Arrow Junction	
Group		Slope Stability Analysis	Scenario
Drawn By		SSA	Company
Date		30/01/2026, 10:00:40 am	Revision
			01
		SLS Case - Potential Option 1	
		Kirk Roberts Consulting	



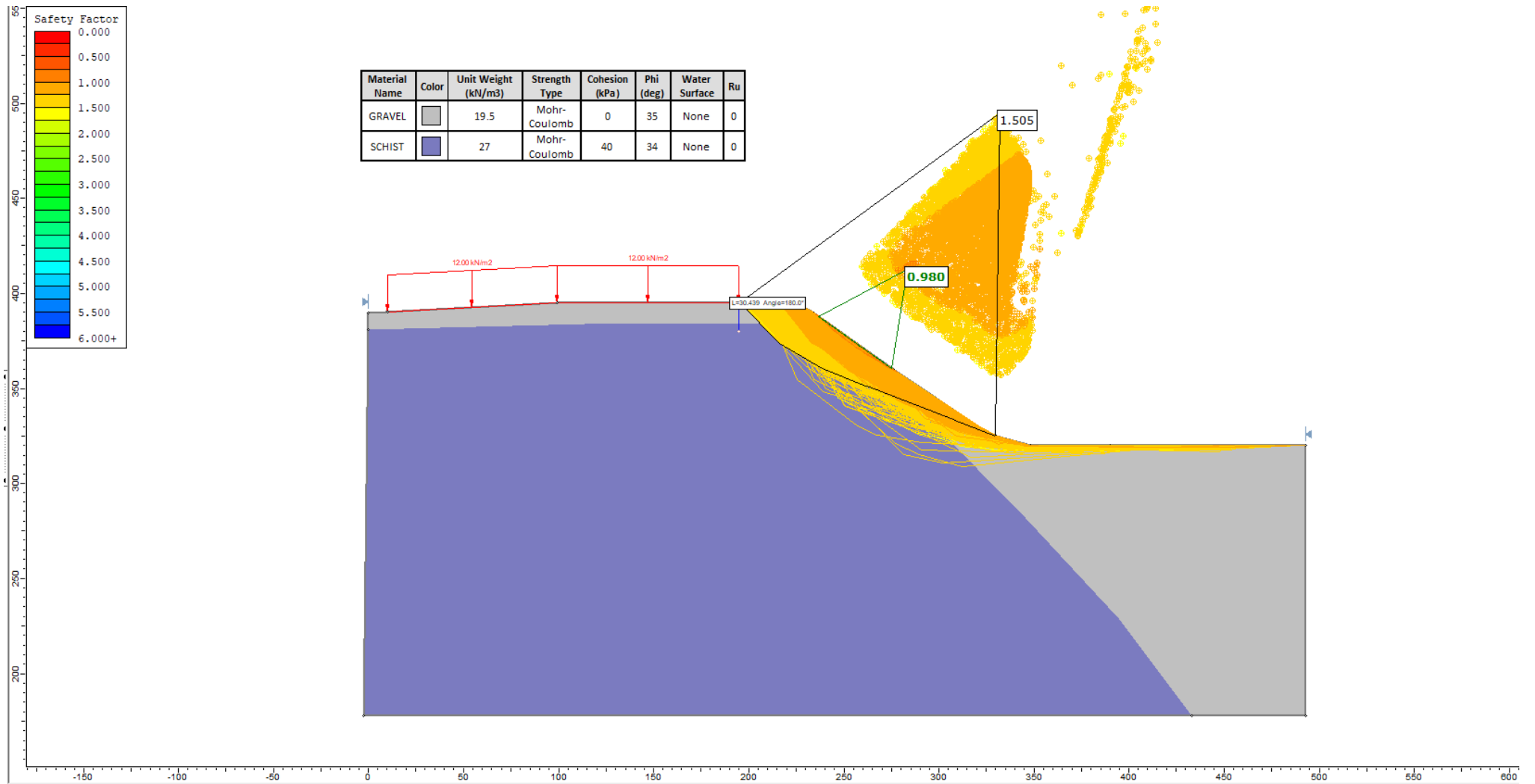
Project		122 Morven Ferry Road, Arrow Junction	
Group	Slope Stability Analysis	Scenario	ULS Case - Potential Option 1
Drawn By	SSA	Company	Kirk Roberts Consulting
Date	30/01/2026, 10:00:40 am	Revision	01



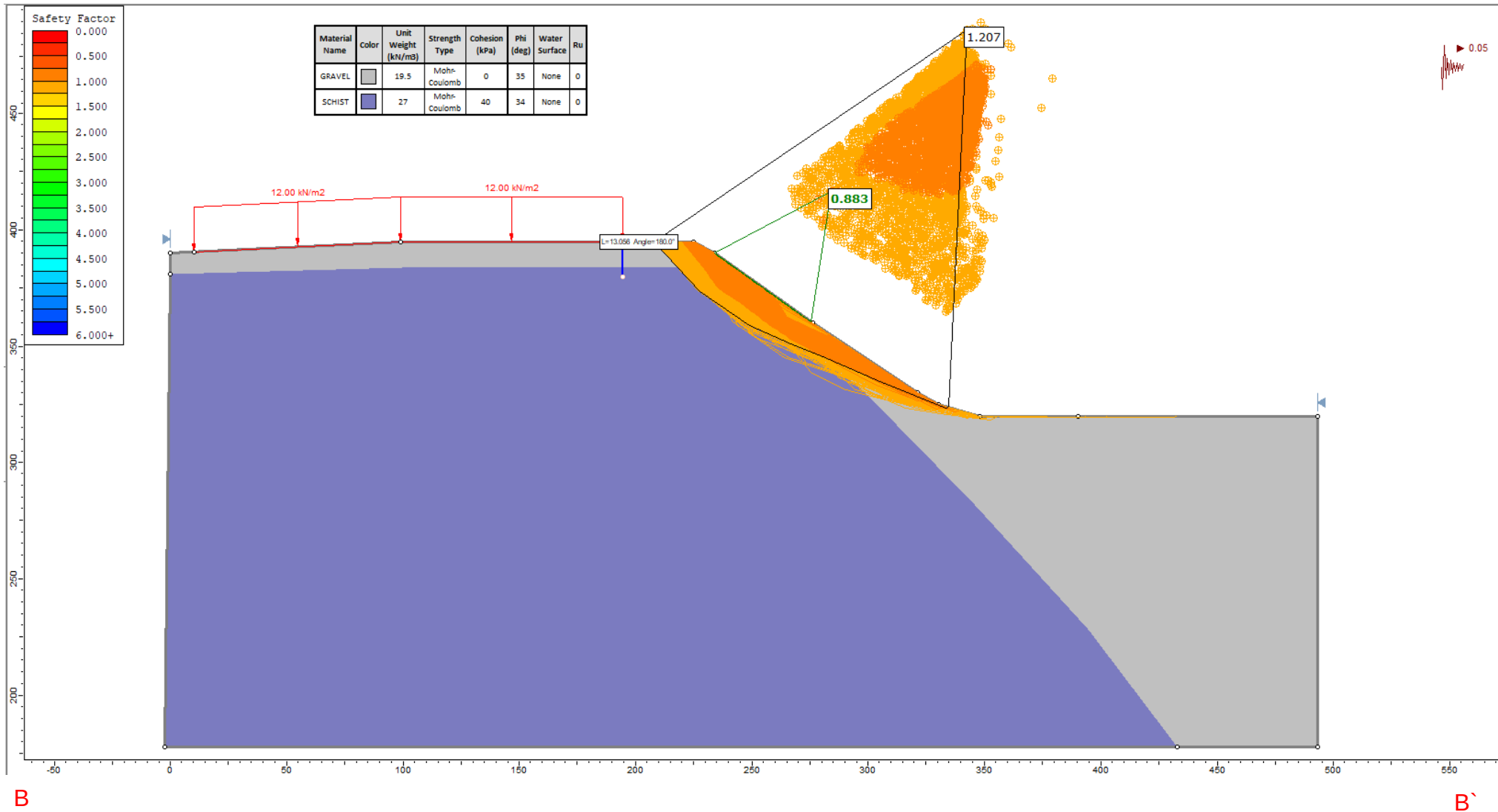
Project		122 Morven Ferry Road, Arrow Junction	
Group		Slope Stability Analysis	Scenar Static Case - Potential Option 2
Drawn By		SSA	Company Kirk Roberts Consulting
Date		30/01/2026, 10:00:40 am	Revision 01



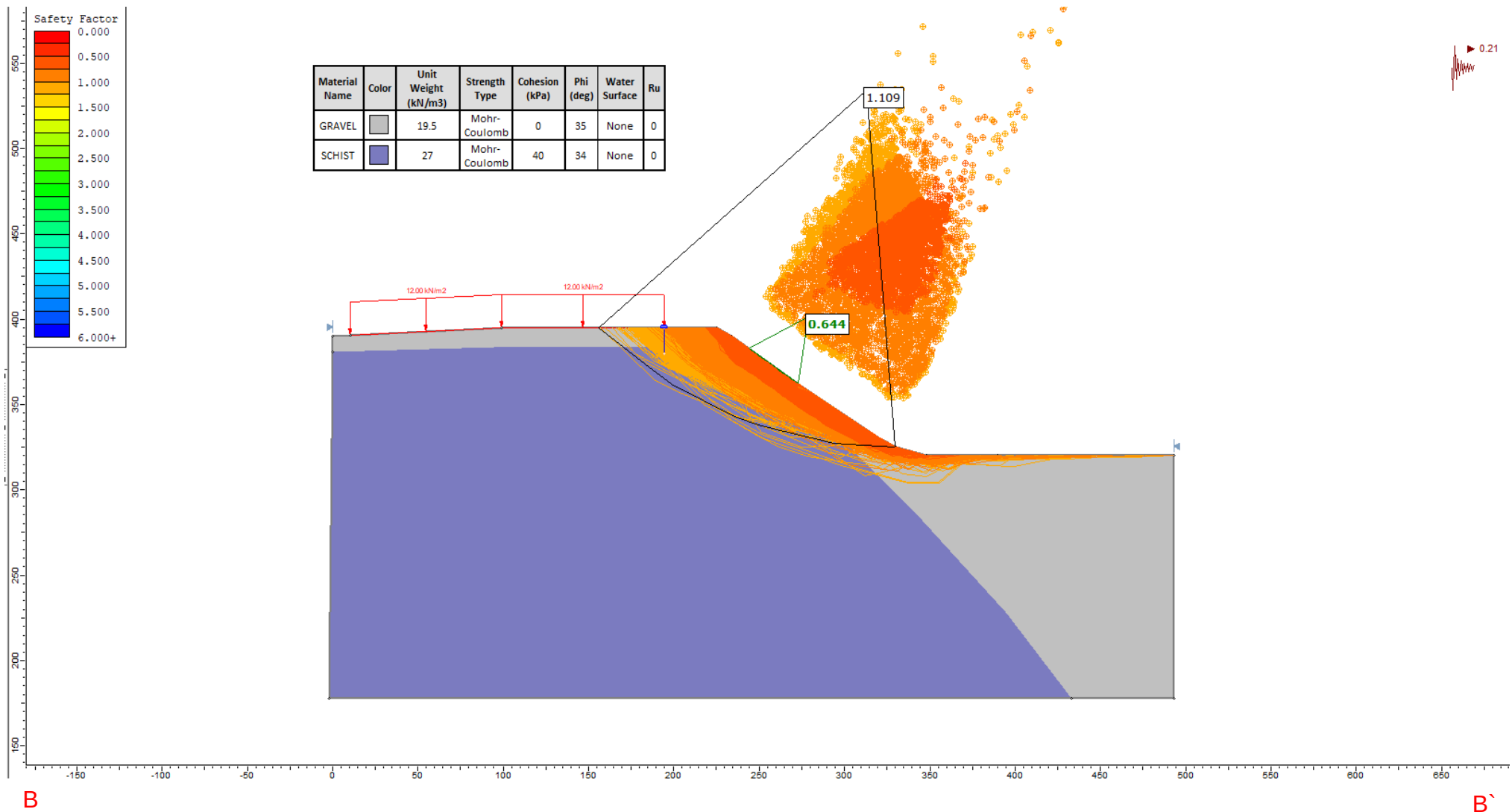
Project		122 Morven Ferry Road, Arrow Junction	
Group		Slope Stability Analysis	Scenario
Drawn By		SSA	Company
Date		30/01/2026, 10:00:40 am	Revision
			01



Project	122 Morven Ferry Road, Arrow Junction		
Group	Slope Stability Analysis	Scenar	Static Case - Potential Option 2
Drawn By	SSA	Company	Kirk Roberts Consulting
Date	30/01/2026, 10:00:40 am	Revision	01



Project		122 Morven Ferry Road, Arrow Junction	
Group		Slope Stability Analysis	Scenario
Drawn By		SSA	Company
Date		30/01/2026, 10:00:40 am	Revision
			01
		SLS Case - Potential Option 2	
		Kirk Roberts Consulting	



Project		122 Morven Ferry Road, Arrow Junction	
Group		Slope Stability Analysis	Scenario
Drawn By		SSA	Company
Date		30/01/2026, 10:00:40 am	Revision
			01
		ULS Case - Potential Option 2	
		Kirk Roberts Consulting	



LEGEND

- Areas Meeting Minimum Factor of Safety (ULS)
- Areas that may meet Minimum Factor of Safety with Additional Investigation
- Areas that may meet Minimum Factor of Safety with Additional Investigation and In-ground Slope Remediation (ULS)

NOTES

Location of Features and Ground Investigation points are approximate only. Aerial Image & Site Boundary Sourced from Master plan prepared by Gibbons Co.

PROJECT: 2555087
CREATED BY: SSA
APPROVED BY: OB
DATE: December 2025

DWG NO: 001
REVISION: A
Scale: Not to Scale

122 Morven Ferry Road
Arrow Junction

SLOPE STABILITY SETBACK ANALYSIS



Appendix E

Stormwater Soakage Calculation Sheets

1. Soakage Calculation Sheets – May 2025
2. Soakage Calculation Sheets – October 2025





JOB TITLE	Morven Ferry Road		
ADDRESS	Morven Ferry Road, Queenstown		
DATE	7/05/2025	PRODUCED BY	MH
JOB No.	2555087	CHECKED BY	OB

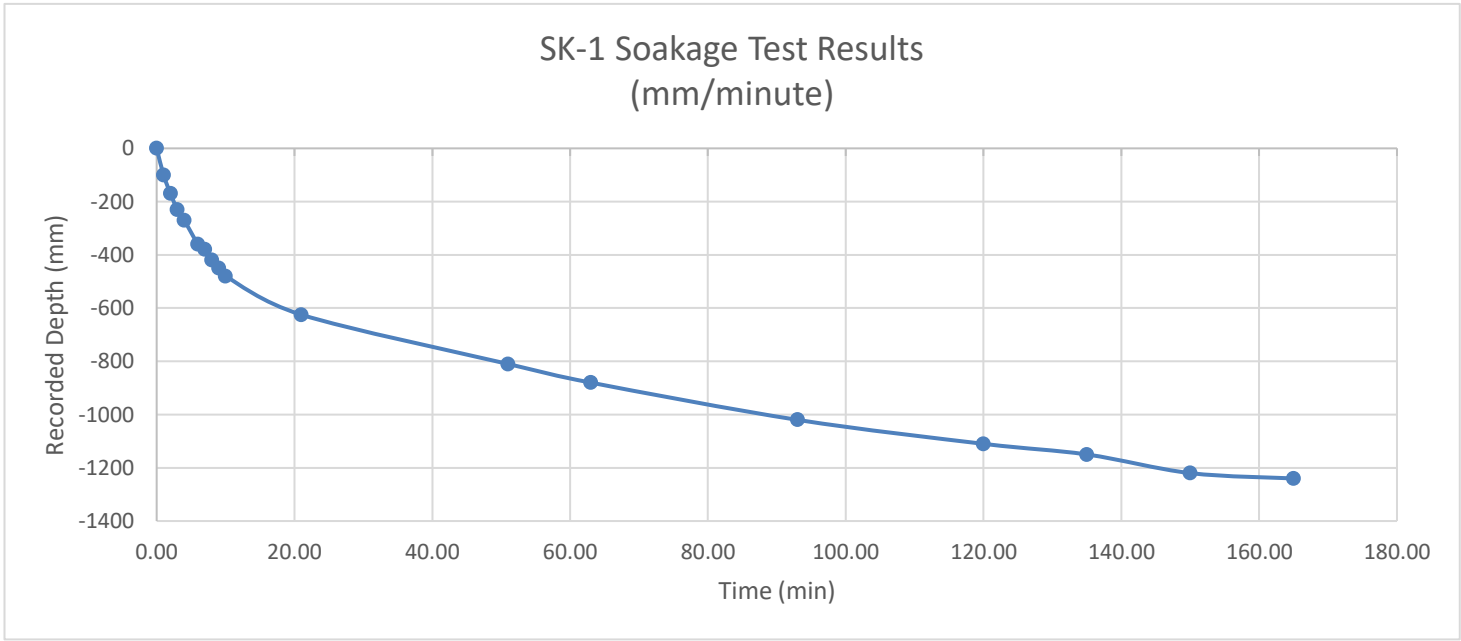
Soakage assessment and calculations undertaken in accordance with QLDC SLUCOP and Auckland City Council Soakage Design Manual 2003.

$$(a) \text{ Percolation rate} = P_1 = \frac{D \times \text{gradient} \times 1000}{4 \times d^*} =$$

SK-1 Borehole Soakage - refer to borehole log for soil profile

Test Hole Diameter	0.2	m
Soakage Column Height	1300	mm

Time (mins)	Recorded Depth (mm)	Drop (mm)	Drainage Rate (mm/hr)	Test Drainage Surface Area (m ²)	y	x	Percolation Rate L/m2/min
0.00	0	0					
1.00	-100	-100	-6000	0.8482			
2.00	-170	-70	-4200	0.7854			
3.00	-230	-60	-3600	0.7414			
4.00	-270	-40	-2400	0.7037			
6.00	-360	-90	-2700	0.6786			
7.00	-380	-20	-1200	0.6220			
8.00	-420	-40	-2400	0.6095			
9.00	-450	-30	-1800	0.5843			
10.00	-480	-30	-1800	0.5655			
21.00	-625	-145	-791	0.5466			
51.00	-810	-185	-370	0.4555			
63.00	-880	-70	-350	0.3393			
93.00	-1020	-140	-280	0.2953			
120.00	-1110	-90	-200	0.2073			
135.00	-1150	-40	-160	0.1508			
150.00	-1220	-70	-280	0.1257			
165.00	-1240	-20	-80	0.0817	20.0	30.0	0.4762



Soakage Rate	0.0	L/m2/hr
Design Soakage Rate FOS2	0.00	L/m2/hr



JOB TITLE	Morven Ferry Road		
ADDRESS	Morven Ferry Road, Queenstown		
DATE	7/05/2025	PRODUCED BY	MH
JOB No.	2555087	CHECKED BY	OB

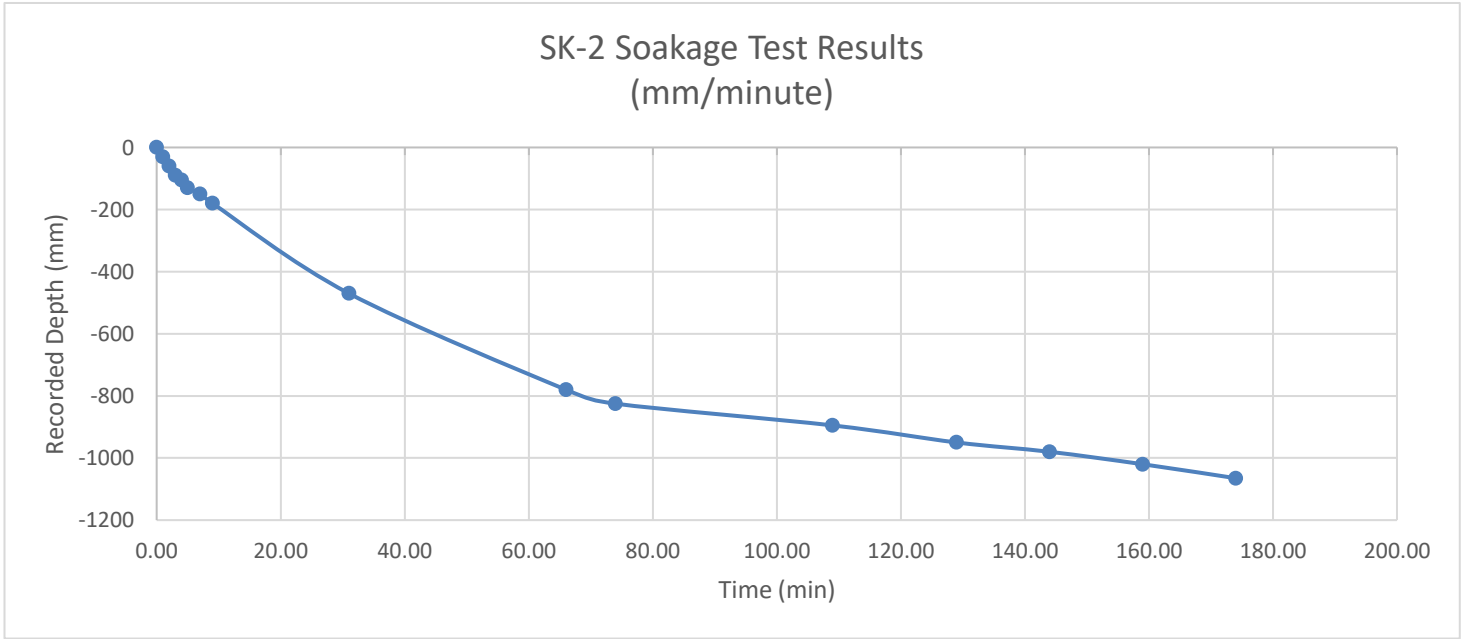
Soakage assessment and calculations undertaken in accordance with QLDC SLUCOP and Auckland City Council Soakage Design Manual 2003.

(a) Percolation rate = $P_1 = \frac{D \times \text{gradient} \times 1000}{4 \times d^*} =$

SK-1 Borehole Soakage - refer to borehole log for soil profile

Test Hole Diameter		0.2	m
Soakage Column Height		1620	mm

Time (mins)	Recorded Depth (mm)	Drop (mm)	Drainage Rate (mm/hr)	Test Drainage Surface Area (m ²)	y	x	Percolation Rate L/m2/min
0.00	0	0					
1.00	-30	-30	-1800	1.0493			
2.00	-60	-30	-1800	1.0304			
3.00	-90	-30	-1800	1.0116			
4.00	-105	-15	-900	0.9927			
5.00	-130	-25	-1500	0.9833			
7.00	-150	-20	-600	0.9676			
9.00	-180	-30	-900	0.9550			
31.00	-470	-290	-791	0.9362			
66.00	-780	-310	-531	0.7540			
74.00	-825	-45	-338	0.5592			
109.00	-895	-70	-120	0.5309			
129.00	-950	-55	-165	0.4869			
144.00	-980	-30	-120	0.4524			
159.00	-1020	-40	-160	0.4335			
174.00	-1065	-45	-180	0.4084	45.0	30.0	0.1299



Soakage Rate	7.8	L/m2/hr
Design Soakage Rate FOS2	3.90	L/m2/hr
	0	



JOB TITLE	Morven Ferry Road		
ADDRESS	Morven Ferry Road, Queenstown		
DATE	7/05/2025	PRODUCED BY	MH
JOB No.	2555087	CHECKED BY	OB

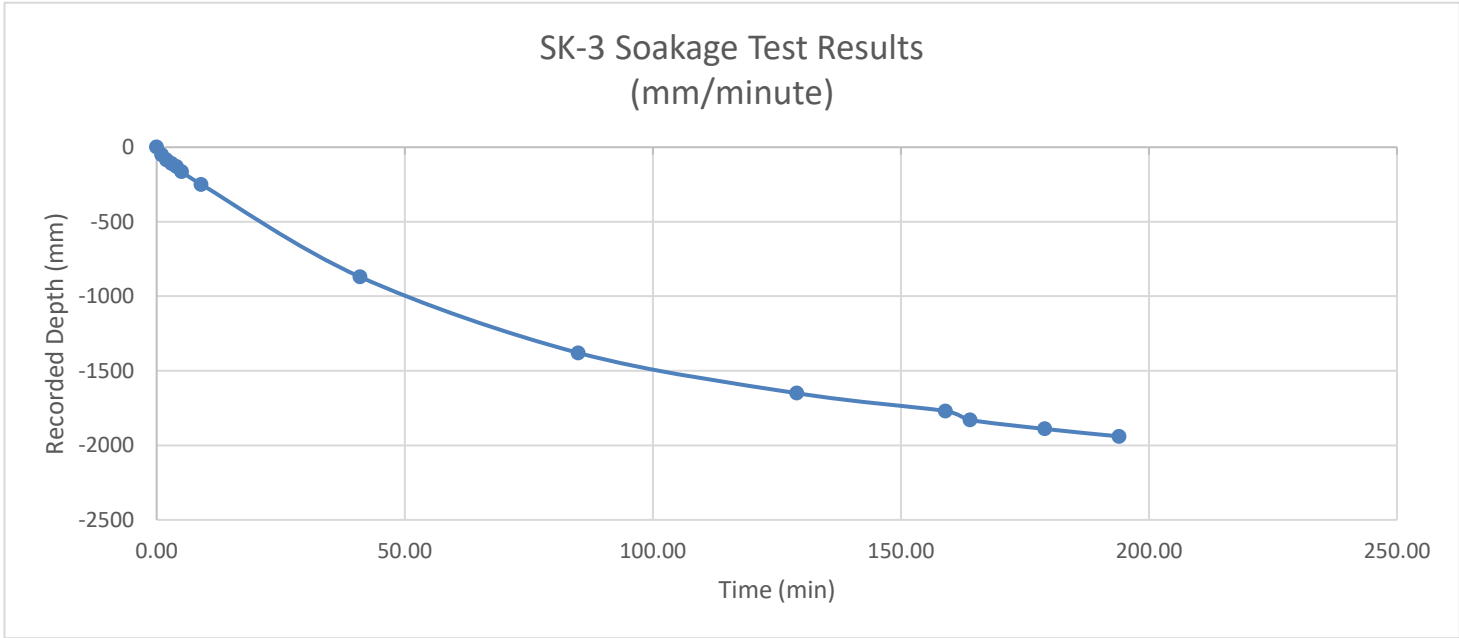
Soakage assessment and calculations undertaken in accordance with QLDC SLUCOP and Auckland City Council Soakage Design Manual 2003.

$$(a) \text{ Percolation rate} = P_1 = \frac{D \times \text{gradient} \times 1000}{4 \times d^*} =$$

SK-1 Borehole Soakage - refer to borehole log for soil profile

Test Hole Diameter		0.2	m
Soakage Column Height		2070	mm

Time (mins)	Recorded Depth (mm)	Drop (mm)	Drainage Rate (mm/hr)	Test Drainage Surface Area (m ²)	y	x	Percolation Rate L/m2/min
0.00	0	0					
1.00	-50	-50	-3000	1.3320			
2.00	-85	-35	-2100	1.3006			
3.00	-110	-25	-1500	1.2786			
4.00	-130	-20	-1200	1.2629			
5.00	-165	-35	-2100	1.2504			
9.00	-250	-85	-1275	1.2284			
41.00	-870	-620	-1163	1.1750			
85.00	-1380	-510	-695	0.7854			
129.00	-1650	-270	-368	0.4650			
159.00	-1770	-120	-240	0.2953			
164.00	-1830	-60	-720	0.2199			
179.00	-1890	-60	-240	0.1822			
194.00	-1940	-50	-200	0.1445	50.0	30.0	0.5376



Soakage Rate	32.3	L/m2/hr
Design Soakage Rate FOS2	16.13	L/m2/hr

 KIRK ROBERTS CONSULTING	JOB TITLE	Morven Ferry Road		
	ADDRESS	Morven Ferry Road, Queenstown		
	DATE	7/05/2025	PRODUCED BY	MH
	JOB No.	2555087	CHECKED BY	OB

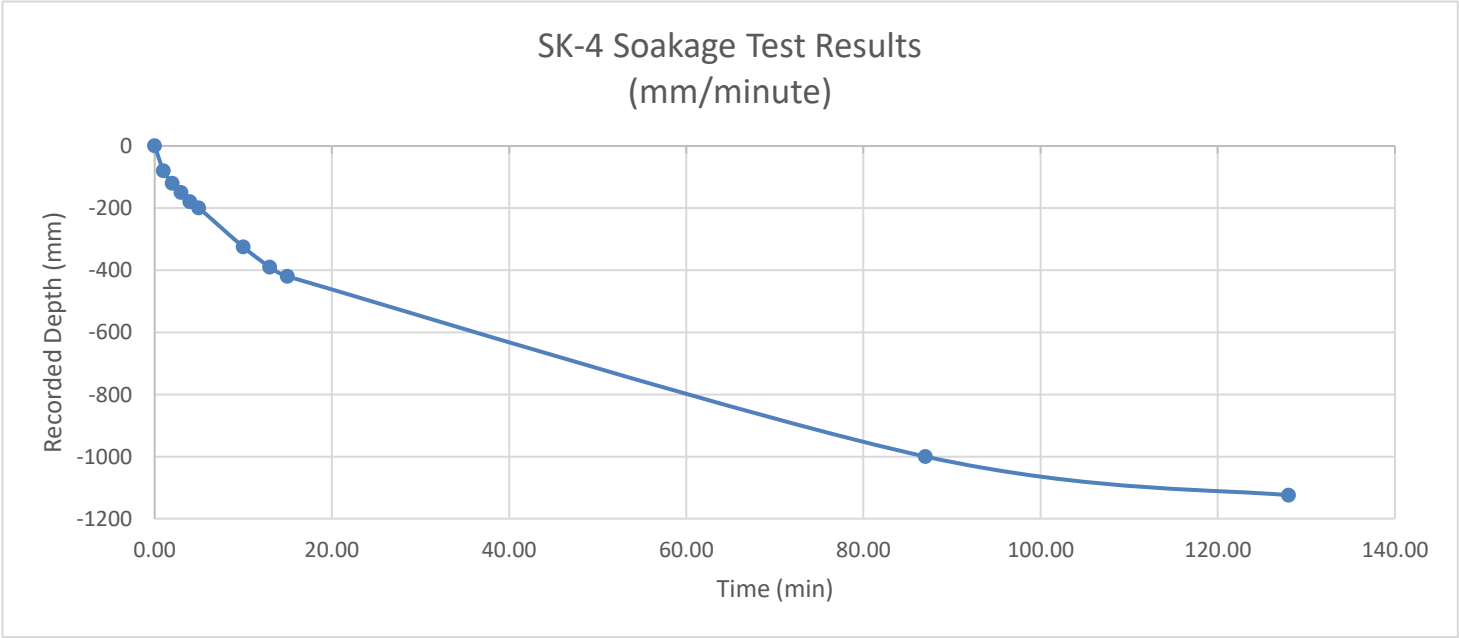
Soakage assessment and calculations undertaken in accordance with QLDC SLUCOP and Auckland City Council Soakage Design Manual 2003.

(a) Percolation rate = $P_1 = \frac{D \times \text{gradient} \times 1000}{4 \times d^*} =$

SK-1 Borehole Soakage - refer to borehole log for soil profile

Test Hole Diameter		0.2	m
Soakage Column Height		1200	mm

Time (mins)	Recorded Depth (mm)	Drop (mm)	Drainage Rate (mm/hr)	Test Drainage Surface Area (m ²)	y	x	Percolation Rate L/m2/min
0.00	0	0					
1.00	-80	-80	-4800	0.7854			
2.00	-120	-40	-2400	0.7351			
3.00	-150	-30	-1800	0.7100			
4.00	-180	-30	-1800	0.6912			
5.00	-200	-20	-1200	0.6723			
10.00	-325	-125	-1500	0.6597			
13.00	-390	-65	-1300	0.5812			
15.00	-420	-95	-1140	0.5812			
87.00	-1000	-610	-495	0.5404			
128.00	-1125	-705	-374	0.5215	705.0	113.0	0.7297



Soakage Rate	43.8	L/m2/hr
Design Soakage Rate FOS2	21.89	L/m2/hr



JOB TITLE	Morven Ferry Road		
ADDRESS	Morven Ferry Road, Queenstown		
DATE	7/05/2025	PRODUCED BY	MH
JOB No.	2555087	CHECKED BY	OB

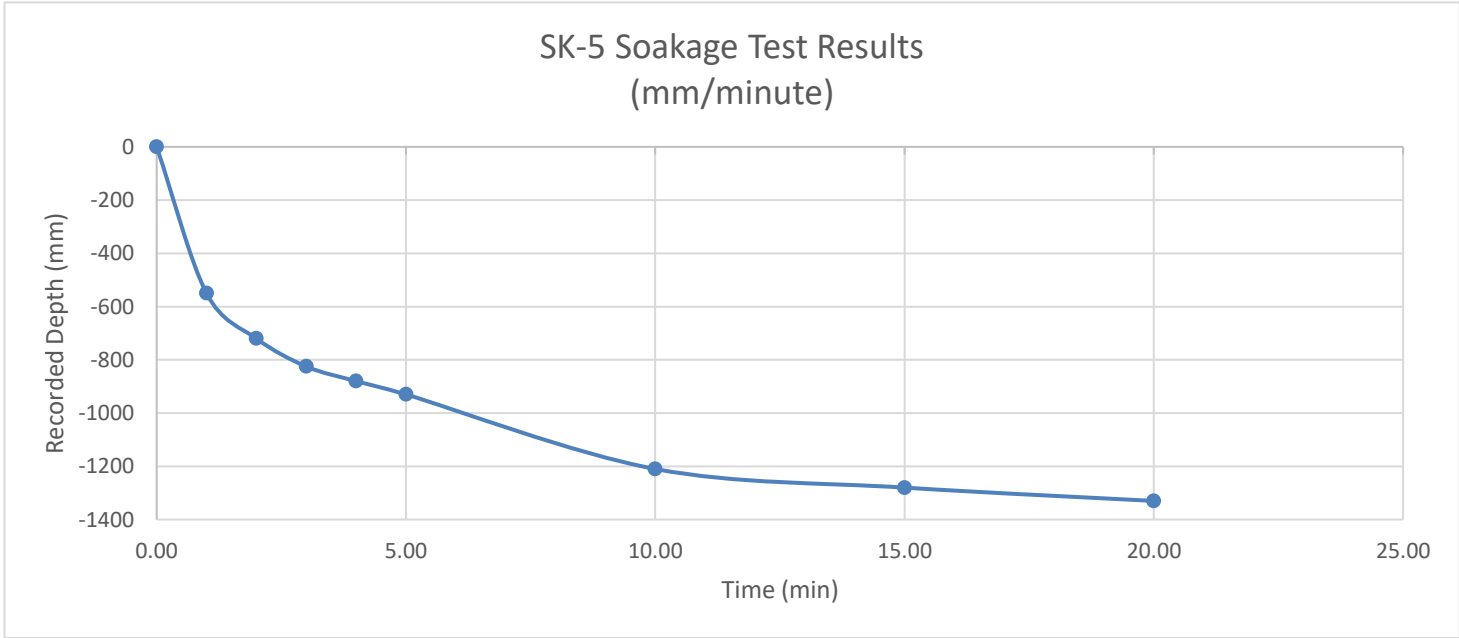
Soakage assessment and calculations undertaken in accordance with QLDC SLUCOP and Auckland City Council Soakage Design Manual 2003.

$$(a) \text{ Percolation rate} = P_1 = \frac{D \times \text{gradient} \times 1000}{4 \times d^*} =$$

SK-1 Borehole Soakage - refer to borehole log for soil profile

Test Hole Diameter		0.2	m
Soakage Column Height		1350	mm

Time (mins)	Recorded Depth (mm)	Drop (mm)	Drainage Rate (mm/hr)	Test Drainage Surface Area (m ²)	y	x	Percolation Rate L/m2/min
0.00	0	0					
1.00	550	-550	-33000	0.8796			
2.00	720	-170	-10200	1.2252			
3.00	825	-105	-6300	1.3320			
4.00	880	-55	-3300	1.3980			
5.00	930	-50	-3000	1.4326			
11.00	1210	-280	-2800	1.4640			
16.00	1280	-70	-840	1.6399			
21.00	1330	-120	-1440	1.6839	120.0	10.0	0.2190



Soakage Rate	13.1	L/m2/hr
Design Soakage Rate FOS2	6.57	L/m2/hr



JOB TITLE Morven Ferry Road, Arrow Junction

ADDRESS Morven Ferry Road, Arrow Junction

DATE 28/10/2025 **PRODUCED BY** SSA

JOB No. 2555087 **CHECKED BY** OMB

CRITICAL STORM CALCULATIONS: The stormwater runoff is assessed as follows using the rational method.

Issue 001

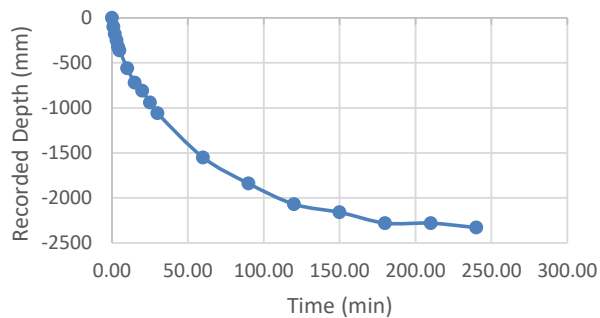
TEST PIT SOAKAGE

SK-01

Test Hole Diameter	0.15	m
Soakage Column Height	3	m

Time (mins)	Recorded Depth (mm)	Drop (mm)	Drainage Rate (mm/hr)	Surface Area (m ²)	Drainage Rate (m ³ /hr)	Drainage Rate per unit Surface (m ³ /hr-m ²)
0.00	0	0				
1.00	100	-100	-6000	1.4078	0.1060	0.0753
2.00	180	-80	-4800	1.3654	0.0848	0.0621
3.00	250	-70	-4200	1.3301	0.0742	0.0558
4.00	320	-70	-4200	1.2971	0.0742	0.0572
5.00	360	-40	-2400	1.2712	0.0424	0.0334
10.00	560	-200	-2400	1.2146	0.0424	0.0349
15.00	720	-160	-1920	1.1298	0.0339	0.0300
20.00	810	-90	-1080	1.0709	0.0191	0.0178
25.00	940	-130	-1560	1.0191	0.0276	0.0271
30.00	1060	-120	-1440	0.9601	0.0254	0.0265
60.00	1550	-490	-980	0.8164	0.0173	0.0212
90.00	1840	-290	-580	0.6326	0.0102	0.0162
120.00	2070	-230	-460	0.5101	0.0081	0.0159
150.00	2160	-90	-180	0.4347	0.0032	0.0073
180.00	2280	-120	-240	0.3852	0.0042	0.0110

SK-1 Soakage Test Results - 2555206
(mm/minute)



Average Soakage Rate 0.03 m³/hr-m²

FoS 2

Design Soakage Rate 0.01 m³/hr-m²



JOB TITLE	Morven Ferry Road, Arrow Junction		
ADDRESS	Morven Ferry Road, Arrow Junction		
DATE	28/10/2025	PRODUCED BY	SSA
JOB No.	2555087	CHECKED BY	OMB

CRITICAL STORM CALCULATIONS: The stormwater runoff is assessed as follows using the rational method.

Issue 001

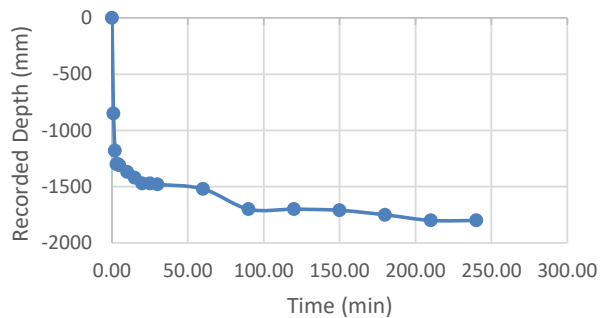
TEST PIT SOAKAGE

SK-02

Test Hole Diameter	0.15	m
Soakage Column Height	3	m

Time (mins)	Recorded Depth (mm)	Drop (mm)	Drainage Rate (mm/hr)	Surface Area (m ²)	Drainage Rate (m ³ /hr)	Drainage Rate per unit Surface (m ³ /hr-m ²)
0.00	0	0				
1.00	850	-850	-51000	1.2311	0.9012	0.7321
2.00	1180	-330	-19800	0.9531	0.3499	0.3671
3.00	1300	-120	-7200	0.8471	0.1272	0.1502
4.00	1300	0	0	0.8188	0.0000	0.0000
5.00	1310	-10	-600	0.8164	0.0106	0.0130
10.00	1370	-60	-720	0.7999	0.0127	0.0159
15.00	1420	-50	-600	0.7740	0.0106	0.0137
20.00	1470	-50	-600	0.7504	0.0106	0.0141
25.00	1470	0	0	0.7387	0.0000	0.0000
30.00	1480	-10	-120	0.7363	0.0021	0.0029
60.00	1520	-40	-80	0.7245	0.0014	0.0020
90.00	1700	-180	-360	0.6727	0.0064	0.0095
120.00	1700	0	0	0.6303	0.0000	0.0000
150.00	1710	-10	-20	0.6279	0.0004	0.0006
180.00	1750	-40	-80	0.6161	0.0014	0.0023
210.00	1800	-50	-100	0.5949	0.0018	0.0030
240.00	1800	0	0	0.5832	0.0000	0.0000

SK-2 Soakage Test Results -
(mm/minute)



Average Soakage Rate	0.10	m ³ /hr-m ²
FoS	2	
Design Soakage Rate	0.05	m ³ /hr-m ²



JOB TITLE	Morven Ferry Road, Arrow Junction		
ADDRESS	Morven Ferry Road, Arrow Junction		
DATE	28/10/2025	PRODUCED BY	SSA
JOB No.	2555087	CHECKED BY	OMB

CRITICAL STORM CALCULATIONS: The stormwater runoff is assessed as follows using the rational method.

Issue 001

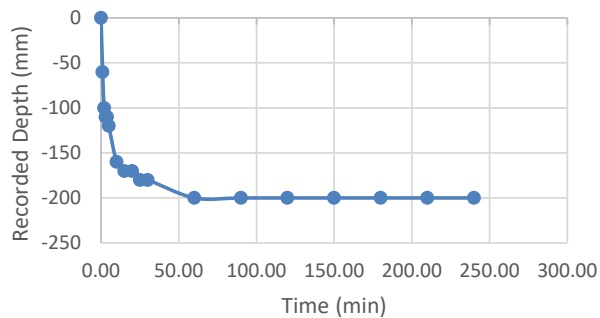
TEST PIT SOAKAGE

SK-03

Test Hole Diameter	0.15	m
Soakage Column Height	1.7	m

Time (mins)	Recorded Depth (mm)	Drop (mm)	Drainage Rate (mm/hr)	Surface Area (m ²)	Drainage Rate (m ³ /hr)	Drainage Rate per unit Surface (m ³ /hr-m ²)
0.00	0	0				
1.00	60	-60	-3600	0.8046	0.0636	0.0791
2.00	100	-40	-2400	0.7811	0.0424	0.0543
3.00	110	-10	-600	0.7693	0.0106	0.0138
4.00	110	0	0	0.7669	0.0000	0.0000
5.00	120	-10	-600	0.7646	0.0106	0.0139
10.00	160	-40	-480	0.7528	0.0085	0.0113
15.00	170	-10	-120	0.7410	0.0021	0.0029
20.00	170	0	0	0.7387	0.0000	0.0000
25.00	180	-10	-120	0.7363	0.0021	0.0029
30.00	180	0	0	0.7340	0.0000	0.0000
60.00	200	-20	-40	0.7292	0.0007	0.0010
90.00	200	0	0	0.7245	0.0000	0.0000
120.00	200	0	0	0.7245	0.0000	0.0000
150.00	200	0	0	0.7245	0.0000	0.0000
180.00	200	0	0	0.7245	0.0000	0.0000
210.00	200	0	0	0.7245	0.0000	0.0000
240.00	200	0	0	0.7245	0.0000	0.0000

SK-3 Soakage Test Results
(mm/minute)



Average Soakage Rate	0.02	m ³ /hr-m ²
FoS	2	
Design Soakage Rate	0.01	m ³ /hr-m ²



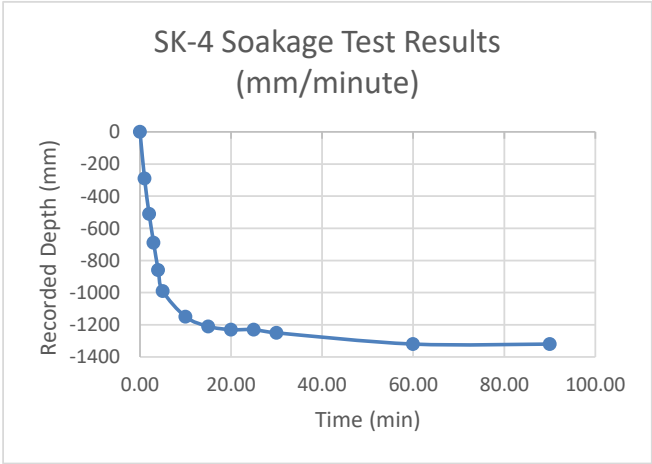
JOB TITLE	Morven Ferry Road, Arrow Junction		
ADDRESS	Morven Ferry Road, Arrow Junction		
DATE	28/10/2025	PRODUCED BY	SSA
JOB No.	2555087	CHECKED BY	OMB

CRITICAL STORM CALCULATIONS: The stormwater runoff is assessed as follows using the rational method.

Issue 001

TEST PIT SOAKAGE	SK-04	
Test Hole Diameter	0.15	m
Soakage Column Height	1.6	m

Time (mins)	Recorded Depth (mm)	Drop (mm)	Drainage Rate (mm/hr)	Surface Area (m ²)	Drainage Rate (m ³ /hr)	Drainage Rate per unit Surface (m ³ /hr-m ²)
0.00	0	0				
1.00	290	-290	-17400	0.7033	0.3075	0.4372
2.00	510	-220	-13200	0.5832	0.2333	0.4000
3.00	690	-180	-10800	0.4889	0.1909	0.3904
4.00	860	-170	-10200	0.4064	0.1802	0.4435
5.00	990	-130	-7800	0.3358	0.1378	0.4105
10.00	1150	-160	-1920	0.2674	0.0339	0.1269
15.00	1210	-60	-720	0.2156	0.0127	0.0590
20.00	1230	-20	-240	0.1967	0.0042	0.0216
25.00	1230	0	0	0.1920	0.0000	0.0000
30.00	1250	-20	-240	0.1873	0.0042	0.0226
60.00	1320	-70	-140	0.1661	0.0025	0.0149
90.00	1320	0	0	0.1496	0.0000	0.0000



Average Soakage Rate	0.23	m ³ /hr-m ²
FoS	2	
Design Soakage Rate	0.12	m ³ /hr-m ²



JOB TITLE	Morven Ferry Road, Arrow Junction		
ADDRESS	Morven Ferry Road, Arrow Junction		
DATE	28/10/2025	PRODUCED BY	SSA
JOB No.	2555087	CHECKED BY	OMB

CRITICAL STORM CALCULATIONS: The stormwater runoff is assessed as follows using the rational method.

Issue 001

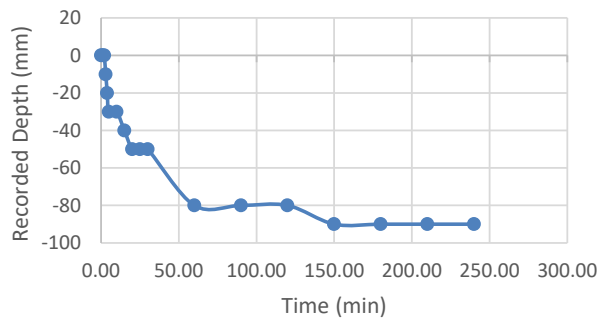
TEST PIT SOAKAGE

SK-05

Test Hole Diameter	0.15	m
Soakage Column Height	2.3	m

Time (mins)	Recorded Depth (mm)	Drop (mm)	Drainage Rate (mm/hr)	Surface Area (m ²)	Drainage Rate (m ³ /hr)	Drainage Rate per unit Surface (m ³ /hr-m ²)
0.00	0	0				
1.00	0	0	0	1.1015	0.0000	0.0000
2.00	0	0	0	1.1015	0.0000	0.0000
3.00	10	-10	-600	1.0992	0.0106	0.0096
4.00	20	-10	-600	1.0945	0.0106	0.0097
5.00	30	-10	-600	1.0897	0.0106	0.0097
10.00	30	0	0	1.0874	0.0000	0.0000
15.00	40	-10	-120	1.0850	0.0021	0.0020
20.00	50	-10	-120	1.0803	0.0021	0.0020
25.00	50	0	0	1.0780	0.0000	0.0000
30.00	50	0	0	1.0780	0.0000	0.0000
60.00	80	-30	-60	1.0709	0.0011	0.0010
90.00	80	0	0	1.0638	0.0000	0.0000
120.00	80	0	0	1.0638	0.0000	0.0000
150.00	90	-10	-20	1.0615	0.0004	0.0003
180.00	90	0	0	1.0591	0.0000	0.0000
210.00	90	0	0	1.0591	0.0000	0.0000
240.00	90	0	0	1.0591	0.0000	0.0000

SK-5 Soakage Test Results
(mm/minute)



Average Soakage Rate	0.00	m ³ /hr-m ²
FoS	2	
Design Soakage Rate	0.00	m ³ /hr-m ²



JOB TITLE Morven Ferry Road, Arrow Junction

ADDRESS Morven Ferry Road, Arrow Junction

DATE 28/10/2025 **PRODUCED BY** SSA

JOB No. 2555087 **CHECKED BY** OMB

CRITICAL STORM CALCULATIONS: The stormwater runoff is assessed as follows using the rational method.

Issue 001

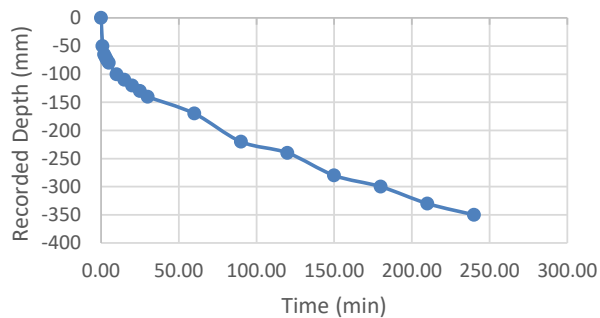
TEST PIT SOAKAGE

SK-06

Test Hole Diameter	0.15	m
Soakage Column Height	0.78	m

Time (mins)	Recorded Depth (mm)	Drop (mm)	Drainage Rate (mm/hr)	Surface Area (m ²)	Drainage Rate (m ³ /hr)	Drainage Rate per unit Surface (m ³ /hr-m ²)
0.00	0	0				
1.00	50	-50	-3000	0.3735	0.0530	0.1420
2.00	65	-15	-900	0.3581	0.0159	0.0444
3.00	70	-5	-300	0.3534	0.0053	0.0150
4.00	75	-5	-300	0.3511	0.0053	0.0151
5.00	80	-5	-300	0.3487	0.0053	0.0152
10.00	100	-20	-240	0.3428	0.0042	0.0124
15.00	110	-10	-120	0.3358	0.0021	0.0063
20.00	120	-10	-120	0.3310	0.0021	0.0064
25.00	130	-10	-120	0.3263	0.0021	0.0065
30.00	140	-10	-120	0.3216	0.0021	0.0066
60.00	170	-30	-60	0.3122	0.0011	0.0034
90.00	220	-50	-100	0.2933	0.0018	0.0060
120.00	240	-20	-40	0.2769	0.0007	0.0026
150.00	280	-40	-80	0.2627	0.0014	0.0054
180.00	300	-20	-40	0.2486	0.0007	0.0028
210.00	330	-30	-60	0.2368	0.0011	0.0045
240.00	350	-20	-40	0.2250	0.0007	0.0031

SK-6 Soakage Test Results
(mm/minute)



Average Soakage Rate 0.01 m³/hr-m²

FoS 2

Design Soakage Rate 0.01 m³/hr-m²



JOB TITLE	Morven Ferry Road, Arrow Junction		
ADDRESS	Morven Ferry Road, Arrow Junction		
DATE	28/10/2025	PRODUCED BY	SSA
JOB No.	2555087	CHECKED BY	OMB

CRITICAL STORM CALCULATIONS: The stormwater runoff is assessed as follows using the rational method.

Soakage assessment and calculations undertaken in accordance with TCC Infrastructure Development Code - DS-5.

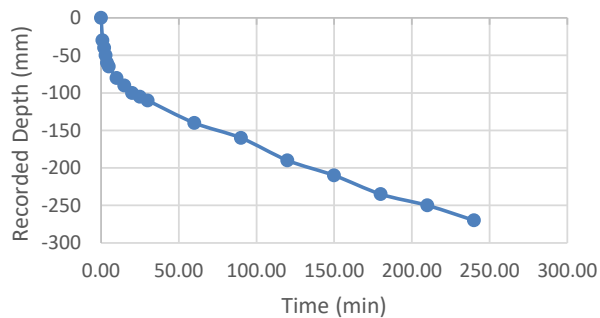
Issue 001

TEST PIT SOAKAGE SK-07

Test Hole Diameter	0.15	m
Soakage Column Height	1	m

Time (mins)	Recorded Depth (mm)	Drop (mm)	Drainage Rate (mm/hr)	Surface Area (m ²)	Drainage Rate (m ³ /hr)	Drainage Rate per unit Surface (m ³ /hr-m ²)
0.00	0	0				
1.00	30	-30	-1800	0.4818	0.0318	0.0660
2.00	40	-10	-600	0.4724	0.0106	0.0224
3.00	50	-10	-600	0.4677	0.0106	0.0227
4.00	60	-10	-600	0.4630	0.0106	0.0229
5.00	65	-5	-300	0.4595	0.0053	0.0115
10.00	80	-15	-180	0.4547	0.0032	0.0070
15.00	90	-10	-120	0.4489	0.0021	0.0047
20.00	100	-10	-120	0.4441	0.0021	0.0048
25.00	105	-5	-60	0.4406	0.0011	0.0024
30.00	110	-5	-60	0.4383	0.0011	0.0024
60.00	140	-30	-60	0.4300	0.0011	0.0025
90.00	160	-20	-40	0.4182	0.0007	0.0017
120.00	190	-30	-60	0.4064	0.0011	0.0026
150.00	210	-20	-40	0.3947	0.0007	0.0018
180.00	235	-25	-50	0.3841	0.0009	0.0023
210.00	250	-15	-30	0.3746	0.0005	0.0014
240.00	270	-20	-40	0.3664	0.0007	0.0019

SK-7 Soakage Test Results
(mm/minute)



Average Soakage Rate	0.01	m ³ /hr-m ²
FoS	2	
Design Soakage Rate	0.00	m ³ /hr-m ²



JOB TITLE Morven Ferry Road, Arrow Junction

ADDRESS Morven Ferry Road, Arrow Junction

DATE 28/10/2025 **PRODUCED BY** SSA

JOB No. 2555087 **CHECKED BY** OMB

CRITICAL STORM CALCULATIONS: The stormwater runoff is assessed as follows using the rational method.

Issue 001

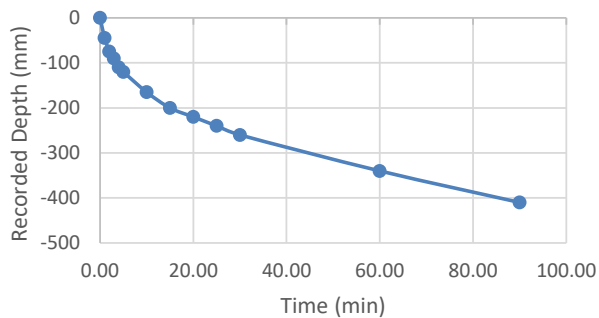
TEST PIT SOAKAGE

SK-08

Test Hole Diameter	0.15	m
Soakage Column Height	0.44	m

Time (mins)	Recorded Depth (mm)	Drop (mm)	Drainage Rate (mm/hr)	Surface Area (m ²)	Drainage Rate (m ³ /hr)	Drainage Rate per unit Surface (m ³ /hr-m ²)
0.00	0	0				
1.00	45	-45	-2700	0.2144	0.0477	0.2225
2.00	75	-30	-1800	0.1967	0.0318	0.1617
3.00	90	-15	-900	0.1861	0.0159	0.0854
4.00	110	-20	-1200	0.1779	0.0212	0.1192
5.00	120	-10	-600	0.1708	0.0106	0.0621
10.00	165	-45	-540	0.1579	0.0095	0.0604
15.00	200	-35	-420	0.1390	0.0074	0.0534
20.00	220	-20	-240	0.1261	0.0042	0.0336
25.00	240	-20	-240	0.1166	0.0042	0.0364
30.00	260	-20	-240	0.1072	0.0042	0.0396
60.00	340	-80	-160	0.0836	0.0028	0.0338
90.00	410	-70	-140	0.0483	0.0025	0.0512

SK-8 Soakage Test Results
(mm/minute)



Average Soakage Rate 0.07 m³/hr-m²

FoS

2

Design Soakage Rate 0.03 m³/hr-m²



JOB TITLE	Morven Ferry Road, Arrow Junction		
ADDRESS	Morven Ferry Road, Arrow Junction		
DATE	28/10/2025	PRODUCED BY	SSA
JOB No.	2555087	CHECKED BY	OMB

CRITICAL STORM CALCULATIONS: The stormwater runoff is assessed as follows using the rational method.

Issue 001

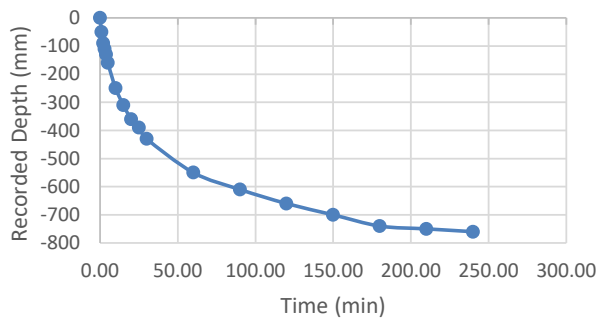
TEST PIT SOAKAGE

SK-09

Test Hole Diameter	0.15	m
Soakage Column Height	1.57	m

Time (mins)	Recorded Depth (mm)	Drop (mm)	Drainage Rate (mm/hr)	Surface Area (m ²)	Drainage Rate (m ³ /hr)	Drainage Rate per unit Surface (m ³ /hr-m ²)
0.00	0	0				
1.00	50	-50	-3000	0.7457	0.0530	0.0711
2.00	90	-40	-2400	0.7245	0.0424	0.0585
3.00	110	-20	-1200	0.7104	0.0212	0.0299
4.00	130	-20	-1200	0.7010	0.0212	0.0303
5.00	160	-30	-1800	0.6892	0.0318	0.0462
10.00	250	-90	-1080	0.6609	0.0191	0.0289
15.00	310	-60	-720	0.6256	0.0127	0.0203
20.00	360	-50	-600	0.5997	0.0106	0.0177
25.00	390	-30	-360	0.5808	0.0064	0.0110
30.00	430	-40	-480	0.5643	0.0085	0.0150
60.00	550	-120	-240	0.5266	0.0042	0.0081
90.00	610	-60	-120	0.4842	0.0021	0.0044
120.00	660	-50	-100	0.4583	0.0018	0.0039
150.00	700	-40	-80	0.4371	0.0014	0.0032
180.00	740	-40	-80	0.4182	0.0014	0.0034
210.00	750	-10	-20	0.4064	0.0004	0.0009
240.00	760	-10	-20	0.4017	0.0004	0.0009

SK-9 Soakage Test Results
(mm/minute)



Average Soakage Rate	0.02	m ³ /hr-m ²
FoS	2	
Design Soakage Rate	0.01	m ³ /hr-m ²



JOB TITLE Morven Ferry Road, Arrow Junction

ADDRESS Morven Ferry Road, Arrow Junction

DATE 28/10/2025 **PRODUCED BY** SSA

JOB No. 2555087 **CHECKED BY** OMB

CRITICAL STORM CALCULATIONS: The stormwater runoff is assessed as follows using the rational method.

Issue 001

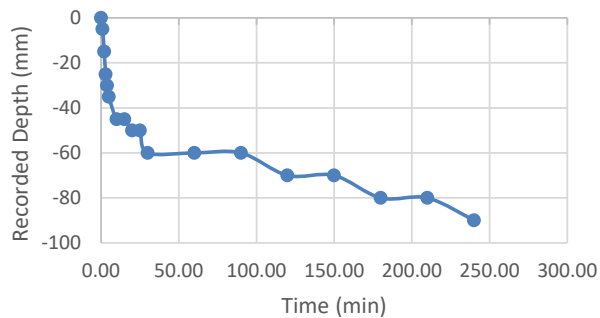
TEST PIT SOAKAGE

SK-10

Test Hole Diameter	0.15	m
Soakage Column Height	1.07	m

Time (mins)	Recorded Depth (mm)	Drop (mm)	Drainage Rate (mm/hr)	Surface Area (m ²)	Drainage Rate (m ³ /hr)	Drainage Rate per unit Surface (m ³ /hr-m ²)
0.00	0	0				
1.00	5	-5	-300	0.5207	0.0053	0.0102
2.00	15	-10	-600	0.5172	0.0106	0.0205
3.00	25	-10	-600	0.5125	0.0106	0.0207
4.00	30	-5	-300	0.5089	0.0053	0.0104
5.00	35	-5	-300	0.5066	0.0053	0.0105
10.00	45	-10	-120	0.5030	0.0021	0.0042
15.00	45	0	0	0.5007	0.0000	0.0000
20.00	50	-5	-60	0.4995	0.0011	0.0021
25.00	50	0	0	0.4983	0.0000	0.0000
30.00	60	-10	-120	0.4960	0.0021	0.0043
60.00	60	0	0	0.4936	0.0000	0.0000
90.00	60	0	0	0.4936	0.0000	0.0000
120.00	70	-10	-20	0.4913	0.0004	0.0007
150.00	70	0	0	0.4889	0.0000	0.0000
180.00	80	-10	-20	0.4866	0.0004	0.0007
210.00	80	0	0	0.4842	0.0000	0.0000
240.00	90	-10	-20	0.4818	0.0004	0.0007

SK-10 Soakage Test Results
(mm/minute)



Average Soakage Rate 0.01 m³/hr-m²

FoS 2

Design Soakage Rate 0.00 m³/hr-m²



JOB TITLE Morven Ferry Road, Arrow Junction

ADDRESS Morven Ferry Road, Arrow Junction

DATE 28/10/2025 **PRODUCED BY** SSA

JOB No. 2555087 **CHECKED BY** OMB

CRITICAL STORM CALCULATIONS: The stormwater runoff is assessed as follows using the rational method.

Issue 001

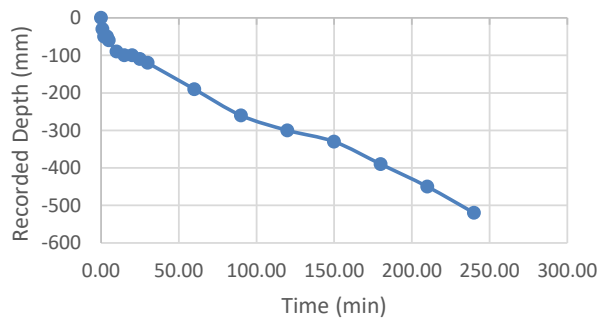
TEST PIT SOAKAGE

SK-11

Test Hole Diameter	0.15	m
Soakage Column Height	2.4	m

Time (mins)	Recorded Depth (mm)	Drop (mm)	Drainage Rate (mm/hr)	Surface Area (m ²)	Drainage Rate (m ³ /hr)	Drainage Rate per unit Surface (m ³ /hr-m ²)
0.00	0	0				
1.00	30	-30	-1800	1.1416	0.0318	0.0279
2.00	50	-20	-1200	1.1298	0.0212	0.0188
3.00	50	0	0	1.1251	0.0000	0.0000
4.00	50	0	0	1.1251	0.0000	0.0000
5.00	60	-10	-600	1.1227	0.0106	0.0094
10.00	90	-30	-360	1.1133	0.0064	0.0057
15.00	100	-10	-120	1.1039	0.0021	0.0019
20.00	100	0	0	1.1015	0.0000	0.0000
25.00	110	-10	-120	1.0992	0.0021	0.0019
30.00	120	-10	-120	1.0945	0.0021	0.0019
60.00	190	-70	-140	1.0756	0.0025	0.0023
90.00	260	-70	-140	1.0426	0.0025	0.0024
120.00	300	-40	-80	1.0167	0.0014	0.0014
150.00	330	-30	-60	1.0002	0.0011	0.0011
180.00	390	-60	-120	0.9790	0.0021	0.0022
210.00	450	-60	-120	0.9507	0.0021	0.0022
240.00	520	-70	-140	0.9201	0.0025	0.0027

SK-11 Soakage Test Results
(mm/minute)



Average Soakage Rate 0.01 m³/hr-m²

FoS 2

Design Soakage Rate 0.00 m³/hr-m²



17 March 2026

Project Ref: 2555087

Rev.: 4

Gibbons Developments Ltd

cam@gibbonsco.co.nz

Wastewater Investigation Letter, 122 Morven Ferry Road, Arrow Junction

Kirk Roberts Consulting has been engaged by Gibbons Developments Ltd (the client) to complete a review of available geotechnical investigation data, complete site investigations, and prepare a wastewater letter to advise on subgrade conditions within the proposed effluent irrigation area for the proposed Ridgeburn subdivision located at 122 Morven Ferry Road, Arrow Junction.

We understand from the email received to Kirk Roberts on the 13th of January 2026 subject “Morven Hill - soil profiles/depths”, that Otago Regional Council (ORC) have set a precedent to utilise a spray irrigation system for wastewater, proposed to be developed across Morven Hill.

To assess the feasibility of this system, Kirk Roberts conducted a site investigation on the 14th of January 2026. The results and recommendations regarding this can be found within this letter.

1 Site Description for Wastewater Disposal Area

The legal description, address and parcel area are presented in Table 1 below for the proposed spray irrigation wastewater disposal areas. Drip lines have been proposed throughout the subdivision area.

Table 1: Site Identification¹

Address	Legal Description	Area
Morven Ferry Road (proposed spray irrigation area)	Section 21 Block IX Shotover SD Section 22 Block IX Shotover SD Section 23 Block IX Shotover SD	779, 830 m ²
Morven Ferry Road (proposed wastewater treatment plant)	Section 21 Block IX Shotover SD	283,938 m ²

At the time of the Kirk Roberts site walkover, the following was noted for the area of interest in relation to the proposed wastewater disposal field:

- The disposal field has been proposed for Morven Hill, bordering the site to the west.
- Access to the wastewater treatment plant would be through the proposed subdivision, positioned to the south of Morven Ferry Road, Arrow Junction.
- The site is currently vacant at the time of this letter, and the primary land use is farming.
- The site is currently undulating in nature, with a general elevation of 400 m RL and an overall elevation increase from east to west.
- The wastewater system disposal area has been suggested to span over Morven Hill.

See Attachment 1 for proposed subdivision plans and positioning of respective wastewater elements.

See Attachment 2 for proposed spray irrigation and dripline areas.

¹ Queenstown Lakes District Council Map Navigator, data retrieved January 2026 from <https://gis-qldc.hub.arcgis.com/>

2 Desktop Geology Review

2.1 Published Geology

We have reviewed the data published by GNS Science on the New Zealand Geology Web Map² for the published surface geology for Morven Hill. This is summarized in Table 2.

Table 2: Published Geology (1:250k scale)

Geological group	Geological sub-group	Geological age	Description
Aspiring Lithologic Association TZIV pelitic schist (Rakaia Terrane)	Basement (Eastern Province) Metamorphic Rocks	176.00 – 251.00 million years	Very well segregated and laminated; abundant pelitic and subordinate psammitic greyschist; minor greenschist and metachert; TZIV.

2.2 WGA Superficial Geology Map

The email mentioned above, included a map of inferred superficial soil profile (Figure 1). This was reviewed prior to the site investigation. The map estimated a thin colluvium soil profile overlying the basement schist bedrock on the disposal site, with exposed schist areas at the top of the ridgeline of Morven Hill, and colluvium layers down near the toe areas.



Figure 1: WGA inferred superficial geology map (Source: WGA, 2026 – provided via email)

3 Wastewater Investigation

3.1 Kirk Roberts Wastewater Investigation

Site-specific geotechnical investigations were undertaken by Kirk Roberts Consulting in January 2026. A summary of the geotechnical investigations is presented in Table 3 below.

² GNS Science – New Zealand Geology Web Map, date retrieved in January 2026 from <http://data.gns.cri.nz/geology/>

Testing was completed to assess the near-surface soil profile in order to categorise the soils and determine characteristics with respect to spray irrigation disposal suitability.

Five (5) Hand-auger boreholes were completed, spread out over site in areas of soil. This was coupled with a walkover by an Engineering Geologist to map out potential areas where soil profile depths would be acceptable for spray irrigation disposal.

Table 3: Summary of Investigations

Investigation	Test type/code	Depth of test (m bgl)	Comments
Kirk Roberts, (January 2026)	Hand-auger boreholes WW-01 to WW-05	0.10 – 0.50	Refusal of Dense Ground

3.2 Soil profile

The hand-auger investigations completed on site (WW-01 to WW-05) were terminated between approximately 0.1 – 0.5 m depth due to very dense soils or rock that could not be penetrated further with a hand auger.

Hand Auger Name	Topsoil depth (m bgl)	Depth of test (m bgl)	Classification (in accordance with AS/NZ 1547:2012)	Comments
WW-01	0.20	0.50	Category 3	-
WW-02	0.25	0.50	Category 3	-
WW-03	0.20	0.30	Category 3	-
WW-04	0.10	0.10	-	Shallow topsoil depth
WW-05	0.30	0.50	Category 3	-

See Attachment 2 for site investigation plan and corresponding detailed site investigation logs.

4 Site Photos



Photograph 1: Proposed Subdivision as seen from Morven Hill.



Photograph 2: Overburden soil profiles exposed within the road batters.



Photograph 3: Soil recovered from the wastewater hand augers.

5 Disposal Area Characteristics and Suitability

The characteristics of the site with respect to the wastewater disposal area is seen in Table 4 below.

Table 4: Site Characteristics for Disposal Area.

Mean annual rainfall total: 750 – 900 mm Otago Regional Council - growOTAGO					
Vegetation Cover: Full grass and shrub coverage (Morven Hill)					
Slope Shape: Varied – mainly linear divergent					
Slope Angle: Steep – approx. 20% slope in the lower half of Morven Hill*					
Surface Water Drainage: Land Application Area set away from pathways and hard surfaces.					
Flooding Potential: QLDC maps indicate no flooding potential for the site.					
Seasonal Water Tables: ORC Bores ³ and GNS National Water Table Map ⁴					
Winter: >20.0 m bgl			Summer: >20.0 m bgl		
Water table: ORC Boremap Review					
Surface Water Separation: Refer to the site plan attached. 50 m clearance to water courses achieved with disposal field in location provided.					
Site Clearances: Refer to the site plan attached. All clearances with exception to water bore separation are as per table 6.2 (R1 and R2 have been adhered to).					
Site Characteristics: Disposal field is on a steep slope clear of any obstructions or negative features that could cause ponding or any other detrimental effects to the receiving soils and is grassed.					
Disposal System Aspect: .					
North		East	√	West	
North-West		South-East		South-West	
North-East	√	South			

* Note: according to AS/NZ 1547:2012, subsurface irrigation systems with a slope gradient of > 30% will require specific engineering design with respect to slope steepness.

³ Otago Regional Council, ORC Bores, data retrieved January 2026 from <https://maps.orc.govt.nz/portal/home/webmap/viewer.html?useExisting=1&layers=e105e799a22b47368e3bcfb7d20a54c1>

⁴ GNS National Water Table interactive map, data retrieved January 2026, from <https://www.gns.cri.nz/data-and-resources/gns-national-water-table-interactive-map/>

6 Discussion

Following the desktop study (including studies of aerial imagery¹ and Google Earth⁵), investigation, and site walkover, an estimation was deduced of the areas where soil thickness may be suitable for spray irrigation. This was combined with the supplied superficial geology map mentioned in Section 2.2 above.

Shallow soil profiles are present on the top half of Morven Hill along with basement rock exposures. The bottom half included areas of soil profiles up to or greater than 0.5 m, aligning with initial assumptions. The primary soil profile was determined to be Silty SAND, classified as a Category 3 soil under AS/NZ 1547:2012.

Photographs and a visual investigation of exposed cuts along the road as well as shallow slip scarps, indicated that the soil profile may be up to 1.0 m in certain areas on the lower half of Morven Hill consisting of silt-natured material overlying completely to highly weathered schist rock. The top 0.5 m was sighted to consist of silt material in these exposed scarp areas. The slips were prominent in areas of steep road batters and some other weathered cliff areas, but no evidence was noted to indicate this was a prominent occurrence.

Our investigation confirmed the assumption that, in our professional opinion, Morven Hill consists suitable material and conditions for a spray irrigation disposal system.

⁵ Google Earth, data retrieved January 2026, from <https://earth.google.com/>

7 Limitations

This report has been prepared at the specific instructions of our client in connection with the above project. The geotechnical investigations and foundation recommendations are limited to the possible building area as discussed above.

Whilst every care was taken during our desktop review, site investigation and interpretation of subsurface conditions, there may well be subsoil strata and features that were not detected.

It must be appreciated that the actual characteristics of the subsurface materials may vary significantly between adjacent test locations and sample intervals other than where observations, explorations and investigations have been made.

It should be noted that because of the inherent uncertainties in subsurface evaluations, changed or unanticipated subsurface conditions may occur that could affect total project cost and/or execution. Kirk Roberts Consulting does not accept responsibility for the consequences of significant variances in the conditions and the requirements for the execution of the works.

This report assesses the land only, not the condition of any structures or retaining walls at the site.

Only our client and the Council are entitled to rely upon this report, and then only for the purpose stated above. Kirk Roberts Consulting Engineers Ltd accepts no liability to anyone other than these parties in any way in relation to this report and the content of it and any direct or indirect effect this report may have. Kirk Roberts Consulting Engineers Ltd does not contemplate anyone else relying on this report or that it will be used for any other purpose.

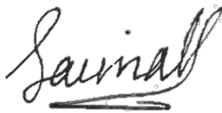
Third parties: This report has been prepared for the sole use of our client, for the particular brief and on the terms and conditions agreed with our client. It may not be used or relied on (in whole or part) by anyone else, or for any other purpose, or in any other contexts, without our prior written agreement. We will not be liable for any loss, damage, cost, or expense incurred by such other persons.

Disciplines are limited to those stated: Although we are a multi-disciplinary organisation, we only provide input on each project from the particular disciplines engaged by our client and expressly stated in this document and our obligations are limited to the inputs expected from those specified disciplines. Please let us know if you would like to engage additional services or disciplines for your project.

Should anyone wish to discuss the content of this report with Kirk Roberts Consulting Engineers Ltd, they are welcome to contact us on 03 379 8600 and www.kirkroberts.co.nz.

Yours faithfully,

Author



Saima Sakik

BSc, MEngGeol

Senior Graduate Engineering Geologist

Reviewer & approver



Ollie Behrent

BAppSc, PMEG, MEngNZ
Geotechnical Team Leader

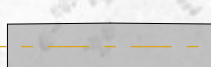
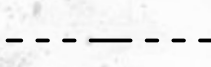
Attachment 1 : Subdivision Concept Plans

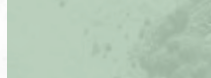




RIDGEBURN
ARROWTOWN JUNCTION

Legend

-  Ponds and waterways
-  Historic water race and 7m setback to edges
-  Primary Rooding network
-  Pedestrian / Cycle amenity network
-  Secondary and tertiary rooding network
-  Outstanding Natural Landscape (ONL) boundary
-  Site boundary
-  Escarpment edge and 30m setback
-  110kV Transmission lines (derived from Transpower GIS - Location TBC)

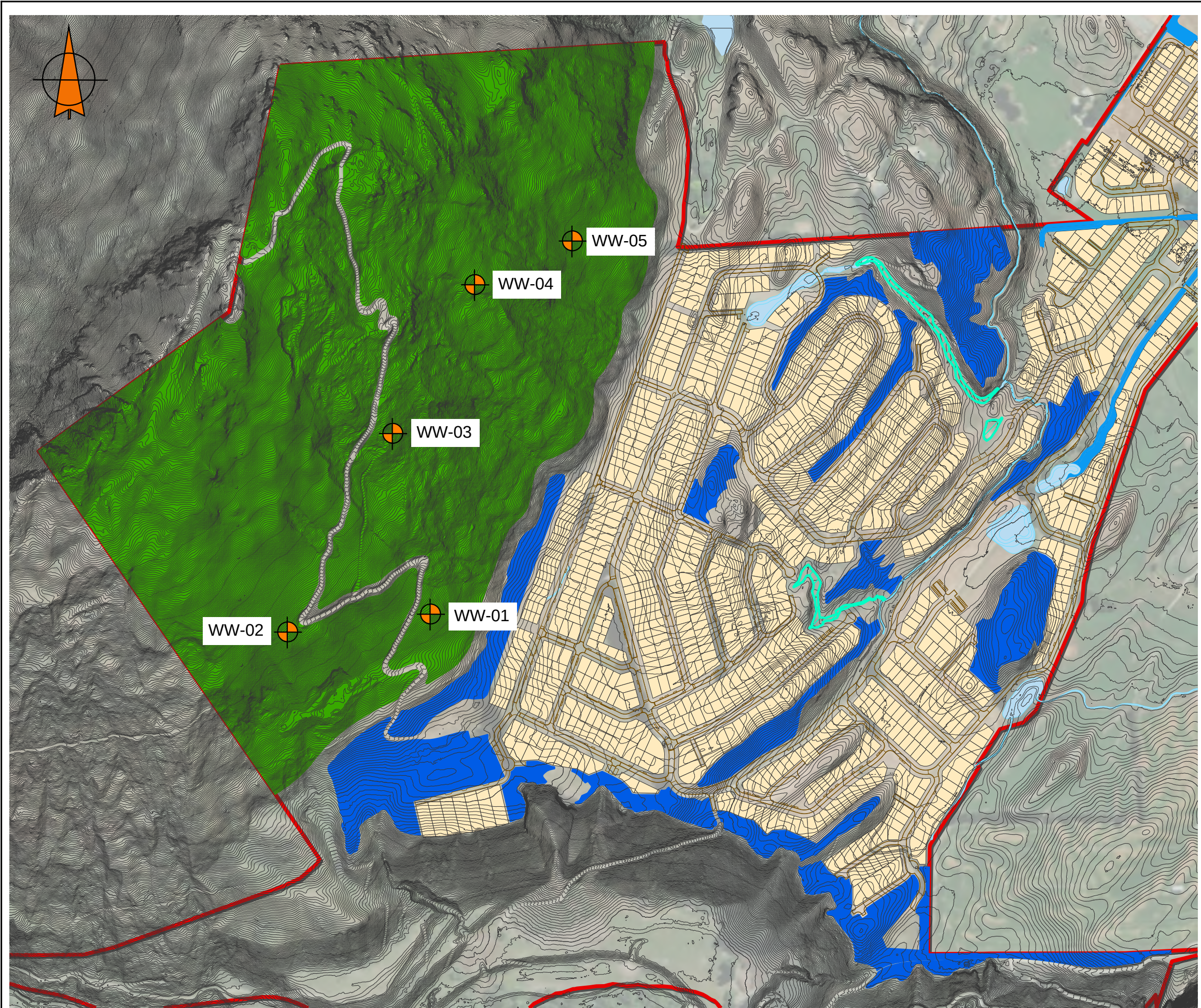
-  Native dry shrubland management
-  natural landscape planting areas
-  Existing rocky outcrops with tussock planting

-  1 Ridgeburn Entrance
-  2 Retail and hospitality commercial hub
-  3 Affordable living units
-  4 Existing farm buildings
-  5 Lookout
-  6 Water race
-  7 Community node + playground
-  8 Development edge rural landscape buffer
-  9 Development edge Morven Ferry Rd landscape buffer
-  10 Development edge 30 escarpment buffer
-  11 Connection to twin rivers trail
-  12 Wetlands and stormwater management areas
-  13 Wastewater disposal area
-  14 Native dry shrubland areas of ecological restoration
-  15 Relocated farm shed / community node
-  16 Wastewater treatment plant - refer civil engineer

Note: This masterplan is indicative / conceptual only. All elements, including site layout, lot configuration, and house typologies, are subject to further design development, regulatory approvals, and stakeholder consultation.

Attachment 2 : Site Investigation Plan and Logs





LEGEND

-  Hand Auger locations, January 2026
-  Proposed Dripline Areas
-  Proposed Spray Areas
-  Site Boundary

NOTES

Location of Features and Ground Investigation points are approximate only.
Aerial Image & Site Boundary supplied via email and prepared by WGA, referenced "Disposal Areas on Morven Hill and the Residential Terrace"

PROJECT: 2555087
CREATED BY: SSA
APPROVED BY: OB
DATE: February 2026

DWG NO: 001
REVISION: 2
Scale: Not to Scale

122 Morven Ferry Road

**WASTEWATER INVESTIGATION
LOCATION PLAN**



HAND AUGER RESULTS


KIRK ROBERTS
CONSULTING

Client: Gibbons Developments Ltd
 Site Address: Morven Ferry Road
 Town/City: Queenstown

Job No.: 2555087
 Hand Auger No. HA-WW-01
 Scala Penetrometer:

Operator: SSA
 Logged By: SSA
 Logged Date: 14/01/26

Checked By: OB
 Checked Date: 19/01/26

Date: 14/01/26
 Weather: Sunny/dry
 Datum: NZGD 2000
 Termination: Refusal on Dense Ground

Geological Formation	Depth (m)	Elevation	Sample Description	Graphic	USCS	D _r	Water Table	Undrained Shear Strength S _u (kPa)	Blows per 100 mm of Penetration																		
Topsoil			SILT, with some sand; dark brownish grey. Dry to moist, non-plastic; sand, fine; With some rootlets.						1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Rakaia Terrane			Silty SAND, with minor gravel; dark brownish grey. Dry to moist, non-plastic, sand, fine; gravel, fine to medium, angular to subround, schist.				Groundwater Not Encountered																				
	0.5	-0.5	End of Borehole - Refusal on Dense Ground. EOH: 0.50m																								

Remarks:
 Scala Penetrometer and Test Bore log tests give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations.
 Elevation datum sourced from council GIS LiDAR contours.

HAND AUGER RESULTS


KIRK ROBERTS
CONSULTING

Client: Gibbons Developments Ltd
 Site Address: Morven Ferry Road
 Town/City: Queenstown

Job No.: 2555087
 Hand Auger No. HA-WW-02
 Scala Penetrometer:

Operator: SSA
 Logged By: SSA
 Logged Date: 14/01/26

Checked By: OB
 Checked Date: 19/01/26

Date: 14/01/26
 Weather: Sunny/dry
 Datum: NZGD 2000
 Termination: Refusal on Dense Ground

Geological Formation	Depth (m)	Elevation	Sample Description	Graphic	USCS	D _r	Water Table	Undrained Shear Strength S _u (kPa)	Blows per 100 mm of Penetration																		
Topsoil			SILT, with some sand; dark brownish grey. Dry to moist, non-plastic; sand, fine; With some rootlets.						1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Rakaia Terrane			Silty SAND, with trace gravel; dark brownish grey. Dry to moist, non-plastic, sand, fine; gravel, fine, angular to subround, schist.				Groundwater Not Encountered																				
	0.5	-0.5	End of Borehole - Refusal on Dense Ground. EOH: 0.50m																								

Remarks:
 Scala Penetrometer and Test Bore log tests give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations.
 Elevation datum sourced from council GIS LiDAR contours.

HAND AUGER RESULTS


KIRK ROBERTS
CONSULTING

Client: Gibbons Developments Ltd
 Site Address: Morven Ferry Road
 Town/City: Queenstown

Job No.: 2555087
 Hand Auger No. HA-WW-03
 Scala Penetrometer:

Operator: SSA
 Logged By: SSA
 Logged Date: 14/01/26

Checked By: OB
 Checked Date: 19/01/26

Date: 14/01/26
 Weather: Sunny/dry
 Datum: NZGD 2000
 Termination: Refusal on Dense Ground

Geological Formation	Depth (m)	Elevation	Sample Description	Graphic	USCS	D _r	Water Table	Undrained Shear Strength S _u (kPa)	Blows per 100 mm of Penetration																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								
Topsoil			SILT, with some sand; dark brownish grey. Dry to moist, non-plastic; sand, fine; With some rootlets.						1 2 3 4 5 6 7 8 9 10 11 12 13 14 15 16 17 18 19																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																																								

Remarks:

Scala Penetrometer and Test Bore log tests give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations.
 Elevation datum sourced from council GIS LiDAR contours.

HAND AUGER RESULTS


KIRK ROBERTS
CONSULTING

Client: Gibbons Developments Ltd
 Site Address: Morven Ferry Road
 Town/City: Queenstown

Job No.: 2555087
 Hand Auger No. HA-WW-04
 Scala Penetrometer:

Operator: SSA
 Logged By: SSA
 Logged Date: 14/01/26

Checked By: OB
 Checked Date: 19/01/26

Date: 14/01/26
 Weather: Sunny/dry
 Datum: NZGD 2000
 Termination: Refusal on Dense Ground

Geological Formation	Depth (m)	Elevation	Sample Description	Graphic	USCS	Dr	Water Table	Undrained Shear Strength S_u (kPa)	Blows per 100 mm of Penetration																		
									1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Topsoil			SILT, with some sand; dark brownish grey. Dry to moist, non-plastic; sand, fine; With some rootlets.				undwater Not Encountered																				
			End of Borehole - Refusal on Dense Ground. EOH: 0.10m																								

Remarks:

Scala Penetrometer and Test Bore log tests give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations.
 Elevation datum sourced from council GIS LiDAR contours.

HAND AUGER RESULTS


KIRK ROBERTS
CONSULTING

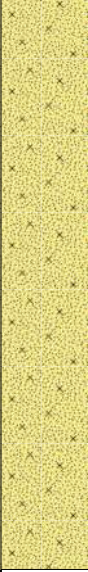
Client: Gibbons Developments Ltd
 Site Address: Morven Ferry Road
 Town/City: Queenstown

Job No.: 2555087
 Hand Auger No. HA-WW-05
 Scala Penetrometer:

Operator: SSA
 Logged By: SSA
 Logged Date: 14/01/26

Checked By: OB
 Checked Date: 19/01/26

Date: 14/01/26
 Weather: Sunny/dry
 Datum: NZGD 2000
 Termination: Refusal on Dense Ground

Geological Formation	Depth (m)	Elevation	Sample Description	Graphic	USCS	Dr	Water Table	Undrained Shear Strength Su (kPa)	Blows per 100 mm of Penetration																		
Topsoil			SILT, with some sand; dark brownish grey. Dry to moist, non-plastic; sand, fine; With some rootlets.						1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
Rakaia Terrane	0.5	-0.5	Silty SAND, with minor gravel; dark brownish grey. Dry to moist, non-plastic, sand, fine to medium; gravel, fine to medium, angular to subround, schist.																								
			End of Borehole - Refusal on Dense Ground. EOH: 0.60m																								

Remarks:
 Scala Penetrometer and Test Bore log tests give an indication of the ground condition at the location of the tests only. While they are representative of typical conditions across the site, they do not identify variations in the ground away from the test locations.
 Elevation datum sourced from council GIS LiDAR contours.



Kirk Roberts Consulting

Engineering (Environmental/Contaminated Land, Geotechnical, Civil, Structural, Fire), Architecture, Building Information Modelling

*Auckland, Hamilton, Tauranga, Christchurch, Dunedin, **Queenstown***

15 Gray Street, Frankton, Queenstown, 9300

03 379 8600

Please visit www.kirkroberts.co.nz to learn about our vision, purpose and values.

